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NUREG-1872, Vol. 1

Final Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site

Final Report

Main Report

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Abstract

This environmental impact statement (EIS) has been prepared pursuant to the review by the U.S. Nuclear Regulatory Commission (NRC) of an application submitted by Southern Nuclear Operating Company, Inc. (Southern) for an early site permit (ESP). The proposed action requested in Southern's application is for the NRC to (1) approve a site within the existing Vogtle Electric Generating Plant (VEGP) boundaries as suitable for the construction and operation of a new nuclear power generating facility and (2) issue an ESP for the proposed location at the VEGP site, adjacent to the existing VEGP Units 1 and 2.

In its application, Southern proposes a plan for redressing the environmental effects of certain construction activities performed by an ESP holder under the additional authorization (in a limited work authorization) that may be sought pursuant to Title 10 of the Code of Federal Regulations (CFR) Section 52.25. These construction activities are defined by 10 CFR 50.10(a). In accordance with the plan, the construction activities would be redressed if the NRC issues the requested ESP (including the site redress plan), the ESP holder performs these construction activities, the ESP is not referenced in an application for a construction permit or combined operating license, and no alternative use is found for the site.

This EIS includes the NRC staff's analysis that considers and weighs the environmental impacts of constructing and operating new units at the VEGP site or at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation to the Commission regarding the proposed action. The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued as proposed. The staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the staff's safety evaluation report and supporting documentation that is anticipated to be published in February 2009. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by Southern; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process and the draft EIS; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. In addition, in making its recommendation, the staff determined that there are no environmentally preferable or obviously superior sites. Finally, the staff has concluded that the construction activities defined by 10 CFR 50.10(a)(1) requested by Southern in its application will not result in any significant adverse environmental impact that cannot be redressed.

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Executive Summary

On August 14, 2006, Southern Nuclear Operating Company, Inc. (Southern) submitted to the U.S. Nuclear Regulatory Commission (NRC) an application for an early site permit (ESP) for a site within the Vogtle Electric Generating Plant (VEGP) site, adjacent to the existing VEGP Units 1 and 2. The site is located in Burke County, Georgia, approximately 42 km (26 mi) southeast of Augusta, Georgia. An ESP is a Commission approval of a site for one or more nuclear power facilities and is a separate action from the filing of an application for a construction permit (CP) or combined license (COL) for such a facility. An ESP is not a license to build a nuclear power plant; rather, the application for an ESP initiates a process undertaken to assess whether a proposed site is suitable should Southern decide to pursue a CP or COL.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321) directs that an environmental impact statement (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. Subpart A of 10 CFR Part 52 contains the NRC regulations related to ESPs. As set forth in 10 CFR 52.18, the Commission has determined that an EIS will be prepared during the review of an application for an ESP. The purpose of Southern's requested action, issuance of the ESP, is for the NRC to determine whether the VEGP site is suitable for the proposed two new units (VEGP Units 3 and 4) by resolving certain safety and environmental issues before Southern incurs the substantial additional time and expense of designing and seeking approval to construct such a facility at the site. Part 52 of CFR Title 10 describes the ESP as a "partial construction permit." An applicant for a CP or COL for a nuclear power plant or plants to be located at the site for which an ESP was issued can reference the ESP, thus eliminating the review of siting issues at that stage of the licensing process. However, granting a CP or COL to construct and operate a nuclear power plant is a major Federal action and would require an EIS be issued in accordance with 10 CFR Part 51.

Three primary issues – site safety, environmental impacts, and emergency planning – must be addressed in the ESP application. In its review of the application, the NRC assesses Southern's proposal in relation to these issues and determines if the application meets the requirements of the Atomic Energy Act of 1954 and the NRC regulations. This EIS addresses the potential environmental impacts resulting from the construction and operation of two new units at the VEGP site.

An ESP application may refer to a plant parameter envelope, which is a set of postulated design parameters that bound the characteristics of one or more reactor designs that might be built at a selected site; alternatively, an ESP application may refer to a detailed reactor design. In its ESP application, Southern has specified the Westinghouse AP1000 as the proposed detailed reactor design.

In its application, Southern requested authorization to perform certain construction activities if an ESP is issued. The application, therefore, includes a site redress plan that specifies how Southern would stabilize and restore the portion of the site associated with construction

activities to its preconstruction condition (or conditions consistent with an alternative use) in the event a nuclear power plant is not constructed on the approved site. In addition, Southern addressed the benefits of the proposed action (e.g., the need for power). In accordance with 10 CFR 52.18, the EIS is focused on the environmental effects of construction and operation of a reactor, or reactors, that have characteristics that fall within the postulated site parameters.

Upon acceptance of the Southern application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent (71 FR 58882) to prepare an EIS and conduct scoping. The staff held a public scoping meeting in Waynesboro, Georgia, on October 19, 2006, and visited the VEGP site in October 2006. Subsequent to the scoping meeting and the site visit, and in accordance with the provisions of NEPA and 10 CFR Part 51, the staff determined and evaluated the potential environmental impacts of constructing and operating new units at the VEGP site. 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 (i.e., issuance of the ESP) and of constructing and operating two additional nuclear units at the ESP site; (2) mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the staff's recommendation regarding the proposed action.

During the course of preparing this EIS, the staff reviewed the application, including the Environmental Report (ER) submitted by Southern; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NRC review standard RS-002, *Processing Applications for Early Site Permits*, to conduct an independent review of the issues. The review standard draws from the previously published NUREG-0800, *Standard Review Plan for the Review of Safety Analysis for Nuclear Power Plants*, and NUREG-1555, *Environmental Standard Review Plan* (ESRP). In addition, the staff considered the public comments related to the environmental review received during the scoping process. These comments are provided in Appendix D of this EIS.

The results of this evaluation were documented in a draft EIS issued for public comment in September 2007. During the comment period, the staff conducted a public meeting on October 4, 2007, in Waynesboro, Georgia, to describe the results of the NRC environmental review, answer questions, and provide members of the public with information to assist them in formulating comments on the draft EIS. After the comment period closed, the staff considered and dispositioned all the comments received. These comments are addressed in Appendix E of this EIS.

To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts using Council on Environmental Quality guidance (40 CFR 1508.27). Using this approach, the NRC established three significance levels – SMALL, MODERATE, or LARGE. The definitions of the three significance levels are as follows:

> SMALL – Environmental effects are not detectable or are so minor that they would 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.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections.

The staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued as proposed. The staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the staff's safety evaluation report anticipated to be published in February 2009.

This recommendation is based on (1) the application and supporting documentation, including the ER submitted by Southern; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of public comments related to the environmental review that were received during the scoping process and the draft EIS public comment period; and (5) the assessments summarized in the EIS, including the potential mitigation measures identified in the ER and this EIS. In addition, in making its recommendation to the Commission, the staff has determined that there are no environmentally preferable or obviously superior sites among the alternative sites considered. Finally, the staff has concluded that the construction activities requested by Southern (as defined under 10 CFR 50.10(a)) would not result in any significant adverse environmental impact that cannot be redressed.

Abbreviations/Acronyms

AADT	Average Annual Daily Traffic
ac	acre(s)
ac-ft	acre-feet
ADAMS	Agencywide Document Access and Management System
ADCNR	Alabama Department of Conservation and Natural Resources
ADEM	Alabama Department of Environmental Management
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
ALNHP	Alabama Natural Heritage Program
ANSP	(The) Academy of Natural Sciences of Philadelphia
APE	Area of Potential Effect
AQCR	Air Quality Control Region
AQI	Air Quality Index
ASMFC	Atlantic States Marine Fisheries Commission
AWEA	American Wind Energy Association
BEIR	Biological Effects of Ionizing Radiation
BMP	best management practices
Bq	becquerel
Bq/yr	becquerel per year
BTS	Bureau of Transportation Statistics
Btu	British thermal unit(s)
Btu/hr	British thermal units per hour
BWR	boiling water reactor
°C	degree Celsius
CAA	Clean Air Act
CDC	U.S. Centers for Disease Control and Prevention
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second (water flow)
Ci	curies
Ci/yr	curies per year
Ci/MTU	curies per metric ton uranium
cm	centimeter(s)
cm/s	centimeters per second
cm/yr	centimeters per year
CO	carbon monoxide
CO_2	carbon dioxide
COL	combined license
CORMIX	Cornell Mixing Zone Expert System
CP	construction permit
CSSI	Coastal Sound Science Initiative

CWA	Clean Water Act
CWIS	cooling water intake structure
CWS	circulating water system
CSX	CSX Transportation, Inc.
d	day
dBA	decibel(s)
DBA	design basis accident(s)
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EAB	exclusion area boundary
ECHD	East Central Health District
EIA	Energy Information Administration
EIS	environmental impact statement
ELF	extremely low frequency
EMC	Electric Membership Corporation
EMF	electromagnetic field(s)
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Division
EPRI	Electric Power Research Institute
ER	Environmental Report
ESA	Endangered Species Act
ESP	early site permit
ESRP	Environmental Standard Review Plan
°F	degree Fahrenheit
FAA	Federal Aviation Administration
Farley	Joseph M Farley Nuclear Plant
FCWA	Federal Clean Water Act (also known as the Clean Water Act)
FERC	Federal Energy Regulatory Commission
FES	Final Environmental Statement
FR	Federal Register
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft/s	feet per second
ft^3/yr	cubic feet per year
FWS	U.S. Fish and Wildlife Service
gal	gallon(s)
gal/d/ft	gallon(s) per day per foot
gal/yr	gallon(s) per year
GBq	gigabecquarel
GDHR	Georgia Department of Human Resources
GDNR	Georgia Department of Natural Resources
GDOT	Georgia Department of Transportation
GEIS	generic environmental impact statement
GOPBP	Georgia Office of Planning and Budget Policy
GOSA	Governor's Office of Student Achievement

GPC	Georgia Power Company
gpd	gallons per day
gpm	gallons per minute
GPSC	Georgia Public Service Commission
GTC	Georgia Transmission Corporation
ha	hectare(s)
Hatch	Edwin I Hatch Nuclear Plant
HLW	high-level waste
hr	hour
hz	hertz
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined cycle
in.	inch(es)
in./s	inch(es) per second
in./yr	inch(es) per year
Inc.	Incorporated
INEEL	Idaho National Engineering and Environmental Laboratory
IRP	Integrated Resource Plan
ISFSI	Independent Spent Fuel Storage Installation
ISWA	Integrated Waste Services Association
kg	kilogram(s)
kg/ac	kilogram(s) per acre
kg/ha/mo	kilogram(s) per hectare per month
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt
kVh	kilovolt hour
L	liter(s)
lb	pound(s)
LC50	Lethal Concentration 50 (i.e., the concentration of a chemical that kills 50 percent of the sample population)
L/d	liter(s) per day
L/d/m	liter(s) per day per meter
L/s	liter(s) per second
lbs/ac/mo	pounds per acre per month
lbs/acre	pounds per acre
LLC	limited liability company
LPZ	low population zone
LWA	limited work authorization
LWR	light-water reactor
m	meter(s)
m/s	meter(s) per second
m^2/s	square meter(s) per second
m^3/d	cubic meter(s) per day
m^3/s	cubic meter(s) per second

m^3/yr	cubic meter(s) per year
MACC2	MELCOR Accident Consequence Code System Version 2
MBq	million Becquerel(s)
MCL	maximum concentration limit
MEAG	Municipal Electric Authority of Georgia
MEI	maximally exposed individual
mg/l	milligram(s) per liter
MGD	million gallons per day
mGy/yr	milligray per year
mi	mile(s)
mi^2	square mile(s)
MIT	Massachusetts Institute of Technology
mL	milliliter(s)
MOX	mixed oxide fuel
mph	miles per hour
mR	milliroentgen(s)
mrad	millirad(s)
mrem	millirem(s)
mrem/hr	millirem(s) per hour
mrem/yr	millirem(s) per year
MSL	mean sea level
mSv	millisievert(s)
mSv/yr	millisievert(s) per year
MT	metric ton(s) (or tonne[s])
MTBE	methyl tert-butyl ether
MTU	metric ton(s)-uranium
MTU/yr	metric ton(s)-uranium/per year
MW	megawatt(s)
MWd/MTU	megawatt-days per metric ton of uranium
MW(e)	megawatts electric
MWh	megawatt hour(s)
MW(t)	megawatts thermal
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NAS	National Academy of Sciences
NAVD	North American Vertical Datum
NCDC	National Climatic Data Center
NCES	National Center for Education Statistics
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act of 1969
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act of 1966
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NOAA-CSC	National Oceanic and Atmospheric Administration's Coastal Service Center
NO_x	nitrogen oxide
NPCC	Northwest Power and Conservation Council
NPDES	National Pollutant Discharge Elimination System
NPF	Nuclear Power Facility
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRSAL	Natural Resource Spatial Analysis Laboratory
NSA	New South Associates
NSC	National Safety Council
NSPS	new source performance standards
OCGA	Official Code of Georgia
OECD	Organization for Economic Co-operation and Development
OPC	Oglethorpe Power Corporation
OSHA	Occupational Safety and Health Administration
PAM	primary amoebic meningoencephalitis
PARS	Publicly Available Records System
pCi/L	picocuries per liter
PM	particulate matter
$PM_{2.5}$	particulate matter smaller than 2.5 micrometers
PM_{10}	particulate matter smaller than 10 micrometers
PNNL	Pacific Northwest National Laboratory
POR	period of record
PPE	plant parameter envelope
ppm	parts per million
PRA	probabilistic risk assessment
PSD	prevention significant deterioration
PWR	pressurized water reactor
RAI	Request(s) for Additional Information
RCRA	Resource Conservation and Recovery Act
RDC	Representative Delineated Corridor
REMP	radiological environmental monitoring program
rkm	River Kilometers
RM	River Mile
ROI	region of interest
RRCC	Robust Redhorse Conservation Committee
RSICC	Radiation Safety Information Computational Center
Ryr	per reactor year
SACTI	Seasonal and Annual Cooling Tower Impacts
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SC DHEC	South Carolina Department of Health and Environmental Control
SC DNR	South Carolina Department of Natural Resources
SCE&G	South Carolina Electric and Gas
SCR	selective catalytic reduction
SDWIS	Safe Drinking Water Information System

SEARPDC	Southeast Alabama Regional Planning and Development Commission
SERC	South Eastern Reliability Council
SER	safety evaluation report
SHPO	State Historic Preservation Office/Officer
SO_2	sulfur dioxide
SO_x	sulfur oxide
Southern	Southern Nuclear Operating Company, Inc.
SPCC	Spill Prevention Control and Countermeasure Plan
SSAR	Site Safety Analysis Report
SSURGO	Soil Survey Geographic
Sv	sievert
Sv/yr	sievert per year
SWPPP	Stormwater Pollution Prevention Plan
SWS	service water system
TBq	terabecquerel
TBq/MTU	terabecquerel per metric ton(s)-uranium
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Offices/Officers
TLD	thermoluminescent dosimeter
tpy	tons per year
TRC	Third Rock Consultants, LLC
TRU	transuranic (waste)
UHS	ultimate heat sink
USACE	U.S. Army Corps of Engineers
USBEA	U.S. Bureau of Economic Analysis
USBLS	U.S. Bureau of Labor Statistics
USC	United States Code
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey
VEGP	Vogtle Electric Generating Plant
VOC	volatile organic compound
Westinghouse	Westinghouse Electric Company, LLC
WMA	Wildlife Management Area
WNA	World Nuclear Association
WSRC	Westinghouse Savannah River Company
χ/Q	dispersion values
yr	year(s)

1.0 Introduction

On August 14, 2006, Southern Nuclear Operating Company, Inc. (Southern) submitted to the U.S. Nuclear Regulatory Commission (NRC) an application for an early site permit (ESP) for a site within the Vogtle Electric Generating Plant (VEGP) site in Burke County, Georgia. The VEGP site and existing facilities are owned by Georgia Power Company, Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, and the city of Dalton, Georgia. Southern is the licensee and operator of the existing VEGP Units 1 and 2, and has been authorized by the VEGP co-owners to apply for an ESP for two additional units at the VEGP site.

Under the NRC regulations in Title 10 of the Code of Federal Regulations (CFR) Part 52, and in accordance with the applicable provisions of 10 CFR Part 51, which are the NRC regulations implementing the National Environmental Policy Act of 1969 (NEPA), the NRC is required to prepare an environmental impact statement (EIS) as part of its review of an ESP application. As required by 10 CFR 51.26, the NRC published in the *Federal Register* a Notice of Intent (71 FR 58882) to prepare an EIS, conduct scoping, and publish a draft EIS for public comment. The staff considered the scoping and draft EIS public comments in developing the final EIS. A separate safety evaluation report (SER) will also be prepared in accordance with 10 CFR Part 52.

1.1 Background

An ESP is a Commission approval of a site or sites for one or more nuclear power facilities. The filing of an application for an ESP is a process that is separate from the filing of an application for a construction permit (CP) or combined license (COL) for such a facility. The ESP application and review processes make it possible to evaluate and resolve safety and environmental issues related to siting before the applicant makes large commitments of resources. If the ESP is approved, then the applicant can "bank" the site for up to 20 years for future reactor siting. In addition, if the ESP applicant requests a limited work authorization (LWA) pursuant to 10 CFR 50.10 and 52.17(c) that is issued by the Commission, and if the ESP includes a site redress plan, the ESP holder can conduct certain construction activities as defined by 10 CFR 50.10(a). An ESP does not authorize construction and operation of a nuclear power plant. To construct and operate a nuclear power plant, an ESP holder must obtain a CP and operating license or a COL, which is a separate major Federal action and would require that an EIS be issued in accordance with 10 CFR Part 51.

To document its evaluation of the environmental impacts of the action proposed in an ESP application, the NRC prepares an EIS in accordance with 10 CFR 52.18. Because site suitability encompasses construction and operational parameters, the EIS addresses impacts of both construction and operation of reactors and associated facilities. In a review separate from

the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These latter two analyses are documented in an SER that presents the conclusions reached by the NRC regarding (1) whether there is reasonable assurance that two Westinghouse Electric Company, LLC (Westinghouse) AP1000 advanced light-water reactors can be constructed and operated at the VEGP site without undue risk to the health and safety of the public, (2) whether there are significant impediments to the development of emergency plans, and (3) whether site characteristics are such that adequate security plans and measures can be developed. In addition, if the applicant proposes major features of emergency plans or complete and integrated emergency plans, the SER would document whether such major features are acceptable or whether the complete and integrated emergency plans provide reasonable assurance that adequate protective measures can and would be taken in the event of a radiological emergency.

1.1.1 Early Site Construction Activities

The holder of an ESP or an applicant for a CP (10 CFR Part 50) or a COL (Subpart C of 10 CFR Part 52) that references an ESP may, with an approved site redress plan, perform construction activities as defined by 10 CFR 50.10(a), provided that the final ESP EIS concludes the activities would not result in any significant adverse environmental impacts that cannot be redressed. Southern provided a site redress plan as part of its ESP application (Southern 2008) to obtain authorization to conduct certain site construction activities. Southern's site redress plan is discussed in more detail in Section 4.11 of this EIS.

1.1.2 ESP Application and Review

In accordance with 10 CFR 52.17(a)(2), Southern submitted an Environmental Report (ER) as part of its ESP application (Southern 2008). The ER focuses on the environmental effects of construction and operation of two Westinghouse AP1000 reactors. Southern's ER also includes an evaluation of alternative sites to determine whether there is an obviously superior alternative to the proposed site (Southern 2008). An ESP ER is not required to include an assessment of energy alternatives or the benefits of the proposed action (e.g., the need for power). However, Southern did include a discussion on need for power and energy alternatives, and the analyses are evaluated in Chapters 8 and 9 of this EIS. In addition, Southern elected to provide a discussion of benefits and costs of the proposed action in its application. Therefore, the staff also performed this analysis, which is provided in Chapter 11 of this EIS.

The NRC standards for review of an ESP application are outlined in 10 CFR 52.18. As does Southern in its ER (Southern 2008), this EIS focuses on the environmental effects of construction and operation of two Westinghouse AP1000 reactors, and includes an evaluation of alternative sites to determine whether there is any obviously superior alternative to the VEGP site.

The NRC staff conducts its reviews of ESP applications in accordance with guidance set forth in review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004). The review standard draws from the previously published NUREG-0800, *Standard Review Plans for the Review of Safety Analysis for Nuclear Power Plants* (NRC 1987), and NUREG-1555, *Environmental Standard Review Plan (ESRP)* (NRC 2000). RS-002 provides guidance to NRC staff reviewers to help ensure a thorough, consistent, and disciplined review of any ESP application.

If a CP or COL application referencing an ESP is filed, the staff will assess any new and significant information pertaining to environmental impacts of the construction and operation of the proposed facilities. As a result of the staff's environmental review of the ESP application, the staff may determine that conditions or limitations on the ESP may be necessary in specific areas, as set forth in 10 CFR 52.24. In this EIS, the staff has identified when and how assumptions and bounding values limit its conclusions on the environmental impacts to a particular resource.

In accordance with the requirements set forth in 10 CFR Part 51, on October 5, 2006, the NRC published a Notice of Intent in the *Federal Register* to prepare an EIS and conduct scoping (71 FR 58882). On October 19, 2006, the NRC environmental staff (and technical experts from the Pacific Northwest National Laboratory [PNNL] who were retained to assist the staff) held a scoping meeting to obtain public input on the scope of the environmental review. To gather information and to become familiar with the sites and their environs, the NRC and PNNL team visited the VEGP site in October 2006 and the alternative sites (Joseph M. Farley Nuclear Plant [Farley], Edwin I. Hatch Nuclear Plant [Hatch], and the Barton site [Barton]) in November 2006. During the VEGP site visit, the staff and its contractors met with Southern staff, public officials, and the public. The staff reviewed the comments received during the scoping process and contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A list of the organizations contacted is provided in Appendix B. Other documents related to the VEGP site were reviewed and are listed as references where appropriate.

The results of the NRC staff's analysis were documented in a draft EIS issued for public comment in September 2007. A 75-day comment period began on September 14, 2007, when the U.S. Environmental Protection Agency issued a Notice of Availability (72 FR 52586) of the draft EIS to allow members of the public to comment on the results of the NRC staff's review. A request for 30-day extension of the comment period was granted, and the comment period officially ended on December 28, 2007. A public meeting was held on October 4, 2007, in Waynesboro, Georgia, during the public comment period. During this public meeting, the staff described the results of the NRC environmental review, answered questions related to the review, and provided members of the public with information to assist them in formulating their comments. Comments on the draft EIS and the staff's response are provided in Appendix E.

This final EIS has change bars in the page margins to denote where changes have been made since the draft EIS was published.

To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts using Council on Environmental Quality guidance (40 CFR 1508.27). Using this approach, the NRC established three significance levels – SMALL, MODERATE, or LARGE. The definitions of the three significance levels are as follows:

> 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 staff's analysis, which considers and weighs the environmental impacts of the proposed action at the VEGP site, including the environmental impacts associated with construction and operation of reactors at the site, the impacts of construction and operation of reactors at alternative sites, the environmental impacts of alternatives to granting the ESP, and the mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's recommendation to the Commission regarding the issuance of the ESP for the VEGP site.

1.2 The Proposed Federal Action

The proposed Federal action is issuance, under the provisions of 10 CFR Part 52, of an ESP for the VEGP site, including a LWA pursuant to 10 CFR 52.24(c). In addition, Southern proposes that a plan for redressing the environmental effects of certain construction activities (i.e., those activities allowed by 10 CFR 50.10(a) is authorized to be performed by an ESP holder pursuant to 10 CFR 52.25. In accordance with the redress plan, the site would be redressed if (1) the NRC issues the requested ESP (containing the site redress plan), (2) the ESP holder performs these preliminary construction activities, and (3) the ESP is not referenced in an application for a CP or COL. While an ESP applicant does not request construction and operation of a new unit, this EIS analyzes the environmental impacts that could result from the construction and operation of new units at the VEGP site or at one of the three alternative sites. These impacts are analyzed to determine if the proposed ESP site is suitable for the addition of the new units and whether any of the alternative sites is considered obviously superior to the proposed site.

The site proposed by Southern is located in Burke County, Georgia, approximately 42 km (26 mi) southeast of Augusta, Georgia. The site is completely within the confines of the current VEGP site, with the proposed new Units 3 and 4 to be adjacent to the existing Units 1 and 2.

In this EIS, the proposed site is evaluated for construction and operation of two Westinghouse AP1000 reactors, with a total combined thermal power rating of 6800 MW(t). The new units would use a closed-cycle cooling system and require a single natural draft cooling tower for each unit.

1.3 The Purpose and Need for the Proposed Action

The purpose and need for the proposed action (i.e., issuance of an ESP) is to provide for early resolution of many safety and environmental issues that may be identified for the ESP site. Alternatively, all safety and environmental issues would have to be addressed at the time of the staff's review of a COL submitted under 10 CFR Part 52 if no ESP for the site were referenced. Although actual construction and operation of the facility would not take place until a COL is granted, certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COL is granted. As a result, without the ESP review process, there could be a considerable expenditure of funds, commitment of resources, and passage of time before site safety and environmental issues are finally resolved.

1.4 Alternatives to the Proposed Action

Section 102(2)(C)(iii) of NEPA states that EISs are to include a detailed statement on 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 discusses the environmental impacts of four categories of alternatives: (1) the no-action alternative, (2) energy source alternatives, (3) system design alternatives, and (4) site alternatives. The Commission determined that evaluation of energy alternatives is not required for an ESP. However, Southern included a discussion of energy alternatives in its ER; therefore, the staff conducted an evaluation of energy alternatives.

The three alternative sites that are considered are all owned by Southern. Plant Hatch is located in Georgia, and Plant Farley and the Barton site (a greenfield site) are located in Alabama. Plant Hatch and Plant Farley both currently have operating nuclear reactors. The environmental analysis of the alternative sites was performed using reconnaissance-level information. Chapter 9 also includes sections discussing (1) Southern's region of interest for identification of alternative plant sites, (2) the methodology used by Southern to select alternative sites and the proposed VEGP site, and (3) generic environmental issues consistent

among alternative sites. Chapter 10 compares the environmental impacts at the VEGP site to the alternative sites and to the no-action alternative and qualitatively determines whether there is an obviously superior alternative site to the proposed site.

1.5 Compliance and Consultations

Prior to construction and operation of new units, Southern is required to hold certain Federal, State, and local environmental permits, as well as meet applicable Federal and State statutory requirements. Southern (2008) provided a list of environmental approvals and consultations associated with the VEGP ESP application. Because an ESP is limited to establishing the acceptability of the proposed site for future development, the authorizations Southern will need from Federal, State, and local authorities for construction and operation are not yet required; therefore, they have not been obtained. However, Southern will need to obtain the necessary authorizations to conduct site-preparation activities that might precede the construction activities specified in the site redress plan as well as those construction activities. Potential authorizations and consultations relevant to the proposed ESP are included in Appendix H. The information provided in Appendix H is based on guidance in NUREG-1555, *Environmental Standard Review Plan (ESRP)* (NRC 2000).

The staff reviewed the list of environmental approvals and consultations and has contacted the appropriate Federal, State, Tribal, and local agencies to identify any compliance, permit, or significant environmental issues of concern to the reviewing agencies that may impact the suitability of the VEGP site for the construction and operation of the proposed two Westinghouse AP1000 reactors.

1.6 Report Contents

The subsequent chapters of this EIS are organized as follows. Chapter 2 describes the proposed site and discusses the environment that would be affected by the addition of the new units. Chapter 3 examines the power plant characteristics to be used as the basis for evaluating the environmental impacts. The evaluations described in Chapter 3 are based on the characteristics of the Westinghouse AP1000 reactor as well as site characteristics for which information is currently available. Chapters 4 and 5 examine site suitability by analyzing the environmental impacts of construction (Chapter 4) and operation (Chapter 5) of the proposed VEGP Units 3 and 4. Chapter 6 analyzes the environmental impacts of the uranium fuel cycle, transportation of radioactive materials, and decommissioning, while Chapter 7 discusses the cumulative impacts of the proposed action. Chapter 8 addresses the need for power. Chapter 9 discusses alternatives to the proposed action, (including the no-action alternative), and analyzes alternative sites, systems, and energy sources. Chapter 10 compares the proposed action with the alternatives, and Chapter 11 summarizes the findings of the preceding chapters and presents the staff's recommendation with respect to (1) the Commission's

approval of the proposed site for an ESP based on the staff's evaluation of environmental impacts and (2) the conclusions regarding the site redress plan.

As mentioned above, the staff analyzes the impacts of construction and operation of the proposed action in Chapters 4 and 5, and discusses cumulative impacts in Chapter 7. As a result of the NRC's recent new rule on the LWAs for nuclear power plants (see 72 FR 57416), the definition of construction activities in 10 CFR 50.10 has changed to more clearly reflect the NRC's jurisdiction. The staff's draft EIS for the VEGP ESP review was published prior to the issuance of the final rule. To reflect the effects of the new rule, site preparation and preconstruction activities would most appropriately be analyzed in the staff's EIS as cumulative impacts rather than as impacts of construction or operation of the proposed facility. However, in this instance, to ensure appropriate consideration of public comments on the draft EIS and avoid confusion from reorganizing the document following those comments, the staff will keep discussions of such impacts (i.e., those no longer defined by regulation as construction activities) in the chapters in which they were discussed in the draft EIS. While the staff's analysis of construction activities in the draft EIS and its discussion of cumulative impacts are different, they are generally at a similar depth of analysis. The staff believes this approach will allow effective consideration of public comments while still ensuring that impacts relevant to the NEPA analysis are disclosed and fully evaluated.

The appendixes provide the following additional information.

- Appendix A – Contributors to the Environmental Impact Statement
- Appendix B – Organizations Contacted
- Appendix C – Chronology of NRC Staff Environmental Review Correspondence Related to Southern Nuclear Operating Company Inc., Application for Early Site Permit at the VEGP Site
- Appendix D – Scoping Meeting Comments and Responses
- Appendix E – Comments on the Draft Environmental Impact Statement and Responses
- Appendix F – Key Early Site Permit Consultation Correspondence Regarding the VEGP Early Site Permit
- Appendix G – Supporting Documentation on Radiological Dose Assessment
- Appendix H – Authorizations and Consultations
- Appendix I – VEGP Site Characteristics, AP1000 Design Parameters and Site Interface Values
- Appendix J – Statements Made in the Early Site Permit Environmental Report Considered in the NRC Staff's Environmental Review

1.7 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."

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

71 FR 58882. October 5, 2006. "Southern Nuclear Operating Company, Inc., Vogtle ESP Site; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, U.S. Nuclear Regulatory Commission.

72 FR 52586. September 14, 2007. "Southern Nuclear Operating Company; Notice of Availability of the Draft Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle ESP Site and Associated Public Meeting." *Federal Register*, U.S. Nuclear Regulatory Commission. Accessed May 1, 2008 at http://www.epa.gov/fedrgstr/EPA-IMPACT/2007/September/Day-14/i18143.htm.

72 FR 57416. November 8, 2007. "Limited Work Authorizations for Nuclear Power Plants." *Federal Register*, U.S. Nuclear Regulatory Commission.

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

Southern Nuclear Operating Company, Inc. (Southern). 2008. *Vogtle Early Site Permit Application, Revision 4*. Southern Company, Birmingham, Alabama. Accession No. ML081020073.

U.S. Nuclear Regulatory Commission (NRC). 1987. *Standard Review Plans for the Review of Safety Analysis Reports for Nuclear Power Plants*. NUREG-0800, Volumes 1 and 2, Nuclear Regulatory Commission, Washington, D.C. Accessed at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan: Standard Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG-1555, Office of Nuclear Reactor Regulation, Washington, D.C. Accessed at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Processing Applications for Early Site Permits*. RS-002, Nuclear Regulatory Commission, Washington, D.C. Accessed July 10, 2008 at http://www.nrc.gov/reactors/new-licensing/esp/esp-public-comments-rs-002.html.

2.0 Affected Environment

The site proposed by Southern Nuclear Operating Company, Inc. (Southern) for an early site permit (ESP) is located in Burke County, Georgia, within the existing boundaries of the current Vogtle Electric Generating Plant (VEGP). The VEGP property is owned by Georgia Power Company (GPC), Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, and the city of Dalton (Dalton Utilities). The site is located on the shores of the Savannah River approximately 24 km (15 mi) east-northeast of Waynesboro, Georgia, and 42 km (26 mi) southeast of Augusta, Georgia. Two operating nuclear generating units (Units 1 and 2) are currently located on the VEGP site. The station location is described in Section 2.1, with the land, meteorology and air quality, geology, radiological environment, water, ecology, socioeconomics, historic and cultural resources, and environmental justice aspects of the site presented in Sections 2.2 through 2.10, respectively. Section 2.11 examines related Federal projects, and references are presented in Section 2.12.

2.1 Site Location

Southern's proposed location for the proposed VEGP Units 3 and 4 is within the VEGP site (see Figure 2-1). The center line of the proposed VEGP Units 3 and 4 would be located approximately 640 m (2100 ft) west and 120 m (400 ft) south of the center of Unit 2 containment building. Unit 4 would be located approximately 244 m (800 ft) west of Unit 3.

The VEGP site is located in rural Burke County. The nearest population center that has more than 25,000 residents is Augusta. Figure 2-2 shows the location of VEGP in relationship to the counties and important cities and towns within an 80-km (50-mi) radius of the site. The VEGP site is generally bounded by River Road, Hancock Landing Road, and the Savannah River. Access to the site is from River Road. Barge access is available from the Savannah River, and a railroad spur runs to the site from the Norfolk Southern Savannah-to-Augusta track. The community of Girard is located approximately 13 km (8 mi) to the south. Rhodes Air Ranch, a privately owned airstrip, is located north of the VEGP site. The VEGP site occupies approximately 1282.5 ha (3169 ac) of land, and it is located directly across the Savannah River from the U.S. Department of Energy's (DOE's) Savannah River Site (Southern 2008a).

2.2 Land

This section discusses land-related issues for the VEGP site. Section 2.2.1 describes the site and the vicinity around the site. Section 2.2.2 discusses the existing and proposed transmission line rights-of-way. Section 2.2.3 discusses the region, defined as the area within 80 km (50 mi) of the VEGP site boundary.

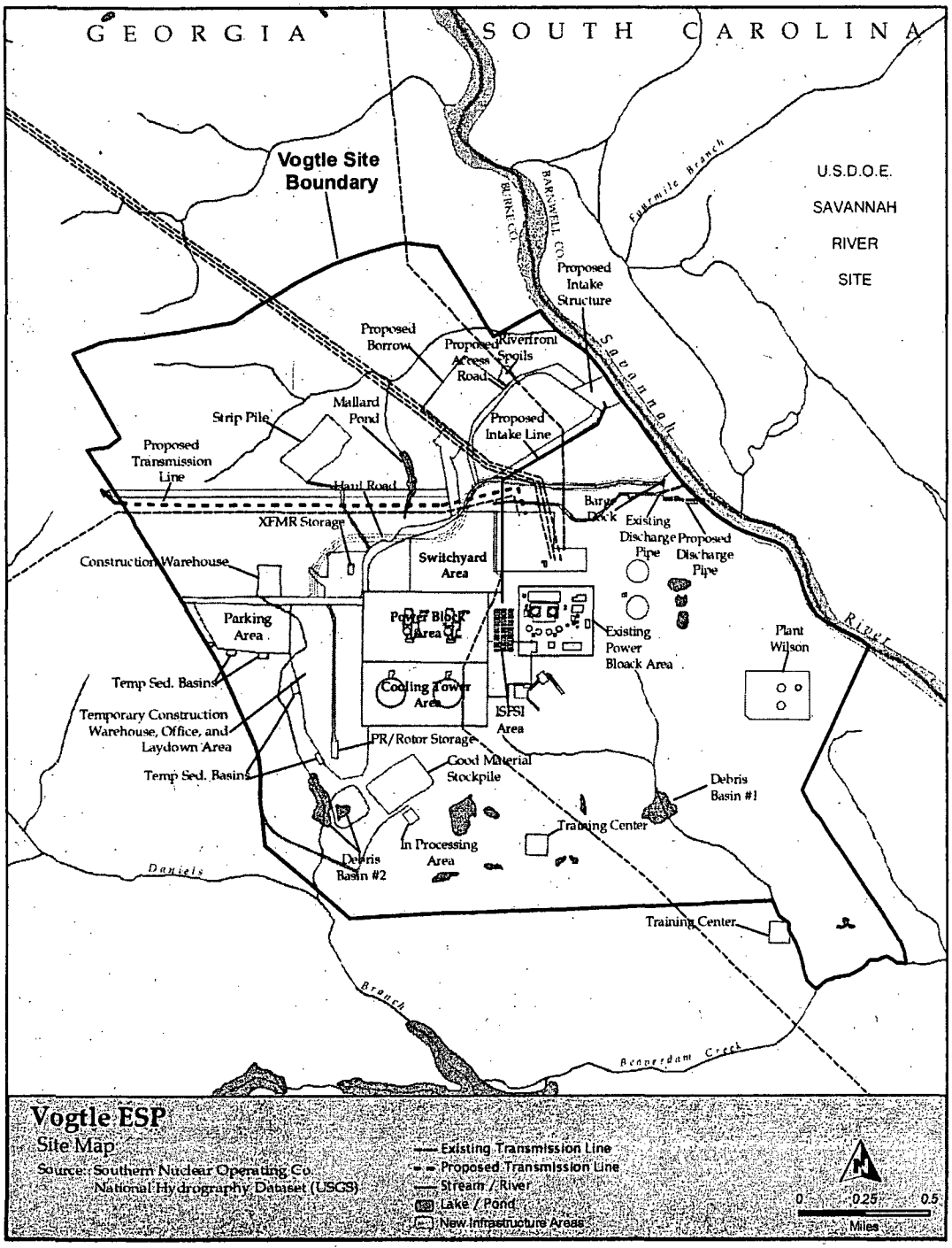

Figure 2-1. Proposed VEGP Site Footprint (Southern 2007a,b)

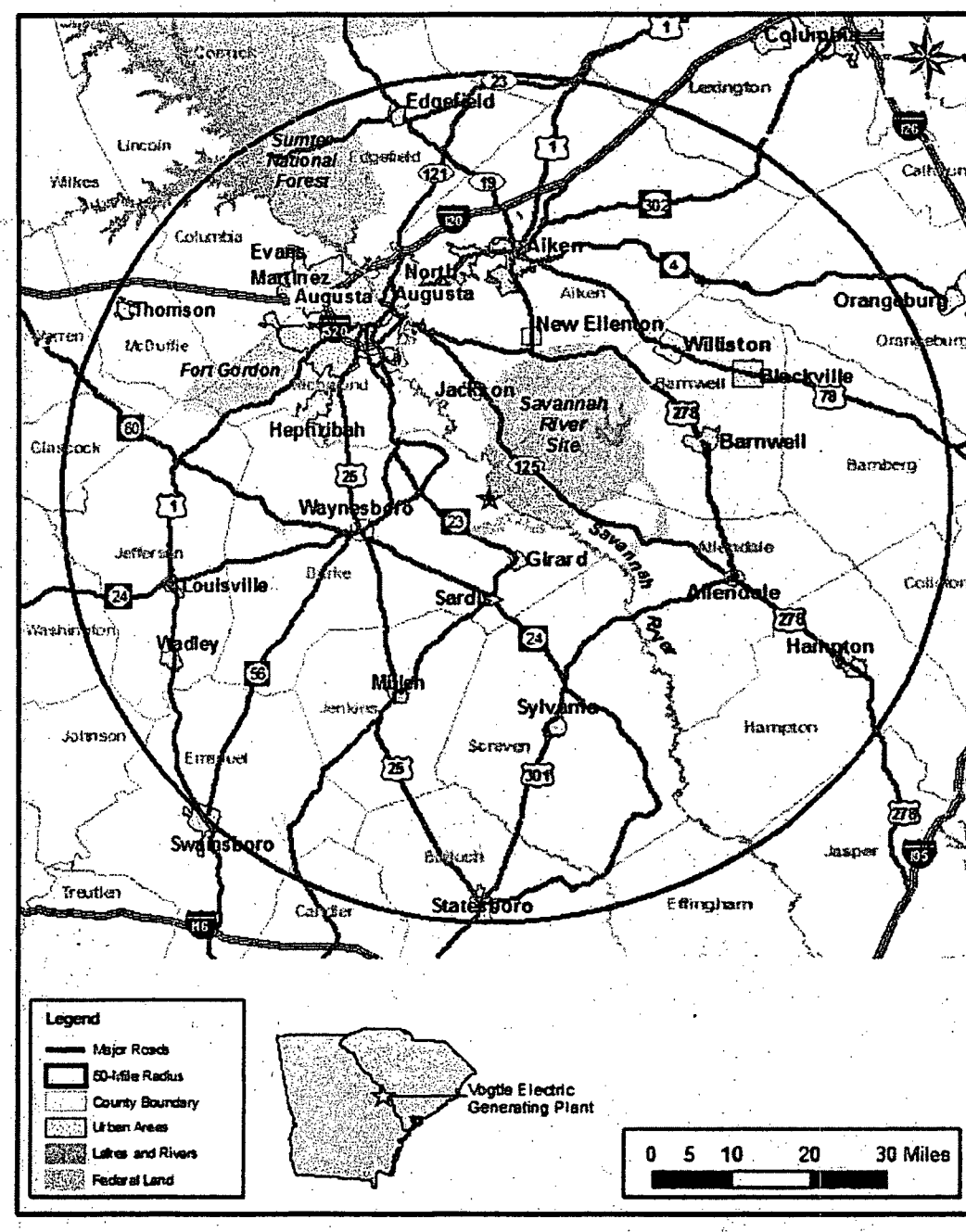

Figure 2-2. The VEGP Site and the 80-km (50-mi) Vicinity (Southern 2008a)

2.2.1 The Site and Vicinity

The VEGP site comprises 1282.5 ha (3169 ac) in an unincorporated area of Burke County, Georgia. The VEGP site, including the planned footprint for the proposed VEGP Units 3 and 4, is shown in Figure 2-1.

The VEGP site contains two existing nuclear generating units, VEGP Units 1 and 2, which are licensed by the U.S. Nuclear Regulatory Commission (NRC) and have a combined net electric generating capacity of 2297 MW(e). Unit 1 began commercial operation in March 1987, and Unit 2 began commercial operation in March 1989. The oil-fired Plant Wilson is also located on the VEGP site. Plant Wilson is a 354-MW(e) peaking power generating facility owned by GPC (Southern 2008a). Together, the two existing nuclear units, Plant Wilson, auxiliary facilities such as the training center, and transmission line rights-of-way occupy approximately 320 ha (800 ac) of the VEGP site. The remaining VEGP site includes approximately 661.3 ha (1634 ac) of pine forest, 247.7 ha (612 ac) of hardwood forest, and 38.8 ha (96 ac) of open areas including mowed grass (Southern 2008a). Several small ponds and three small unnamed streams are located on the VEGP site (Figure 2-1).

The VEGP site boundary is located on a bluff adjacent to the southwest bank of the Savannah River. The centerline of proposed VEGP Units 3 and 4 would be approximately 640 m (2100 ft) west and 120 m (400 ft) south of the center of the existing Unit 2 containment building. The Unit 4 containment building would be approximately 244 m (800 ft) west of the Unit 3 containment building (Southern 2008a).

The 803-km^2 (310-mi^2) Savannah River Site is located immediately across the Savannah River from the VEGP site. The Savannah River Site has restricted access that is controlled by the DOE and its contractors. The VEGP site is approximately 24 km (15 mi) east-northeast of Waynesboro, the county seat of Burke County, and 42 km (26 mi) southeast of Augusta, Georgia. Features within a 10-km (6-mi) radius of the VEGP site are shown in Figure 2-3.

Most of the VEGP site is separated from the Savannah River floodplain by steep bluffs. The Savannah River is not a wild and scenic river as that term is defined in Title 36 of the Code of Federal Regulations (CFR) 297.3.

Access to the VEGP site is from River Road to the east of the site on a spur road owned by the VEGP site owners (see Figure 2-3). A railroad spur runs to the VEGP site from the Norfolk Southern Savannah-to-Augusta track. No natural gas pipelines traverse the VEGP site.

Currently, no zoning applies to the VEGP site. The GPC maintains a land management plan for the VEGP site. None of the site constitutes prime farmland as that term is defined by the U.S. Department of Agriculture Natural Resources Conservation Service at 7 CFR 657.5(a). No mineral deposits or mines occur in Burke County (Southern 2008a).

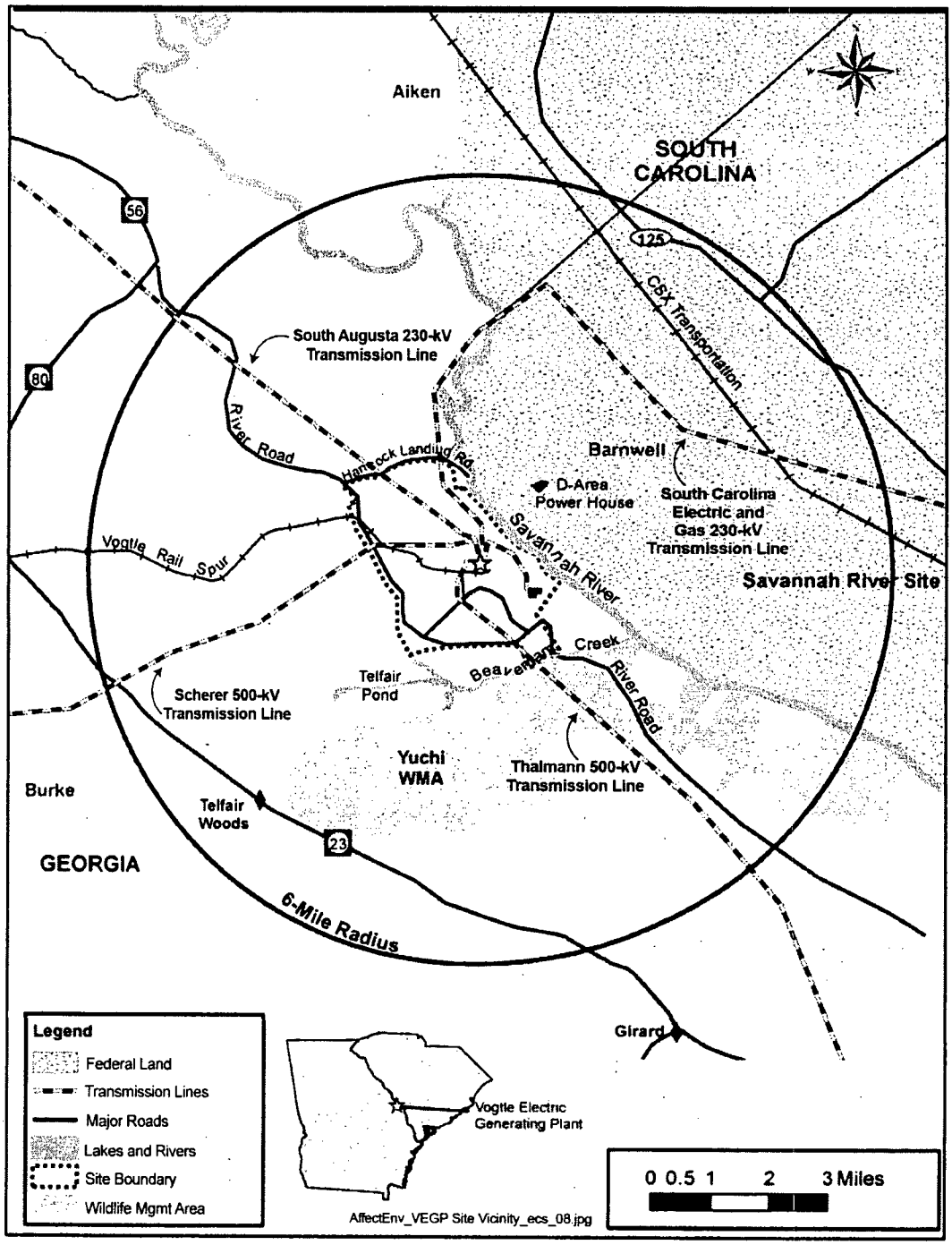

Figure 2-3. The VEGP Site and 10-km (6-mi) Vicinity (Southern 2008a)

The topography in the vicinity of the VEGP site consists of low rolling hills with elevations ranging from 24 m (80 ft) to 91 m (300 ft) above mean sea level (MSL). The vicinity of the VEGP site on the Georgia side of the Savannah River is primarily rural undeveloped land with a few homes and small farms. The 3160-ha (7800-ac) Yuchi Wildlife Management Area (WMA) managed by the Georgia Department of Natural Resources (GDNR) is south of the VEGP site (see Figure 2-3). The GPC provides access to the Savannah River at a boat landing immediately downstream of the VEGP site.

Approximately 46 percent of the land in Burke County is agricultural, 43 percent is forest, and 9 percent are wetlands (Southern 2008a). Burke County is not within the portion of Georgia covered by the Coastal Zone Management Act (GDNR 2003).

2.2.2 Transmission Line Rights-of-Way

The existing transmission system supporting VEGP Units 1 and 2 has two 500-kV lines and four 230-kV transmission lines in four rights-of-way (Southern 2008a). An additional 230-kV transmission line to Plant Wilson can provide offsite power to the VEGP site in case of emergency. The existing transmission system in the vicinity of the VEGP site is shown in Figure 2-3.

The Scherer 500-kV transmission line right-of-way generally runs west from the VEGP site to Plant Scherer, north of Macon, Georgia. The Scherer transmission line right-of-way is approximately 248 km (154 mi) long and 46 m (150 ft) wide in most areas, although it is up to 120 m (400 ft) wide in some locations. The Thalmann 500-kV transmission line right-of-way generally runs to the south of the VEGP site to the West McIntosh substation north of Savannah, Georgia. The Thalmann right-of-way is approximately 256 km (159 mi) long and 46 m (150 ft) wide. The South Augusta right-of-way contains three 230-kV transmission lines. The right-of-way runs north from the VEGP site to the Goshen and Augusta Newsprint substations. Two lines run approximately 31 km (19 mi) to the Goshen substation in a 83.8-m (275-ft)-wide right-of-way. A third line runs 27 km (17 mi) in the South Augusta right-of-way and then branches off for approximately 5 km (3 mi) to the Augusta Newsprint substation in a 30- to 38.1-m (100- to 125-ft)-wide right-of-way. The South Carolina Electric and Gas (SCE&G) right-of-way contains a 230-kV transmission line. The right-of-way runs north and east for 7.2 km (4.5 mi), crosses the Savannah River, and then runs an additional 27 km (17 mi) to a substation operated by SCE&G on the Savannah River Site. The portion of the right-of-way in Georgia is 38.1 m (125 ft) wide; the portion in South Carolina is 30 m (100 ft) wide.

2.2.3 The Region

The region surrounding the VEGP site is shown in Figures 2-2 and 2-3. Waynesboro, the County Seat of Burke County, and the Burke County communities of Girard and Sardis are shown in Figure 2-2. The principal highways, parks, wildlife refuges, national forests, and

military installations in proximity to the VEGP site also are shown in Figures 2-2 and 2-3. There are no tribal lands for Federally recognized Indian Tribal entities within the region.

All or portions of 16 counties in Georgia and 12 counties in South Carolina are within 80 km (50 mi) of the VEGP site. Seventy-nine percent of employees currently working at the VEGP site reside in Burke, Columbia, and Richmond Counties in Georgia. Land use within these three counties is shown in Table 2-1.

Table 2-1. Land Use in Burke, Columbia, and Richmond Counties, Georgia

Land Uses	Burke County, 1990	Columbia County, 2000	Richmond County, 2003
Residential	10,440 ha (25,800 ac)	17,480 ha (43,200 ac)	21,970 ha (54,300 ac)
Commercial	296 ha (731 ac)	979 ha (2420 ac)	2335 ha (5770 ac)
Industrial	81 ha (201 ac)	894 ha (2210 ac)	3800 ha (9400 ac)
Transportation/ Communication/ Utilities	No data	3104 ha (7670 ac)	4820 ha (11,900 ac)
Public/Institutional	3743 ha (9250 ac)	1748 ha (4320 ac)	21,410 ha (52,900 ac)
Parks/Open Space/ Conservation	No data	4170 ha (10,300 ac)	2390 ha (5900 ac)
Agriculture/Forestry/ Undeveloped	178,000 ha (440,000 ac) (includes open space)	51,400 ha (127,000 ac)	28,300 ha (70,000 ac)

Source: Southern 2008a

2.3 Meteorology and Air Quality

The following three subsections describe the climate and air quality of the VEGP site. Section 2.3.1 describes the climate of the region and area in the immediate vicinity of the VEGP site, Section 2.3.2 describes the air quality of the region, and Section 2.3.3 describes the meteorological monitoring program at the site.

2.3.1 Climate

Climatological information was obtained from the Augusta, Georgia (Bush Field), first-order National Weather Service station (NCDC 2006), which is approximately 32 km (20 mi) northwest of the VEGP site. In addition, climatological data from the nearby Savannah River Site was obtained (Hunter 2004). The Savannah River Site maintains a comprehensive meteorological observation network, and its primary observation station, called the Central Climatology site, is 13 km (8 mi) northeast of the VEGP site. Both the Augusta National Weather Service and Savannah River Site stations can be used to characterize the climate at the ESP site and surrounding region because of their comparable elevation, location within the Savannah River Valley, and long period of record.

The climate in and around the VEGP site is classified as subtropical, with long, warm, humid summers and relatively short, mild winters. Summer-like conditions generally begin in early May and continue through mid-September. During this period, the Bermuda high builds in the western Atlantic and anticyclonic (clockwise) winds transport warm, moist air into the region. Thunderstorm activity peaks in July, with a monthly average of 12 thunderstorms (NCDC 2006). Mean daily temperatures also peak in July, with a normal maximum temperature of 33.3°C (92.0°F) and a normal minimum temperature of 20.9°C (69.6°F) (NCDC 2006). The winter months of December through February are characterized by frequent periods of cooling and warming from mid-latitude, low-pressure systems and associated fronts passing through the area. Extremely cold temperatures are rare, because the Appalachian Mountains to the north and northwest generally block arctic air masses from the region. January is the coldest month of the year, with a normal daily maximum and minimum temperature of 13.6°C (56.5°F) and 0.6°C (33.1°F), respectively (NCDC 2006). Both spring and autumn tend to be short, transitional seasons. Spring is normally the windiest season, with the highest monthly mean wind speed of 3.3 m/s (7.4 mph) occurring in March. Autumn is the driest season, with a minimum monthly mean precipitation amount of 6.81 cm (2.68 in.) at Augusta (NCDC 2006) and 7.37 cm (2.90 in.) at Savannah River Site during November (Hunter 2004).

2.3.1.1 Wind

Regionally, predominant wind direction patterns exist that can be characterized by season. From late spring through early fall, the wind has a southerly component and reflects the flow associated with the Bermuda high in the Western Atlantic. Wind speeds tend to be lighter during this time, with mean speeds ranging between 2.2 to 2.7 m/s (5.0 to 6.0 mph). Through much of autumn, the prevailing wind direction is from the northeast. Then, from late fall through the early spring, winds become more westerly, as low-pressure storm systems approach the area from the west. Mean wind speeds are generally highest during this time and average around 3.1 m/s (7.0 mph) (NCDC 2006).

Based on onsite meteorological data collected from 1998 through 2002 at VEGP, the prevailing winds are from the west-southwest at both the 10- and 60-m (33- and 197-ft) levels. A secondary maximum occurs from the northeast. On a seasonal basis, the prevailing winds are from the southwest at both levels in the spring and summer. During winter, the prevailing winds are from the west; during autumn, the winds are from the northeast at both levels (Southern 2008a). This annual and seasonal wind pattern is consistent with nearby Augusta and Savannah River Site observation stations in the Savannah River Valley.

The mean annual wind speeds at the VEGP site are 2.5 m/s (5.6 mph) and 4.6 m/s (10.3 mph) at the lower- and upper-tower levels, respectively (Southern 2008a). The mean wind speed varies seasonally. At the 10-m (33-ft) level, maximum average winds of 2.8 m/s (6.3 mph) occur in the spring; minimum average winds of 2.3 m/s (5.1 mph) occur in autumn. At the 60-m (197-ft) level, maximum average winds of 5.0 m/s (11.2 mph) occur during both winter and

spring; minimum average wind speeds of 4.1 m/s (9.2 mph) are observed during the summer. The annual frequency of calm winds is 0.52 and 0.09 percent for the lower and upper levels, respectively (Southern 2008a). These trends are consistent with other stations in the region.

Wind persistence is defined as a continuous flow from a given direction or range of directions. This is determined by grouping continuous hourly wind direction readings into one of sixteen 22.5-degree cardinal range directions, centered on north and continuing clockwise through a complete circle through north-northwest. The longest wind persistence event at the 10-m (33-ft) level is 24 hours from the northeast. At the 60-m (197-ft) level, the longest wind persistence event is 36 hours and is also from the northeast direction (Southern 2008a).

2.3.1.2 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 Safety Guide 23 (AEC 1972). Categories are defined using letter designations A through G, which represent a range of atmospheric stabilities. When the temperature decreases rapidly with height, the atmosphere is unstable and atmospheric dispersion is greater. Unstable conditions are designated by categories A, B, and C, representing extreme, moderate, and slight instability, respectively. Conversely, when temperature increases with height, the atmosphere is stable and dispersion is more limited. Stable conditions are designated by categories E, F, and G, representing slight, moderate, and extreme stability, respectively. Neutral atmospheric conditions exist between slightly stable and slightly unstable conditions, and is designated by category D.

Five years (1998 to 2002) of temperature difference measurements made between the 60- and 10-m (197- and 33-ft) VEGP onsite meteorological tower levels indicate that unstable categories A, B, and C occur 6.48 percent, 4.54 percent, and 7.34 percent of the time, respectively. Stable categories E, F, and G occur 28.99 percent, 13.97 percent, and 11.17 percent of the time, respectively. Neutral conditions (category D) occur 27.50 percent of the time (Southern 2008a). Seasonally, spring and summer tend to have more extremely unstable conditions because of increased solar heating occurring at the surface. Autumn and winter months exhibit more extremely stable conditions because of reduced solar heating resulting in greater radiational cooling at the surface.

2.3.1.3 Temperature

Temperature measurements made at the 10-m (33-ft) level of VEGP's onsite meteorological tower are considered to be representative of the VEGP site. The average temperature at this level for the 5-year period from 1998 through 2002 is 18.1°C (64.6°F). This value is consistent with the average temperature of 17.9°C (64.2°F) measured at the Savannah River Site

(Hunter 2004) for the same period and is 0.8°C (1.5°F) higher than the longer, 30-year average measured at Augusta, Georgia (NCDC 2006). The maximum and minimum temperatures at the VEGP's onsite tower during the same 5-year period were 39.8°C (103.6°F) and -8.6°C (16.6°F), respectively. These temperature extremes are consistent with the range of temperatures observed at Augusta and the Savannah River Site.

2.3.1.4 Atmospheric Moisture

The moisture content of the atmosphere can be represented in a variety of ways; however, the most common are precipitation, relative humidity, and fog.

Annual precipitation amounts average around 113.23 cm (44.58 in.) at Augusta. On average, March is the wettest month, with a monthly average of 11.71 cm (4.61 in.). A secondary precipitation maximum occurs during August, with an average of 11.38 cm (4.48 in.); this maximum is the result of higher thunderstorm activity and tropical storm remnants. November is the driest month, with an average of 6.81 cm (2.68 in.) (NCDC 2006). At the Savannah River Site, the annual average precipitation amount is higher at 125.7 cm (49.5 in.) (Hunter 2004). However, similar monthly and seasonal precipitation trends exist.

The 5-year period (1998 through 2002) used in the analysis provided in the Environmental Report (ER) (Southern 2008a) was an abnormally dry period in the southeast. At Augusta, Georgia, the annual average precipitation amount during this 5-year period was 99.95 cm (39.35 in) or 13.28 cm (5.23 in.) less than normal (NCDC 1999, 2000, 2001, 2002, 2003). The Savannah River Site had an annual average of 107.85 cm (42.46 in.), which is 17.88 cm (7.04 in.) less than the normal 30-year average measured at the Savannah River Site.

Relative humidity is not measured at the VEGP site. However, relative humidity is measured at both Augusta and the Savannah River Site, and these stations are representative of the regional climate. Measurements from these stations show that relative humidity varies diurnally, with a maximum occurring during the early morning hours and a minimum occurring during the early afternoon. In Augusta, morning mean relative humidity ranges from 84 percent in January and February to 92 percent in August; afternoon mean relative humidity ranges from 45 percent in April to 56 percent in August (NCDC 2006). Similar diurnal trends in relative humidity occur at the Savannah River Site. Relative humidity also varies on a seasonal basis. The springtime months of March and April have the lowest average relative humidity of 66 percent; the mid-to-late summertime months of August and September have the highest average relative humidity of 77 percent (NCDC 2006). Overall, the annual average relative humidity is 72 percent (NCDC 2006) at Augusta and 69 percent at the Savannah River Site (Hunter 2004). On about 36 days per year, the air becomes saturated and fog forms, which limits visibility to less than 0.40 km (0.25 mi) (NCDC 2006).

The dew point temperature, which is related to relative humidity, is measured at the 10-m (33-ft) level on the VEGP onsite meteorological tower. The dew point temperature is the temperature at which air becomes saturated when it is cooled. When the ambient temperature and dew point temperature are equal, the relative humidity is 100 percent. The dew point depression, which is the difference between the ambient temperature and dew point temperature, can be used in the design of wet cooling systems and to predict the occurrence of fog. Staff analyzed VEGP onsite meteorological data at the 10-m (33-ft) level for the period of 1998 through 2002 to determine frequency of occurrence when the dew point depression was 5.0°C (9.0°F) or less. Over the 5-year period, a dew point depression of 5.0°C (9.0°F) or less occurred 39 percent of the time. September had the highest frequency of occurrence (51 percent), and May had the lowest (23 percent). These trends are consistent with the seasonal trends for relative humidity, as noted previously.

2.3.1.5 Severe Weather

The VEGP site can experience severe weather in the form of thunderstorms, hail, and tornadoes. On average, thunderstorms occur 52 days per year, with approximately 30 of those occurring during the summer months of June through August (NCDC 2006). In contrast, the months of October through January average one thunderstorm per month (NCDC 2006). Hail can sometimes accompany thunderstorms. Over the 10-year period spanning 1996 through 2005, 21 separate hail events with hail a diameter of 1.9 cm (0.75 in.) or greater were reported in Burke County (NCDC 2007).

From 1996–2005, three tornadoes were reported in Burke County (NCDC 2007). The strongest tornado reported on record (1950–2005) occurred on January 13, 1972, and was a magnitude F3 (i.e., wind speed between 70.6 and 92.1 m/s [158 and 206 mph])(NCDC 2007). Using tornado data for the period from January 1, 1950, through August 31, 2003, the best estimate tornado strike probability for a 1-degree box that includes VEGP is 3.76×10^{-4} (Ramsdell 2005).

Snowfall events are infrequent in the Savannah River Valley. Annually, the region receives an average of 3.6 cm (1.4 in.) of snowfall each year. Days with snowfall in excess of 2.54 cm (1.0 in.) are rare. However, a 35.6-cm (14.0-in.) snowfall event did occur in February 1973 (NCDC 2006).

Burke County is sufficiently far inland that tropical cyclones are often less than hurricane strength by the time they are in the vicinity of the VEGP site. The National Oceanic and Atmospheric Administration's Coastal Service Center (NOAA-CSC) maintains a database of tropical cyclone tracks and intensities that covers the period from 1851 through 2005. Hurricane Gracie, which moved through the region on September 29, 1959, is the strongest hurricane to pass within an 80-km (50-mi) radius of the site. Gracie was a Category 3 hurricane, with maximum sustained surface 10-m (33-ft) winds of 49.6 m/s (111.0 mph) to 58.1 m/s (130.0 mph), inclusive

(NOAA-CSC 2007). In addition to Gracie, four other Category 3 hurricanes have passed within a 160-km (100-mi) radius of the site since 1851 (NOAA-CSC 2007).

2.3.2 Air Quality

The VEGP site is centrally located within the Augusta (Georgia) - Aiken (South Carolina) Interstate Air Quality Control Region (AQCR) (40 CFR 81.114). All of the counties in this AQCR are designated as in attainment or unclassified for all criteria pollutants for which National Ambient Air Quality Standards (NAAQS) have been established (40 CFR 81.314). Parts of Richland and Lexington Counties, South Carolina, which are within the Columbia Intrastate AQCR (40 CFR 81.108) and border the Augusta (Georgia) – Aiken (South Carolina) AQCR to the north-northeast, are in non-attainment with respect to the 8-hour ozone standard (40 CFR 81.341). There are no mandatory Class 1 Federal Areas where visibility is an important issue within the 160-km (100-mi) radius of the VEGP site.

The Environmental Protection Division (EPD) of the GDNR operates a statewide air-monitoring network, with more than 68 monitoring locations in 37 counties (Georgia EPD 2005). Burke County does not have a monitoring station; the closest monitoring station is located in Richmond County. Monitoring takes place throughout the year, with the exception for ozone, which is sampled from March through October. Monitoring results for this location for the years 2001 through 2005 show an exceedance with respect to the 8-hour ozone standard in 2001 (3 days), 2002 (5 days), 2004 (3 days), and 2005 (1 day) (Georgia EPD 2002, 2003, 2004, 2005, 2006). Standards were not exceeded for any other measured criteria pollutant.

The Air Quality Index (AQI) is a national standard method for reporting air-pollution levels for the general public. The AQI is based on comparison of the concentrations of six pollutants within the NAAQS. The six pollutants are ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter smaller than 10 micrometers (PM_{10}), and particulate matter smaller than 2.5 micrometers ($PM_{2.5}$). 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.

According to the U.S. Environmental Protection Agency (EPA), AQIs are available for Richmond County (EPA 2007). From 2001 to 2005, there were no days where the AQI was classified as Unhealthy, Very Unhealthy, or Hazardous. On average, the air quality was classified as Unhealthy for Sensitive Groups on 4 days each year for this period. For the remainder of the time, the air quality was classified as Good or Moderate, with Good days far outnumbering Moderate days.

The area for which air monitoring has been conducted and AQIs have been calculated generally reflect the more densely populated Augusta city region within Richmond County. It is likely that air quality in Burke County and in the immediate vicinity of the VEGP site is better than that of Richmond County.

2.3.3 Meteorological Monitoring

The meteorological monitoring for the proposed VEGP site would consist of the current onsite monitoring program used for VEGP Units 1 and 2. The meteorological monitoring program has been in place since 1972 and is described in the ER for the ESP site (Southern 2008a). Meteorological data for the period of January 1, 1998, to December 31, 2002, were used to generate atmospheric dispersion factors (χ/Q values) to estimate radiological impacts in the areas surrounding the VEGP site.

The primary meteorological monitoring system is a 60-m (197-ft) tower instrumented at the 10-m (33-ft) and 60-m (197-ft) levels. Wind speed, wind direction, wind direction fluctuation, and temperature are measured at both levels. The vertical temperature difference is calculated by taking the difference between the measured temperature at both levels. Dew point temperature is also measured at the 10-m (33-ft) level. A tipping bucket rain gauge is used to measure precipitation near the base of the tower and is augmented with human observations. A 45-m (148-ft) backup meteorological tower is sited nearby and provides additional measurements of wind speed, wind direction, wind direction fluctuation, and temperature at the 10-m (33-ft) level. Data from both towers are collected and processed on a digital recording system that is located in a shelter near the base of the meteorological tower. These data are available locally on digital strip chart recorders that are housed within the shelter. Five-second-sampled data are averaged to 15-minute and hourly values and made available to control room and facility personnel. The data collection process uses an uninterruptible power supply to provide backup power for data storage and transmission in the event of power failure at the site.

The current meteorological monitoring system would remain in operation during the site preparation, construction, and operational phases of the proposed VEGP Units 3 and 4 at the VEGP site. The proposed cooling towers for these units will be 180-m (600-ft) tall and located approximately 915 m (3000 ft) north of the existing meteorological monitoring site.

The staff reviewed the available information relative to the onsite meteorological measurements program and the data collected by the program. The staff concludes that the system provides adequate data to represent onsite meteorological conditions as required by 10 CFR 100.20 and 10 CFR 100.21. The onsite data also provide an acceptable basis for making estimates of atmospheric dispersion for design-basis accident and routine releases from the plant to meet the requirements of 10 CFR Part 20, 10 CFR 50.34, and 10 CFR Part 50, Appendix I.

2.4 Geology

A detailed description of the geological, seismological, and geotechnical conditions at the VEGP site is provided in Section 2.5 of the Site Safety Analysis Report (SSAR) (Southern 2008a). A summary of the geology of the proposed VEGP site is provided in Section 2.6 of the ER (Southern 2008a). In addition to characterization conducted for the existing plant, results of subsurface investigations performed as part of the ESP application provide further definition of the site geology. The staff's description of the site and vicinity geological features and the detailed analyses and evaluation of geological, seismological, and geotechnical data as required for an assessment of the site-safety issues related to the proposed VEGP site are included in the staff's safety evaluation report.

The VEGP site lies within the Coastal Plain Physiographic Province, and is approximately 48 km (30 mi) southeast of the Fall Line, which represents the transition between the Piedmont and Coastal Plain Physiographic Provinces (Figure 2-4). The Coastal Plain province is a wedge of unconsolidated and semi-consolidated sediments that increases in thickness as it extends to the southeast from the contact with the Piedmont to the edge of the continental shelf. The thickness of Coastal Plain sediments varies from less than 60 m (200 ft) at the Fall Line to 1200 m (4000 ft) at the coastline, and is approximately 300 m (1000 ft) thick at the VEGP site (Southern 2008a; Clarke and West 1997). Sediments below the site range in age from Cretaceous at depth to Quaternary at the surface. The Coastal Plain sediments are underlain by bedrock consisting of sedimentary Triassic basin rock and Paleozoic crystalline rock.

A surface topography of gently rolling hills at the VEGP site ranges in elevation from 24 m (80 ft) above MSL to nearly 91 m (300 ft) above MSL in the immediate vicinity of the VEGP site (Southern 2008a). Developed portions of the site have ground surface elevations of approximately 67 m (220 ft) above MSL. The Savannah River has incised the Coastal Plain sediments and formed steep bluffs exhibiting topographic relief of nearly 46 m (150 ft) from the river (approximately 24 m [80 ft] above MSL) to the developed portions of the existing VEGP site. Alluvial material that forms the floodplain of the Savannah River is 1.8 to 3.0 m (6 to 10 ft) above the river.

U.S. Geological Survey (USGS) documentation on the mineral industry of Georgia and South Carolina indicates that there are no major production areas for mineral resources in Burke County, Georgia (USGS 2003a, b). Neighboring counties with mineral resources are Richmond County, Georgia, which produces crushed stone, common clay, construction sand and gravel, and kaolin; Jefferson County, Georgia, which produces kaolin and Fuller's earth, and Aiken County, South Carolina, which produces construction sand and gravel, kaolin, crushed stone, and common clay. Other neighboring counties are not noted for major mineral production areas (USGS 2003a,b).

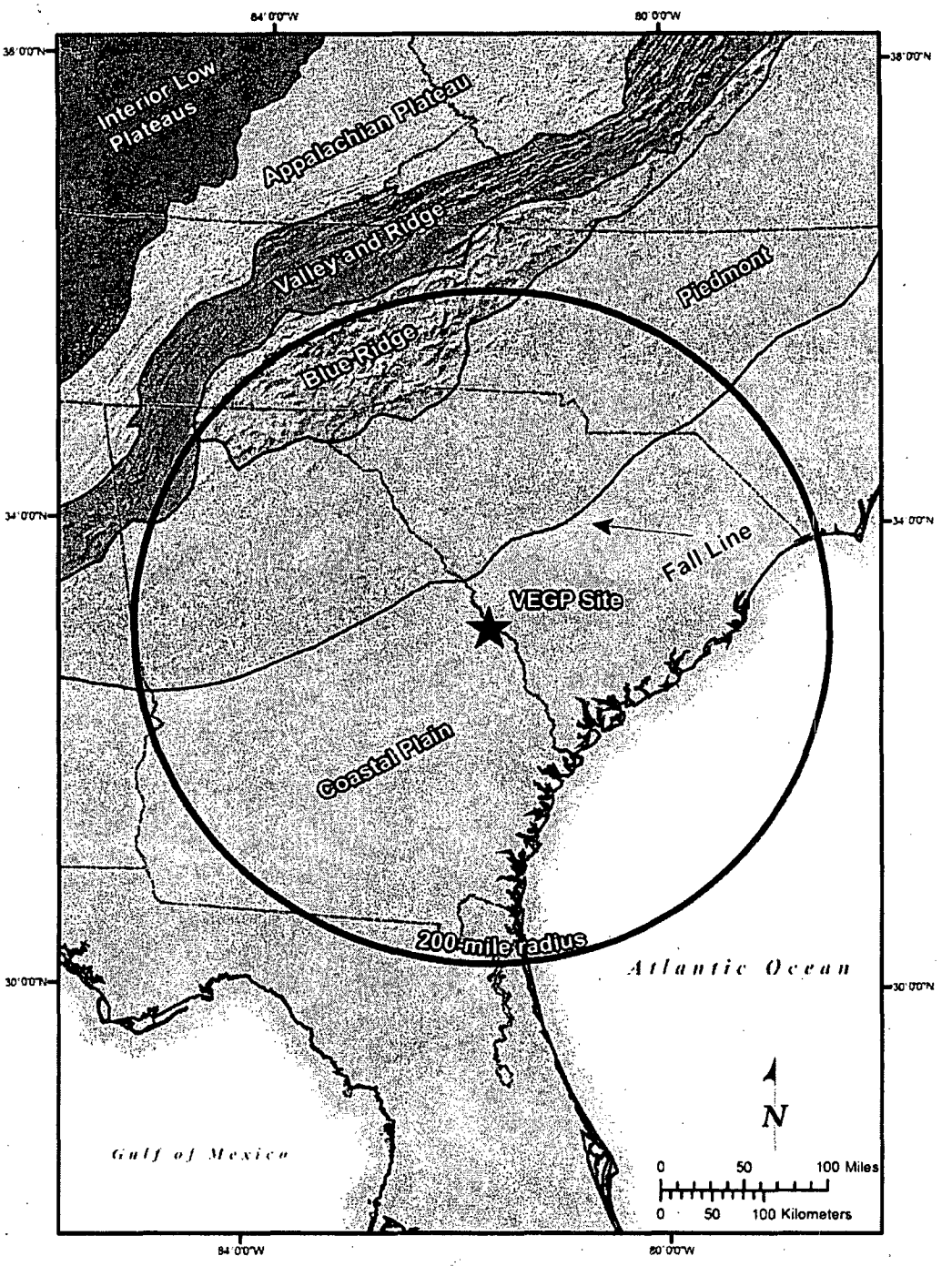

Figure 2-4. Physiographic Map (Southern 2008a)

There is no sole-source aquifer within a 320-km (200-mi) radius of the VEGP site (EPA 2006; Southern 2008a).

The staff acquired and reviewed a recently completed USGS national assessment of the oil and gas reserves potentially existing in geologic provinces onshore and offshore of the United States (USGS 2007). Two provinces, the Appalachian Basin Province (USGS 2003c) and the South Florida Basin Province (Pollastro et al. 2001), touch on the State of Georgia. The former touches the northwest corner of the State and the latter touches the boundary with Florida, but neither are near Burke County. There is no estimate of any potential additions to oil, gas, and natural gas reserves in or near Burke Country.

2.5 Radiological Environment

A radiological environmental monitoring program (REMP) has been conducted around the VEGP site since operations began in 1987. This program measures radiation and radioactive materials from all sources, including the existing units at VEGP and the Savannah River Site. The REMP includes the following pathways: direct radiation, atmospheric, aquatic and terrestrial environments; and ground water and surface water. A pre-operational environmental monitoring program was conducted before 1987 to establish a baseline to observe fluctuations of radioactivity in the environment after operations began. After routine operation of Unit 1 started in 1987 and Unit 2 started in 1989, the monitoring program continued to assess the radiological impacts to workers, the public, and the environment. The results of this monitoring are documented in an annual environmental operating report for the VEGP site. The NRC staff reviewed historical data from the REMP reports for a 4-year period (2001 through 2004). Each year, Southern issues a report entitled *Annual Radioactive Effluent Release Report for the Vogtle Power Station*, which documents gaseous and liquid releases and resulting doses from VEGP. The NRC staff reviewed annual radioactive effluent release reports for calendar years 2001 through 2004 (Southern 2002, 2003a, 2004, 2005). Maximum doses to a member of the public were calculated using effluent concentration and historical meteorological data for the site. For the 4 years reviewed, the maximum annual dose to a member of the public was less than 0.001 mSv (less than 0.1 mrem) for operation of VEGP Units 1 and 2. These data show that doses to the maximally exposed individuals around the VEGP site were a small fraction of the limits specified in Federal environmental radiation standards, 10 CFR Part 20; 10 CFR Part 50, Appendix I; and 40 CFR Part 190.

In addition, these data show that exposures or concentrations in air, water, and vegetation at locations near the plant perimeter (i.e., indicator locations) and at distances greater than 16 km (10 mi) (i.e., control locations) are comparable, if not statistically indiscernible. During the 10-year period from 1992 to 2001 the average annual direct radiation exposure at the indicator and control locations ranged from 48.0 to 54.4 mR and 48.4 to 54.4 mR, respectively (Southern 2002). The indicator and control location results are similarly comparable for drinking

water, vegetation, and fish. The maximum exposure to a member of the public resulting from operation of VEGP Units 1 and 2 is a small fraction of the exposure measured at the control locations (i.e., background) and much smaller than the variability of measured exposure values (i.e., 48.4 to 54.4 mR).

Concerning the groundwater, the State of Georgia (Summerour et al. 1998) determined that elevated levels of tritium in the unconfined aquifer in Georgia originated from the Savannah River Site, are a result of atmospheric deposition from Savannah River Site releases, are well below the drinking water standard, and are not a public health threat. The USGS (Clarke and West 1997, 1998; Cherry 2006) determined that transriver flow is not responsible for the elevated tritium levels measured in the unconfined aquifer. See Sections 2.6.3.2, 7.3.2.2, and 7.8 for more information on offsite sources of tritium and other radionuclides.

2.6 Water

This section describes the hydrological processes governing movement and distribution of water in the existing environment at the VEGP site. The historic low-water periods with VEGP Units 1 and 2 in operation were considered in the analysis. However, since Savannah River discharge at the site during low-water periods is regulated by upstream dam operations, present-day operating rules adapted from U.S. Army Corps of Engineers (USACE) (USACE 2006a; NRC 2007a,b) for the upstream dams were also factored into the analysis.

2.6.1 Hydrology

This section describes the site-specific and regional hydrological features that could be altered by construction and operation of the proposed VEGP Units 3 and 4. A description of the site's hydrological features was presented in Section 2.3.1 of the ER (Southern 2008a). Hydrological features of the site related to site safety (e.g., probable maximum flood) are described by Southern in the Site Safety Analysis Report (SSAR) portion (Part 2) of the application (Southern 2008a).

2.6.1.1 Surface-Water Hydrology

The dominant hydrological feature of the VEGP site is the Savannah River, which forms the border between Georgia and South Carolina. The total size of the Savannah River watershed is approximately 27,400 km^2 (10,579 mi^2), 15,200 km^2 (5870 mi^2) of which are in Georgia, 11,700 km^2 (4530 mi^2) in South Carolina, and 464 km^2 (179 mi^2) are in North Carolina (USACE 1996a). The confluence of the Seneca and Tugaloo Rivers, which is now part of Hartwell Lake, is considered the upstream end of the Savannah River (USACE 1996a). The Savannah River then flows 464.9 km (288.9 mi) from Hartwell Dam to its mouth, where it enters the Atlantic Ocean at Savannah, Georgia.

Affected Environment

The VEGP site is located at Savannah River river mile (RM) 150.9, and three large dams, constructed and operated by the USACE, lie upstream of the site. Hartwell Dam, at Savannah RM 288.9, is 222 km (138 mi) upstream of the VEGP site and is capable of storing a maximum of 4230 million m^3 (3,430,000 acre-feet (ac-ft)) (USACE 1996a). The dam was completed and began storing water in February 1961 (USACE 1996a). Richard B. Russell Dam, at Savannah RM 259.1, is 174 km (108 mi) upstream of the VEGP site and is capable of storing a maximum 1836 million m^3 (1,488,155 ac-ft) (USACE 1996a). This was the last of the three large dams to be completed, and it began storing water in October 1983. At Savannah RM 221.6, J. Strom Thurmond Dam is 114 km (71 mi) upstream of the VEGP site. Its reservoir is capable of storing a maximum of 4564 million m^3 (3,700,000 ac-ft) of water. J. Strom Thurmond Dam, first of the three dams to be completed, began storing water in December 1951 (USACE 1996a).

Between J. Strom Thurmond Dam and the VEGP site lies Stevens Creek Dam (RM 208.1), the city of Augusta (approximately RM 200), New Savannah Bluffs Lock and Dam (RM 187.7), and the mouths of several small creeks (USACE 1996a). Stevens Creek Dam, operated by SCE&G, functions as a re-regulating reservoir to mitigate the large flow variations from J. Strom Thurmond Dam and to generate hydroelectric power. New Savannah Bluffs Dam, constructed and operated by USACE, is part of the inactive Savannah River Below Augusta Navigation Project (USACE 1996a).

Channel modifications have been made to the Savannah River to allow for a 2.7-m (9-ft) deep by 27-m (90-ft) wide navigation channel from the Savannah Harbor to the city of Augusta. By 1980, shipping along the river had essentially ceased, and maintenance of the channel was discontinued (USACE 2006a). Consequently, Hartwell, Russell, and Thurmond dams are no longer operated for navigation, and minimum discharges from J. Strom Thurmond Dam are based on the needs of downstream water supply withdrawals without concern for navigation (USACE 2006a).

USGS flow gage 02197320, located near Jackson, South Carolina, was installed approximately 9.6 km (6 mi) upstream of the VEGP site at Savannah RM 156.8 (USGS 2002). The staff computed flow statistics for the gage's entire period-of-record (October 1971 to September 2002). The average-daily discharge during the period-of-record was 250 m^3/s (8830 cfs), the maximum discharge was 623 m^3/s (22,000 cfs) (December 2, 1976; April 16, 1977; August 29, 1994; March 9, 1997; January 19, 1998), and the minimum discharge was 91.2 m^3/s (3220 cfs) (December 9, 1981). The period-of-record discharge dataset is shown in Figure 2-5.

USGS stream flow gages are typically accurate to within 5 to 10 percent of the actual stream flow (Hirsch and Costa 2004). Each flow gage dataset appearing in published USGS reports have an assigned accuracy level. USGS (2002) states that the accuracy of daily-reported discharges collected at the Jackson, South Carolina gage are within 10 percent of the true value.

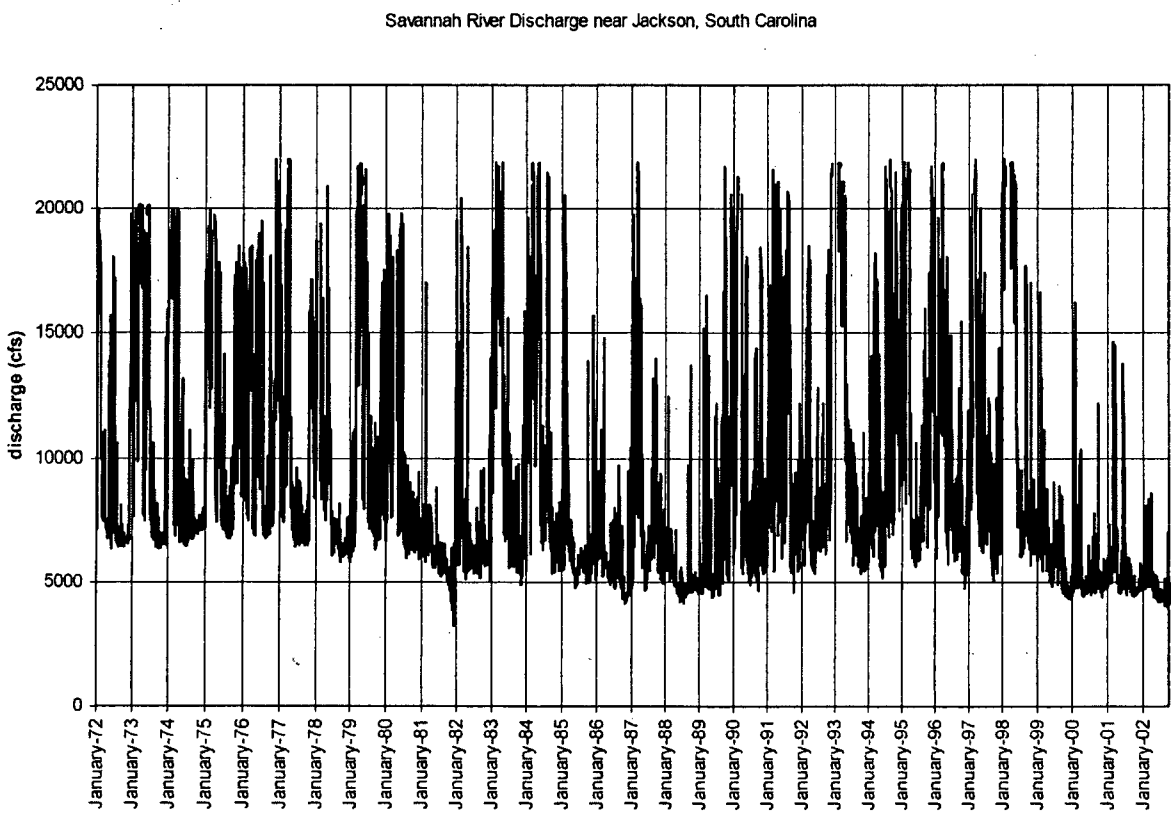

Figure 2-5. Daily Averaged Savannah River Discharge near Jackson, South Carolina (USGS 2002)

Discharge passing the VEGP site is highly regulated by releases from J. Strom Thurmond Dam. Although the dams located downstream of J. Strom Thurmond Dam re-regulate the daily peaks and troughs of water released from J. Strom Thurmond Dam, they are not capable of storing any significant volumes of water. Therefore, the average discharge passing the VEGP site is directly proportional to the average quantity of flow released from J. Strom Thurmond Dam. The quantity of flow released from J. Strom Thurmond Dam is based on Drought Contingency Plan rule curves. During periods of relative water scarcity, outflow released from J. Strom Thurmond Dam is a function of the volume of water stored behind the Hartwell and J. Strom Thurmond dams (the two dams with significant storage capacity). The most recent Drought Contingency Plan developed by USACE is presented in Table 2-2 (USACE 2006a; NRC 2007a,b).

Table 2-2. Savannah River Drought Rule Curves

Drought Level	April 1 – Oct 15 Elevation (ft above MSL)	Dec 15 – Jan 1 Elevation (ft above MSL)	Action
1	Hartwell = 656 ft Thurmond = 326 ft	Hartwell = 654 ft Thurmond = 324 ft	Limit Thurmond Dam discharge to maximum of 4200 cfs
2	Hartwell = 654 ft Thurmond = 324 ft	Hartwell = 652 ft Thurmond = 322 ft	Limit Thurmond Dam discharge to maximum of 4000 cfs
3	Hartwell = 646 ft Thurmond = 316 ft	Hartwell = 646 ft Thurmond = 316 ft	Limit Thurmond Dam discharge to maximum of 3800 cfs
4	Hartwell = 625 ft Thurmond = 312 ft	Hartwell = 626 ft Thurmond = 312 ft	Inflow to Thurmond Lake = Outflow from Thurmond Dam (i.e., keep reservoir at minimum conservation pool elevation)

Source USACE 2006a.

The Drought Contingency Plan rule curves were developed after the extreme drought that affected the southern United States between 1998 and 2002 (USACE 2006a). This drought exceeded the previous drought-of-record for the region, which lasted from 1986 to 1989 (USACE 1996). The impacts of these drought periods on the average-daily flows in the Savannah River near the site can be seen in Figure 2-5.

Although the Savannah River near the VEGP site is highly regulated by upstream dams, Southern developed a statistical analysis of the low flows in the Savannah River at Augusta (Southern 2008a). By examining the period between April 1986 and March 2003, Southern developed a 7Q10 low-flow statistic, which is an estimate of the lowest 7 consecutive-day average flow with a statistical recurrence interval of 10 years. The 7Q10 reported by Southern was 108.40 m^3/s (3828 cfs) (Southern 2008a). Coincidentally, this low-flow statistic is approximately equal to the Drought Level 3 release (see Table 2-2) discharge from J. Strom Thurmond Dam proposed by the USACE in the draft Drought Contingency Plan (USACE 2006a).

Savannah River water temperature data were collected by the GDNR at Shell Bluff Landing, approximately 11 river miles upstream of the VEGP site, and reported by Southern (Southern 2006a). The period of record for these monthly grab-sampled water temperature measurements was from January 30, 1973, to August 13, 1996. From these data, the following water temperature statistics were generated: minimum = 5.0°C (41.0°F), average = 17.4°C (63.4°F), median = 18.0°C (64.4°F), and maximum = 27.2°C (81.0°F).

2.6.1.2 Groundwater Hydrology

The groundwater aquifers in the region and in the vicinity of the site are described in Sections 2.3.1.2 and 2.3.3.2 of the ER (Southern 2008a). Within a 320-km (200-mi) radius of the VEGP site, there are parts of four physiographic provinces. The VEGP site lies within the Coastal Plain Physiographic province, about 48 km (30 mi) southeast of the Fall Line that separates the Piedmont province from the Coastal Plain province. The Coastal Plain sediments range in thickness from less than 60 m (200 ft) thick at the Fall Line to more than 1200 m (4000 ft) thick in an eastern-to-southeastern direction, and are approximately 300 m (1000 ft) thick at the VEGP site (Southern 2008a; Clarke and West 1997). They range in age from Holocene at the surface to Cretaceous at depth, and overlie an eastward extension of the Piedmont province, which is composed of crystalline igneous and metamorphic bedrock. The stratigraphic section for VEGP is shown in Figure 2-6. This figure details the geologic age, geologic units, hydrogeologic units, and the depth of sediments underlying the VEGP site.

Geotechnical and hydrogeological investigations performed by Southern for the ESP application have shown the site to be underlain by the Southeastern Coastal Plain aquifer system composed of the Water Table aquifer (also known as the Upper Three Runs aquifer), the Tertiary aquifer, and the Cretaceous aquifer (Southern 2008a). The upper two aquifers are separated by the Lisbon Formation, a confining unit that provides hydraulic isolation between the unconfined and confined aquifers. The lower two aquifers are separated by the Snapp Formation and Black Mingo Formation, comprising a semi-confining unit. This semi-confining unit allows some hydraulic connection between the two lower aquifers. The lowest confined aquifer system is composed of Cretaceous aged sediments, and spans from the Cape Fear Formation to the Steel Creek Formation. The middle aquifer, also a confined aquifer system, is composed of Tertiary aged permeable sands of the Still Branch sands and Congaree Formation. The uppermost aquifer is unconfined and is composed of Tertiary aged sands, silts, clays and limestone of the Barnwell Formation. The hydrostratigraphic section for the VEGP site is shown in Figure 2-6. Naming conventions for aquifers vary. In State of Georgia reports on water quality, the Barnwell Formation sediments of the Water Table aquifer are described as the Jacksonian aquifer (Donahue 2004). As the aquifers dip to the southeast, the Water Table aquifer becomes confined and is the upper Floridan aquifer, and the Tertiary aquifer becomes the lower Floridan aquifer (Clarke and West 1997; Summerour et al. 1994). During its review of numerous reports on the regional and local hydrogeology, the staff found the comparison of hydrogeologic unit naming conventions found in Figure 4 of Clarke and West (1997) to be useful.

Geologic Time		SNC ESP Nomenclature			
Period	Series	Geologic Unit	Hydrogeologic Unit	Depth (ft)	Elevation (ft MSL)
Tertiary	Eocene	Barnwell Gr.	Water Table Aquifer	Ground Surface	+223
		Lisbon Fm./Blue Bluff Mbr.	Confining Unit	86	+137
		Still Branch Fm. Congaree Fm.	Tertiary Sand Aquifer	149	+74
	Paleocene	Snapp Fm. Black Mingo Fm.	Semi-Confining Unit	331	-108
Cretaceous		Steel Creek Fm.	Cretacous Aquifer	477	-254
		Gaillard Fm./ Black Creek Fm.			
		Pio-Nono Fm./ Unnamed Sands			
		Cape Fear Fm.		1049	-826

Notes: Geologic unit naming convention (Huddleston and Summerour 1996; Falls and Prowell 2001)
Regional hydrogeologic unit naming convention (Miller 1990)
Depths and elevations from boring B-1003 (Southern 2007a)

Figure 2-6. Schematic Hydrostatigraphic Column for the Southeastern Coastal Plain Aquifer System Underlying the VEGP Site (Southern 2008a)

Water Table Aquifer

The water table of the unconfined aquifer at the VEGP site is described by the tabular and graphic representations of piezometric head provided by Southern (Southern 2008a). The contour map showing the piezometric head for June 2005 is representative and is shown in Figure 2-7. The local high of the water table is approximately 50 m (165 ft) above MSL

(Southern 2008a), and the hydraulic gradient indicates groundwater flow to the north towards Mallard Pond through the powerblock area and to the south from the cooling tower area for the proposed VEGP Units 3 and 4 region. The top of the Blue Bluff Marl, the unit of the Lisbon Formation that forms the base of the unconfined aquifer has a maximum elevation of approximately 49 m (160 ft) above MSL but drops off sharply to the northwest of the powerblock.

Hydraulic head and flow within the Water Table aquifer is governed by local topography and net infiltration from precipitation. Discharge from the Water Table aquifer is to local drainages (i.e., springs, streams, and ponds), the Savannah River, and wells.

Tertiary Aquifer

The piezometric head of the confined Tertiary aquifer at the VEGP site is described by Southern in Section 2.3.1 of the ER (Southern 2008a). The contour map showing the piezometric head for June 2005 is representative and is shown in Figure 2-8. The highest plotted contour of 38.1 m (125 ft) above MSL lies to the west of the proposed site for VEGP Units 3 and 4 and drops to 27.4 m (90 ft) above MSL near the river (Southern 2008a). The contours indicate flow toward and potential interception by the Savannah River. Southern states the zero flow level or river bottom elevation is approximately 20.59 m (67.56 ft) above MSL (Southern 2008a) opposite the proposed VEGP Units 3 and 4 intake location, and this is lower than the reported base elevation of the Lisbon Formation opposite the VEGP site, portions of which are approximately 24 m (80 ft) above MSL (Southern 2008a). The USGS (Clarke and West 1997) also indicates the potential for the Savannah River to have incised the confining unit of the Tertiary aquifer (the Lisbon Formation) where it intercepts the Pen Branch fault in the vicinity of the plant, and the potential for the Tertiary aquifer to discharge locally to the Savannah River alluvium.

The base of the Blue Bluff Marl forms the top of the confined Tertiary aquifer. This surface has a maximum elevation of approximately 24 m (80 ft) above MSL in the vicinity of the proposed site for VEGP Units 3 and 4 but drops off sharply to the north-northwest. The base of the Tertiary aquifer is at the upper surface of the Paleocene-age Black Mingo and Snapp Formations, which are at approximately 33 m (108 ft) below MSL. The staff concurs with Southern's interpretation that the Tertiary aquifer is confined by the Blue Bluff Marl, and is substantially, if not completely isolated hydraulically from the Water Table aquifer. Local to the VEGP site, there is a downward hydraulic gradient from the Water Table aquifer toward the Tertiary aquifer.

Recharge to the confined Tertiary aquifer occurs primarily at outcrop regions between the VEGP site and the Fall Line, which lies approximately 48 km (30 mi) to the northwest at RM 203, where Tertiary sediments are exposed to infiltration from precipitation. Discharge from the Tertiary aquifer occurs to the alluvial deposits underlying the Savannah River in regions where the confining unit has been incised, and to groundwater wells, natural springs, and subaqueous outcrops offshore (Southern 2008a).

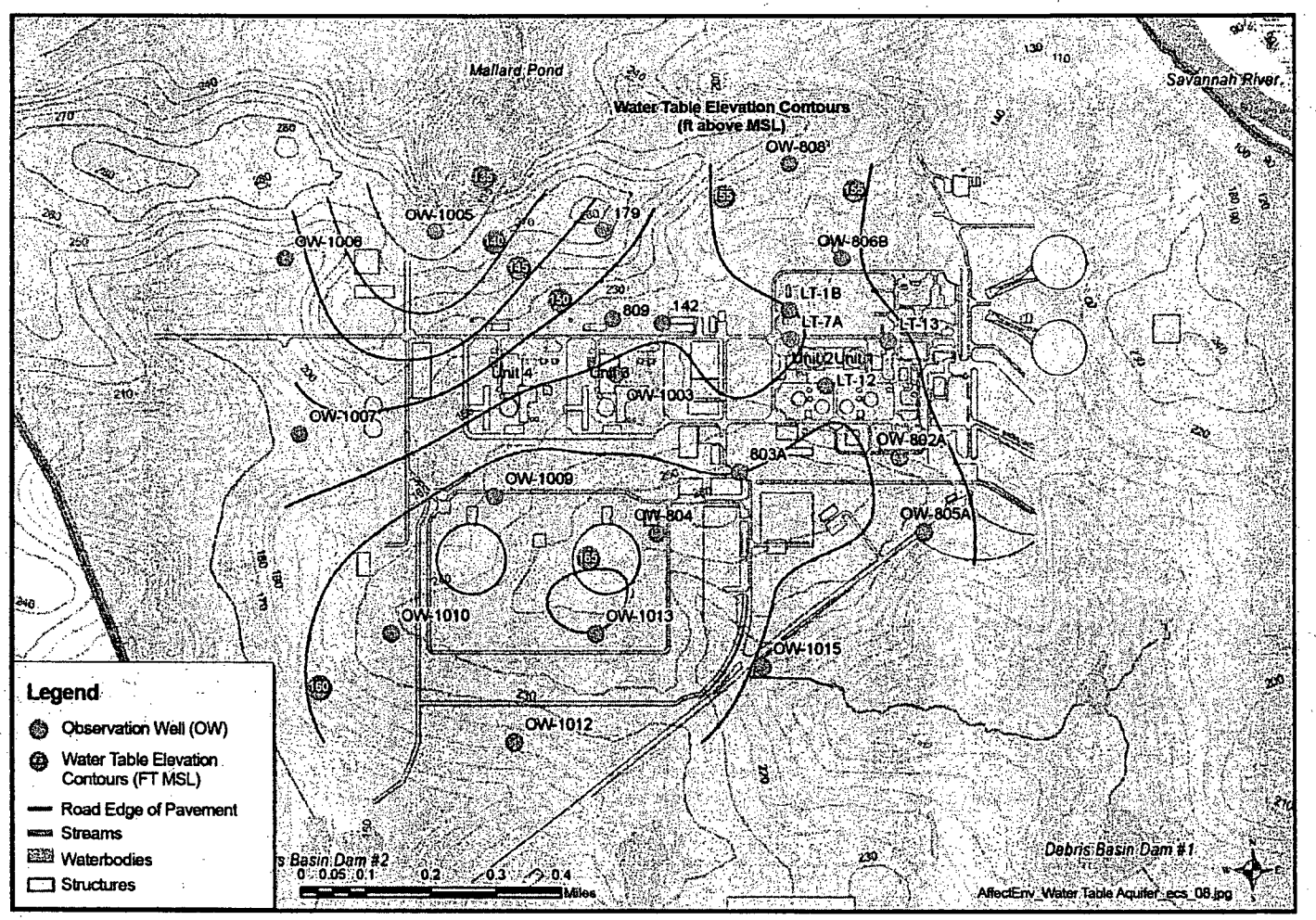

Figure 2-7. Water Table Aquifer: Piezometric Contour Map for June 2005 (Southern 2008a)

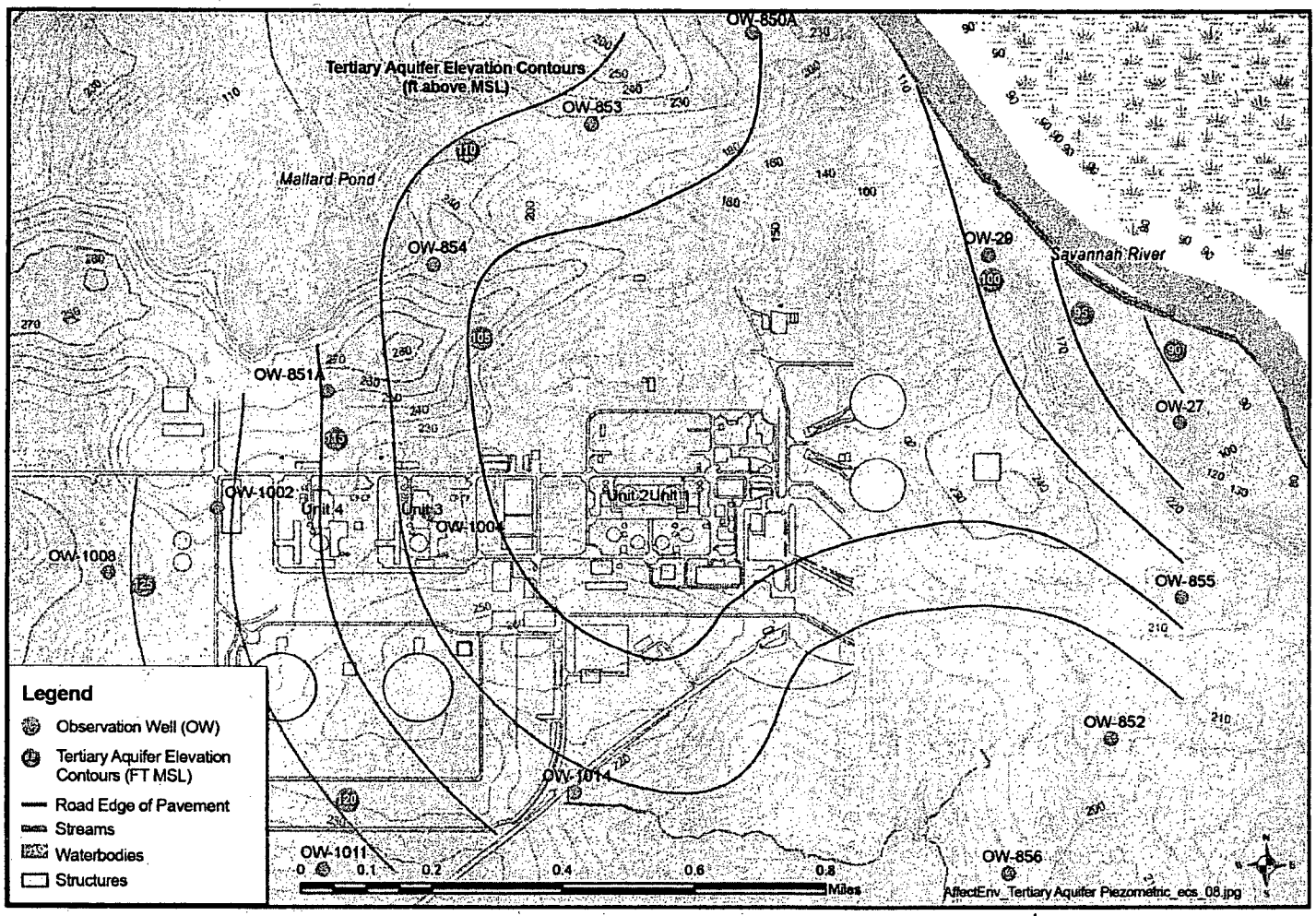

Figure 2-8. Tertiary Aquifer: Piezometric Contour Map for June 2005 (Southern 2008a)

Cretaceous Aquifer

The piezometric head of the confined Cretaceous aquifer at the VEGP site is represented in the contour maps shown in Figure 2-9 A,B for the years 1992 and 2002 (Cherry 2006). These two panels show the hydraulic head in upper and lower sequences of the Cretaceous aquifer, described here as the Dublin aquifer system and the Midville aquifer system, respectively. The staff's interpretation of this figure indicates the hydraulic head of the Dublin aquifer system in the vicinity of the VEGP site has decreased from 49 to 43 m (160 to 140 ft) above MSL between 1992 and 2002, while the deeper Midville aquifer system has decreased from 52 to 49 m (170 to 160 ft) above MSL.

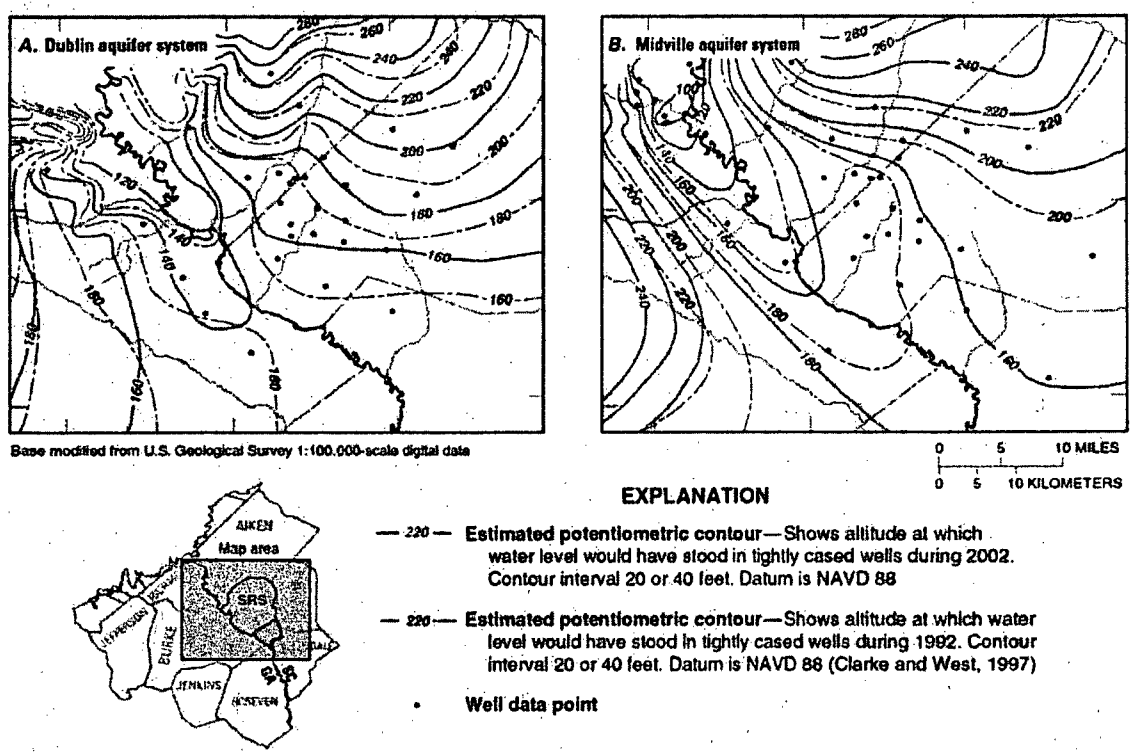

Figure 2-9. Potentiometric-Surface Maps for the (A) Dublin Aquifer System, and (B) Midville Aquifer System during 1992 and 2002, Near the Savannah River Site, Georgia and South Carolina (Cherry 2006).

The Dublin aquifer system is confined above by the Black Mingo and Snapp formations and its groundwater is identified with the Steel Creek Formation through Black Creek Formation in Figure 2-6. The Midville aquifer system is confined above by the Midville confining unit that is located in the middle to lower portion of the Black Creek Formation (Clarke and West 1997). Groundwater of the Midville aquifer system is identified with the Pio-Nono Formation through

Cape Fear Formation of the hydrostratigraphic cross section (Figure 2-6). Elevations of the upper surfaces of the hydrogeologic units identified in the B-1003 boring are shown in Figure 2-6. The Cretaceous sediments consist of fluvial and estuarine deposits of cross-bedded sand and gravel with silt and clay interbeds. They extend from the upper surface of the Steel Creek Formation (i.e., elevation -77.4 m [-254 ft] above MSL), to the upper surface of the Triassic basin bedrock (i.e., elevation -251.8 m [-826 ft] above MSL). Local to the VEGP site, there is an upward hydraulic gradient from the Cretaceous aquifer toward the Tertiary aquifer through the semi-confining unit that separates them.

Recharge to and discharge from the Cretaceous aquifer is similar to that of the Tertiary aquifer. Recharge to the Cretaceous aquifer occurs primarily in outcrop regions near the Fall Line (RM 203) where Cretaceous sediments are exposed to infiltration from precipitation. Flow in the Cretaceous aquifer is initially unconfined, but as the sediments become more deeply overlain by the Tertiary deposits, they become confined beneath the Snapp and Black Mingo Formations. Discharge from the Cretaceous aquifer occurs primarily to presumed subaqueous outcrops offshore; however, the Cretaceous aquifer also discharges to alluvial deposits underlying the Savannah River in regions where the confining unit has been incised upstream of the VEGP site and to groundwater wells (Southern 2008a; Clarke and West 1997).

Groundwater and the Accessible Environment

Southern's consideration of pathways in the two uppermost aquifers, (i.e., the Water Table and Tertiary aquifers) (Southern 2008a) make it clear that the Water Table aquifer provides the most immediate pathway to the terrestrial and aquatic environment and man. Southern concludes that release from the Water Table aquifer is to a surface-water drainage headed by Mallard Pond on the VEGP site, and therefore, immediate impacts would be to potential wetlands controlled by Southern and not to the public. Review of the change in the piezometric surface in the Water Table aquifer since 1971 leads staff to conclude that alteration of the land surface, infiltration patterns, run-off patterns, and vegetation can influence the piezometric surface and subsurface flow paths.

Hydraulic Properties

Measured values of aquifer and sediment properties are reported in Section 2.3.1.2.4 of the ER (Southern 2008a). Measurements completed during the ESP site investigation are supplemented by earlier reported values in the FSAR for existing VEGP Units 1 and 2 (Southern 2003b). The staff reviewed USGS reports on the regional aquifer to confirm the range of values reported by Southern (Clarke and West 1998).

Key hydraulic properties of the Cretaceous aquifer, which supplies the bulk of the groundwater required by VEGP Units 1 and 2 and would supply the groundwater required by the proposed VEGP Units 3 and 4, are the transmissivity and storage coefficient of the deep confined aquifer

system. Aquifer tests conducted when the existing deep production wells were installed provide the mid-range transmissivity of 2.27×10^{-2} m^2/s (158,000 gal/d/ft), and the mean storage coefficient of 3.1×10^{-4} (dimensionless). These values are shown in the ER and used by Southern in calculations (Southern 2008a). The staff performed independent calculations and independently reviewed work conducted by the USGS to confirm these values. The USGS derived minimum and maximum ranges of transmissivity estimates based on field data (i.e., 4×10^{-5} m^2/s to 2.75×10^{-2} m^2/s [300 to 191,000 gal/d/ft]) and regional simulation (i.e., 1×10^{-6} m^2/s to 3.69×10^{-2} m^2/s 10 to 257,000 gal/d/ft) bracket the mid-range value of transmissivity identified by Southern (Clarke and West 1998). The USGS modeling effort (Clarke and West 1998) cites storage coefficients for the Cretaceous aquifers ranging from 7.1×10^{-5} to 4.4×10^{-4} that are similar to those cited by Southern (i.e., 2.1×10^{-5} to 6.60×10^{-4}).

Key hydraulic properties of the Tertiary aquifer are the hydraulic conductivity and storage coefficients, as well as the effective porosity. Southern reports the geometric mean of the hydraulic conductivity as 2.9×10^{-6} m/s (0.83 ft/day) (Southern 2008a) based on five slug tests. Storage coefficient of the Tertiary aquifer was not measured; however, Southern stated that tests on the combined Tertiary and Cretaceous aquifers suggest 1×10^{-4} is a reasonable estimate. Southern estimates an effective porosity of 31 percent. The USGS-derived minimum and maximum ranges of transmissivity estimates based on field data (i.e., 1.9×10^{-4} m^2/s to 1.31×10^{-2} m^2/s [1346 to 91,200 gal/d/ft]) and regional simulation (i.e., 1.4×10^{-5} m^2/s to 2.66×10^{-2} m^2/s [100 to 185,000 gal/d/ft]) when combined with the local thickness of the Tertiary aquifer (i.e., approximately 55 m (182 ft) bracket the central value of hydraulic conductivity found by Southern but are generally higher (Clarke and West 1998). The USGS modeling effort (Clarke and West 1998) cites storage coefficients for the Tertiary aquifer ranging from 3.0×10^{-4} to 3.7×10^{-4} that are similar to, but higher than, the value assumed by Southern (i.e., 1×10^{-4}).

Key hydraulic properties of the Water Table aquifer are the hydraulic conductivity, storage coefficient, and the effective porosity. Southern presents previously derived values for hydraulic conductivity from the Final Safety Analysis Report (FSAR) (Southern 2003b) for the Barnwell sands, silts, and clays ranging from 1.9×10^{-6} to 2.6×10^{-6} m/s (200 to 267 ft/yr) for well permeameter tests and from 9.5×10^{-8} to 2.9×10^{-6} m/s (9.8 to 302 ft/yr) for undisturbed samples in the laboratory. The potentially highly transmissive material is the Utley Limestone, and its pumping test values ranged from 3.1×10^{-5} to 1.2×10^{-3} m/s (3250 to 125,400 ft/yr). Falling and constant head tests on Utley Limestone suggest a lower range from 9.3×10^{-7} to 5.6×10^{-5} m/s (96 to 5800 ft/yr). The mean total porosity of Barnwell material is reported as 44 percent. Hydraulic conductivity and effective porosity determined recently as part of the ESP investigation yielded a geometric mean of 1.75×10^{-6} m/s (0.5 ft/d) and mean of 32 percent, respectively (Southern 2008a). Specific yield was estimated by Southern from published literature to range between 0.20 and 0.33 (Southern 2008a). The staff independently determined that the USGS-derived minimum and maximum range of transmissivity estimates based on field data (i.e., 5.4×10^{-4} to 1.0×10^{-2} m^2/s [3700 gal/d/ft to 71,000 gal/d/ft])

(Clarke and West 1998), when combined with the local thickness of the Water Table aquifer (i.e., approximately 9 m (30 ft), are indicative of the higher values of the Utley limestone portion of the Barnwell.

Interactions between the site surface and groundwater, and between aquifers

The Water Table aquifer is unconfined and recharge to it is infiltration from precipitation. Locally, discharge from the aquifer is to surface-water drainages and groundwater wells. Discharge to Utley Cave at the head of Mallard Pond (Huddlestun and Summerour 1996) is one example of unconfined aquifer discharge in the immediate vicinity of the VEGP site. The USGS (Clarke and West 1997) shows the Savannah River has incised into the Water Table aquifer in the vicinity of and downstream of the VEGP site. Thus, in addition to discharging to drainages, springs, seeps, and groundwater wells, the aquifer discharges to the alluvial deposits in the river valley. The majority of the hydraulic head data for the Water Table aquifer suggest an aquifer dominated by infiltration from precipitation and by topography. Based on potentiometric contour maps (Southern 2008a), groundwater movement from the VEGP site powerblock region appears to be toward Mallard Pond. The staff notes that an alternate conceptual model is supported by two data points. The data and alternate model are discussed in the following paragraph.

The Tertiary aquifer is believed to be confined in the vicinity of the VEGP site; however, some isolated data suggest the potential for local communication between the Water Table aquifer and the Tertiary aquifer in the immediate vicinity of the Pen Branch fault (Southern 2008a). This communication may provide a pathway from the Water Table aquifer into the uppermost confined aquifer. Hydraulic head in the Water Table aquifer ranges from 49 to 44.2 m (160 to 145 ft) above MSL over the powerblock while the Tertiary aquifer ranges from 37 to 32 m (120 to 105 ft) above MSL in the same vicinity. The anomalous data indicate a Water Table aquifer hydraulic head of 35.7 to 36.0 m (117 to 118 ft) MSL in the vicinity of monitoring wells OW-1001 and B-1004 at the eastern edge of the powerblock. Thus, groundwater flow could be downward into the Tertiary aquifer at this point. If this communication exists, it appears to be local and not linear (e.g., it is only observed at a single point). The Water Table aquifer does not appear to be strongly influenced by a line sink representing a loss of groundwater into the confined system along the entire structural feature of the Pen Branch fault. Based on potentiometric contour maps of the Tertiary aquifer (Southern 2008a), groundwater movement from the powerblock region is directed toward the Savannah River. Infiltration from precipitation recharges the aquifer in its outcrop area to the northwest of the VEGP site. Some recharge also moves through the upper and lower confining beds to recharge the Tertiary aquifer. The USGS (Clarke and West 1997) show the Savannah River has incised into the upper confining unit of the Tertiary aquifer upstream of the VEGP site, and the aquifer is believed to discharge into the Savannah River alluvium and into the river in the vicinity of the incision.

The Cretaceous aquifer is separated from the overlying Tertiary aquifer by a leaky confining unit. Heads in the vicinity of the VEGP site in the Tertiary aquifer range from 38.1 m (125 ft) above MSL east of the powerblock to 25.9 m (85 ft) above MSL at the Savannah River shoreline. Heads in the Cretaceous aquifer vary but are approximately 46 m (150 ft) above MSL in the deep production wells (Southern 2006b). Thus, leakage would occur from the Cretaceous upward into the Tertiary aquifer. Some interpret seismic survey data to suggest that fractures (stress release faults) in close association with the Pen Branch fault may cut the aquitards separating aquifers within the Cretaceous sediments and aquitards separating the Tertiary and Cretaceous deposits (Summerour et al. 1998). However, the deep production wells are open to conductive zones of the aquifer from the lower portion of the confining zone above the Cretaceous sediments for nearly the entire depth of the Cretaceous sediments. Thus, communication among and between the aquifers that comprise the Cretaceous aquifer is locally a function of the well screen and not only the fault structure. Based on potentiometric contour maps (Clarke and West 1997; Cherry 2006), groundwater movement in the Cretaceous aquifer system underlying the VEGP site is made complex because of the location of a groundwater divide that separates groundwater flow toward regions where the Savannah River has incised through the semi-confining units that overlay the Cretaceous sediments (upstream of the VEGP site) and groundwater flow toward the coast and presumed discharge points offshore. It appears that in both the shallow (Dublin aquifer system) and the deep (Midville aquifer system) portions of the Cretaceous aquifer, groundwater beneath the site is moving northeast toward discharge points in the Savannah River alluvial deposits.

The contour plot (see Figure 2-9) for the Dublin aquifer system (i.e., shallow Cretaceous aquifer) also suggests that current pumping from the VEGP site deep production wells may draw water toward the VEGP site from South Carolina and Georgia's portions of the deep aquifer. The staff believes that because the Savannah River incision into the Cretaceous deposits occurs relatively far upstream from the VEGP site, there is no evidence to suggest barriers to groundwater flow from South Carolina in the deep aquifer; therefore, communication or transriver flow is possible. However, because the Savannah River does incise into the Water Table aquifer adjacent to the VEGP site and into the Tertiary aquifer adjacent to or immediately upstream of the VEGP site, there is less likelihood of transriver flow in these aquifer systems. Cherry (2006) also shows that tracer particles originating in South Carolina that are subject to transriver flow appear to be intercepted by the Savannah River alluvial deposit shortly after migrating into the State of Georgia. The staff found no evidence to suggest physical or hydraulic barriers to groundwater movement between the two states in the Cretaceous aquifer, and has examined the influence of an alternate conceptual model allowing transriver flow when evaluating the potential impact of planned deep groundwater production in this EIS.

The confined aquifers are recharged in outcrop areas between the VEGP site and the Fall Line, which lies approximately 48 km (30 mi) to the northwest. The USGS provides an estimate of the deep aquifer baseflow in Aucott et al. (1987). That estimate of baseflow is based on the

difference in measured Savannah River streamflow between Augusta and Millhaven, Georgia, and on the measured flow in tributaries to the river. The estimated deep aquifer baseflow is 4.36 m^3/s (154 cfs, 100 MGD) based on measurements made during September to October 1968, a drought period in the region. The USGS estimated groundwater usage in the deep aquifer during the period from 1961 to 1970 to be 0.83 m^3/s (29.4 cfs, 19 MGD) (Clarke and West 1998). Thus, a pre-development (pre-1953) deep aquifer baseflow is estimated to be 5.21 m^3/s (184 cfs, 119 MGD). In the 1990s, the USGS estimated a basin-wide water budget for a 13,330 km^2 (5147 mi^2) study area extending southeast of the Fall Line and focused on the Savannah River Site and Burke County, Georgia (Clarke and West 1997, 1998). The USGS concluded that the mean annual groundwater discharge to the Savannah River was 34.5 m^3/s (1220 cfs), and of that discharge, 13 percent or 4.36 m^3/s (154 cfs) is from the regional (Cretaceous) aquifer system (Clarke and West 1997). This more recent USGS work is based in part on the Aucott et al. (1987) estimate of deep aquifer baseflow. Long-term average recharge was approximated by the USGS (Clarke and West 1997) by weighting the groundwater discharge values according to drainage area. Of the estimated average groundwater recharge of 36.8 cm/yr (14.5 in./yr), USGS estimates 17.3 cm/yr (6.8 in./yr) is to the Water Table aquifer, 14.7 cm/yr (5.8 in./yr) is to the Tertiary aquifer, and 4.8 cm/yr (1.9 in./yr) is to the Cretaceous aquifers in the study region.

Recently, the USGS completed an update of the Clarke and West (1997, 1998) model and examined future groundwater management scenarios (Cherry 2006). Defining the deep regional aquifer as the Cretaceous strata from which Southern draws groundwater, water balance elements (i.e., inflows and outflows) were obtained from the USGS report (Cherry 2006). Examining three water-use periods of 1987 to 1992, 2002, and an estimated 2020, the deep regional aquifer flux over time is respectively 10.7 m^3/s, (378 cfs) (244 MGD), 10.3 m^3/s (364 cfs) (235 MGD), and 10.1 m^3/s (356 cfs) (230 MGD). The regional flux estimates based on outflow include discharges to the river, to wells, and from lateral boundaries of the model. The sums of discharges to the river and wells, which would align with the pre-development baseflow value, are 9.57 m^3/s (218.4 MGD), 9.16 m^3/s (209.1 MGD), and 8.97 m^3/s (204.7 MGD), respectively. These are approximately within a factor of two of the earlier estimate (i.e., 5.21 m^3/s [119 MGD]) of baseflow.

2.6.1.3 Hydrological Monitoring

This section describes the hydrological monitoring programs. Thermal and chemical monitoring programs are discussed in Sections 2.6.3.3 and 2.6.3.4.

As a result of ongoing monitoring associated with the two existing units, Southern was able to consider this existing monitoring program as part of the pre-application monitoring program for the VEGP site (Southern 2008a). If the new units were built, many of these same monitoring activities would likely be continued (Southern 2008a).

Surface Water

Discharge in the Savannah River is collected by the USGS, in cooperation with Southern, near the existing barge slip on the VEGP Site. This site, named Savannah River near Waynesboro, is assigned USGS gage number USGS 021973269, and the accuracy of the USGS reported daily-discharge data is within about 10 percent of the true value (USGS 2006a).

The USGS reports discharge and reservoir storage upstream of the VEGP Site, including conditions at Hartwell, Russell, and Thurmond dams. Other USGS stream gages near the VEGP Site include (1) Savannah River at Augusta, USGS gage 02197000 (USGS 2006b), located at Savannah RM 187.4 and accurate to within 15 percent of the true discharge; (2) Savannah River near Jackson (POR October 1971 to September 2002), USGS gage 02197320 (USGS 2002), located at Savannah RM 156.8 and accurate to 10 percent of the true discharge; and (3) Savannah River at Burton's Ferry Bridge near Millhaven, USGS gage 02197500 (USGS 2006b), located at Savannah RM 118.7 and accurate to within 15 percent of the true discharge.

Southern (2008a) describes the hydrological (i.e., flow) monitoring that occurs onsite in accordance with National Pollutant Discharge Elimination System (NPDES) Permit GA0026786 and Industrial Stormwater Permit GAR000000. Discharge-monitoring locations include the following: final plant discharge, cooling tower blowdown from VEGP Units 1 and 2, wastewater retention basins for VEGP Units 1 and 2, sewage treatment plant emergency outflow, liquid radwaste systems discharge from VEGP Units 1 and 2, and the nuclear service cooling tower blowdown.

Southern states in the ER that it would prepare an Erosion, Sedimentation and Pollution Control Plan in support of the NPDES Construction Stormwater Permit. This permit is required before site preparation can commence on the new units.

If the new units are built and operated, monitoring of the discharge from the new units would likely be similar to the monitoring for the existing VEGP Units 1 and 2. Future monitoring of the Savannah River, intake structure withdrawals, and discharge outfall would be performed in coordination with required permits to be issued by the State of Georgia and obtained by Southern prior to operation of the new units.

Groundwater

Southern describes two ongoing monitoring programs measuring the drawdown or the groundwater level at the VEGP site: (1) a program that meets the GDNR EPD requirements of the groundwater use permit, and (2) the NRC groundwater monitoring program (Southern 2008a).

Southern would continue to monitor groundwater levels in support of the existing units during construction of the proposed units. Southern has committed to developing and deploying groundwater monitoring programs during construction and operation of the proposed units in coordination with the State of Georgia and the NRC (Southern 2008a).

2.6.2 Water Use

Consideration of water use requires estimating the magnitude and timing of consumptive and non-consumptive water uses. Non-consumptive water use does not result in a reduction in the available water supply. For example, water withdrawn from the river and used to wash fish from the intake screens would result in no net change in water supply to downstream water users if the same volume of water pumped from the river would eventually be returned back into the river. On the other hand, consumptive water-use results in a net reduction of the water supply available for downstream users. For instance, the circulating water system (CWS) withdraws water for normal cooling. The majority 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 non-consumptive users of surface water and groundwater near the VEGP site.

2.6.2.1 Surface-Water Use

The existing VEGP Units 1 and 2 at rkm 243 (RM 151) and the Savannah River Site D-Area Powerhouse at rkm 249 (RM 155) are the largest (consumptive) water users in proximity to the proposed VEGP Units 3 and 4. Data reported by Southern (2008a) state that average surface-water use for VEGP Units 1 and 2 was approximately 2.8 m^3/s (98.8 cfs) between January 2003 and December 2004. Between June 2004 and May 2005, the monthly average surface-water withdrawal for the Savannah River Site was 0.13 m^3/s (4.5 cfs)(Southern 2008a). This value excludes the D-Area Powerhouse, which is located on the Savannah River Site; however, it is now operated by SCE&G. For the 12-month period beginning in June 2004 and ending in May 2005, the D-Area Powerhouse used 1.94 m^3/s (68.4 cfs) of water on-average per month (Southern 2008a). The Urquhart Station, which is also operated by SCE&G and is located upstream of the VEGP site near Augusta at rkm 314 (RM 195), withdrew 3.61 m^3/s (127.5 cfs) on-average per month during the same period (Southern 2008a).

Southern states that the nearest surface-water users downstream from the VEGP Site are the Fort James Operating Company and GPC, both of which are located in Effingham County, Georgia, and lie downstream from the site at approximately 170 km (106 mi) (Southern 2008a).[a]

(a) River miles (RM) are calculated from the mouth of the river or, for upstream tributaries, from the confluence with the main river. The Savannah River originates at the confluence of the Seneca and Tugaloo rivers in Hart County, Georgia.

Water-use data for a period of 20 years ending in the year 2000 suggested that withdrawal rates for surface water and groundwater remained nearly unchanged (Fanning 2003) in the vicinity of the VEGP site. However, projected surface-water and groundwater demands in Burke County, Georgia indicate an increase of 50 percent by 2035 (Rutherford & Associates 2000). In South Carolina, combined surface-water and groundwater demand is projected to increase by 50 percent between 2000 and 2045 (SCDNR 2004). Near the mouth of the Savannah River and approximately 241 km (150 mi) downstream of the site, saltwater is intruding into the Floridan aquifer because of groundwater withdrawals (GDNR 2006a). To preserve the groundwater resource in the future, existing groundwater users may shift the source of their water supply from the Floridan aquifer to water originating from the Savannah River, which would also increase demands for Savannah River water downstream of the VEGP site in the future.

2.6.2.2 Groundwater Use

Aquifers and Their Relationship to the Savannah River

Southern provides a description of groundwater use in the area affected by the proposed VEGP site in Section 2.3.2.2 of the ER (Southern 2008a). Groundwater is highly related to the geology of the site, and a description of the geology in the vicinity of the VEGP site is presented in Section 2.4 of this EIS. The groundwater resource in the vicinity of the VEGP site resides in three aquifers: the Water Table aquifer, the Tertiary aquifer, and the Cretaceous aquifer. As implied in its name, the Water Table aquifer is unconfined, relatively shallow, and subject to seasonal and interannual changes in response to precipitation. Those using this groundwater resource generally pump at lower rates indicative of domestic household use and are exempt from the requirement of a groundwater-use permit. Non-agricultural water users requiring in excess of 379,000 L/d (100,000 gpd) are required to apply for a permit in the State of Georgia (GDNR 2001). The Tertiary aquifer is the first confined aquifer and includes sands, silts, and gravels that can yield substantial groundwater. The Cretaceous aquifer is composed of a sequence of aquifers and aquitards with strata also yielding substantial groundwater to wells. The production wells for the VEGP site withdraw groundwater from the Cretaceous aquifer as do most high-production wells in the region. Several lower-yield wells at the VEGP site withdraw groundwater from the Tertiary aquifer. All existing wells at the VEGP site are under Georgia Water-Use Permit Number 017-0003 (Georgia EPD 2008), which allows a maximum monthly average pumping rate of 23,000 m^3/d (6.0 MGD) and a yearly average pumping rate of 20,800 m^3/d (5.5 MGD).

The VEGP site is located on a bluff above the Savannah River. The Water Table aquifer drains to surrounding stream channels: the Savannah River to the east, Hancock Landing drainage to the north, and Beaverdam Creek drainage to the south. This aquifer is replenished locally by net infiltration from precipitation. The base of the Blue Bluff Marl that isolates the Water Table aquifer from the Tertiary aquifer appears to be incised by the Savannah River in the immediate vicinity of the VEGP site, and the USGS notes hydraulic connection between this first confined

aquifer and the Savannah River in the vicinity of the Pen Branch fault adjacent to the VEGP site and upstream of Flowery Gap Landing, somewhat upstream of the VEGP site (Clarke and West 1997). Figure 2-10 shows the extent of hydrogeologic units underlying the Savannah River. In this figure, aquifers and confining units are exposed to the Savannah River alluvial material from downstream to upstream in order of progressively older sediments. The Upper Three Runs (or Water Table) aquifer is exposed in the lower right, and the Pre-Cretaceous basement rock is exposed in the upper left (Clarke and West 1997). In the figure, the VEGP site is located adjacent to the Pen Branch fault on the Georgia shore of the Savannah River; Flowery Gap Landing is east of TR-92-6 and on the Georgia shore of the Savannah River. The Gordon aquifer in USGS nomenclature shown in this figure is denoted by the Tertiary aquifer in this EIS. USGS studies have suggested a potential for transriver flow in the vicinity of the VEGP site; however, their models suggest that flow crossing the river in either direction upwells into the alluvial valley near the river (Clarke and West 1998; Cherry 2006). The Tertiary aquifer is replenished at upgradient outcrop locations exposed to precipitation, and locally flows toward the Savannah River. Thus, the Savannah River appears to intercept both the Water Table and Tertiary aquifers.

The confining unit overlying the Cretaceous aquifer is not incised by the Savannah River adjacent to the VEGP site (Figure 2-10). The USGS maps the incision as occurring nearly 16 km (10 mi) upstream of the site (Clarke and West 1997). Thus, the staff's interpretation of the hydrogeology is that in the vicinity of the VEGP site, aquifers and aquitards that comprise the Cretaceous aquifer are hydraulically isolated from the Savannah River and have hydraulic connection between the States of Georgia and South Carolina. The Cretaceous aquifer is replenished at upgradient outcrop locations exposed to precipitation. The updated model of Cherry (2006) was used to simulate potential future pumping at the VEGP site (Cherry and Clarke 2007). For scenarios examining the anticipated pumping rate for proposed VEGP Units 3 and 4, the groundwater was shown to originate in upland areas of Georgia, with none of the recharge originating in South Carolina. One scenario involving a long-term increase in pumping rate of over three times the proposed operational rate did cause a portion of the recharge drawn to the well to originate in South Carolina, but it did not originate from within the Savannah River Site operated by DOE. This aquifer system exhibits a groundwater divide downstream of the VEGP site, and locally, groundwater in the system is moving toward the incised location upstream of the site, which is a hydraulic sink. Based on USGS studies (Aucott et al. 1987; Clarke and West 1997, 1998; Cherry 2006) the deep aquifer baseflow has been estimated to be between 5.21 and 9.57 m^3/s (119 and 218 MGD) (see Section 2.6.1.2). Groundwater in this system that is sufficiently removed from the Savannah River laterally, flows past the divide toward the coast and discharges, in general, to downgradient groundwater wells or from subaqueous exposures of the aquifer along the continental shelf.

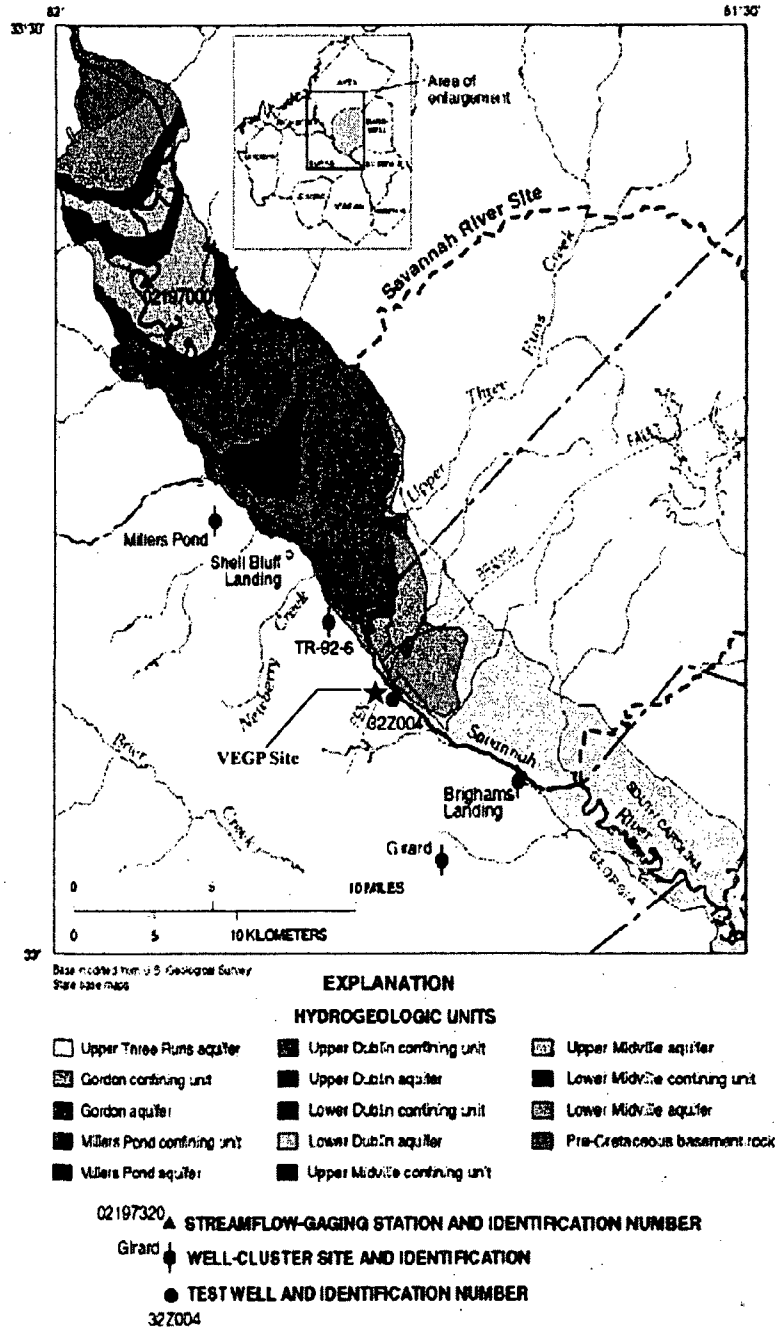

Figure 2-10. Extent of Hydrogeologic Units Underlying the Savannah River; the Upper Three Runs (a Water Table) Aquifer is Exposed in the Lower Right, and the Pre-Cretaceous Basement Rock is Exposed in the Upper Left (Clark and West 1997)

Average and Maximum Plant Water Use

The VEGP site maintains three wells completed in the Cretaceous aquifer and six wells completed in the Tertiary aquifer. The three wells in the Cretaceous are deep production wells with design yields of 63 to 126 L/s (1000 to 2000 gpm). These wells provide makeup water for the plant processes (e.g., 1158 million L [306 million gallons] in 2005 for VEGP Units 1 and 2 or a rate of 3.17 million L/d [0.838 MGD]) (Southern 2008a). The six wells in the Tertiary aquifer have design yields of 1.3 to 9.5 L/s (20 to 150 gpm) and provide irrigation water, potable water for the recreation area and the simulator training building, water supply for the nuclear operations garage, water supply for the security tactical training area, water supply for fire protection, and a non-potable water supply for the new plant entrance security building (e.g., 8 million L [2 million gallons] in 2005 for VEGP Units 1 and 2 or a rate of 0.0212 million L/d [0.0056 MGD]) (Southern 2008a). Thus, in 2005 the total pumping rate was 3.19 million L/d (0.843 MGD). Southern has estimated the average pumping rate for normal operation of VEGP Units 1 and 2 as 46.1 L/s (730 gpm, 1.05 MGD). Southern estimates a maximum pumping rate of 145 L/s (2300 gpm, 3.312 MGD) for VEGP Units 1 and 2 (Southern 2008a). Both the normal and maximum operation levels are for VEGP Units 1 and 2 simultaneously operating in the same mode.

Southern projects groundwater consumptive use for normal operation of proposed VEGP Units 3 and 4 at an average rate of 47.4 L/s (752 gpm, 1.08 MGD) and a maximum operation rate of 198.1 L/s (3140 gpm, 4.52 MGD) (Southern 2008a). During normal operation approximately 19.2 L/s (305 gpm) of groundwater and during maximum operation approximately 106 L/s (1681 gpm) of groundwater is returned as surface water to the Savannah River (Southern 2008a). Both the normal and maximum operation water-use rates are for the proposed VEGP Units 3 and 4 simultaneously operating in the same mode.

Dewatering Experience during Construction of VEGP Units 1 and 2

Southern states that construction of the proposed VEGP Units 3 and 4 would employ a similar dewatering method as was employed for existing VEGP Units 1 and 2 (Southern 2008a). Construction of VEGP Units 1 and 2 required excavation of the sediments comprising the Water Table aquifer overlying the Blue Bluff Marl. Four pumps, each with a capacity of 32 L/s (500 gpm), were used to remove the water from the excavation site; thus, normal dewatering had a maximum capacity of 126 L/s (2000 gpm). Additional capacity was employed to remove water during at least one storm event (Southern 2003b). Data from observation wells monitored during construction of VEGP Units 1 and 2 revealed a variable response in the Water Table aquifer near the excavation site (Southern 2008a). The most distant well in the vicinity of the excavation for which a record exists, well #804, approximately 300 m (1000 ft) southwest of the excavation, was not substantially impacted (i.e., 0.6 m (approximately 2 ft) decline and subsequent recovery). Southern states that water continued to flow through Mallard Pond

during the dewatering activity for existing VEGP Units 1 and 2, which lasted for more than 6 years from mid-1976 until early-1983 (Southern 2007c, 2008a).

Water-Use Permit and the Moratorium

Since 1974, the State of Georgia has required a groundwater-use permit for all non-agricultural groundwater users of more than 379,000 L/d (100,000 gpd). In 1997, the State of Georgia, as part of an interim strategy to manage salt water intrusion into the Floridan aquifer, instituted a moratorium on groundwater withdrawal permits for municipal, industrial, and agricultural uses in 24 Georgia counties (GDNR 2006a). Burke County was among the 24 counties. The VEGP site is 100 km (62 mi) or more from regions being impacted by saltwater intrusion. In 2006, Georgia issued its permitting plan for managing salt water intrusion (GDNR 2006a). That plan identified Burke County among 19 counties that did not contribute substantially to the development or extent of salt water intrusion in coastal areas (GDNR 2006a). However, in this 19-county region of Georgia, applications for water-use permits (i.e., industrial, institutional, commercial, municipal, and residential) continue to be reviewed to ensure a justified need exists, and that aggressive and practical conservation and reuse principles and wastewater management are being applied (GDNR 2006a). Southern notes in Section 2.3.2.2.2 of its ER (Southern 2008a) that groundwater wells would be completed in the Cretaceous aquifer to supply water for operation of the proposed VEGP Units 3 and 4, and that Southern would request a modification of its existing water-use permit.

Nearest Neighboring Wells

In the vicinity of the VEGP site, groundwater is used by permit holders for agriculture, industry, and municipal water supply. There are also domestic wells that withdraw relatively low quantities and wells that serve the public listed by EPA in the Safe Drinking Water Information System (SDWIS). The nearest neighboring well is a domestic well located across River Road from the VEGP site (Southern 2008a). Groundwater wells permitted by the State of Georgia are relatively distant from the VEGP site. The nearest permitted agricultural well is located 5.5 km (3.4 mi) northwest, the nearest industrial well is located 13.7 km (8.5 mi) northwest, and the nearest municipal well is located 23.3 km (14.5 mi) west-southwest. The nearest SDWIS well is located 7.9 km (4.9 mi) southwest at the DeLaigle Mobile Home Park (Southern 2008a). The agricultural and SDWIS wells were completed in Tertiary sediments, while the industrial and municipal wells were completed in Cretaceous sediments. Southern states that "...these wells are sufficiently distant from (Plant Vogtle) such that pumping these wells would have no effect on groundwater levels at Plant Vogtle" (Southern 2008a). The Savannah River Site withdraws groundwater from the deep confined aquifer at several locations (Wells and Hiergesell 2005). The D-Area, approximately 6.4 km (4 mi) from the VEGP site, withdraws groundwater for domestic as well as process purposes. This groundwater well into the deep confined aquifer appears to be the closest potential offsite user to the VEGP site.

Historical and Future Trends in Water Use

Water-use data for a period of 20 years ending in the year 2000 suggest that withdrawal rates for surface water and groundwater remained nearly unchanged (Fanning 2003) in the vicinity of the VEGP site. Projected water demand in Burke County, Georgia, indicates an increase of 50 percent by 2035 (Rutherford & Associates 2000). In South Carolina, an increase of 50 percent is projected by 2045 (SCDNR 2004). However, despite these projections, a recent report by the USGS assigned lower groundwater pumping rates for the region in the future (i.e., through 2020) than have occurred during the recent drought (Cherry 2006). Thus, there is reason to believe that stress on the groundwater resource was highest during the recent drought and could now diminish.

In the Savannah River basin, water users depend primarily on surface water to satisfy current and future demands (GDNR 2001; SCDHEC 2005). Because of evidence of salt water intrusion in developed coastal regions, the states of Georgia, South Carolina, and Florida, and others jointly undertook an effort in the past decade to develop and apply a management plan to stabilize and halt the intrusion of salt water into the Upper Floridan aquifer (GDNR 2006a). Under the management plan, the State of Georgia would review applications for new and renewed water withdrawal permits in Burke County to ensure water quantities are justified and that permits include requirements for water conservation, water reclamation and reuse, and wastewater management. It is anticipated that groundwater users in the lower basin (i.e., in the vicinity of the observed saltwater intrusion) would be required to replace groundwater sources with surface-water sources in the future (Southern 2008a).

There are no aquifers designated as "sole source" within 320 km (200 mi) of the VEGP site (EPA 2006).

2.6.3 Water Quality

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

2.6.3.1 Surface-Water Quality

This section describes the water quality of the Savannah River near the VEGP site, which is the only offsite surface-water body that would be impacted by either the construction or operation of the new units. Southern presents a discussion of the water-quality conditions in Section 2.3.3.1 of the ER (Southern 2008a). The thermal load discharged from the two operating units results in localized elevated water temperatures in the river. Operational impacts of the proposed units on Savannah River water quality are discussed in Section 5.3.3.1 of this EIS. Monitoring programs for thermal and chemical water quality are discussed in Sections 2.6.3.3 and 2.6.3.4, respectively.

Affected Environment

The State of Georgia has classified the water use in the Savannah River near the VEGP site as "Fishing: propagation of fish, shellfish, game and other aquatic life" (Georgia EPD 2007a). Daily average dissolved oxygen levels are required to be a minimum of 6.0 mg/L. Upstream of the VEGP site and between J. Strom Thurmond Dam (RM 221.6) and Stevens Creek Dam (RM 208.1), the Savannah River is listed as not fully supporting the designated water use for dissolved oxygen levels on the Georgia 303(d)/305(b) list (Georgia EPD 2007b). However, near the VEGP site at Savannah RM 150.9, the river is not listed as impaired by the State of Georgia. This conclusion is supported by data provided by Southern in its ER, which states that during 2003 dissolved oxygen levels near the site ranged between 6.1 mg/L and 11.4 mg/L with a mean of 8.4 mg/L.

South Carolina monitors water quality in the Savannah River near the VEGP site (SCDHEC 2003). The nearest water-quality stations upstream (Savannah River Lock and Dam: Station SV-323 (RM 187) and downstream (Savannah River at U.S. Highway 301, 20 km [12.5 mi] southwest of Allendale: Station SV-118 [RM 119]) of the VEGP site are presented in SCDHEC (2003). Data presented in the report show recreational and aquatic life uses were fully supported at both sites between January 1996 and December 2000 (reporting period). Water-quality parameter trends (1984 to 2000) and the number of samples exceeding the appropriate standard (1996 to 2000) discussed in the SCDHEC report include dissolved oxygen, pH, total phosphorus, total nitrogen, turbidity, fecal coliform, ammonia, cadmium, chromium, copper, lead, mercury, nickel, and zinc. At the downstream station (SV-118), an increasing trend in total phosphorus concentration was noted. There was also a decreasing trend in pH. A decreasing trend in total nitrogen and fecal coliform bacteria concentrations suggest improving conditions for these two parameters.

In addition to Georgia and South Carolina, the DOE has monitored the water quality of the Savannah River for over 50 years. DOE monitors Savannah River water quality at sampling sites located at RM 160, RM 150.4, RM 141.5, RM 129.1, and RM 118. In 2003, the data showed no indication of degradation or impairment (Southern 2008a; Mamatey 2004).

Discharges from VEGP Units 1 and 2 are controlled by a GDNR NPDES permit (permit number GA0026786 [GDNR 2004a]). The most recent permit was issued on June 30, 1999. Before the proposed VEGP Units 3 and 4 could begin to operate, Southern would be required to obtain a NPDES permit for discharges from these units. Southern would also be required to demonstrate to GDNR that the effluent limitations for the proposed VEGP Units 3 and 4 are adequate to ensure protection and propagation of a balanced, indigenous population of fish and wildlife through a Clean Water Act Section 316(a) demonstration. If determined to be necessary, GDNR may require additional monitoring before or after issuance of an NPDES permit.

2.6.3.2 Groundwater Quality

Groundwater quality in the vicinity of the proposed VEGP site is described in Section 2.3.3.2 of the ER (Southern 2008a). The GDNR Environmental Protection Division has the responsibility for protecting the groundwater resource, and maintains the Georgia Ground-Water Monitoring Network, which monitors the ambient water quality of nine aquifers (Donahue 2004). Among these aquifers is the Jacksonian system (Donahue 2004), which is close to the VEGP site and includes the Water Table aquifer, also known as the Upper Three Runs aquifer (Summerour et al. 1994). For groundwater in the vicinity of the VEGP site, the State of Georgia (Donahue 2004) reported on water quality of the Jacksonian aquifer from eight wells drawing water from the Barnwell Group. Samples were analyzed for nitrate/nitrite and volatile organic compounds, including methyl tert-butyl ether; however, no volatile organic compounds were identified above the report limit of 0.5 µg/L. The nitrate/nitrite level was detectable in six wells, and elevated in one of them (i.e., 7.6 ppm) but below the primary maximum contamination level (10 ppm for nitrate measured as nitrogen). Donahue (2004) describes a regional issue with acidic groundwater in the outcrop areas of Cretaceous sediments (i.e., downgradient of the Fall Line), and notes that treatment may be required. The acidity is natural and may result from the inability of the sediment to neutralize acidic rainwater and from biologically influenced, acid-producing reactions between water and soils or deeper sediments. Groundwater is of the calcium-sodium bicarbonate type found in the vicinity of the VEGP site. Total dissolved solids are less than 200 ppm with lower values in the Water Table aquifer and values approaching 200 ppm in the confined aquifers (Southern 2008a). This is below the secondary standard for total dissolved solids of 500 ppm. Overall, the State of Georgia found the quality of groundwater water excellent (Donahue 2004).

As a result of saltwater intrusion observed at three locations in the Upper Floridan aquifer (in the vicinity of Hilton Head Island, South Carolina, approximately 140 km southeast, the Savannah/ Chatham County pumping center in Georgia, approximately 140 km southeast, and in groundwater in the vicinity of Brunswick, Georgia, more than 200 km south-southeast of the VEGP site), the State of Georgia, in concert with others, established an interim strategy for protecting the groundwater resource in 1997 (GDNR 2006a). Included in the interim strategy was a moratorium on water-use permits in Georgia for the Upper Floridan aquifer. At that time, the State of Georgia and others undertook to complete the Coastal Sound Science Initiative, a suite of studies to define and understand the saltwater intrusion challenge facing the region. At the conclusion of the Coastal Sound Science Initiative, a permitting plan (GDNR 2006a) was issued that would guide Georgia Environmental Protection Division water resource management decisions and actions. Burke County is included under the plan, and is among 19 counties identified in Georgia as having minimal impact on coastal regions and the saltwater intrusion problem (GDNR 2006a). With regard to the 19 counties, the management plan would ensure water-use permits are issued consistent with a justified need and with requirements of water conservation, water reclamation and reuse, and wastewater management.

In 2006, South Carolina, in cooperation with the USGS, issued Technical Publication No. 011-06, which is an evaluation of the downward migration of saltwater into the Upper Floridan Aquifer (Ransom et al. 2006). The South Carolina Water Plan, issued in 2004 (Badr et al. 2004) recommended, in part, that (1) the use of groundwater and surface-water resources should be optimized to reduce the effects that withdrawal have on either source and the environment, (2) the withdrawal from an aquifer should not result in salt water intrusion, and (3) efficient irrigation techniques, recycling of treated municipal wastewater, and desalination should all be studied and promoted as alternative water sources.

Tritium has been identified as a pollutant in the Water Table aquifer in the vicinity of the VEGP site (Summerour et al. 1998). First discovered in 1988 in a public water supply well serving the DeLaigle Mobile Home Park a short distance (i.e., less than 2 miles west) from the VEGP site, it was initially believed that tritium contaminated the confined aquifer system. However, a thorough cooperative study of the region conducted by the GDNR and the USGS and described in Summerour et al. (1994, 1998), Clarke and West (1997, 1998) and Cherry (2006) has revealed:

- There are elevated levels of tritium in the Water Table aquifer in eastern Burke County, but the levels measured are well below the drinking water standard for tritium (20,000 pCi/L), and no public health threat exists.
- There is no evidence of regional tritium contamination of the confined Tertiary aquifer (i.e., also known as the Gordon aquifer); however, high-resolution tritium analyses show very low levels of tritium (i.e., less than 25 pCi/L) in all confined aquifers.
- The age of confined aquifer water (i.e., old water), particularly that of the deep confined system, suggest that very low tritium detection is due to downward leakage from other aquifers or contamination during drilling or sampling.
- Although assumed to be a secondary pathway for tritium found in the Georgia aquifer systems (Summerour et al. 1998), transriver flow originating in South Carolina at the Savannah River Site has been studied by the USGS (Clarke and West 1997, 1998; Cherry 2006) and found to be an unlikely source for the broadly based tritium observed in Georgia groundwater wells in the Water Table and Tertiary aquifers. The Savannah River incises the Water Table aquifer and acts as a discharge boundary for the aquifer in both Georgia and South Carolina. With regard to the Tertiary aquifer, groundwater flow is either toward the river from both states, or toward an upriver location where the river incises the Tertiary aquifer (Clarke and West 1997).
- The evidence indicates the primary pathway for tritium pollution of the Water Table aquifer is through recharge of the aquifer by atmospheric deposition of tritium released from the Savannah River Site, which is located in South Carolina and upwind of the VEGP site.

An indication of the groundwater quality of the Cretaceous aquifer underlying the Savannah River Site operated by DOE is that groundwater recovered from the deep confined Cretaceous aquifer supplies drinking water for the DOE site (Wells 1999). To sustain this water quality, DOE has required, since the 1980s, that any substantial quantity of groundwater be recovered from the lowermost aquifer and at rates that preserve the natural head difference between aquifers (Wells 1999). This ensures the continued existence of an upward hydraulic head gradient over most of the DOE site between the deep aquifer and overlying aquifers that may be contaminated. This DOE management practice in South Carolina preserves the natural hydraulic barrier to downward migration of contaminants into the deep aquifer, and maintains its water quality.

2.6.3.3 Thermal Monitoring

This section describes thermal monitoring programs. Southern is able to consider ongoing monitoring programs associated with the existing VEGP Units 1 and 2 operation to provide some pre-application and pre-operational monitoring data for the VEGP site. Many of the same monitoring activities would be continued if the proposed units were completed and would become part of the operational monitoring for the proposed units. In Section 6.1 of the ER, Southern describes the existing river temperature measurements directly associated with the current site operation that were required under terms of its existing NPDES permit (Southern 2008a).

The GDNR has classified the Savannah River near the VEGP sites as "fishing" water use (GDNR 2004b). The water-quality standards for temperature are not to exceed 32°C (90°F), and at no time is the temperature of the receiving waters to be increased more than 2.8°C (5°F) above intake temperature. A provision is included that allows for use of a reasonable and limited mixing zone; however, evidence must be provided that such a zone would not create an objectionable or damaging pollution condition.

The current temperature monitoring requirements do not require routine thermal monitoring (Southern 2008a). Thermal monitoring of the intake and final plant discharge is performed once every 5 years to support renewal of the NPDES permit. If determined to be necessary, GDNR may require additional monitoring before issuance of any new NPDES permits. GDNR may also require ongoing monitoring as a condition of any new NPDES permits.

2.6.3.4 Chemical Monitoring

This section describes the pre-application and operational chemical monitoring programs. As a result of ongoing monitoring associated with the existing two units, Southern considered the operational monitoring program as part of the pre-application and pre-operational monitoring program for the VEGP site. Many of these same monitoring activities would be continued if the proposed VEGP Units 3 and 4 were completed, and would likely become part of the operational

monitoring program. In its ER, Southern describes the chemical monitoring that is required under terms of Southern's existing NPDES permit (Southern 2008a). The surface-water-quality parameters currently monitored under the NPDES permit at various locations, (i.e, not all are monitored at each location), are hydrazine, pH, free available chlorine, total residual chlorine, total chromium, total zinc, total suspended solids, oil and grease, and biological oxygen demand (Southern 2008a, GDNR 2004a). The NPDES permit obtained for the existing units specifies chemical monitoring at a variety of locations internal to the VEGP site and at the final plant discharge location.

2.7 Ecology

This section describes the terrestrial and aquatic ecology of the site and vicinity that might be affected by the design, siting, construction, operation, and maintenance of two additional units at the VEGP site. Sections 2.7.1 and 2.7.2 provide general descriptions of terrestrial and aquatic environments on and in the vicinity of the VEGP site and in the vicinity of one additional 500-kV transmission line right-of-way that would be required to distribute the additional generation from the proposed VEGP Units 3 and 4 (Southern 2008a). The proposed new transmission line right-of-way would likely connect the VEGP site with the Thomson substation 32 km (20 mi) west of Augusta. The transmission line right-of-way may cross Burke, Jefferson, McDuffie, and Warren Counties. It is anticipated it would be a 46-m (150-ft)-wide right-of-way approximately 97 km (60 mi) long (see Figure 4-1) (Southern 2008a; NRC 2007c).

Detailed descriptions are provided where needed to support the analysis of potential environmental impacts from construction, operation, and maintenance of new nuclear power generating facilities and the new transmission line right-of-way. The descriptions are provided to support mitigation activities identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts. Descriptions are also provided to help compare the alternative sites to the VEGP site. Also included are descriptions of monitoring programs for terrestrial and aquatic environments.

2.7.1 Terrestrial Ecology

This section identifies terrestrial ecological resources and describes species composition and other structural and functional attributes of biotic assemblages that could be affected by the construction, operation, and maintenance of the proposed VEGP Units 3 and 4. It also identifies "important" terrestrial resources, as defined in NUREG 1555, such as wildlife sanctuaries and natural areas that might be impacted by the proposed action.

The VEGP site is approximately 1282.5 ha (3169 ac) in size and is in the sandhills of the Upper Coastal Plain Physiographic Province approximately 48 km (30 mi) southeast of the Fall Line (Southern 2007d; Southern 2008a). The site has 12 soil types (Figure 2-11) and several

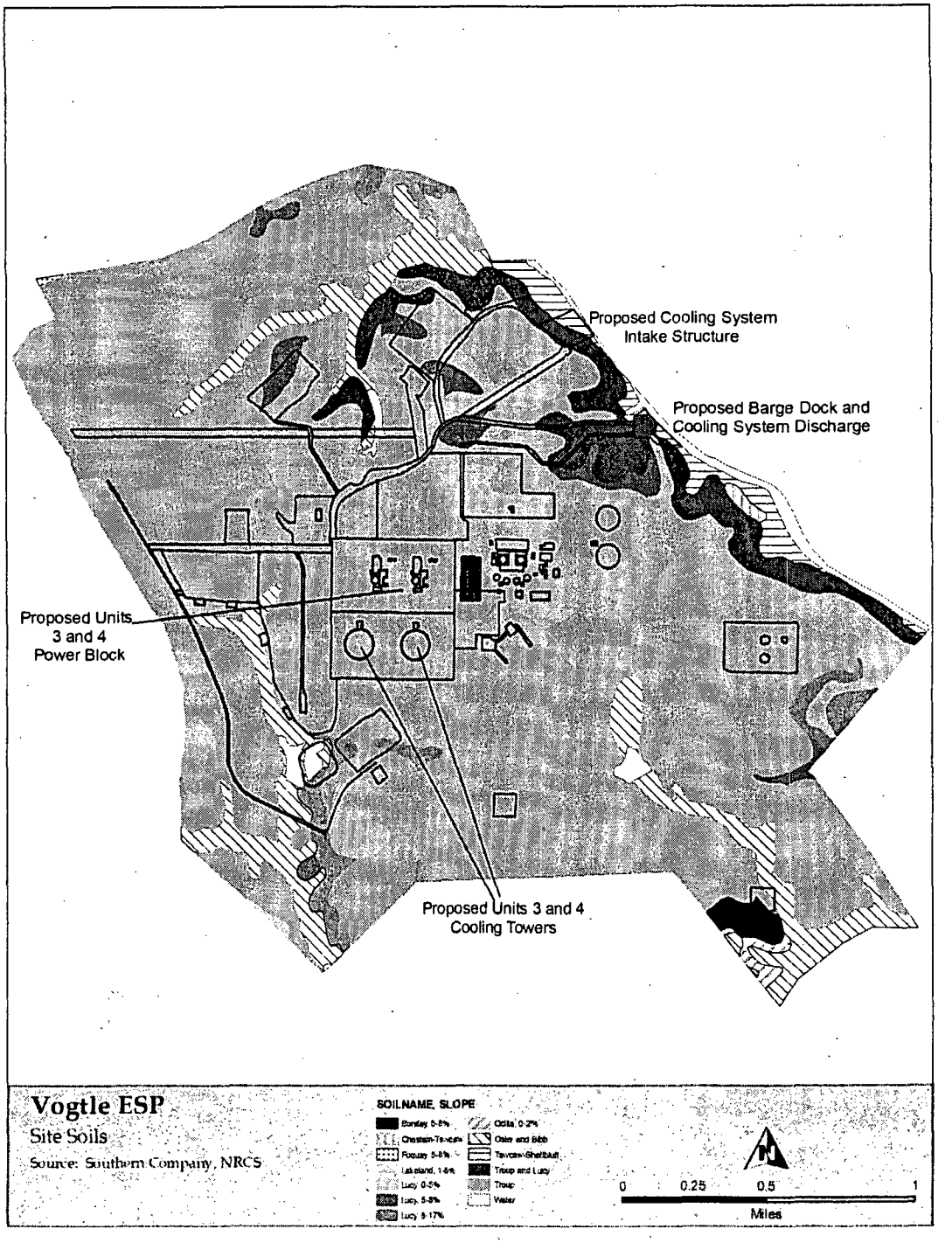

Figure 2-11. VEGP Site Soil Map (NRCS 2003a)

major habitat types, including man-made or beaver-created ponds, pine plantations, native upland pines, and the bottomland hardwoods along stream drainages and adjacent to the Savannah River (NRCS 2003a; TRC 2006). Approximately 320 ha (800 ac) of the VEGP site consists of the existing Units 1 and 2 and associated auxiliary facilities, Plant Wilson (a 554-MW(e) peaking power generating facility), the training center, and transmission line rights-of-way. Previously disturbed areas onsite, including areas within the footprint for the proposed VEGP Units 3 and 4, are vegetated with a mix of planted pines and old field vegetation (Southern 2008a). Approximately 247.7 ha (612 ac) of hardwoods, 661.3 ha (1634 ac) of pine forests, and 38.8 ha (96 ac) of open areas such as mowed grass and old fields are on the VEGP site (Southern 2008a).

The land surrounding the VEGP site consists mostly of both agricultural and naturally vegetated parcels. Pasture or farmland, pine plantations, and abandoned (old) fields predominate the agricultural portions, while much of the naturally vegetated land is composed of oak-hickory hardwoods and sand hill-upland pine communities (Southern 2007e, 2008a).

The Savannah River floodplain ranges from approximately 30 to 240 m (100 to 800 ft) wide at the VEGP site. However, most of the VEGP site is situated atop steep river bluffs along the Savannah River shoreline and is separated from the floodplain (Southern 2008a). The top of the bluff is about 11.9 m (125 ft) above the high water mark.

Directly across the Savannah River from the VEGP site is the Savannah River Site, a DOE facility with restricted access (Southern 2008a). River swamp, bottomland hardwood, and upland pine-hardwood communities occur on the Savannah River Site within 10 km (6 mi) of the VEGP site (Southern 2008a). The Savannah River Swamp comprises about 3800 ha (9400 ac) and borders the Savannah River on the southwestern edge of Savannah River Site, across the river from the VEGP site (Wike et al. 2006).

The Yuchi WMA is immediately south of the VEGP site and is managed by GDNR for public deer and turkey hunting and primitive camping (Southern 2008a; GDNR 2006b). This WMA encompasses 3160 ha (7800 ac) and is composed of 101 ha (250 ac) of Savannah River bottom; 121 ha (300 ac) of creek bottom; 283 ha (700 ac) of mesic ravine; 2400 ha (6000 ac) of planted loblolly (*Pinus taeda*), slash (*P. elliottii*) or longleaf pine (*P. palustris*) of various ages; and 223 ha (550 ac) of native pine and mixed pine-hardwood (GDNR 2006b). Southern also maintains a public boat landing immediately downstream of the VEGP site that provides both employees and the general public access to the Savannah River for recreational purposes (Southern 2008a). In early 2003, Southern's Land Department began restoration of a forested area near the boat ramp, which included planting 26,000 longleaf pine trees and 15,000 wiregrass (*Aristida stricta*) plugs. VEGP partnered with National Wild Turkey Federation-Energy for Wildlife, GPC, and the Forestry for Wildlife Partnership on this restoration project (Southern 2007e). No other recreation areas occur within 10 km (6 mi) of the VEGP site (Southern 2008a).

The VEGP site has been designated as a Certified Wildlife Habitat since 1993. This designation is through the Wildlife Habitat Council, a non-profit, Washington D.C.-based wildlife organization (Southern 2008a). In July 2006, Southern submitted an application to the Wildlife Habitat Council for re-certification as a Certified Wildlife Habitat and was awarded this re-certification November 14, 2006 (Southern 2007c). GPC also manages wildlife habitat within some of the transmission line rights-of-way by employing a GDNR program called Wildlife Incentive for Non-Game and Game Species (WINGS). This program aims to assist land owners in the conversion of transmission rights-of-way into wildlife habitat areas (NRC 2008).

Although the VEGP site hosts ticks and mosquitoes, no vector-borne diseases have been reported at the site. In addition, there are no other pre-existing stresses or stressors to wildlife known to occur on the VEGP site (Southern 2006c, 2008a).

2.7.1.1 Terrestrial Communities of the VEGP Site

Wildlife Habitats on the VEGP site

The VEGP site is characterized by low, gently rolling sandy hills. Scrub oaks, including turkey oak (*Quercus laevis*), and post oak (*Q. stellata*); willow oak (*Q. phellos*); and longleaf pine occur in the upland wooded areas that were not previously cultivated. Red oak (*Q. rubra*), water oak (*Q. nigra*), and maple (*Acer* sp.) dominate the lowland hardwood areas. Bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) characterize the Savannah River floodplain. To prevent erosion, grasses and the leguminous forb sericea lespedeza (*Lespedeza cuneata*) were planted in several open areas created during construction of VEGP Units 1 and 2 (Southern 2007e).

Longleaf Pine-Scrub Oak and Oak-Hickory Upland Communities

The longleaf pine-scrub oak community is found on ridge tops as well as south and west slopes in undisturbed upland areas on the VEGP site. Common canopy species in this habitat include longleaf pine, turkey oak, and bluejack oak (*Q. incana*). The shrub layer is composed of sparkleberry (*Vaccinium arboreum*), dwarf huckleberry (Gaylussacia dumosa), and yellow jessamine (*Gelsemium sempervirens*). The density and diversity of the herbaceous ground cover varies with the degree of canopy closure. Under dense shade, only clumps of slender woodoats (*Chasmanthium laxum*) are found. In more open areas, gopher weed (*Baptisia perfoliata*), jointweed (*Polygonella americana*), tread-softly (*Cnidoscolus stimulosus*), and reindeer lichen (*Cladina rangiferina*) are common (TRC 2006).

The north and east slopes in the undisturbed uplands support the more mesic oak-hickory community. The canopy in this community is mainly composed of white oak (*Q. alba*), white ash (*Fraxinus americana*), mockernut hickory (*Carya alba*), and flowering dogwood (*Cornus florida*). A few turkey oaks and a scattering of shortleaf pine (*Pinus echinata*) are also present (TRC 2006).

A steep bluff separates the dry upland forest from the intermittently flooded bottomland along the Savannah River. The bluff is completely wooded and in places still supports some very large trees, several in excess of 0.9 m (3 ft) in diameter. Common canopy species include oak, mockernut hickory, tuliptree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), American elm (*Ulmus americana*), basswood (*Tilia americana*), and Florida maple (*Acer barbatum*). The understory is composed of smaller trees, shrubs, and vines. Common understory species include pawpaw (*Asimina triloba*), hophornbeam (*Ostrya virginiana*), muscadine grape (*Vitis rotundifolia*), American beautyberry (*Callicarpa americana*), crossvine (*Bignonia capreolata*), and poison ivy (*Toxicodendron radicans*). The herbaceous ground cover varies with soil moisture. On the upper slope, where the soil is drier, Christmas fern (*Polystichum acrostichoides*), white snakeroot (*Ageratina altissima*), and several species of aster are common. On the lower slopes and around seeps, dominant plant species include mottled trillium (*Trillium maculatum*), wild ginger (*Asarum canadense*), false nettle (*Boehmeria cylindrica*), and jewelweed (*Impatiens capensis*) (TRC 2006).

Planted Pine

The planted pine plantations on the VEGP site are of various ages and differ in the stocking rates. The plantations vary from a nearly closed canopy with very little understory to areas that resemble old fields with only scattered pine. The sparse herbaceous ground cover in areas with a closed canopy consists mostly of bracken fern (*Pteridium aquilinum*). In the more open areas, dog fennel (*Eupatorium capillifolium*), broomsedge (*Andropogon virginicus*), and blackberry (*Rubus* sp.) are common. Loblolly and longleaf pines are the primary overstory species (TRC 2006). Pine plantations are managed through prescribed burning every 3 to 5 years, timber thinning after 20 years, and aesthetic cuts after thinning. Burning is limited to 25 to 30 percent of the upland and planted pine acreage each year (Southern 2007e). Planted loblolly plantations cover approximately 142 ha (350 ac) of lands that have been reclaimed from original plant construction (Southern 2007e).

Native longleaf pines are being reestablished by Southern on or near the VEGP site. These pines are managed on a long rotation basis, allowing the trees to live from 60 to 100 years (Southern 2007e).

Streams and Wetlands

The wetlands associated with the VEGP site include those near the Savannah River, as well as those near ponds and streams located onsite. Eco-Sciences was contracted by Southern to survey the VEGP site in December 2006 to determine where wetlands and other potentially jurisdictional waters of the United States (as defined in 33 CFR 328) occur. They followed the three-parameter approach outlined in the USACE 1987 Wetlands Delineation Manual for the delineation of wetlands (USACE 1987). The USACE manual provides a system for identifying

wetlands based on satisfying three criteria: the presence of hydrophytic vegetation, hydric soils, and wetland hydrology (Southern 2007d).

Approximately 69 ha (170 ac) of potentially jurisdictional wetlands and other waters of the United States were identified on the site during the Eco-Sciences survey (Southern 2007c). These include 48 wetlands, 6 perennial streams, 13 intermittent streams, and 3 ephemeral streams. In early 2007, Southern submitted the Request for Jurisdictional Determination Form to the USACE to initiate the Section 404 permitting process (Southern 2007c).

Principal waterbodies onsite include Mallard Pond and two streams in the southern portion of the VEGP site (see Figure 2-1). Mallard Pond is a man-made, 2-ha (5-ac) pond that was already present on the VEGP site prior to construction of Units 1 and 2. It is in a hardwood cove just north of the footprint for the proposed new VEGP Units 3 and 4 powerblock (Southern 2007e). A small unnamed stream flows out from Mallard Pond. It enters the Savannah River at Hancock Landing, approximately 1 km (0.6 mi) upstream of the intake structure for Units 1 and 2 (NRC 2008). The stream is approximately 0.6 m (2 ft) to 1.2 m (4 ft) wide and less than 0.3 m (1 ft) deep, except where beavers (*Castor canadensis*) have created dams and ponds (Southern 2008a). Another stream flowing out of the northwest corner of the site joins the unnamed stream flowing from Mallard Pond approximately one-third of the way to the Savannah River.

Two streams are located in the southern portion of the VEGP site (see Figure 2-1). One of these streams is located in the southwestern portion of the VEGP site and drains south through Debris Basin #2, into Daniels Branch and then into Telfair Pond. Telfair Pond drains to the east via Beaverdam Creek, which enters the Savannah River approximately 3.2 km (2 mi) downstream of the existing intake structure. The other small stream is in the southeastern portion of the site and flows south through the Debris Basin #1 (Southern 2008a). This unnamed tributary flows directly into Beaverdam Creek. Although Beaverdam Creek is outside the VEGP site boundary, the two small streams mentioned above are within the site. Eco-Sciences identified several wetland areas within each of these stream drainages during a jurisdictional water survey conducted in December 2006 (Southern 2007d), including wetlands associated with the two debris basins. Debris Basins #1 and #2 were originally built as stormwater retention basins during construction of VEGP Units 1 and 2 (See Figure 2-1).

Debris Basin #1 is about 2.4 ha (6 ac) in size, and Debris Basin #2 is about 2 ha (5 ac) (Southern 2007e). Eco-Sciences found the dominant vegetation in wetlands associated with Debris Basin #1 included black willow (*Salix nigra*), cinnamon fern (*Osmunda cinnamomea*), sweetgum, giant cane (*Arundinaria gigantea*), and red maple (*Acer rubrum*). Dominant vegetation associated with wetlands around Debris Basin #2 includes black willow, sedges (*Carex* spp.), greenbrier (*Smilax* spp.), sweetgum, and giant cane (Southern 2007d).

There is also a runoff catch pond between the two basins that was formed from a depression left after construction of VEGP Units 1 and 2. The runoff pond is about 1.2 ha (3 ac) in size and retains water throughout the year (Southern 2007e).

The natural or beaver enhanced wetlands associated with these drainages have open to closed canopies depending on water depth. In those areas with a tree canopy, the dominant species are water oak, red maple, and blackgum (*Nyssa sylvatica*). There is also a relatively dense understory of vines and shrubs composed of giant cane, trumpet creeper (*Campsis radicans*), muscadine grape, and American holly (*Ilex opaca*). The herbaceous ground cover is dominated by cinnamon fern and royal fern (*Osmunda regalis*) (TRC 2006).

The general habitat along the Savannah River at VEGP is a mix of hardwood forest and bald cypress-water tupelo forest. Bald cypress and water tupelo are the dominant canopy species in the wetter sites along the river. American sycamore (*Platanus occidentalis*), boxelder (*A. negundo*), sugarberry (*Celtis laevigata*), and swamp chestnut oak (*Quercus michauxii*) occupy the slightly higher drier ground. The understory is composed of American holly, ironwood (*Carpinus caroliniana*), water locust (*Gleditsia aquatica*), giant cane, and buttonbush (*Cephalanthus occidentalis*). Ground cover is sparse and limited to those species that can survive both inundation and dense shade. Dominant groundcover species include richweed (*Pilea pumila*), lizard's tail (*Saururus cernuus*), sensitive fern (*Onoclea sensibilis*), and Virginia dayflower (*Commelina virginica*) (TRC 2006).

Southern has estimated that 8.5 ha (21.0 ac) of wetlands along the Savannah River would be affected during construction of the cooling water intake structure, the barge facility, and the discharge structure for the proposed VEGP Units 3 and 4 (Southern 2008b). Southern (2007d) identified three potential jurisdictional wetlands in the vicinity of these proposed structures (Figure 2-12). The soil in these wetlands is classified as loamy sand that is more than 91 cm (36 in.) deep. The dominant species present in two of the wetlands are bald cypress, American sycamore, and red maple. A smaller wetland (0.006 ha [0.015 ac]) is also located near the proposed water intake. The dominant species in this wetland include ironwood and giant cane.

A rare-plant survey was conducted by GDNR biologists on April 13, 2007, along the river bluffs at the proposed new water intake structure and the adjacent upland sandhill habitat. During this survey, GDNR did not observe any Federally or State-listed species (Patrick 2007).

Wildlife Habitats in the Vicinity of the Proposed 500-kV Transmission Line

In 2007, GPC completed a macro-corridor study to evaluate route alternatives for the proposed new 500-kV transmission line routing. The transmission line right-of-way is within the Piedmont and Coastal Plain Physiographic Regions of Georgia. The Piedmont is characterized by rolling

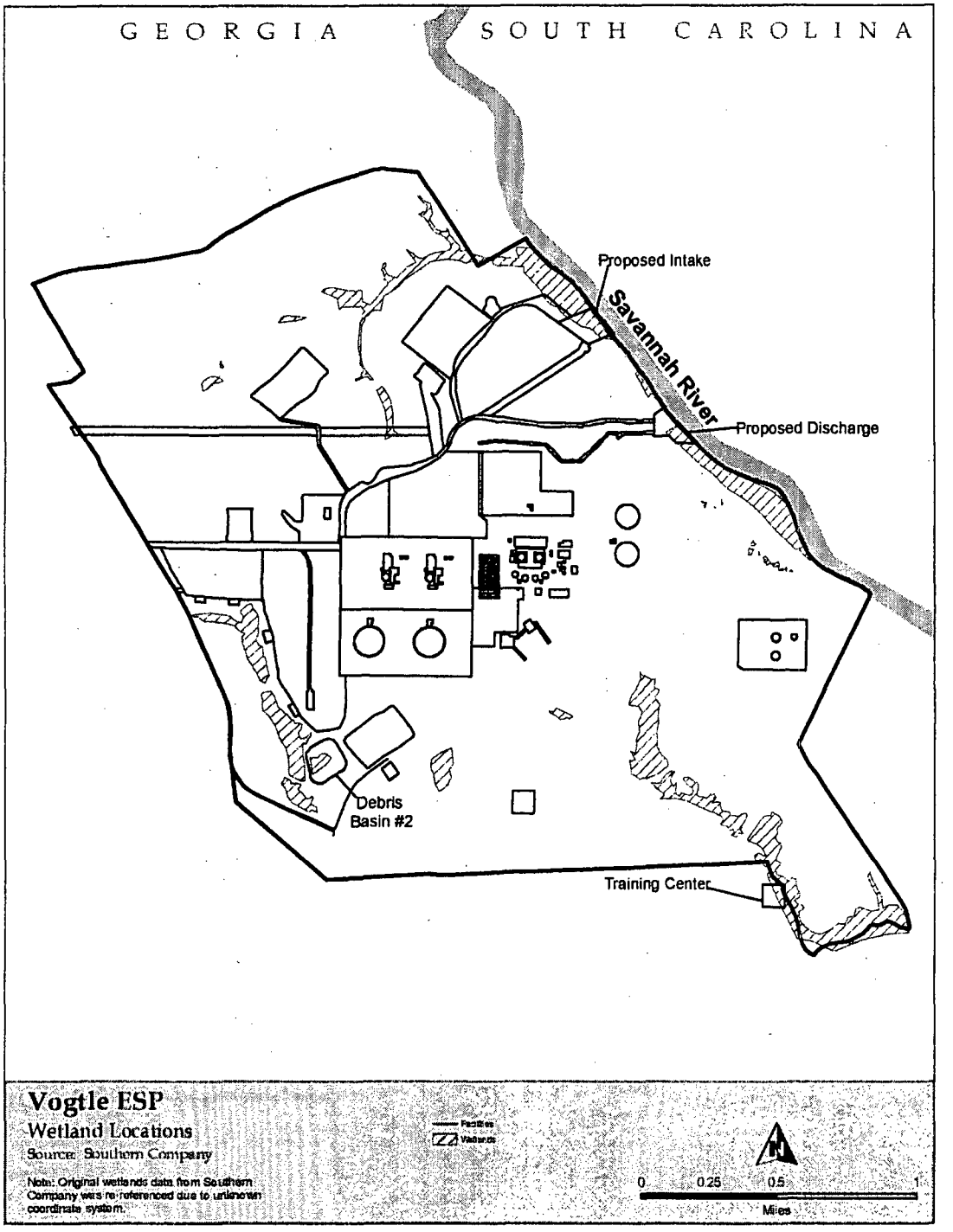

Figure 2-12. VEGP Site Wetlands Map

hills and irregular plains. The soils are finely textured and can be highly erodable. The Coastal Plain is composed of mostly flat areas with some rolling hills with well-drained soils (GPC 2007). The modeled right-of-way was less than 1.6 km (1 mi) to a little over 5 km (3 mi) in width and over 80 km (50 mi) in length (Southern 2008a). Using the EPRI-GTC (Electric Power Research Institute-Georgia Transmission Corporation) Transmission Line Siting Methodology, Southern and GPC identified a narrower corridor (termed the Representative Delineated Corridor [RDC]) that would be used as the basis for identifying actual routing of rights-of-way alternatives within it (see Figure 4-1). The RDC represents a narrowing of the modeled right-of-way to avoid wetlands and stream crossings and reduce the overall length and land potentially affected (GPC 2007).

There are no U.S. Forest Service Wilderness Areas, Wild/Scenic Rivers, Wildlife Refuges, State parks or national parks within the RDC (GPC 2007). The Savannah River and Brier Creek, a tributary of the Savannah River, are the primary waterways that occur in the corridor. The general wildlife habitats within the RDC include forested land, planted pine stands, open land, and open water. The exact habitat types within the new 500-kV transmission line right-of-way are not known at this time, but it is assumed they comprise similar habitats to those on the VEGP site. GPC has estimated the total acreage for a 46-m (150-ft)-wide hypothetical representative right-of-way within the RDC to be 416 ha (1029 ac) of land. GPC estimates that a right-of-way could contain about 23 percent forest, 32 percent planted pine, and 15 percent open land (see Table 4-1) (Southern 2007a).

Wildlife Species on the VEGP Site

Wildlife species found on the VEGP site are representative of those commonly found in eastern Georgia (Southern 2008a). There have been 19 mammal species identified on the site (Southern 2007e). Common mammals onsite include the white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis*), Eastern cottontail (*Sylvilagus floridanus*), coyote (*Canis latrans*), and gray fox (*Urocyon cinereoargenteus*). Small mammals such as moles, shrews, and a variety of mice and voles also occur onsite (Southern 2008a). Sixty species of reptiles and amphibians have been identified onsite including the American alligator (*Alligator mississippiensis*), green anole (*Anolis carolinensis*), bullfrog (*Rana catesbeiana*), and many other snakes, turtles, salamanders, lizards, and toads (Southern 2007e). Habitats located in the vicinity of the VEGP site are suitable for a variety of migratory songbirds, upland game birds, waterfowl, and raptors. One hundred forty-three bird species have been identified onsite (Southern 2007e). Common bird species at the VEGP site include the American crow (*Corvus brachyrhynchos*), Northern bobwhite quail (*Colinus virginianus*), blue jay (*Cyanocitta cristata*), Carolina chickadee (*Poecile carolinensis*), mourning dove (*Zenaida macroura*), black vulture (*Coragyps atratus*), turkey vulture (*Cathartes aura*), song sparrow (*Melospiza melodia*), white-throated sparrow (*Zonotrichia albicollis*), dark-eyed junco (*Junco hyemalis*), Northern cardinal

(*Cardinalis cardinalis*), tufted titmouse (*Baeolophus bicolor*), red-bellied woodpecker (*Melanerpes carolinus*), and Northern flicker (*Colaptes auratus*) (Southern 2008a).

Southern started bluebird (*Sialia sialis*) and wood duck (*Aix sponsa*) nest monitoring programs in March 1993 by placing bluebird and wood duck nest boxes in suitable nesting habitats at the VEGP site. Wood duck boxes are located on Mallard Pond, Debris Basins #1 and #2, the run-off catch pond, and the river boat ramp. In the last 3 years, Southern has recorded up to 50 fledglings from these locations each year (Southern 2007e).

The primary game species at the VEGP site are Eastern cottontail, white-tailed deer, gray squirrel, Northern bobwhite quail, mourning dove, and American woodcock (*Scolopax minor*). Turkey (*Meleagris gallopavo*) are also commonly found on the VEGP site. Land management practices to benefit turkey and Northern bobwhite quail have been in place since 1983. Southern plants browntop millet, rye, and chufa to benefit the turkey, quail, and other birds on the VEGP site, and food plots are provided for quail (Southern 2007e). The reestablishment of longleaf pine onsite also provides cover for quail and turkey (Southern 2007e). There are no significant "travel corridors" for game species on the VEGP site (Southern 2008a).

Southern has partnered with the non-game management branch of GDNR, the Southeast region of the National Fish and Wildlife Federation, National Wild Turkey Federation, and the Migratory Bird Division of the U.S. Fish and Wildlife Service (FWS) on wildlife enhancements programs and habitat management projects on the VEGP site (Southern 2007e).

Wildlife Species in the Vicinity of the Proposed 500-kV Transmission Line

Common Georgia wildlife species occurring along the transmission line right-of-way are expected to be similar to those found on the VEGP site.

State-Listed Species in the Vicinity of the VEGP site

This section describes Georgia and South Carolina State-listed and proposed threatened and endangered terrestrial species and designated and proposed critical habitat that may occur in the vicinity of the site. State-listed endangered, threatened, and other special-status species that may occur in the vicinity of the VEGP site are listed in Table 2-3. This list is composed of Georgia State-listed species with recorded occurrences in Burke County (GDNR 2007a), species listed on the FWS website as having the potential to occur in Burke County (FWS 2004), or species within 16 km (10 mi) of the site in Aiken and Barnwell Counties in South Carolina (SCDNR 2007a). A rare plant survey was conducted by GDNR biologists on April 13, 2007, along the river bluffs at the proposed new water intake structure and adjacent upland sandhill habitat. No State-listed species were observed during this survey (Patrick 2007). During the spring (April 12 to 21), summer (August 22 to 31), and fall (October 2 to November 2) of 2005, Third Rock Consultants, LLC (TRC) conducted three surveys at the VEGP site for State-listed species classified as threatened and endangered (TRC 2006).

Table 2-3. South Carolina and Georgia State-Listed Terrestrial Species with Known Occurrence within 16 km (10 mi) of the VEGP Site[(a)(b)(c)]

Scientific Name	Common Name	Georgia State Status	South Carolina State Status	County of Occurrence
Plants				
Agalinis linifolia	flaxleaf false-foxglove		SC	Aiken
Allium cuthbertii	striped garlic		SC	Barnwell/Aiken
Astragalus michauxii	sandhills milkvetch		SC	Barnwell
Astragalus villosus	bearded milkvetch		SC	Barnwell
Baptisia lanceolata	lance-leaf wild-indigo		SC	Barnwell
Carex cherokeensis	Cherokee sedge		SC	Barnwell
Carex decomposita	cypress-knee sedge		SC	Barnwell
Carex socialis	social sedge		SC	Barnwell
Coreopsis rosea	rose coreopsis		RC	Barnwell/Aiken
Croton elliottii	Elliott's croton		SC	Barnwell/Aiken
Echinacea laevigata	smooth coneflower	SE	SE	Barnwell/Aiken
Echinodorus parvulus	dwarf burhead		SC	Barnwell/Aiken
Elliottia racemosa	Georgia plume	ST		Burke
Epidendrum conopseum	green-fly orchid		SC	Barnwell
Gaura biennis	biennial gaura		SC	Barnwell/Aiken
Ilex amelanchier	sarvis holly		SC	Barnwell/Aiken
Lindera subcoriacea	bog spicebush		RC	Barnwell/Aiken
Ludwigia spathulata	spatulate seedbox		SC	Barnwell/Aiken
Macbridea caroliniana	Carolina bird-in-a-nest		SC	Barnwell
Monarda didyma	Oswego tea		SC	Barnwell
Nestronia umbellula	Indian olive	SR	SC	Barnwell/Aiken, Burke
Nolina georgiana	Georgia beargrass		SC	Barnwell/Aiken
Paronychia americana	American nailwort		SC	Barnwell
Platanthera lacera	green-fringed orchid		SC	Barnwell/Aiken
Quercus sinuata	Durand's white oak		SC	Barnwell
Rhododendron flammeum	Piedmont azalea		SC	Barnwell/Aiken
Rhynchospora inundata	drowned hornedrush		SC	Barnwell/Aiken
Rorippa sessiliflora	stalkless yellowcress		SC	Barnwell
Sagittaria isoetiformis	slender arrow-head		SC	Barnwell
Sarracenia rubra	sweet pitcherplant	ST		Burke
Schisandra glabra	Bay star-vine	ST		Burke, found on the VEGP site[(d)]
Scutellaria ocmulgee	Ocmulgee skullcap	ST		Burke
Trepocarpus aethusae	Aethusa-like trepocarpus		SC	Barnwell
Utricularia floridana	Florida bladderwort		SC	Barnwell

Table 2-3. (contd)

Scientific Name	Common Name	Georgia State Status	South Carolina State Status	County of Occurrence
Mammals				
Condylura cristata	star-nosed mole		SC	Barnwell/Aiken
Corynorhinus rafinesquii	Rafinesque's big-eared bat	SR	SE	Barnwell/Aiken
Geomys pinetis	southeastern pocket gopher	ST		mounds in Burke County[d]
Neotoma floridana	eastern woodrat		SC	Barnwell, Aiken
Spilogale putorius	eastern spotted skunk		SC	Aiken
Birds[e]				
Haliaeetus leucocephalus	bald eagle	ST	SE	Barnwell
Mycteria americana	wood stork	SE	SE	Barnwell
Picoides borealis	red-cockaded woodpecker	SE	SE	Barnwell/Aiken
Amphibians and Reptiles				
Ambystoma tigrinum tigrinum	eastern tiger salamander		SC	Barnwell
Heterodon simus	southern hognose snake	ST	SC	Barnwell/Aiken
Hyla avivoca	bird-voiced treefrog		SC	Barnwell/Aiken
Micrurus fulvius	eastern coral snake		SC	Barnwell/Aiken
Pituophis melanoleucus	pine snake		SC	Barnwell/Aiken
Rana capito	gopher frog	SR	SE	Barnwell/Aiken
Seminatrix pygaea	black swamp snake		SC	Barnwell

(a) State status determined by the GDNR and SCDNR : SE = State endangered, ST = State threatened, SR = State Rare, SU = State Unusual, RC= Of concern regionally, SC = species of concern (GDNR 2007a; SCDNR 2007a).
(b) All State occurrence data and distances are provided by GDNR (2007a) and SCDNR (2007a).
(c) All species listed have known occurrences between 2 and 10 mi from the VEGP site.
(d) The only State-listed species known to occur within 3.2 km (2 mi) of the site is the bay star-vine. Mounds suggestive of the southeastern pocket gopher have been found on the property just north of the VEGP site (Southern 2008a).
(e) The bald eagle, wood stork and red-cockaded woodpecker are listed as potentially occurring in Burke County (FWS 2004). However, there are no records of these species in Burke Country within 16 km (10 mi) of the VEGP site. The wood stork has been recorded within 3.2 km (2 mi) of the VEGP site on the Savannah River Site in South Carolina.

Bay star-vine (*Schisandra glabra*), State-listed as threatened in Georgia, was the only State-listed species found at the site. Bay star-vine is found twining over understory trees in rich forested areas, especially bottomlands and slopes. Older vines may occur on overstory tree trunks or rooted while sprawling along the ground, especially near mountain laurel (*Kalmia latifolia*) thickets (Patrick et al. 1995). The bay star-vine was found at several locations along the wooded bluff bordering the Savannah River, including in the area of the proposed cooling water intake structure, and in a wooded wetland in the southern portion of the VEGP site (Southern 2007c).

With the exception of bay star-vine described above, there are no known State-listed plant species occurrences within 3.2 km (2 mi) of the VEGP site (GDNR 2007a; SCDNR 2007a).

Four Georgia State-listed plant species have been recorded in Burke County within 16 km (10 mi) of the VEGP site: Ocmulgee skullcap (*Scutellaria ocmulgee*), Georgia plume (*Elliottia racemosa*), sweet pitcherplant (*Sarracenia rubra*), and Indian olive (*Nestronia umbellula*). All are listed as State threatened except for the Indian olive, which is listed as rare in Georgia. The smooth coneflower (*Echinacea laevigata*) is listed in both Georgia and South Carolina as State-endangered, and 29 additional plant species are of concern both locally and regionally in South Carolina within 16 km (10 mi) of the VEGP site.

Three Georgia State-listed bird species, the bald eagle (*Haliaeetus leucocephalus*), wood stork (*Mycteria americana*), and red-cockaded woodpecker (*Picoides borealis*), have the potential to occur in suitable habitats within Burke County (FWS 2004). The wood stork and red-cockaded woodpecker are also Federally endangered. These species are discussed in Section 2.7.1.2. Red-cockaded woodpeckers and wood storks have been observed on the Savannah River Site, which is in South Carolina adjacent to the VEGP site (Wike et al. 2006).

The bald eagle is currently listed as State-threatened in Georgia and South Carolina. It was Federally delisted on July 9, 2007 (72 FR 37346). Bald eagles are found throughout the United States, are permanent Georgia residents, and are most abundant in the coastal region (GDNR 2007b). In 2005, there were 82 known occupied nests in Georgia. Although the coastal region has the greatest density of nesting eagles, territories are found throughout much of the state where there is sufficient open water habitat and large trees for nesting (GDNR 2007b). Records of bald eagle sightings in the Savannah River area date back to 1904 (Wike et al. 2006).

Bald eagle nests are large, measuring up to 1.8 m (6 ft) across. Nest sites typically include at least one perch with a clear view of the water where the eagles usually forage (FWS 2006). Nests in the region around the VEGP site are typically found in large pine trees (Wike et al. 2006). However, eagles are also known to occasionally nest in cypress trees. Fish are the major component of the diet, which results in the majority of nest sites being built near a body of water such as coastal shorelines, bays, rivers, lakes, farm ponds, and reservoirs. Winter foraging areas are usually located near open water on rivers, lakes, reservoirs, and bays where fish and waterfowl are abundant. Bald eagles also feed on other prey species such as waterfowl, gulls, rabbits, rodents, deer, and carrion (FWS 2003a, 2006).

The bald eagle is listed as having the potential to occur in the vicinity of the VEGP site, in Burke County, Georgia (FWS 2004) as well as Aiken and Barnwell Counties in South Carolina (FWS 1999). There are no known historical occurrences of bald eagles on the site, and bald eagles were not identified in the 2005 threatened and endangered species survey (Southern 2006c; TRC 2006). Bald eagles have been recorded within 3.2 km (2 mi) of the VEGP site in

the Savannah River Swamp on the Savannah River Site, but known nest locations on the Savannah River Site are more than 8 km (5 mi) away (Wike et al. 2006). The majority of bald eagles seen on Savannah River Site have been reported in the Par Pond system more than 16 km (10 mi) from the VEGP site. The last successful nesting attempt on the Savannah River Site was in 1998 (Wike et al. 2006). Bald eagles are observed during all months of the year on the Savannah River Site, but most eagles are seen during the fall and winter when this species is nesting and wintering in the region. Birds seen during the summer are most likely migratory transients (Wike et al. 2006).

It is unlikely that bald eagles nest onsite. However, bald eagles may occasionally use large trees along the Savannah River or in wetland areas for roosting or perching.

Although no State-listed herpetofauna have been reported in Georgia within 16 km (10 mi) of the VEGP site, seven species have been observed within this distance in South Carolina (SCDNR 2007a), including the gopher frog (*Rana capito*), which is South Carolina endangered and Georgia rare, and six species of various levels of concern in one or both states: (1) eastern tiger salamander (*Ambystoma tigrinum tigrinum*), (2) southern hognose snake (*Heterodon simus*), (3) bird-voiced treefrog (*Hyla avivoca*), (4) eastern coral snake (*Micrurus fulvius*), (5) pine or gopher snake (*Pituophis melanoleucus*), and (6) black swamp snake (*Seminatrix pygaea*).

Listed mammals within 16 km (10 mi) of the VEGP site have only been recorded in South Carolina (SCDNR 2007a). Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), a South Carolina endangered species, has been observed in Barnwell and Aiken Counties. The star-nosed mole (*Condylura cristata*), eastern woodrat (*Neotoma floridana*), and eastern spotted skunk (*Spilogale putorius*), are State species of concern in Aiken and/or Barnwell Counties in South Carolina.

In October 2006, the GDNR updated its list of protected species, including the addition of the threatened southeastern pocket gopher (*Geomys pinetis*). This species was not targeted in the 2005 threatened and endangered species surveys of the site (NRC 2007c). The southeastern pocket gopher is found in upland areas of dry, sandy soil or well-drained, fine-grained gravelly soil (GDNR 2000). There are no known records of the pocket gopher in Burke County (GDNR 2007a). However, surface mounds suggestive of the pocket gopher have been observed in property adjoining the northern boundary of the VEGP site (Southern 2008a). No mounds similar to those made by the southeastern pocket gopher have been reported from the VEGP site, although suitable habitat appears to be available. The habitat type used by the pocket gopher was not observed in any of the areas that will be disturbed by construction (Southern 2008b).

State-Listed Species in the Vicinity of the Proposed 500-kV Transmission Line

Fourteen State-listed plant species have been recorded within the counties where the proposed 500-kV transmission line may cross (Burke, Jefferson, McDuffie, Warren) (Table 2-4). Canby's dropwort is Federally endangered and is discussed in Section 2.7.1.2. In addition to the

Table 2-4. State-Listed Terrestrial Species in Georgia Counties Crossed by the Proposed Thomson-Vogtle Transmission Line Right-of-Way (Warren, McDuffie, Burke, Jefferson Counties)

Scientific Name	Common Name	Georgia State Status[a]	Counties of Occurrence
Plants			
Ceratiola ericoides	sandhill rosemary	ST	Burke
Cypripedium acaule	pink ladyslipper	SU	McDuffie
Elliottia racemosa	Georgia plume	ST	Burke
Macbridea caroliniana	Carolina bogmint	SR	McDuffie
Nestronia umbellula	Indian olive	SR	Burke, Jefferson
Oxypolis canbyi	Canby's dropwort	SE	Burke
Penstemon dissectus	cutleaf beardtongue	SR	Jefferson
Quercus oglethorpensis	Oglethorpe oak	ST	McDuffie
Sarracenia minor	hooded pitcherplant	SU	Burke
Sarracenia rubra	sweet pitcherplant	ST	Burke, Jefferson
Scutellaria ocmulgee	Ocmulgee skullcap	ST	Burke
Sedum pusillum	granite stonecrop	ST	Warren
Stewartia malacodendron	silky camellia	SR	Burke
Symphyotrichum georgianum	Georgia aster	ST	McDuffie
Birds[b]			
Haliaeetus leucocephalus	bald eagle	ST	Burke, Jefferson, McDuffie, Warren
Mycteria americana	wood stork	SE	Burke, Jefferson
Picoides borealis	red-cockaded woodpecker	SE	Burke, Jefferson
Amphibians and Reptiles			
Ambystoma cingulatum	flatwoods salamander	ST	Burke, Jefferson
Clemmys guttata	spotted turtle	SU	Burke, Jefferson, Warren
Heterodon simus	southern hognose snake	ST	Burke, Jefferson, McDuffie
Rana capito	gopher frog	SR	Burke

(a) State status determined by the GDNR: SE = State Endangered, ST = State Threatened, SR = State Rare, SU = State Unusual (GDNR 2007c).
(b) Counties for the listed bird species based on GDNR (2007c) and FWS (2004).

State-threatened sandhill rosemary (*Ceratiola ericoides)*, Ocmulgee skullcap, Georgia plume, and sweet pitcherplant already discussed in the VEGP site vicinity, Georgia aster (*Symphyotrichum georgianum*), Oglethorpe oak (*Quercus oglethorpensis*), and granite stonecrop (*Sedum pusillum*) also occur in the right-of-way counties. Georgia aster is a Federal candidate and is discussed in Section 2.7.1.2. Indian olive, silky camellia (*Stewartia malacodendron)*, cutleaf beardtongue (*Penstemon dissectus*), and Carolina bogmint (*Macbridea caroliniana*) are State-listed rare species within the corridor counties. State-listed species classified as unusual in these counties include the hooded pitcherplant (*Sarracenia minor*) and pink ladyslipper (*Cypripedium acaule*).

The State-listed animal species with potential to reside in these counties are the same species that have the potential to occur in the vicinity of the VEGP site: bald eagle, wood stork, red-cockaded woodpecker, gopher frog, southern hognose snake, spotted turtle, and flatwoods salamander.

Three State-listed species have been documented by the GDNR as occurring within the RDC: the silky camellia, sandhill rosemary, and bald eagle. The silky camellia (Georgia rare) typically occurs within the rich understory along streams and open edges of lower slopes with beech (*Fagus* sp.), magnolia (*Magnolia* sp.*)*, and Florida maple (*Acer barbatum*) (Patrick et al. 1995). Sandhill rosemary is an evergreen shrub, and consistent with its namesake, it is found in deep sand ridges typical of the Ohoopee Dunes of Georgia (Patrick et al. 1995).

The bald eagle is listed as potentially occurring within Burke, Jefferson, McDuffie, and Warren Counties (FWS 2004). There is one known location of an active nest in the McDuffie County portion of the RDC. GPC stated that they would ensure the right-of-way would not come within 180 m (600 ft) of this known bald eagle nesting site (GPC 2007). In addition, there are several bald eagle nests within 16 km (10 mi) of the RDC in Jefferson County (GDNR 2007b). In the absence of a ground or aerial survey for bald eagles in suitable foraging, roosting, and nesting habitat in areas that would be affected by construction of the proposed 500-kV transmission line, it is unknown if this species occurs at additional locations within the RDC.

2.7.1.2 Threatened and Endangered Terrestrial Species

This section describes Federally listed and proposed threatened and endangered terrestrial species and designated and proposed critical habitat that may occur in the vicinity of the site and in the vicinity of the proposed 500-kV transmission line. Endangered, threatened, and other special-status species that may occur in the vicinity of the VEGP site are listed in Table 2-5. This list is composed of Federally listed species with recorded occurrences in Burke County (GDNR 2007c) , species listed on the FWS website as having the potential to occur in Burke County (FWS 2004), or species within 16 km (10 mi) of the site in Aiken and Barnwell Counties in South Carolina (SCDNR 2007a).

Table 2-5. Federally Listed Terrestrial Species Occurring in the Vicinity of the VEGP Site

Scientific Name	Common Name	Federal Status[a]	County of Occurrence	Distance from the VEGP Site[b]
Plants				
Echinacea laevigata	smooth coneflower	E	Aiken, Barnwell	< 16 km (10 mi)
Oxypolis canbyi	Canby's dropwort	E	Burke	> 16 km (10 mi)
Trillium reliquum	relict trillium	E	Aiken	> 16 km (10 mi)[c]
Birds				
Mycteria americana	wood stork	E	Barnwell, Aiken, Burke	< 3.2 km (2 mi)
Picoides borealis	red-cockaded woodpecker	E	Barnwell, Aiken, Burke	16 km (10 mi)
Amphibians and Reptiles				
Alligator mississippiensis	American alligator	T(S/A)	Barnwell, Aiken, Burke	Occurs onsite[d]
Ambystoma cingulatum	flatwoods salamander	T	Burke	> 16 km (10 mi)

(a) Federal status rankings determined by the FWS under the Endangered Species Act, E = Endangered, T = Threatened, T(S/A) = Threatened due to similarity of appearance (FWS 2004).
(b) GDNR 2007c; SCDNR 2007a; Wike et al. 2006
(c) Suitable habitat exists for the relict trillium onsite (PNNL 2006
(d) TRC (2006)
Species included in this table meet at least one of the following criteria:
- species have been recorded to occur on the VEGP site
- species have been recorded to occur within 16 km (10 mi) of the VEGP site in Aiken and Barnwell Counties, South Carolina
- species are listed by FWS (2004) as occurring or having the potential to occur in Burke County, Georgia
- species were known to have suitable habitat on the VEGP site

A list of Federally listed species occuring in counties that may be crossed by the proposed new 500-kV transmission line (Burke, Jefferson, McDuffie, Warren) was obtained from FWS county listings for the State of Georgia, and location information was obtained from the GDNR element occurrence database (Table 2-6) (FWS 2004; GDNR 2007c).

Surveys were conducted by TRC in the spring, summer, and fall of 2005 on 675.4 ha (1669 ac) of the 1282.5 ha (3169 ac) that comprise the VEGP site (Figure 2-13). TRC first gathered information on the distribution, habitat requirements, and seasonal preferences of each Federally listed species that might occur at the site. This information was then used to generate a species list by season, and surveys were conducted in those habitats that most likely contained the target species (Southern 2008b). A majority of the areas surveyed were places that had not been previously disturbed during original construction (TRC 2006). No Federally listed plant species were found. The American alligator was the only Federally listed animal species observed. One adult alligator was observed in Mallard Pond during the summer survey. It is Federally listed as "threatened due to similarity of appearance" to the endangered American crocodile (*Crocodylus acutus*) (TRC 2006).

Table 2-6. Federally Listed Terrestrial Species in Counties that are Proposed to Contain the Proposed Thomson-Vogtle Transmission Line Right-of-Way (Burke, McDuffie, Jefferson and Warren Counties in Georgia)

Scientific Name	Common Name	Federal Status[(a)]	Counties of Occurrence
Plants			
Oxypolis canbyi	Canby's dropwort	E	Burke
Symphyotrichum georgianum	Georgia aster	C	McDuffie
Birds			
Mycteria americana	wood stork	E	Burke, Jefferson
Picoides borealis	red-cockaded woodpecker	E	Burke, Jefferson
Amphibians and Reptiles			
Alligator mississippiensis	American alligator	T(S/A)	Burke
Ambystoma cingulatum	flatwoods salamander	T	Burke

(a) Federal status rankings determined by the FWS under the Endangered Species Act, C = Candidate E = Endangered, T = Threatened, T(S/A) = Threatened due to similarity of appearance (FWS 2004).

The paragraphs below summarize natural history data and potential occurrence information for each Federally listed species occurring in the vicinity of the VEGP site and proposed transmission line corridor. Three Federally listed terrestrial plant and four animal species have the potential to occur in the vicinity of the VEGP site. One Federally listed terrestrial plant and four animal species and one Federal candidate species have the potential to occur in the vicinity of the proposed transmission line right-of-way. There is no designated or proposed critical habitat for terrestrial species known to occur on or in the general area of the site or in the general vicinity of the proposed transmission line right-of-way.

Red-Cockaded Woodpecker – Endangered

The red-cockaded woodpecker (*Picoides borealis*) was listed by the FWS as endangered in 1970 (35 FR 16047). Historically, the red-cockaded woodpecker's range extended from north Florida to New Jersey and Maryland, as far west as Texas and Oklahoma, and inland to Missouri, Kentucky, and Tennessee. This species has been extirpated in New Jersey, Maryland, Tennessee, Missouri, and Kentucky (FWS 2007a), and currently it is estimated that about 6000 family groups of red-cockaded woodpeckers, or 15,000 birds, from Florida to Virginia and west to southeast Oklahoma and eastern Texas represent about 1 percent of the woodpecker's original range (FWS 2007a). Critical habitat has not been established for red-cockaded woodpeckers (FWS 2007b). In 1998, there were 665 family groups of red-cockaded woodpeckers in Georgia (GDNR 1999).

The red-cockaded woodpecker is endemic to open, mature, old growth pine ecosystems in the southeastern United States. Red-cockaded woodpeckers require open pine woodlands and

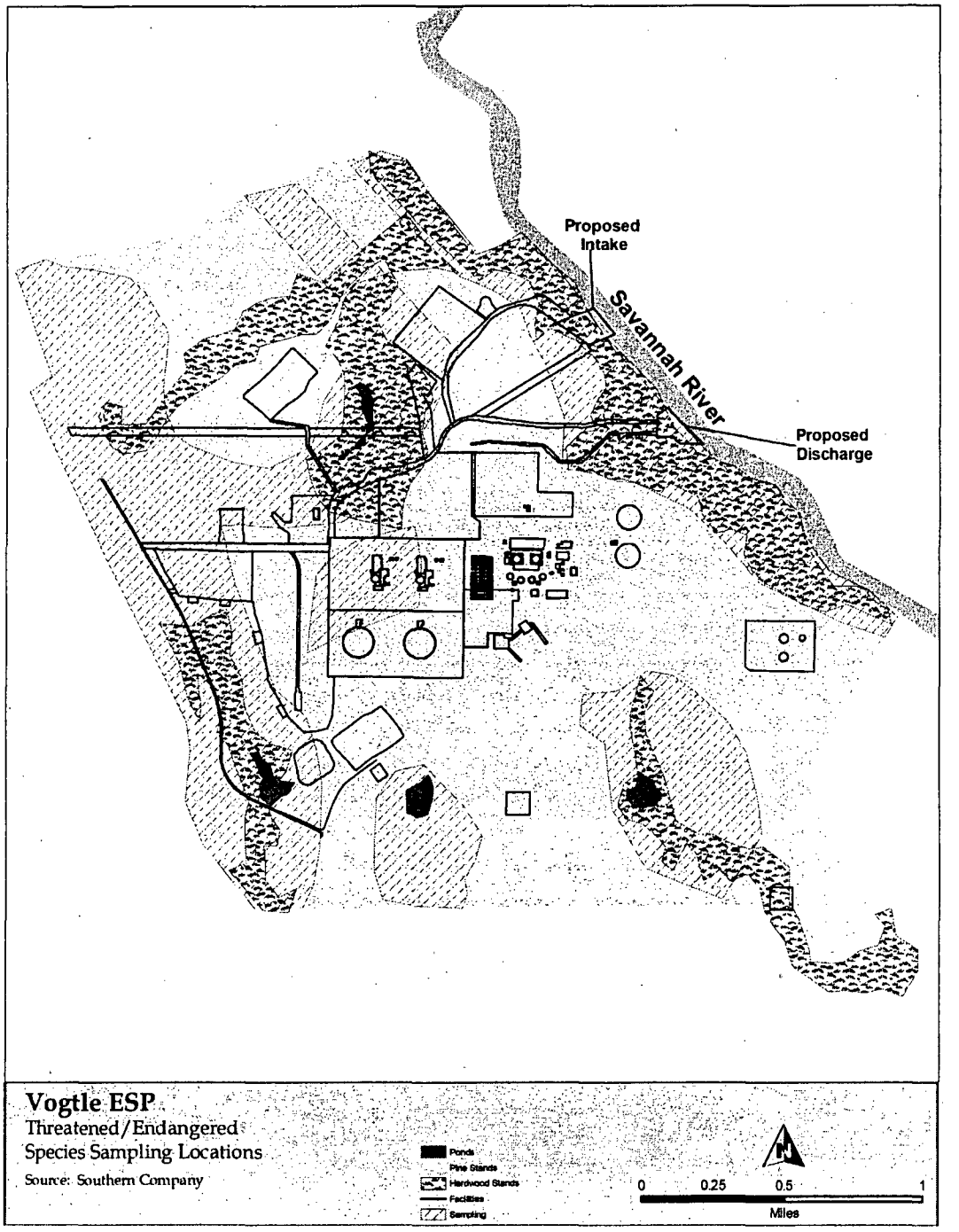

Figure 2-13. 2005 Threatened and Endangered Species Survey Locations at the VEGP Site (Southern 2007c).

savannahs with large old pines for nesting and roosting habitat for family groups (clusters). Large old pines are required as cavity trees because the cavities are excavated completely

within inactive heartwood, and the higher incidence of heartwood decay in older trees greatly facilitates excavation. Cavity trees must be in open stands with little or no hardwood midstory and few or no overstory hardwoods. 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 2003b).

Red-cockaded woodpeckers are a cooperatively breeding species, living in family groups that typically consist of a breeding pair with or without one or two male helpers. In red-cockaded woodpeckers (and other cooperative breeders), a large pool of helpers is available to replace breeders when they die. Helpers do not disperse very far and typically occupy vacancies on their natal territory or a neighboring one (FWS 2003b). A typical territory for an active group ranges from approximately 51 to 80 ha (125 to 200 ac), but can be as large as 240 ha (600 ac). The size of the particular territory is related to both habitat and population density (FWS 2007a). Dispersal is undertaken primarily by young birds. Mate loss and an apparent avoidance of inbreeding sometimes causes adults to disperse, and adults may also occasionally move to neighboring territories for unknown reasons (Walters et al. 1988). In a North Carolina study, females dispersed a maximum of 31.4 km (19.5 mi) and males a maximum of 21.1 km (13.1 mi) (Walters et al. 1988).

GPC and Southern signed a Safe Harbor Management Agreement with the Georgia Department of Natural Resources (GDNR) in June 2007. Under the agreement, two large tracts surrounding the VEGP site will be managed to benefit red-cockaded woodpeckers (The Outdoor Wire 2007). Safe Harbor Agreements are arrangements that encourage voluntary management for red-cockaded woodpeckers while protecting the participating landowners and their rights for development in the event these woodpeckers become established on the private property. Landowners entering into safe harbor agreements must establish a baseline number of individuals that would be maintained in the event that they are observed. Surveys at the VEGP site conducted in February 2006 found no occurrence of red-cockaded woodpeckers onsite (Southern 2007e).

There are no recorded occurrences of the red-cockaded woodpecker in Burke County, Georgia (GDNR 2007a) and no active colonies within 16 km (10 mi) of the site in South Carolina (SCDNR 2007a); however, red-cockaded woodpeckers are listed as having the potential to occur in Burke County in Georgia (FWS 2004) and Aiken and Barnwell Counties in South Carolina (FWS 1999). There are no known historical occurrences of the red-cockaded woodpecker on the VEGP site and they were not identified in the 2005 threatened and endangered species survey or the 2006 Safe Harbor Program baseline survey (Southern 2006d, 2007e, 2008a; TRC 2006). In 2003, a total of 177 red-cockaded woodpeckers in 45 family groups were recorded on the Savannah River Site, with the closest active colony being approximately 16 km (10 mi) from the

VEGP site (Wike et al. 2006). Suitable habitat for the red-cockaded woodpecker exists on the VEGP site, but this habitat is not in the vicinity of the construction area footprint.

Proposed 500-kV Transmission Line

The red-cockaded woodpecker has the potential to occur in Burke and Jefferson Counties (FWS 2004). In addition, the red-cockaded woodpecker has been recorded on Fort Gordon (Mitchell1999). In 1998, there were two active groups on Fort Gordon, representing less than 1 percent of the total number of groups in Georgia. There are no known occurrences of the red-cockaded woodpecker in the general vicinity of the proposed RDC (GDNR 2007a). At this time, it is not known if suitable nesting or foraging habitat exists in the vicinity of the proposed 500-kV transmission line right-of-way.

Wood Stork – Endangered

Breeding populations of the wood stork (*Mycteria americana*) are Federally listed as endangered and currently occur or have recently occurred only in Alabama, Florida, Georgia, and South Carolina (49 FR 7332; FWS 1997). There were 13 active colonies of wood storks in Georgia during the 2002 breeding season with an estimated 1227 nesting pairs (FWS 2003c). No critical habitat has been designated for this species (FWS 2007c).

The wood stork is a highly colonial species, usually nesting and feeding in flocks. The wood stork inhabits freshwater and brackish wetlands, and normally nests in bald cypress or red mangrove (*Rhizophora mangle*) swamps. At freshwater sites, nests are often constructed in bald cypress and swamp-tupelo (*Nyssa bifora*). Wood storks in Georgia and South Carolina lay eggs from March to late May, with fledging occurring in July and August (FWS 1997).

Wood storks have a unique feeding technique (tacto-location) and typically require higher prey concentrations than other birds. They tend to rely on depressions in marshes or swamps where prey can become concentrated during low-water periods (FWS 1997). A study from a wood stork colony in east-central Georgia found the diet was mostly composed of fish, including sunfishes (*Lepomis* spp.), bowfin (*Amia calva*), redfin pickerel (*Esox americanus americanus*), and lake chubsuckers (*Erimyzon* spp.) (FWS 1997).

Wood storks in east-central Georgia forage in a wide variety of habitats including hardwood and cypress swamps, ponds, marshes, drainage ditches, and flooded logging roads. Typical wood stork foraging sites have reduced quantities of both submerged and emergent macrophytes. The water in the foraging areas is either still or very slowly moving, and the depth is normally between 5 and 41 cm (2 and 16 in.). It has been suggested storks may have difficultly feeding in water more than 50 cm (20 in.) deep (Coulter and Bryan 1993).

Differences among seasonal rainfall and surface-water patterns often cause storks to change where and when certain habitats are used for nesting, feeding, or roosting. These hydrological

changes may cause storks to shift the timing or intensity of feeding at a local wetland, or cause entire regional populations of birds to make large geographic shifts between one year and the next. Because nesting storks generally use foraging sites that are located within about 50 km (31 mi) of the colony, most successful colonies are in regions where birds have options to feed under a variety of rainfall and surface-water conditions. Maintaining a wide range of feeding site options requires that many different types of wetlands, both large and small and with relatively long and short annual hydroperiods, be available for foraging (FWS 1997).

The closest known wood stork colonies to the VEGP site are located in Jenkins and Screven Counties, Georgia. The Birdsville colony is located at Big Dukes Pond, a 570-ha (1400-ac) cypress swamp, 12.6 km (7.8 mi) northwest of Millen, in Jenkins County, Georgia. The VEGP site is approximately 45 km (28 mi) from the Birdsville colony. The Chew Mill Pond colony in Jenkins County is approximately 6 km (3.7 mi) southwest of the Birdsville colony. Chew Mill Pond has a history of being a wood stork foraging site and a wading bird rookery. Researchers consider it to be an overflow or satellite colony of the Birdsville colony (Wike et al. 2006). The Jacobsons Landing colony in Screven County is approximately 43 km (27 mi) southeast of the VEGP site. In 1996, it contained an estimated 40 wood stork nests. These colonies are all within 60 to 70 km (37 to 43 mi) of the VEGP site, the maximum radius that wood storks can travel during daily feeding flights (Coulter and Bryan 1993). Wood storks have been recorded foraging throughout Burke County (Coulter and Bryan 1993; Wike et al. 2006), and within 3.2 km (2 mi) of the site in the Savannah River Swamp on the Savannah River Site in South Carolina (Wike et al. 2006).

Wood storks were reported in the vicinity of the Savannah River Site before the site was established in 1952, and before the discovery of the Birdsville colony. Storks have been followed from the Birdsville colony to the Savannah River Site. Data from the aerial wood stork surveys of the Savannah River Swamp and the studies at the Birdsville colony suggest that the Savannah River Swamp probably is not used extensively during the breeding or prefledging phases of the Birdsville colony. Most of the observations of storks on the Savannah River Site occur during the late-nestling or the post-fledging period, which occurs between June and September. Some of the birds observed foraging in the Savannah River Swamp may be storks from farther south, either non-breeders or birds that have already finished breeding for the year (Wike et al. 2006).

No wood storks were identified in the threatened and endangered species surveys completed onsite in 2005, and there are no known historical records of wood storks occurring on the VEGP site (Southern 2006c; TRC 2006). The closest known colony is more than 40 km (25 mi) from the VEGP site. Although forage areas may be 60 to 70 km (37 to 43 mi) from the colony, 85 percent are within 19 km (12 mi) (Coulter and Bryan 1993). Suitable foraging habitat includes wetlands and open waters with low flow rates, depths less than 50 cm (20 in.), and reduced quantities of both submerged and emergent macrophytes. These habitats exist on the VEGP site, and wood storks have been seen within 3.2 km (2 mi) of the site in the Savannah

River Swamp. Foraging on the VEGP site appears possible from June to September in wetland areas along stream drainages, man-made ponds, drainage ditches, and the wetlands along the Savannah River.

Proposed 500-kV Transmission Line

Wood storks have the potential to occur in Burke and Jefferson Counties (FWS 2004). There are no known nesting colonies in these counties and there are no documented occurrences of wood storks in the vicinity of the proposed RDC (GDNR 2007a). Wood storks have been seen foraging on Fort Gordon in Richmond County (Mitchell 1999). However, it is unknown how close this foraging activity is to the RDC. Wood storks have the potential to forage within the RDC.

Flatwoods Salamander – Threatened

The flatwoods salamander (*Ambystoma cingulatum*) was listed by FWS as threatened in 1999 (64 FR 15691). The historical range of the flatwoods salamander included parts of the states of Alabama, Florida, Georgia, and South Carolina that are in the lower Coastal Plain of the southeastern United States. Survey work completed since 1990 indicates that 51 populations of flatwoods salamanders are known from across the historical range. Most of these occur in Florida (36 populations or 71 percent). Eleven populations have been found in Georgia, four in South Carolina, and none have been found in Alabama. The last breeding record for Burke County was in the 1940s (FWS 2004). Critical habitat was proposed in February 2007 in Miller and Baker Counties, Georgia (72 FR 5856). These counties are over 290 km (180 mi) southeast of the VEGP site.

Adults and sub-adults are fossorial (dig and live underground), occur in open mesic pine forests, and are closely associated with pine/wiregrass habitats dominated by longleaf or slash pine maintained by frequent fire (Petranka 1998). During the breeding period, which coincides with heavy rains from October to December, these salamanders move to isolated, shallow, small, acidic, tannin-stained depressions (forested with emergent vegetation) that dry completely on a cyclic basis (ephemeral ponds) (72 FR 5856).

There are no recorded occurrences within 16 km (10 mi) of the VEGP site, no known historical occurrences on the site, and they were not identified in the 2005 threatened and endangered species survey (Southern 2006c, 2008a; TRC 2006; GDNR 2007a). Suitable habitat for the flatwoods salamander may occur onsite, but suitable habitat is not found within the construction area footprint for the proposed VEGP Units 3 and 4.

Proposed 500-kV Transmission Line

Flatwoods salamanders have the potential to occur in Burke County (FWS 2004). There are no documented occurrences of flatwoods salamander in the vicinity of the RDC (GDNR 2007a).

American Alligator – Threatened Based on Similarity of Appearance

In 1967, the American alligator (*Alligator mississippiensis*) was classified by FWS as endangered throughout its range, including Georgia. By 1987, following several reclassification actions in other states, it was reclassified to "threatened based on similarity of appearance" to the American crocodile in the remainder of its range, including Georgia (52 FR 21059). The alligator is no longer biologically imperiled in Georgia. Its populations are considered disjunct, limited to suitable habitat, and stable. The reclassification helps prevent excessive take of the alligator and protects the American crocodile (52 FR 21059).

During surveys of the VEGP site made by TRC in the summer of 2005, an alligator was observed in Mallard Pond (TRC 2006). Alligator habitat consists of swamps, marshes, ponds, lakes, and slow-moving streams and rivers. Alligators appear to be relatively common in the general vicinity of the site (Wike et al. 2006).

Proposed 500-kV Transmission Line

The American alligator has the potential to occur in suitable habitat within the RDC.

Canby's Dropwort – Endangered

Canby's dropwort (*Oxypolis canbyi*) was listed as endangered by FWS in 1986 (51 FR 6690). This species is native to the Coastal Plain from Delaware (historical only), Maryland, North Carolina, South Carolina, and Georgia. Historically, this plant was found in Burke, Dooly, Lee, and Sumter Counties in Georgia. There is no critical habitat designated for this species (FWS 1990a).

Canby's dropwort has been found in a variety of habitats, including ponds dominated by pond cypress *(Taxodium nutans)*, grass-sedge-dominated Carolina bays, wet pine savannahs, shallow pineland ponds, and cypress-pine swamps or sloughs. The largest and most vigorous populations occur in open bays or ponds, which are wet throughout most of the year and have little or no canopy cover. Sites occupied by this species generally have infrequent and shallow inundations (5 to 30 cm [2 to 12 in.]). The species' water requirements are narrow, with too little or too much water being detrimental (FWS 1990a). Suitable habitat is normally on a sandy loam or loam soil underlain by a clay layer, which along with the slight gradient of the areas, results in the retention of water. Known soil types that support populations of Canby's dropwort are Rembert loam, Portsmouth loam, McColl loam, Grady loam, Coxville fine sandy loam, and

Rains sandy loam. These soil types are similar in that they have a medium-to-high organic content, high water table, and are deep, poorly drained, and acidic (FWS 1990a). These soil types do not occur on the VEGP site. Soil types found on the VEGP site include soils in the Chastain-Tawcaw association; Lucy, Osier, and Bibb soils; Tawcaw-Shellbluff association; and Fuquay, Bonifay, and Troup series soils (NRCS 2003a). The soil types that would be impacted during construction include Lucy, Troup, and Tawcaw-Shellbluff (Figure 2-11). Lucy and Troup soils are deep, well-drained soils occurring in the upland (NRCS 1997, 2003b). The Tawcaw-Shellbluff soils occur in the Savannah River floodplain and are acidic, poorly drained, and deep (NRCS 2002, 2003c). Though the Savannah River Tawcaw-Shellbluff soils found on the VEGP site have characteristics similar to the soil types associated with Canby's dropwort, these areas are likely not suitable habitat because of the frequency and depth of inundations along the Savannah River.

Canby's dropwort has not been recorded within 16 km (10 mi) of the site. There are no known historical occurrences on the site, and it was not identified in the 2005 threatened and endangered species survey (Southern 2006c, 2008a; TRC 2006; GDNR 2007a). There are two historical records in Burke County around Waynesboro (51 FR 6690); these populations are currently thought to be extirpated (FWS 1990a). It is unlikely that suitable habitat for the Canby's dropwort is found in areas that would be disturbed by the construction of VEGP Units 3 and 4.

Proposed 500-kV Transmission Line

Canby's dropwort is listed as potentially occurring in Burke County (FWS 2004). However, there are no known populations within the RDC. The closest known population is approximately 5.6 km (3.5 mi) from the RDC in Burke County (GDNR 2007a).

Smooth Coneflower – Endangered

The smooth coneflower (*Echinacea laevigata*) was listed by FWS as endangered in 1992 (57 FR 46340). There are no known occurrences of smooth coneflower in Burke County (FWS 2004), no historical occurrences on the VEGP site, and it was not recorded in the 2005 threatened and endangered species survey (TRC 2006; Southern 2006c). It is known to occur in Stephens County, Georgia (Patrick et al. 1995), and is also found in Aiken and Barnwell Counties, South Carolina, more than 8 km (5 mi) from the VEGP site (SCDNR 2007a).

The smooth coneflower occurs in meadows and open woodlands on basic or near-neutral soils. These types of soils do not occur on the VEGP site. It is often found with eastern redcedar (*Juniperus virginiana*) or button snakeroot (*Eryngium yuccifolium*) (Patrick et al. 1995). Neither species is known to occur on the VEGP site (Southern 2007e), and it is unlikely that suitable habitat occurs onsite.

Proposed 500-kV Transmission Line

Smooth coneflower is not known to occur in any of the counties that may be crossed by the proposed 500-kV transmission line.

Relict Trillium – Endangered

The relict trillium (*Trillium reliquum*) was listed as endangered by FWS in 1988 (53 FR 10879). Populations of relict trillium are limited to portions of Georgia, South Carolina, and Alabama (FWS 1990b). In 1990, 14 known populations of this species occurred in Clay, Lee, Early, Talbot, Columbia, and Macon Counties, Georgia. Relict trillium is also known to occur in Aiken County, South Carolina, more than 16 km (10 mi) from the VEGP site (SCDNR 2007a).

There are no known occurrences of relict trillium in Burke County (FWS 2004), no historical occurrences on the VEGP site, and the relict trillium was not recorded in the 2005 threatened and endangered species survey (TRC 2006; Southern 2006c). Relict trillium is found primarily in moist hardwood forests that have had little or no disturbance in the recent past. The soils on which it grows vary from rocky clays to alluvial sands, but all exhibit high levels of organic matter in the upper soil layer. Most sites appear to be free from the influence of fire, both in the recent and distant past. Timber harvesting at the known sites has been limited to selective cutting. Relict trillium does, however, occur on less than optimum sites, such as power and sewer line rights-of-way, and can apparently become reestablished after intense disturbance to the habitat, such as agricultural activity (FWS 1990b).

The staff met with biologists from the GDNR in October 2006. Relict trillium GDNR staff told NRC staff that relict trillium had the potential to occur on the VEGP site in suitable habitat along the Savannah River (PNNL 2006). The forested bluff at the VEGP site provides suitable habitat. This bluff was surveyed during the seasonal field surveys conducted in 2005 and in 2007 (TRC 2006; Patrick 2007). The spring 2005 and 2007 surveys were conducted during the flowering period for relict trillium, which is best for positive identification of this species (Patrick et al. 1995) was a targeted species that received special attention during the surveys (Southern 2007c, Patrick 2007). Although suitable habitat for the relict trillium appears to exist within the construction footprint, this species was not been identified by the surveys, and it is unlikely that it would occur in the future.

Proposed 500-kV Transmission Line

Relict trillium is not known to occur in any of the counties that may be crossed by the proposed 500-kV transmission line.

Georgia Aster – Candidate

Georgia aster is a candidate for Federal listing (70 FR 24870). It is not known to occur in Burke County in the vicinity of the VEGP site.

Proposed 500-kV Transmission Line

Georgia aster is known to occur about 9.0 km (5.5 mi) from the RDC in McDuffie County, Georgia (GDNR 2007a). There are no known populations within the RDC (FWS 2004; GDNR 2007a). Historically, 97 populations of Georgia aster were known to exist; 34 of these have apparently been lost. The species appears to have been eliminated from Florida, one of the five states in which it originally occurred. It remains in 31 counties in North Carolina, South Carolina, Alabama, and Georgia (70 FR 24870).

Georgia aster is a relict species of post oak savannah/prairie communities that existed in the southeast before widespread fire suppression and the extirpation of large native grazing animals. Most populations are small, and since the species' main mode of reproduction is vegetative, each isolated population probably represents just a few genotypes (70 FR 24870).

Most remaining populations of this species survive adjacent to roads, railroads, utility rights-of-way, and other openings where land management mimics natural disturbance regimes. However, plants in such settings are inherently vulnerable to accidental destruction from herbicide application, road shoulder grading, and other maintenance activities. Many populations are threatened also by development (several are within planned residential subdivisions), highway expansion/improvement, and woody succession resulting from fire suppression (70 FR 24870).

2.7.1.3 Terrestrial Ecology Monitoring

The VEGP Units 1 and 2 Environmental Protection Plan, Appendix B to VEGP operating license nuclear power facility (NPF) 68 and NPF 81, Section 4.1, entitled "Unusual or Important Environmental Events" requires NRC notification of any unusual environmental events, including excessive bird mortality, on site plant or animal disease outbreaks and the mortality or unusual occurrence of any species protected by the Endangered Species Act (ESA) (NRC 1989). To date no reports to the NRC have been made.

Formal terrestrial ecological monitoring for threatened and endangered species was conducted on 675.4 ha (1669 ac) of the VEGP site in the spring, summer, and fall of 2005 by TRC (TRC 2006). These surveys were conducted to document the presence of Federal and State species of concern. Red-cockaded woodpeckers surveys were also conducted by GPC biologists in February 2006 (Southern 2007e).

Threatened and endangered species surveys are conducted prior to timber harvests or thinning. These surveys are conducted by GPC biologists using available county records maintained by the FWS and the GDNR, with field surveys used for verification. No threatened and endangered species were identified in any of these surveys from 2002 to 2005 (Southern 2007c).

Eco-Sciences made visits to the site in December 2006. The purpose of these visits was to delineate and describe the jurisdictional wetlands on the VEGP site (Southern 2007d). Descriptions of the various types of wetlands found on the VEGP site based on these visits are provided in Section 2.7.1.1.

Wetlands are considered an important habitat as defined in NUREG 1555 (NRC 2000). Besides wetlands, no other important habitats are known to occur on the VEGP site. Approximately 8.5 ha (21 ac) of wetlands would be disturbed by the construction of the proposed VEGP Units 3 and 4 and the associated facilities (Southern 2008b). If necessary, Southern would mitigate the disturbance or loss of wetlands based on USACE recommendations through the Clean Water Act 404 permitting process (Southern 2008a).

The wood stork is known to occur within 3.2 km (2 mi) of the VEGP site in the Savannah River Swamp on the Savannah River Site. Surveys were conducted for the wood stork in 2005 on 675.4 ha (1669 ac) of the VEGP site (TRC 2006). This species was not documented on the VEGP site during the surveys (TRC 2006). The wood stork may also occasionally use wetlands associated with stream drainages, man-made ponds, and areas along the Savannah River for foraging.

The VEGP site is approximately 16 km (10 mi) from the closest known active group of red-cockaded woodpeckers on the Savannah River Site (Wike et al. 2006). Surveys were conducted on the site for red-cockaded woodpeckers in February 2006 in support of a Safe Harbor Agreement, and in 2005 on 675.4 ha (1669 ac) of the site in support of this ESP application. However, the red-cockaded woodpecker has never been documented onsite (TRC 2006; Southern 2006c, 2007e). The types of habitat that would be disturbed during construction mainly consist of previously disturbed areas, planted pines, hardwoods, wetlands along the Savannah River, and open fields. Red-cockaded woodpeckers are found mainly in large stands of old longleaf pine. These habitats would not be impacted during construction, and the red-cockaded woodpecker is not likely to be found in the areas impacted by construction.

Relict trillium, smooth coneflower, Canby's dropwort, and the flatwoods salamander are not known to occur in the vicinity of the VEGP site. Surveys were conducted for these species in 2005 on 675.4 ha (1669 ac) of the site in support of this ESP application. However, they have not been documented onsite (TRC 2006). It is unlikely these species occur in the vicinity of the proposed construction footprint.

2.7.2 Aquatic Ecology

This section describes the aquatic environment and biota in the vicinity of the VEGP site and other areas likely to be impacted by the construction, operation, or maintenance of the proposed VEGP Units 3 and 4. It describes the spatial and temporal distribution, abundance, and other structural and functional 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 impacted by the proposed action.

The aquatic communities associated with the VEGP site include those of the Savannah River, as well as small streams and ponds located onsite. The VEGP site is bordered on the northeast by the Savannah River (Southern 2008a), which is the largest and most important aquatic resource in the vicinity of the plant. Other aquatic communities in the vicinity of the VEGP site include Beaverdam Creek, which drains Telfair Pond and is characterized as an impounded blackwater creek (Southern 2008a). Beaverdam Creek is located just south of the plant site. Two stormwater retention basins were built in the early stages of construction of VEGP Units 1 and 2 (Southern 2007c). Debris Basin #1, on the southeast side of the plant drains to Beaverdam Creek halfway between Telfair Pond and the Savannah River. Debris Basin #2 is located in the southwest corner of the site and drains via a small creek into Daniels Branch and then into Telfair Pond (Southern 2008a).

Mallard Pond, a man-made pond that was on the site before construction, is also characterized as an impounded blackwater creek; it is located just north of the new plant footprint. Mallard Pond is drained by a small, unnamed stream that flows into the Savannah River floodplain upstream of the proposed river intake structure. At least two beaver ponds are located on the stream below Mallard Pond (Southern 2007c). Another stream flowing out of the northwest corner of the site joins the unnamed stream flowing from Mallard Pond approximately one-third of the way to the Savannah River.

There are no sanctuaries or preserves that could be affected by the proposed action. The nearest managed area is the 3160-ha (7800-ac) Yuchi WMA, which is managed by GDNR for public hunting. The Yuchi WMA is located adjacent to the VEGP site (Southern 2008a). The northern edge of the Yuchi WMA lies on the southern shore of Beaverdam Creek (Figure 2-3) (Southern 2008a).

2.7.2.1 Aquatic Communities of the VEGP Site

Onsite Ponds and Streams

The stormwater retention ponds were created in the early stages of the construction of VEGP Units 1 and 2. The ponds were built to provide sediment retention for stormwater before discharge to Beaverdam Creek. Over the years both ponds have developed distinct wetland

characteristics. No analyses have been performed of the aquatic biota of these ponds or various small drainages on the property (Southern 2007c)

No analyses of the aquatic communities of Mallard Pond or of its drainage have been performed (Southern 2008a).

Three studies were conducted on the aquatic ecology of Beaverdam Creek to look at the effects of construction of the site. From March 1977 to May 1978, a study was conducted to determine the extent of use of Beaverdam Creek by anadromous fishes for spawning and the effects of construction on spawning (Wiltz 1982a). Eggs and adults were collected in gill net, hoop net, and larval drift surveys. A total of 674 individual fish (including eggs and larvae) from 29 species were collected. The study concluded that Beaverdam Creek was a minor contributor with respect to spawning of blueback herring (*Alosa aestivalis*). Although the habitat was suitable for hickory shad (*A. mediocris*), only 17 individuals were found, and none were observed spawning (Wiltz 1982a).

A second study by Wiltz on Beaver Creek conducted from 1977 to 1978 evaluated the potential effects of siltation and sedimentation on resident fish populations during construction of VEGP Units 1 and 2. A total of 2435 fish representing 39 species were collected in the study. Collections were dominated by minnows, sunfish, and darters. Dusky shiners (*Notropis cummingsae*), bluegill (*Lepomis macrochirus*), mosquitofish (*Gambusia affinis*), and blackbanded darter (*Percina nigrofasciata*) were the species most often collected. Collectively these four species made up 68 percent of all fish collected during the study. The Savannah darter (*Etheostoma fricksium*) was also observed in smaller numbers (31 individuals, collected over a 2-year period). This species has since been listed as a "species of concern" by the State of Georgia. The study concluded that siltation was not a factor influencing the resident fish population in Beaverdam Creek. Turbidity and runoff decreased quickly after heavy rainfall. The only increase in turbidity was caused by transmission line right-of-way construction and logging operations adjacent to the VEGP site property (Wiltz 1982b).

A third study (Staats 1983) looked at the macroinvertebrate populations of Beaverdam Creek between 1973 and 1978. The purpose of the study was to determine the possible environmental effects of plant construction (erosion and siltation) on the aquatic macroinvertebrate community inhabiting Beaverdam Creek. It was concluded that species composition at the altered stations (those affected by access road construction) were similar to the control stations throughout the study indicating that plant construction had little or no effect on the macroinvertebrate fauna of Beaverdam Creek. Species compositions at the altered stations recovered from the construction and there was no long-term impact to the macroinvertebrate population.

No further analyses of biotic communities have been conducted on Beaverdam Creek since the late 1970s.

Savannah River

The VEGP site is located on the Savannah River from rkm 241 to 244 (RM 150 to 152). This area is within the middle Savannah River (defined as occurring from the Fall Line, which is at rkm 355 (RM 220) downstream to the mouth of the Brier Creek, (rkm 156 [RM 97])(Marcy et al. 2005). The middle reach of the Savannah River is typical of other southeastern river basins. It is home to a diverse fish fauna, and like other southeastern rivers, its watershed is increasingly affected by the region's growing human population. The Savannah River has several habitat types that are used by the fish populations, including the main river channel, cutoff bends or "dead rivers," swampy habitats (such as habitats located in Phinezy Swamp, adjacent to Augusta, or on the Savannah River Site), floodplains (such as in the area of the proposed intake structure), and streams or tributaries that empty into the river (Marcy et al. 2005).

The potential for impacts from operation of the proposed VEGP Units 3 and 4 to aquatic biota would be primarily to organisms inhabiting the Savannah River. The aquatic species include attached algae and aquatic macrophytes, diatoms, benthic macroinvertebrates (including mussels, clams, aquatic insects), and fish. The aquatic communities of the Savannah River adjacent to the VEGP site has been well studied because of the location of the Savannah River Site immediately across the river.

The Academy of Natural Sciences of Philadelphia (ANSP) has conducted biological and water-quality studies of this area of the Savannah River since 1951 for the purpose of assessing potential effects of the Savannah River Site on the aquatic communities in the Savannah River. Within this study area, the ANSP has also conducted studies starting in 1985 in the vicinity of the VEGP site at rkm 243.3 (RM 151.2) the approximate location of the proposed intake structure for the proposed VEGP Units 3 and 4, and rkm 241.1 (RM 149.8) approximately 1.6 km (1 mi) downstream from the VEGP site (ANSP 2003). The surveys at the VEGP site sampling stations were conducted to assess potential impacts of the VEGP site so that these impacts could be separated from potential impacts from the Savannah River Site (ANSP 2003). Since 1985, studies occurred approximately every 2 years through 1996. Aquatic organisms studied by the ANSP included diatoms, attached algae, and aquatic plants, non-insect macroinvertebrates (sponges, worms, molluscs, snails, crustaceans, mites, and leeches), aquatic insects and fish. Starting in 1997, sampling at the station located adjacent to the VEGP site, rkm 243.3 (RM 151.2) was limited to diatom surveys only (ANSP 2003), although a mussel survey also occurred at the VEGP sites in 1998 (ANSP 2003). The sampling was also scaled back for the station at rkm 241 (RM 149.8), downstream from the VEGP site at rkm 241 (RM 149.8). Diatometer sampling and analysis was included for this station through 2003 (ANSP 2003, 2005). Non-insect macro-invertebrate, insect macroinvertebrates, and fish surveys were conducted into 2001; however, with the exception of the mussel survey that was reported, the results of the other surveys were archived for future reference without being analyzed and reported. Starting in 2003, only diatom sampling results were reported by the ANSP.

Attached Algae and Aquatic Macrophytes

The ANSP qualitatively sampled attached algae and aquatic macrophytes. The algal flora was found to be similar at all four stations (the reference station upstream of the Savannah River Site and three stations downstream of the VEGP site and potentially impacted by the Savannah River Site). There was evidence of nutrient enrichment at all stations, apparently attributable to sources upstream from the study site. No significant beds of submerged aquatic vegetation were observed in this reach of the river (ANSP 2003).

Diatoms

Studies by the ANSP since 1951 included an investigation of diatom diversity, richness and evenness as a measure of water quality in the river. The studies involved comparing diatom assemblages grown on artificial substrates at a reference station with those found at the Savannah River Site stations below the VEGP site and farther down river below the Savannah River Site. Historically, the most abundant species of diatoms (especially *Gomphonema parvulum* and *Melosira varians)* have wide ecological tolerances and adjust to a range of conditions. However, these species are not usually indicative of severe conditions. The composition and tolerances of diatom species in the Savannah River above and below the Savannah River Site were similar during the 2001 study (ANSP 2003). Most of the dominant species observed in the 2001 study were similar to those found in previous studies and are characteristic of alkaline, nutrient-enriched waters. The differences in distribution patterns that were observed for the relative abundance of dominant species were seasonal rather than spatial and, thus, were not related to the operation of the Savannah River Site or the existing VEGP Units 1 and 2. However, the reference station located above the Savannah River Site, showed higher species-richness rank, lower dominance rank and higher diversity rank than the other stations, although there was no corresponding pattern in ecological or pollution tolerances of the dominant species, which made the evidence unclear regarding a potential Savannah River Site impact on water-quality parameters to which the diatoms would be most sensitive (ANSP 2003).

Aquatic Insects

The ANSP studied the species composition of insect fauna. The most species-rich group was the dipterans (47 taxa, mainly from the family Chironomidae), beetles (28 taxa), dragonflies and damselflies (15 taxa), mayflies (17 taxa) and caddisflies (14 taxa). Species richness in 2001 was similar to that from the studies of previous years. Overall, the results of the 2001 aquatic insect study (ANSP 2003) suggest that the differences detected among sites reflects the natural spatial variation found in all rivers and streams. The results of the statistical analysis between stations indicate that the condition of the aquatic insect assemblages at the stations exposed to the Savannah River Site tend to be as good as, or superior to, the condition at the reference sites (located upstream of the Savannah River Site and VEGP site). The same conclusion was demonstrated by the results of the 1999 study and the 2000 study (ANSP 2003).

Affected Environment

Molluscs

Molluscs found in the vicinity of the VEGP site include snails and bivalves such as Asiatic clams, fingernail clams, pea clams, and mussels (ANSP 2003). Sixteen species of mussels have been identified from the surveys conducted by the ANSP between 1951 and 2001. The introduced Asiatic clam (*Corbicula fluminea*) was abundant in a variety of substrates at all collection stations (silts and mud to fine- through coarse-grained sands) and numerically dominated the benthic habitat of the Savannah River, composing between 96 to 98 percent of the bivalves taken in sieve studies (ANSP 2001). ANSP 2001 reported that the mussel fauna has changed since the early 1951 to 1968 studies when the yellow lamp mussel (*Lampsilis cariosa*), eastern elliptio (*Elliptio complanata*), Carolina slabshell (*E. congarea*), Atlantic spike (*E. producta*), variable spike (*E. icterina*), and rayed pink fatmucket (*L. splendida*) were all listed as the most abundant species. In 1961, an "almost uniform distribution" of mussels "...from juveniles through old adults (over 8 years of age)" was reported. Reduced numbers of juvenile mussels have commonly been reported since the early 1960s. Slightly lower numbers of species were identified in the 2001 studies (ANSP 2003), which appears to be a continuation of the trend that began in 1999 and is thought to reflect drought conditions in the basin and lower flows in the Savannah River during the years since June 1998. Although the results produced fewer taxa than other recent studies (1993 to 1999), the numbers fell within the long-term trends of 1972 to 2000. The 2001 study results did not indicate an impact from the Savannah River Site (ANSP 2003).

A recent survey of freshwater mussels was conducted in late 2006 on the Savannah River for the U.S. Fish and Wildlife Service (The Catena Group 2007). The survey encompassed stretches of the Savannah River between rkm 36.7 (RM 22.8) and rkm 327 (RM 203). The closest sampling points to the VEGP site were located at rkm 200 (RM 124.3) (42 km [26 mi] downstream of the VEGP site) and rkm 273 (RM 169.6) (29 km [18 mi] upstream of the VEGP site). A total of 26 freshwater mussels were identified during the survey, including eight mussels that are considered state-endangered, state-threatened, or state species of concern. The Asiatic clam was found at all the sites and was the most abundant species.

Fish

Numerous studies have been performed on the fish located in the middle Savannah River. The most comprehensive studies include Bennett and McFarlane (1983) (written to provide background information for biologists initiating ichthyofaunal studies on the Savannah River Site), Specht (1987) (the Comprehensive Cooling Water Study initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant); Marcy et al. (2005); and the series of studies performed by the ANSP, including the two most recent studies (ANSP 2001, 2003).

Marcy et al. (2005) indicates that 95 species of fish are found in the middle Savannah River, including 82 native species and 13 introduced species. The fishes of the middle Savannah River can be grouped into four groups: (1) resident freshwater fish (found in the area year-around), (2) diadromous species (present during seasonal migrations), (3) marine/estuarine species (sometimes found in the river upstream of the saltwater-freshwater interface) and (4) upland species (typically found above the fall line). A listing of the native resident diadromous, marine and upland fish species of the middle Savannah River (as taken from Marcy et al. 2005) is given in Table 2-7. Table 2-8 contains a list of the introduced species in the middle Savannah River.

The ANSP conducted assessments of the fish assemblages in the vicinity of the Savannah River Site since 1951, between rkm 259 and rkm 196 (RM 161 and RM 122). Until 1997, these assessments also included comprehensive studies at sampling sites in the Savannah River between along the Savannah River Site, cursory studies in the Savannah River in the vicinity of the Savannah River Site, and independent monitoring of locations near the VEGP site. Comprehensive studies included a twice-per-year assessment every 4 to 5 years at four stations. The cursory studies were annual assessments at three of four stations. Studies in the vicinity of the VEGP site, which included the same components as the comprehensive surveys but different sampling locations, were initiated in 1985 to assess the potential impacts from VEGP Units 1 and 2, so they could be separated from potential Savannah River Site impacts.

Table 2-7. Native, Resident, Diadromous, Marine, and Upland Fish Species of the Middle Savannah River (as taken from Marcy et al. 2005 and presented in phylogenetic order)

Scientific Family	**Common Name**	**Scientific Name**
Resident Species		
Lepisosteidae (gars)	longnose gar	*Lepisosteus osseus*
	Florida gar	*Lepisosteus platyrhincus*
Amiidae (bowfins)	bowfin	*Amia calva*
Clupeidae (herring & shad)	gizzard shad	*Dorosoma cepedianum*
Cyprinidae (minnows)	bannerfin shiner	*Cyprinella leedsi*
	whitefin shiner	*Cyprinella nivea*
	eastern silvery minnow	*Hybognathus regius*
	rosyface chub	*Hybopsis rubrifrons*
	bluehead chub	*Nocomis leptocephalus*
	golden shiner	*Notemigonus crysoleucas*
	ironcolor shiner	*Notropis chalybaeus*
	dusky shiner	*Notropis cummingsae*
	spottail shiner	*Notropis hudsonius*
	yellowfin shiner	*Notropis lutipinnis*
	taillight shiner	*Notropis maculatus*

Table 2-7. (contd)

Scientific Family	Common Name	Scientific Name
	coastal shiner	*Notropis petersoni*
	pugnose shiner	*Opsopoeodus emiliae*
	lowland shiner	*Pteronotropis stonei*
	creek chub	*Semotilus atromaculatus*
Catostomidae (suckers)	quillback	*Carpiodes cyprinus*
	highfin carpsucker	*Carpiodes velifer*
	creek chubsucker	*Erimyzon oblongus*
	lake chubsucker	*Erimyzon sucetta*
	northern hogsucker	*Hypentelium nigricans*
	spotted sucker	*Minytrema melanops*
	notchlip redhorse	*Moxostoma collapsum*
	robust redhorse	*Moxostoma robustum*
	brassy jumprock	*Scartomyzon* sp. cf. *lachneri*
Ictaluridae (bullheads & catfish)	snail bullhead	*Ameiurus brunneus*
	white catfish	*Ameiurus catus*
	yellow bullhead	*Ameiurus natalis*
	brown bullhead	*Ameiurus nebulosus*
	flat bullhead	*Ameiurus platycephalus*
	tadpole madtom	*Noturus gyrinus*
	margined madtom	*Noturus insignis*
	speckled madtom	*Natures leptacanthus*
Esocidae (pikes & pickerels)	redfin pickerel	*Esox americanus*
	chain pickerel	*Esox niger*
Umbridae (mudminnows)	eastern mudminnow	*Umbra pygmaea*
Aphredoderidae (pirate perch)	pirate perch	*Aphredoderus sayanus*
Amblyopsidae (cave fish)	swampfish	*Chologaster cornuta*
Fundulidae (top minnows)	golden topminnow	*Fundulus chrysotus*
	lined topminnow	*Fundulus lineolatus*
Poeciliidae (live bearers)	eastern mosquitofish	*Gambusia holbrooki*
Atherinopsidae (new world silversides)	brook silverside	*Labidesthes sicculus*
Centrarchidae (sunfish)	mud sunfish	*Acantharchus pomotis*
	flier	*Centrarchus macropterus*
	blackbanded sunfish	*Enneacanthus chaetodon*
	bluespotted sunfish	*Enneacanthus gloriosus*
	banded sunfish	*Enneacanthus obesus*
	redbreast sunfish	*Lepomis auritus*
	pumpkinseed	*Lepomis gibbosus*
	warmouth	*Lepomis gulosus*
	bluegill	*Lepomis macrochirus*

Table 2-7. (contd)

Scientific Family	Common Name	Scientific Name
	dollar sunfish	*Lepomis marginatus*
	redear sunfish	*Lepomis microlophus*
	spotted sunfish	*Lepomis punctatus*
	largemouth bass	*Micropterus salmoides*
	black crappie	*Pomoxis nigromaculatus*
Elassomatidae (pygmy sunfish)	everglades pygmy sunfish	*Elassoma evergladei*
	bluebarred pygmy sunfish	*Elassoma okatie*
	banded pigmy sunfish	*Elassoma zonatum*
Percidae (darters & perch)	Savannah darter	*Etheostoma fricksium*
	swamp darter	*Etheostoma fusiforme*
	christmas darter	*Etheostoma hopkinsi*
	turquoise darter	*Etheostoma inscriptum*
	tessellated darter	*Etheostoma olmstedi*
	sawcheek darter	*Etheostoma serrifer*
	blackbanded darter	*Percina nigrofasciata*
Diadromous species		
Acipenseridae (sturgeon)	shortnose sturgeon	*Acipenser brevirostrum*
	Atlantic sturgeon	*Acipenser oxyrinchus*
Anguillidae (eels)	American eel	*Anguilla rostrata*
Clupeidae (herrings & shads)	blueback herring	*Alosa aestivalis*
	hickory shad	*Alosa mediocris*
	American shad	*Alosa sapidissima*
Moronidae (temperate bass)	striped bass	*Morone saxatilis*
Marine/Estuarine Species		
Megalopidae (tarpons)	tarpon	*Megalops atlanticus*
Belonidae (needle fish)	Atlantic needlefish	*Strongylura marina*
Mugilidae (mullets)	mountain mullet	*Agonostomus monticola*
	striped mullet	*Mugil cephalus*
Achiridae (new world soles)	hogchoker	*Trinectes maculatus*
Upland Species		
	redeye bass[(a)]	*Micropterus coosae*

(a) The Savannah River is the only area of the redeye bass's range where it occurs below the Fall Line

Table 2-8. Introduced Fish Species in the Middle Savannah River Basin and their Status (as taken from Marcy et al. 2005)

Scientific Family	Common Name	Scientific Name
Clearly established		
Clupeidae (herrings & shads)	threadfin shad	*Dorosoma petenense*
Cyprinidae (carps & minnows)	common carp	*Cyprinus carpio*
Ictaluridae (bullhead & catfish)	channel catfish	*Ictalurus punctatus*
Percidae (perch and darters)	yellow perch	*Perca flavescens*
Rare and possibly not established		
Cyprinidae (carps & minnows)	goldfish	*Carassius auratus*
Moronidae (temperate bass)	white perch	*Morone americana*
	white bass	*Morone chrysops*
Centrarchidae (sunfish)	green sunfish	*Lepomis cyanellus*
	white crappie	*Pomoxis annularis*
Clearly not established		
Cyprinidae (carps & minnows)	grass carp	*Ctenopharyngodon idella*
Salmonidae (salmon)	rainbow trout	*Oncorhynchus mykiss*
Too little information		
Ictaluridae (bullhead & catfish)	blue catfish	*Ictalurus furcatus*
	flathead catfish	*Pylodictis olivaris*

The location of the sampling sites were rkm 243 (RM 151.2) and a downstream station, located approximately 1.6 km (1.0 mi) below the VEGP cooling water discharge at rkm 241 (RM 149.8). The last post-larval studies of fish in the vicinity of the VEGP site were conducted in 1996. However, sampling at a location immediately downstream from the VEGP site, rkm 241 (RM 149.8) continued up to 2001, although the data for the 2001 study were collected but not analyzed. Data collected up to 2001 from study sites at 257 rkm (RM 160) and rkm 196 to 198 (RM 122 to 123) were analyzed and reported (ANSP 2003).

The latest fish survey performed by ANSP at rkm 196 to 198 (RM 122 to 123) and rkm 267 (RM 166) was in the fall of 2001. In total, 3951 specimens of 48 species of fish were collected in 2001, including a single southern flounder (*Paralichthys lethostigma*) (ANSP 2003). The most common species were the spottail shiner (*Notropis hudsonius*) (24.4 percent of the total fish), followed by the taillight shiner (*N. maculatus*) (19.5 percent of the total number of fish). The bluegill (*Lepomis macrochirus*), bannerfin shiner (*Cyprinella leedsi*), and whitefin shiner (*C. nivea*) were also common. Together 75 percent of the total catch was composed of these five taxa (assuming that the unidentified minnows were from the genus *Cyprinella*) (ANSP 2003). The 2000 ANSP Savannah River survey, which included a site at rkm 241 (RM 149.8), captured a total of 4599 individuals of 50 species of fish. Again the spottail shiner was the most abundant (36.5 percent of the total number of fish), followed by the bannerfin shiner (11.7 percent of the total number of fish). The bluegill, whitefin shiner, and brook silverside (*Labidesthes sicculus*) were also common. Together 74 percent of the total catch was composed of these five species (plus the unidentified minnows of the genus *Cyprinella*) (ANSP 2001).

Results from the 2001 ANSP study indicated that species richness was significantly higher at the sampling location farther downstream than at the sampling location upstream. However, neither species diversity nor the densities of common species differed significantly between stations (ANSP 2003). In general, the studies performed by the ANSP showed greater temporal variation in fish assemblages than spatial variation within the study sites (ANSP 2003).

Ichthyoplankton studies from the Savannah River Site in 1984-1985 showed that larval densities in the oxbows (all of which were connected to the river at both ends but with current velocities usually too low to measure) were significantly greater than in the river, suggesting that oxbows may be important spawning areas. Species composition in the oxbows were dominated by gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*D. petenense*). The dominant ichthyoplankton in the river was the American shad (*Alosa sapidissima*) although gizzard shad, threadfin shad and crappie were also abundant (Specht 1987). Studies of the vertical distribution of larvae in the river showed an absence of significant differences between top and bottom samples at all but one transect site. Egg densities, however, exhibited significant differences between top and bottom at over half the transect sites. In all cases the bottom densities were higher than the top densities (Paller et al. 1986).

Important Species

A number of important species of fish occur within the Savannah River. The NRC (NRC 2000) defines "important" aquatic species as "rare" species that are Federally listed as threatened or endangered, proposed for Federal listing or a candidate for Federal listing; listed as threatened, endangered or other species of concern by the State or States in which the proposed facilities are located; commercially or recreationally valuable; and species that are either essential to the maintenance and survival of species that are rare, commercially or recreationally valuable; critical to the structure and function of the aquatic ecosystem; or could serve as biological indicators of the aquatic environment.

Commercially Important Fisheries

Commercial fisheries allowed on the middle Savannah River include American shad (*Alosa sapidissima*), channel catfish (*Ictalurus punctatus*) (Halverson et al. 1997), white catfish (*Ameiurus catus*) (Marcy et al. 2005), and American eels (*Anguilla rostrata*) (GDNR 2007d). These species are fished commercially primarily by non-professional, local fishermen. Previously, a fishery existed for Atlantic sturgeon (*Acipenser oxyrinchus*); however, all Atlantic coastal states have enacted a closure or moratorium on the harvest of Atlantic sturgeon. There is a commercial blueback herring (*Alosa aestivalis*) fishery on the South Carolina portions of the Savannah River (SCDNR 2007b), but no herring are taken in Georgia because of netting restrictions (Marcy et al. 2005; Halverson et al. 1997). Historically, the commercial landing data indicated that the commercial fishery for catfish was significantly smaller than the fishery for American shad. For this reason, the catfish fishery is not discussed further.

American Shad (*Alosa sapidissima*)

American shad are anadromous; the adults are marine fish and come into the Savannah River to spawn. They rarely appear in brackish estuaries and freshwater outside of the spawning season. Spawning usually occurs at night and may occur anywhere in a river, but the most frequented sites have flats or shallow water. Eggs hatch in 71 to 86 hours and are demersal (they sink) or pelagic (they stay in the water column). Eggs may travel 1.6 to 6.4 km (1 to 4 mi) from the point where they are broadcast. Larvae are carried downstream to the estuary (Meyer et al. 2003) and juveniles remain in the freshwater until temperatures decline in late fall (Marcy et al. 2005). Specht (1987) reported that American shad were the dominant taxa in the ichthyoplankton assemblage (primarily as eggs) in the river. They were not as abundant in the oxbows, creeks or intake canals on the Savannah River Site indicating that the primary location for spawning was the river. Bailey et al. (2004) estimated the population size of American shad that reached the New Savannah Bluff Lock and Dam (located approximately 56 km [35 mi] upstream of the VEGP site) at 158,000 in 2001 and 217,000 in 2002. These numbers suggest a substantial numbers of American shad pass by the VEGP site during their annual spawning runs.

The Savannah River has supported the third largest commercial river-specific shad fishery in South Carolina since 1979. Fishermen from both Georgia and South Carolina catch shad in the Savannah River. Commercial landings of American shad from the Savannah River between 2000 and 2005 ranged between 2882 kg (6353 lbs) for 2002 and 9787 kg (21,576 lbs) for 2005, for both South Carolina and Georgia. This has dropped significantly from the early 1980s when estimates of between 39,000 kg (86,000 lbs) and 139,000 kg (306,000 lbs) were recorded (ASMFC 2007). The total monetary value for the years 2000 to 2003 ranged from $21,000 to $32,000 (NMFS 2007).

American Eel (*Anguilla rostrata*)

In 2004, a petition was filed with FWS and the National Oceanic and Atmospheric Administration (NOAA) to list the American eel as an endangered species (McCord 2004). The FWS initiated a status review in 2005, and in 2007, determined that listing the American eel as threatened and endangered is not warranted (72 FR 4967). Although the American eel has not been listed at either the State or Federal level, there is widespread concern about the declines in its numbers across the eastern seaboard. The Atlantic States Marine Fisheries Commission (ASMFC) instigated the development of an American Eel Interstate Fishery Management Plan, which was published in 2000. Eels have been captured upstream and downstream of the VEGP site in the Savannah River and its tributaries (Marcy et al. 2005). It is legal to fish commercially for eels in Georgia and in South Carolina. However, in 2006, the ASMFC approved a mandatory catch and effort monitoring program for the American eel, which would help determine whether the population is declining (ASMFC 2006).

American eels are catadromous, living for several years in freshwater until it is time to spawn. All American eels from North America form a single spawning population, with all sexually mature eels moving to the Sargasso Sea in the Atlantic Ocean during the fall and winter to spawn before they die. Newly hatched eels (leptocephali) drift in ocean currents toward the Atlantic coast where they begin to metamorphose into glass eels (McCord 2004). Glass eels actively move toward freshwater sources and may actually move into rivers (ASMFC 2000) during winter and spring while they are still age 0. After they reach freshwater, the glass eels become pigmented and metamorphose into elvers. At this point in their lives, they are generally about 10 cm (4 in.) long. Some elvers continue to migrate upstream, burrowing in soft river bottoms or deep water during the day and moving about at night (ASMFC 2000). Elvers mature into yellow eels around age 2. Female yellow eels may continue to migrate upstream or establish home ranges for several years, while males generally remain in brackish water and estuaries (McCord 2004). They are bottom dwellers and opportunistic feeders of both live and dead organisms, and inhabit a variety of habitats (ASMFC 2000). In the middle Savannah River, yellow eels prefer relatively shallow reaches with riffles, pools, and rocks (McCord 2004), but can survive drought and low-oxygen conditions for short periods of time.

Historically, the American eel constituted up to 25 percent of the fish biomass in eastern rivers (ASMFC 2000). Data on the number of eels caught per unit of effort indicate large localized declines in rivers across the Atlantic coast. Decline in population numbers may be occurring if the stock are overfished at various life stages anywhere in their range of occurrence, because eels are commercially caught as juveniles for fish farming and bait and as adults for human consumption or bait (ASMFC 2000; Haro et al. 2000). Other factors in their decline may be loss of spawning habitat or eggs because of seaweed harvesting in the Sargasso Sea, or loss of adult habitat in rivers and estuaries from dams, dredging, and wetland destruction (McCord 2004). Another possible factor in their decline is impingement and entrainment as they migrate past dams and water intakes (Haro et al. 2000). However, McFarlane et al. (1978) found only one eel impinged on water intake screens at the Savannah River Site in biweekly samples over a 10-month period in 1977.

Recreationally Important Fish

Sports fishermen are the principal consumers of river fishes in the middle Savannah River. The harvest includes mostly sunfish (*Lepomis* spp.) and crappie (*Pomoxis* spp.) (Halverson et al. 1997). Striped bass (*Morone saxatilis*), which is classified as a game fish in South Carolina and Georgia, is considered a favorite of fishermen in the region around Augusta. The staff recognizes that there are other species that are popular game fish (Halverson et al. 1997).

Striped Bass (*Morone saxatilis*)

The striped bass is considered anadromous (Meyer et al. 2003) and ascends rivers to spawn in fresh or brackish water in February through June and then seeks out cooler water for the

summer months. However, some reproducing landlocked and largely riverine populations exist (Marcy et al. 2005). Striped bass migrate upriver and into tributaries for spring spawning in March, April, and May (Marcy et al. 2005). Spawning occurs in strong currents of large rivers when the temperature is above 14.4°C (57.9°F) and in areas above the salt wedge of the estuary (Marcy et al. 2005). The eggs are semipelagic, and sufficient current is required to keep the eggs in the water column to allow them to hatch before sinking to the bottom (Marcy et al. 2005). Specific areas of the estuary near the mouth of the Savannah River (specifically the Back and Middle Rivers of the estuary and possibly the Front River) are considered the nursery areas (Meyer et al. 2003).

Before 1982, the major known spawning area for striped bass in the Savannah River was in the tidally influenced area 30 to 40 km (19 to 25 mi) upstream from the river mouth (Dudley et al. 1977). Data collected between 1983 and 1985 as part of an ichthyoplankton study for the Savannah River Site (Specht 1987) indicated a possible occurrence of an important spawning area in the region of rkm 228 (RM 141.7), downstream from the VEGP site (rkm 242.8 [RM 150.9]). Peaks in striped bass eggs and larvae also occurred at rkms 207, 249, and 267 (RMs 129, 155, and 166), both above and below the VEGP site, as reported by Paller et al. 1986.

The population of striped bass drastically declined in the 1980s throughout the species' range on the Atlantic coast. It is also thought that the Savannah River harbor modifications resulted in habitat alterations in the estuarine spawning grounds and contributed to the decline of the fishery in the Savannah River (GDNR 2007e; Reinert et al. 2005). The alterations changed the flow patterns of the river and increased the salinity levels in parts of the river that were vital for striped bass (GDNR 2007e). Because of the dramatic decreases in striped bass numbers in the river, a moratorium was placed on the harvest of striped bass in the Savannah River by the State of Georgia in 1988 and, subsequently, by the State of South Carolina in 1991. The moratorium affected the entire free-flowing portion of the river up to the New Savannah Bluff Lock and Dam near Augusta, Georgia (approximately rkm 312 [RM 194]) (Reinert et al. 2005). Restoration activities that began in the 1990s included environmental remediation that attempted to restore salinity and flow patterns, including cessation of the tide gate operation and closure of the diversion canal. Stock enhancement programs were also evaluated and optimized in the early 1990s (Reinert et al. 2005). The dramatic increase in the catch-per-unit effort of adult striped bass since 1990 is primarily the result of fish stocking, which made up at least 70 percent of the catch annually (Reinert et al. 2005). The increased numbers of striped bass were the result, in part, of a management program in the 1990s that included a mix of monitoring and intensive stocking efforts. The number of naturally reproducing striped bass remains low (GDNR 2007e). On October 1, 2005, the regulations were changed in both Georgia and South Carolina to allow limited harvest of striped bass and striped white bass hybrids (GDNR 2007e).

Testing of striped bass in the Savannah River has shown significant amounts of mercury in the fish. As a result, the GDNR has issued advice regarding the amount of fish that should be eaten by the general public (no more than one meal per month of striped bass that are 69 cm [27 in.] or greater in length) (GDNR 2007e).

Non-Native and Nuisance Species

According to the 1985 Final Environmental Impact Statement for VEGP Units 1 and 2, populations of the Asiatic clam were first discovered at or near the VEGP site in 1972 (NRC 1985). The Asiatic clam is an introduced species that was found in surveys by the ANSP to be abundant in a variety of substrates at all sampling stations both above and below the VEGP site, during sampling in the years 1997 to 2001 (ANSP 2003). The ANSP reported that the substrates where the Asiatic clam occurred ranged from silts and muds to fine- through coarse-grained sands, often containing leaf litter, leaf fragments, and sticks (ANSP 2003). According to the ANSP, the Asiatic clam first appeared in collections in 1972, and by 1976 it was present at all stations and appeared to be affecting the native mussel fauna. The survey at four stations in 2001 (40 quadrants) produced 1877 molluscs, 85.1 percent of which were Asiatic clams. Based on this data, the ANSP states that it is apparent that the introduced Asiatic clam numerically dominates the macrobenthic habitat of the Savannah River and because of its great numbers competes with the mussels for space and food resources (ANSP 2003).

Other introduced or non-native species occurring in the Savannah River include the following species that are clearly established: threadfin shad (*Dorosoma petenense*), common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), and yellow perch (*Perca flavescens*). Table 2-8 lists nine other introduced species that are not established or that are rare. None of the fish species are considered nuisance species (Marcy et al. 2005).

No invasive aquatic plant species have been noted in the aquatic environments at the VEGP site (Southern 2006d).

Critical Habitats

No critical habitat has been designated by the FWS or Essential Fish Habitat by the NMFS in the vicinity of the VEGP site (Southern 2008a; NMFS 2008).

State-Listed Species

This section describes Georgia and South Carolina State-listed and proposed threatened and endangered aquatic species in the vicinity of the site and along the transmission line rights-of-way. Federally and State-listed aquatic species that occur near the VEGP site are listed in Table 2-9. The State of Georgia lists the shortnose sturgeon (*Acipenser brevirostrum*) and the robust redhorse (*Moxostoma robustum*) as State-endangered. The shortnose sturgeon also is

Federally listed and is discussed in Section 2.7.2.2. The robust redhorse is not listed as occurring within Burke County; however, data show that it is present in the Savannah River near the VEGP site (Grabowski and Isely 2006).

The Atlantic pigtoe mussel, (*Fusconaia masoni)* is listed by the State of Georgia as state endangered and occurring within Burke County in the vicinity of the VEGP site. The Savannah lilliput (*Toxolasma pullus*) is considered threatened in Georgia but is not listed as occurring in Burke County. It is a species of concern in South Carolina and is one of the nine species of concern for the South Carolina county closest to the VEGP site.

Table 2-9. Federally and State-Listed (Georgia and South Carolina) Aquatic Species in the vicinity of the VEGP Site that are Endangered, Threatened, and Species of Concern

Scientific Name	Common Name	Federal Status[a]	Georgia State Status[b]	S. Carolina State Status[c]
Fish				
Acipenser brevirostrum	shortnose sturgeon	FE	SE	
Etheostoma fricksium	Savannah darter[d]		SC	
Moxostoma robustum	robust redhorse		SE	
Mussels				
Fusconaia masoni	Atlantic pigtoe		SE	
Anodonta couperiana	barrel floater			SC
Elliptio congaraea	Carolina slabshell			SC
Lampsilis cariosa	yellow lampmussel			SC
Lampsilis splendida	rayed pink fatmucket			SC
Pyganodon cataracta	eastern floater			SC
Toxolasma pullus	Savannah lilliput[e]		ST	SC
Utterbackia imbecillis	paper pondshell			SC
Villosa delumbis	eastern creekshell			SC
Villosa vibex	southern rainbow			SC

(a) Federal status rankings determined by the FWS under the Endangered Species Act, FE = Endangered.
(b) State status determined by the GDNR: SE = State Endangered, ST = State Threatened, SC = state species of concern (GDNR 2008).
(c) Species information provided by the SCDNR Natural Heritage Program SC = State Species of Concern (SCDNR 2008).
(e) Price 2007

Federally and State-listed species that occur in counties that are traversed by the proposed Thomson-Vogtle transmission line right-of-way are listed in Table 2-10. The shortnose sturgeon and the Atlantic pigtoe mussel are reported from counties crossed by the proposed transmission line. In addition the sandbar shiner, *Notoropis scepticus*, a Georgia State listed rare species is found in McDuffie county. Four species, the Savannah darter (*Etheostoma fricksium*), the ironcolor shiner (*Notropis chalybaeus*), the lowland shiner (*Pteronotropis stonei*), and the yellow lampmussel (*Lampsilis cariosa*) are considered species of special concern in the state of Georgia, are also included in Table 2-10, however, none of them have legal protected status.

Mussels Family Unionidae

The Atlantic pigtoe is Georgia State-listed as endangered for Burke County. It is found in unpolluted, fast-flowing water in coarse sand-gravel substrate (USACE 2006b). Surveys performed for the USFWS (The Catena Group 2007) identified four specimens that were tentatively identified as the Atlantic pigtoe. These specimens were located at rkm 326.4 and 326.7 (RM 202.8 and 203) (within the Augusta Shoals area), approximately 84 km (52 mi) upstream of the VEGP site. No sampling was conducted in the vicinity of the VEGP site. The ANSP monitored freshwater

Table 2-10. Listed Terrestrial and Aquatic Species in Georgia Counties Crossed by the Proposed New 500-kV Transmission Line Right-of-Way

Scientific Name	Common Name	Federal Status[a]	Georgia State Status[b]	Counties of Occurrence
Fish				
Acipenser brevirostrum	shortnose sturgeon	FE	SE	Burke
Etheostoma fricksium	Savannah darter[c]		SC	Burke
Notropis chalybaeus	ironcolor shiner[c]		SC	Jefferson
Notropis scepticus	sandbar shiner		SR	McDuffie
Pteronotropis stonei	lowland shiner[c]		SC	Jefferson
Mussels				
Fusconaia masoni	Atlantic pigtoe		SE	Burke, Jefferson, Warren
Lampsilis cariosa	yellow lampmussel[c]		SC	Jefferson

(a) Federal status rankings determined by the FWS under the Endangered Species Act, FE = Endangered, (FWS 2004).
(b) State status determined by the GDNR: SE = State Endangered, SR = State Rare, SC = State Species of Concern (GDNR 2008a, b, c, and d).
(c) The Savannah darter, ironcolor shiner, lowland shiner, and yellow lampmussel are Georgia State species of concern. They do not have legal protected status,

mussels in the vicinity of the VEGP site from 1951 to 2001. A total of 16 species of mussels were identified during comprehensive surveys (ANSP 2003). However, the Atlantic pigtoe was not identified during any of the ANSP studies as being found in the vicinity of the VEGP site.

South Carolina lists nine species of mussels as being species of concern in Barnwell County, South Carolina, which is directly across the river from the VEGP site. Eight of the nine species have been collected in the comprehensive surveys conducted by the ANSP of the Savannah River from 1951 to 2001 at multiple sampling locations. The barrel floater (*Anodonta couperiana*) was found as recently as the 1998 survey. The yellow lampmussel (*Lampsilis cariosa*), and the Eastern floater (*Pyganodon cataracta*) were found as recently as the 1999 sampling season. The Carolina slabshell (*Elliptio congaraea*), the rayed pink fatmucket (*L. splendida*), the paper pondshell (*Utterbackia imbecillis*), and the southern rainbow (*Villosa delumbis*) were found as recently as the 2001 sampling season. The ANSP reported in its 2001 study that the Carolina slabshell constituted 28.7 percent (35 individuals) of the mussels collected in 2001 (ANSP 2003). Yearly ranking of abundance from 1993 to 1999 collected by hand showed the Carolina slabshell to be one of the five most abundant mussel

species. The eastern floater, yellow lamp mussel, and barrel floater were the least abundant. The paper pondshell and rayed pink fatmucket were considered to be moderately abundant (ANSP 2003). Communications with the State of South Carolina identified a ninth mussel species of concern, the Savannah lilliput (*Toxolasma pullus*) (Price 2007). The Savannah lilliput was found in the vicinity of the VEGP site as recently as 2001 sampling season (ANSP 2003).

The surveys for the USFWS (The Catena Group 2007) also identified one individual Savannah lilliput at rkm 273 (RM 169.6), which is 32 km (20 mi) upstream of the VEGP site). They also identified the barrel floater from four sites in fairly low numbers, the Carolina slabshell at 33 sites, the yellow lampmussel at 12 sites, the rayed pink fatmucket at 17 sites, the eastern floater at six sites in low numbers, and the paper pondshell at two sites (the closest approximately 37 km [23 mi] from the VEGP site, also in low numbers (2 and 1 individuals, respectively) and the eastern creekshell at 18 sites, the closest at approximately 43 km (27 mi) from the VEGP site.

Robust Redhorse (*Moxostoma robustum)*

The robust redhorse is State-listed as endangered in Georgia, and although it is known to occur in the Savannah River, it is not listed as occurring in Burke County. Adult fish are approximately 63 cm (25 in) long and 4.1 kg (9 lbs) in weight, although some exceed 70 cm (27.5 in.) and weigh up to 8 kg (17.6 lbs) The size of the population in the Savannah River is unknown (Nichols 2003). The robust redhorse is a large riverine catostomid (sucker) whose taxonomy was in dispute until 1991 when it was collected from the Oconee River. The first documentation of a robust redhorse from the Savannah River occurred in 1997 when an adult specimen was collected near the VEGP site. Portions of the Savannah River were later surveyed for the robust redhorse. A population was found near Augusta and other surveys have discovered the robust redhorse from numerous locations between Augusta and U.S. Hwy 301 (rkm 191 [RM 119]) (Hendricks 2002). A radio-tagging study involving 17 wild adult robust redhorses from below the Lower Savannah Lock and Dam at rkm 301 (RM 187) demonstrated that some individuals moved as much as 195 km (121 mi) in the river away from their release sites. Overwintering fish dispersed along the length of the river down to rkm 90 (RM 56). Fish returned in the spring to spawn either at a mid-channel gravel bar at rkm 283.7 (RM 176.3), about 40 river kilometers (25 river miles) or to staging and holding areas immediately upstream or downstream of it. The eggs developed within the gravel and the larval fish remained there for approximately 7 days after hatching. Adult fish spent the remainder of the spring and early summer in the vicinity of their spawning grounds before dispersing downstream in late June and early July to their overwintering areas (Grabowski and Isely 2006). For the most part, the robust redhorse appeared to stay within the main channel. High-water events were the only times that radio-tagged fish were located outside the main river channel. In most cases they relocated to the floodplain immediately adjacent to the river channel (Grabowski and Isely 2006).

Robust redhorse larvae (13 to 20 mm [0.5 to 0.8 in.] in length) are capable of swimming speeds that range from 7 to 12 cm/s (0.25 to 0.4 ft per second) (Nichols 2003). Spawning occurs during late April through late May at temperatures ranging from 17 to 26.7°C (Marcy 2005. They exhibit avoidance behavior of high flow rates in laboratory systems (Nichols 2003).

The multi-agency Robust Redhorse Conservation Committee was formed in 1995 to investigate the decline of the species and to restore the species to a sustainable level without the need to be listed under the Federal Endangered Species Act (RRCC 2008).

2.7.2.2 Threatened and Endangered Aquatic Species

This section describes Federally listed threatened, endangered, and proposed aquatic species and designated and proposed critical habitats known to occur on or in the vicinity of the VEGP site. The only Federally listed aquatic species known to occur in the Savannah River in the vicinity of the VEGP site is the shortnose sturgeon (*Acipenser brevirostrum*) (NMFS 2006). There are no candidate species present or designated critical habitat. However, the Atlantic sturgeon (*A. oxyrinchus*) is considered a species of concern by NOAA. Species of concern are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future. Both the Atlantic sturgeon and the shortnose sturgeon are anadromous; that is, they ascend coastal rivers to spawn. More is known about the life history of the shortnose sturgeon than that of the Atlantic sturgeon in the southeastern United States (Collins and Smith 1997).

Shortnose Sturgeon (*Acipenser brevirostrum)*

The shortnose sturgeon is a member of the Family Acipenseridae, a long-lived group of ancient anadromous and freshwater fishes. The species is currently known by at least 19 distinct populations inhabiting 25 river systems ranging from New Brunswick, Canada, to northern Florida (NMFS 1998). The shortnose sturgeon was originally listed as an endangered species by the FWS on March 11, 1967, under the Endangered Species Preservation Act (32 FR 4001). The National Marine Fisheries Service (NMFS) assumed jurisdiction for the shortnose sturgeon in 1974.

Dadswell et al. (1984) provided a synopsis of biological data for the shortnose sturgeon. Juvenile shortnose sturgeon eat available benthic crustaceans or insects. Adult shortnose sturgeon, from freshwater portions of the Winyah Bay estuary in South Carolina, eat largely molluscs; however, crustaceans and aquatic insects were also observed as a food source.

The age at sexual maturity for shortnose sturgeon varies from the north to the south (Dadswell et al. 1984). Age of first maturation of males possibly occurs at 2 to 3 years old in Georgia. Females mature at age 6 or younger in Georgia. Temperature is probably the major factor governing spawning. All sources referenced by Dadswell et al. (1984) reported shortnose

sturgeon spawning to occur between 9° and 12°C (50°F and 54°F). Other factors influencing spawning are the occurrence of freshets (i.e., increased freshwater flow resulting from sudden rain or melting snow) and substrate characteristics. Spawning grounds were described as being in regions of fast flow (40 to 60 cm/s [1.3 to 2.0 ft/sec]) with gravel or rubble bottoms. The locations are generally well upriver of the summer foraging and nursery grounds (rkm 100 to 200 [RM 62 to 124]). Although inconsistent with oberservations from other spawning studies, Dadswell et al. (1984) cited unpublished data that reported that in South Carolina, spawning occurred in flooded, hardwood swamps along inland portions of the rivers (including the Savannah River) (Dadswell et al. 1984).

Shortnose sturgeon eggs are demersal and adhesive after fertilization, sinking quickly and adhering to sticks, stones, gravel and rubble on the stream bottom. Hatchlings (less than a day old) were rheotactic, photonegative, benthic, and vigorously sought cover. If they were denied cover, they exhibited vertical swim-up and drift behavior until cover was found. Older embryos (1 to 8 days old) exhibited the same behaviors as hatchlings, and when denied cover would search along the bottom until cover was found. Between 9 and 16 days old, the larvae left cover and were positively rheotactic and photopositive. Three-quarters of the larvae left the bottom cover and swam in the water column (Richmond and Kynard 1995).

A recent investigation was conducted to determine any differences in larval behavior resulting from latitudinal variation from shortnose sturgeon populations in the Connecticut River in Massachusetts and the populations in the Savannah River. Specific parameters investigated included habitat preference and dispersal and diel activity and timing for early life stages of shortnose sturgeon. Yolk sac larvae from both rivers preferred dark habitat and used rock cover. The use of cover decreased with age until Day 13, when all fish were foraging in the open, although they generally stayed near the bottom. The shortnose sturgeon larvae showed an ontogenic behavioral shift to preferring bright, open habitat. Both groups showed some downstream movement as yolk-sac larvae. The Savannah River shortnose sturgeon used rock cover less in the first few days after hatching. Fish continued a low-level of downstream movement for the whole larval period and as early juveniles. Laboratory studies by Parker (2007) showed that during the first 30 days, larvae consistently swam to a mean height of 67 to 117 cm (26.4 to 46.0 in.).

Shortnose sturgeon were discovered in the lower Savannah River in the late 1970s (Dadswell et al. 1984). From 1984 to 1992 more than 100,000 sturgeon (18 percent of which were tagged) were stocked in the Savannah River (Smith et al. 2001) by the Marine Resources Research Institute of South Carolina's Department of Natural Resources. Information collected during the stocking efforts in the Savannah River and shortly thereafter indicated that stocked juveniles comprised a minimum of 35.4 percent of the juvenile population in the lower river nursery area. Based on records of marked fish and results from double tagging studies, it was estimated that at least 37.7 percent of the adult population in the Savannah River during the 1997 to 2000 time frame was comprised of stocked fish. Population estimates indicate that the adult population is

increasing, but juveniles are still rare. Smith et al. (2001) attributed this to a recruitment bottleneck in the early life stages and in part because of water-quality degradation in the nursery habitat in the lower Savannah River (Smith et al. 2001). Collins et al. (2002) indicates the nursery habitat for juvenile shortnose sturgeon in the Savannah River is in the lower river approximately from rkm 31.5 (RM 19.6) to rkm 47.5 (RM 29.5), which is well distant from the VEGP site.

Shortnose sturgeon larvae were collected in the vicinity of the Savannah River Site during ichthyoplankton surveys conducted from 1982 to 1985. Differentiating shortnose sturgeon larvae from Atlantic sturgeon larvae can be difficult based on their similar appearance. However, a total of 12 of the 43 sturgeon larvae collected were identified as shortnose sturgeon. Four of the shortnose sturgeon larvae were taken from the river downstream from the VEGP site between rkm 128 and 193 (RM 79.9 and 120). The remaining eight shortnose sturgeon larvae were taken above the VEGP site between rkm 250 and rkm 269 (RM 155.4 and RM 166.6). The shortnose sturgeon larvae were taken during March and the Atlantic sturgeon larvae during April (Paller et al. 1986). Wike (1998) investigated the potential effect of increased Savannah River Site river water withdrawal (an additional 694 L/s [11,000 gpm] from the river) on the shortnose sturgeon population and concluded that the existing and proposed operations at Savannah River Site would not jeopardize the continued existence of the shortnose sturgeon in the Savannah River.

Collins and Smith (1993) captured 626 adult shortnose sturgeon in the Savannah River from 1984 to 1992. They found significantly more fish in the lower river between rkm 42 (RM 26) and rkm 75 (RM 47) than in the upper river between rkm 160 (RM 99) to rkm 299 (RM 186). Twenty-four adults shortnose sturgeon were implanted with radio transmitters. Telemetry data indicated that only a portion of the population participated in the upriver spawning migration. Migrating sturgeon began moving upriver in late January to mid-March traveling at speeds of up to 50 km (31 mi) per day. Hall et al. (1991) also performed telemetry studies to determine seasonal movements and habitat areas of adult and juvenile shortnose sturgeon. They reported upriver spawning migrations from mid-February to mid-March when temperatures ranged from 9 to 12°C (50 to 54°F). Migration rates were as high as 33 km (21 mi) per day.

The area near the VEGP site located at rkm 241 to 244 (RM 150 to 152), has not been identified as a known or suspected spawning site. Probable spawning sites were identified by monitoring the movement of adult shortnose sturgeon in the Savannah River. Hall et al. (1991) reported two areas, one downstream of the VEGP site (rkm 179 to 190 [RM 111 to 118]) and one upstream (rkm 275 to 278 [RM 171 to 172]) had repeatedly served as the destinations of migrating adult fish and were occupied for several days during the spawning season. Thus they were identified as probable spawning sites. Collins and Smith (1993) reported a probable spawning location between rkm 179 and 228 (RM 111 and 142). Figure 2-14 illustrates the location of the probable spawning sites for the shortnose sturgeon in relation to the VEGP site.

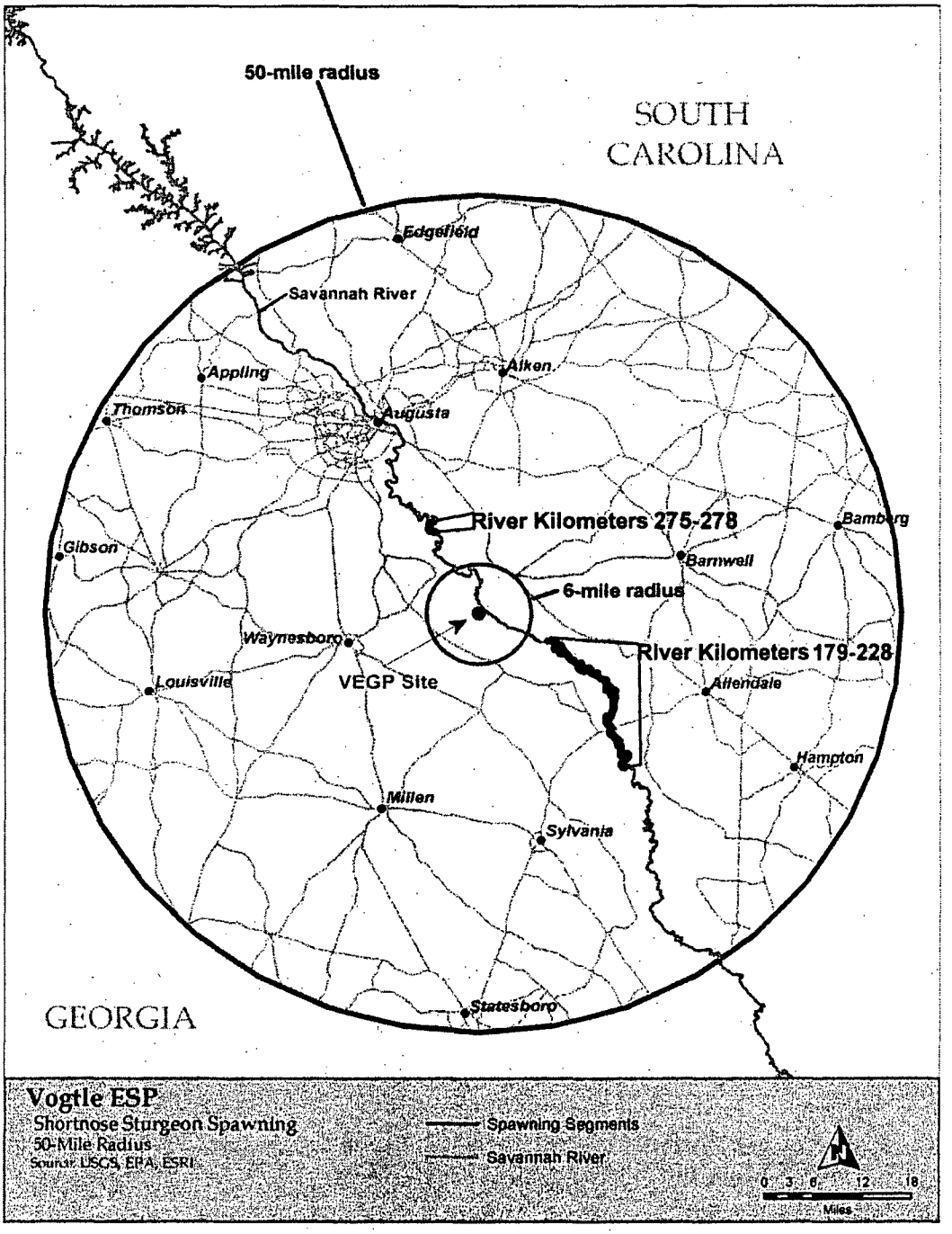

Figure 2-14. Shortnose Sturgeon Probable Spawning Within an 80 km (50 mi) Radius of the VEGP Site (based on data from Hall et al. 1991; Collins and Smith 1993)

Hall et al. (1991) described the environment at these two locations. They indicated that the substrate in the river bend portions of these locations was distinctly different from the other sections of the river. The sharp river bends were characterized by "...submerged timber, with scoured sand, clay, and gravel as substrate." The outside banks were hardpacked clay, which was scoured by the swift currents, preventing any sediment accumulation. Fish located in the spawning areas were always situated in the main channel. Hall reported that the maximum depths in the river bends of these two areas were 6 to 9 m (20 to 30 feet) and current velocities ranged from 52 to 104 cm/s (1.7 to 3.4 ft/s) at the surface. Bottom velocities during the spawning season averaged 82 cm/s (2.7 ft/s). Hall theorized that the sharp bends in certain sections of the Savannah River create the necessary velocity and turbulence for spawning. Substrate in the area provided suitable attachment for the highly adhesive eggs. Dadswell et al. (1984) and Buckley and Kynard (1985) had reported that spawning is usually associated with areas where the predominant substrate is composed of gravel, rubble, and cobble. Hall et al. (1991) indicated that their visual observations of the bend areas in the suspected spawning grounds in the Savannah River confirmed the presence of such materials. Collins and Smith (1993) also reported that the probable spawning areas contain sharp bends with strong currents, submerged timber, and a substrate of gravel, clay, and sand.

It is unlikely that spawning activity occurs in the vicinity of the VEGP site because the substrate, the depth and the sinuosity of the river is unlike the characteristics observed in the identified spawning areas.

2.7.2.3 Aquatic Ecology Monitoring

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

The NRC does not impose conditions of operation, including monitoring requirements, in the area of water quality. Regulation of water quality is implemented by an NPDES permit issued by the EPA or the states (in this case, Georgia). The NRC's role in water quality is limited to assessing aquatic impacts as part of its National Environmental Policy Act of 1969 (NEPA) evaluation.

The current NPDES permit does not require monitoring of aquatic ecological resources. There are no requirements in the license for the current VEGP Units 1 and 2 to do any monitoring of aquatic resources including specific aquatic ecological monitoring of the algal community, benthic invertebrates or fish. However, the VEGP Units 1 and 2 Environmental Protection Plan, Appendix B to VEGP operating licenses nuclear power facility (NPF) 68 and NPF 81, Section 4.1, entitled "Unusual or Important Environmental Events" requires NRC notification of any unusual environmental events, citing specific fish kills or impingement events at the plant. To date, no such report has been submitted for VEGP Units 1 and 2.

Affected Environment

Monitoring of the aquatic ecology in the Savannah River near the VEGP site was part of preconstruction monitoring for VEGP Units 1 and 2. Preconstruction monitoring of the fish population occurred in May and September of 1972 (AEC 1974). Sampling of benthic invertebrates occurred on October 1971, January 1972, and February 1972. Aquatic macrophytes were also surveyed in October 1972 (AEC 1974). Preoperational monitoring was conducted from October 1971 to November 1981. During this time GPC conducted various studies in the Savannah River in the vicinity of the VEGP site to obtain information on the species composition, trophic relationships, relative abundance, and the reproductive cycle of the aquatic community (NRC 1985). GPC conducted larval fish studies from January through August 1974 (Wiltz 1983), studies of adult fish from September 1977 through December 1978, feeding habit studies from October 1980 through September 1981 (Wiltz and Miracle 1982), macroinvertebrate drift studies in the Savannah River from September 1980 through August 1981 (Nichols 1983), and surveys of plankton from January 1981 through September 1981 (NRC 1985).

Southern initiated impingement monitoring at VEGP Units 1 and 2 in March 2008. The applicant is conducting 24-hour, bi-weekly (once every two weeks) impingement sampling at the VEGP Units 1 and 2 cooling water intake structure to identify and enumerate fish impingement rates (Southern 2008e). The impingement monitoring will be performed every 2 weeks for approximately one year. The sampling consists of two 12-hour sampling periods. As of May 23, 2008, 6 of the 24 impingement monitoring events had been completed. All fish and shellfish collected on the screens have been or will be identified and enumerated.

Entrainment monitoring of the VEGP Units 1 and 2 is also currently being conducted to estimate the species composition and density of ichthyoplankton entrained by the Units 1 and 2 cooling water withdrawals (Southern 2008e). The study began in spring 2008 and will be performed once every 2 weeks through June 2008 or longer if the water temperatures continue to be optimal for spawning. Sampling in the Savannah River upstream of the Units 1 and 2 intake canal is being conducted to provide site-specific background ichthyoplankton values. Ichthyoplankton samples are collected every 6 hours and composited into one 12-hour "day" and one 12-hour "night" sample.

The GPC also conducted studies to assess the effect of plant construction activities on the resident aquatic fauna of Beaverdam Creek. These studies began in July 1973 and continued during construction at approximately 6-week intervals from July 1973 to February 1975 and from May 1976 to June 1978. The purpose of the study was to determine the environmental effects of plant construction (erosion and siltation) on the aquatic macro-invertebrate community in Beaverdam Creek. The effects of siltation from access road construction and other land grading activities were also examined. The results of the study showed that plant construction had little or no impact on the aquatic macroinvertebrate fauna of Beaverdam Creek (Staats 1983). Species composition at stations that were affected by access road construction became

increasingly similar to those of control stations within approximately a year and a half after the construction.

Two other studies evaluated the fish located in Beaverdam Creek. The first study investigated the potential for anadromous fish to spawn in Beaverdam Creek (Wiltz 1982a). The only anadromous species they found was the blueback herring, although the creek is also suitable for hickory shad. The second study examined the potential effects of siltation and sedimentation on resident fish populations over a two-year period (1977 and 1978) (Wiltz 1982b).

Southern did not conduct surveys for Federally listed aquatic threatened and endangered or proposed species or of designated or proposed critical habitats, because other than the shortnose sturgeon, which has been well studied in the portion of the Savannah River in the vicinity of the site, there are no Federally listed species and no designated or proposed critical habitats.

2.8 Socioeconomics

This section describes the socioeconomic baseline of the proposed site. It describes the characteristics of the region surrounding the VEGP site, including population demographics, regional economic characteristics, and community infrastructure that form the basis for assessing the potential social and economic impacts from the construction and operation of the proposed two new nuclear units on the VEGP site.

These impacts are for the region[(a)] surrounding the proposed site. This discussion focuses on the socioeconomic characteristics of Burke, Richmond, and Columbia Counties, although it considers the entire region within an 80-km (50-mi) radius of the proposed site. The scope of the review of community characteristics is guided by the magnitude and nature of the expected impacts of construction, maintenance, and operation of the proposed project and by those site-specific community characteristics that can be expected to be affected by these impacts.[(b)]

The population data for the analytical area are based on the 2000 U.S. Census data and estimated with SECPOP 2000, a computer program that calculates population by emergency planning zone sectors (Southern 2008a). In addition, the NRC staff analyzed the economic, employment, and population trends for the region using additional U.S. Census data sets and population projections from the Georgia Office of Planning and Budget Policy.

(a) For the purposes of the EIS, the relevant region is limited to that area necessary to include social and economic baseline data for (1) the county in which the proposed plant would be located and (2) those specific portions of surrounding counties and urbanized areas (generally, up to 80 km [50 mi] from the station site) from which the construction/operations workforce would be principally drawn, or that would receive stresses to community services from in-migrating construction/operations workers.

(b) Table G-3 in Appendix G provides summary statistics for all counties within an 80-km (50-mi) radius of the VEGP site that were used to assist in narrowing the scope to assess socioeconomic impacts.

The analytical area is an 80-km (50-mi) circle centered on the proposed powerblock and includes all or a portion of 28 counties in Georgia and South Carolina. Table 2-11 identifies the counties and some summary geographic and demographic information for each county. Figure 2-2 shows a map of the analytical area.

Table 2-11. Counties within 80 km (50 mi) of the Proposed VEGP Site

County	State	Number of Current VEGP Employees (2005)	Population Density per mi^2 (2000)	Largest Town/City within County: Name	Population	Driving Distance to VEGP	Median Income (1999)
Bulloch	GA	10	82.1	Statesboro	22,698	58.8	$29,499
Burke	GA	170	26.8	Waynesboro	5813	16.8	$27,877
Candler	GA	2	38.8	Metter	3879	64	$25,022
Columbia	GA	289	307.9	Martinez	27,749	37	$55,682
Effingham	GA	0	78.3	Rincon	4376	75.6	$46,505
Emanuel	GA	12	31.8	Swainsboro	6943	57.6	$24,383
Glascock	GA	2	17.7	Gibson	694	60.2	$29,743
Jefferson	GA	13	32.7	Louisville	2712	41.2	$26,120
Jenkins	GA	16	24.5	Millen	3492	32.9	$24,025
Johnson	GA	2	28.1	Wrightsville	2223	70.9	$23,848
Lincoln	GA	3	39.5	Lincolnton	1595	85	$31,952
McDuffie	GA	3	81.7	Thomson	6828	61.1	$31,920
Richmond	GA	224	616.5	Augusta-Richmond County	195,182	32.5	$33,086
Screven	GA	58	23.7	Sylvania	2675	35.3	$29,312
Warren	GA	0	22.2	Warrenton	2013	72.3	$27,366
Washington	GA	1	31.1	Sandersville	6144	66.9	$29,910
Aiken	SC	37	132.9	Aiken	25,337	47.9	$37,889
Allendale	SC	1	27.5	Allendale	4052	39.9	$20,898
Bamberg	SC	2	42.4	Bamberg	3733	66.6	$24,007
Barnwell	SC	4	42.8	Barnwell	5035	57.1	$28,591
Colleton	SC	0	36.2	Walterboro	5153	91.7	$29,733
Edgefield	SC	1	49	Edgefield	4449	64.1	$35,146
Hampton	SC	0	38.2	Hampton	2837	55.1	$28,771
Jasper	SC	0	31.5	Ridgeland	2518	85.6	$30,727
Lexington	SC	0	308.9	West Columbia	13,064	106.9	$44,659
McCormick	SC	4	27.7	McCormick	1489	71.1	$31,577
Orangeburg	SC	0	82.8	Orangeburg	12,765	84.6	$29,567
Saluda	SC	0	42.4	Saluda	3066	78.6	$35,774

Source: Southern 2007c

2.8.1 Demographics

For the purposes of this analysis, the staff divided the total population within the analytical area into three major groups: residents who live permanently in the area; transients who may temporarily live in the area but have a permanent residence elsewhere, and migrant workers who travel into the area to work for some period of time and then leave after their job is done.

Transients and migrant workers are not fully characterized by the U.S. Census, which generally captures only resident populations.

2.8.1.1 Resident Population

Figure 2-15 shows the estimated population in 2000 within 80 km (50 mi) of the center of the proposed VEGP site. The location of the powerblock represents the center of the 80-km radius circle mapped on Figure 2-15, with concentric circles in 16-km (10-mi) increments up to 80 km (50 mi) from the proposed location. Population data for the area surrounding the VEGP site indicate low-population densities and a rural setting. Contributing to the population sparseness near the plant is the Savannah River Site, a secured U.S. Government facility with no permanent residents across the Savannah River and adjacent to the plant in neighboring South Carolina. The Savannah River Site occupies approximately 803 km^2 (310 mi^2), approximately 20 percent of which lies within a 32-km (20-mi) radius of the VEGP site, principally in Aiken and Barnwell Counties. The only population center within 16 km (10 mi) of the VEGP site is Girard, Georgia, approximately 13 km (8 mi) to the southeast with a population of 227 (USCB 2007a).

Three larger towns are within 32 km (20 mi) of the VEGP site, including Waynesboro (population 5813) and Sardis (population 1171) to the west and south of the plant in Georgia, and Jackson (population 1625) to the north of the plant in South Carolina. As shown in Figure 2-15, the more densely populated areas in the region are more than 32 km (20 mi) from the proposed site along the Interstate-20 (I-20) corridor. Augusta, located in Georgia to the northwest of the plant, and North Augusta and Aiken, both located to the north of the plant in South Carolina, have the largest populations with 195,102 people, 17,574 people, and 25,337 people, respectively.

Augusta, Georgia, is the largest metropolitan area within an 80-km (50-mi) radius of the VEGP site, and most of the current 862 VEGP employees live in Augusta, its suburban communities, or in unincorporated sections of Columbia and Richmond Counties. The towns neighboring Augusta, such as Evans (population 17,727), and Hephzibah (population 3880) in Georgia; and North Augusta (population 17,574) and Aiken (population 25,337) in South Carolina have also experienced a high rate of suburban growth in recent years. Outside the Augusta area, there are a few small towns, such as Waynesboro (population 5813), which have town centers, shopping, and several services. There are also several rural communities, similar to Girard (population 227), that provide limited services (Southern 2006d; USCB 2007a).

Table 2-12 provides population totals for Burke, Columbia, and Richmond Counties and the State of Georgia from 1970 through 2000 and estimated population projections for these areas through 2015, based on estimates developed by the State of Georgia's Office of Planning and Budget. Additional population estimates and projections for counties throughout the analytical area are found in Appendix G (includes projected populations by sector through 2090). The

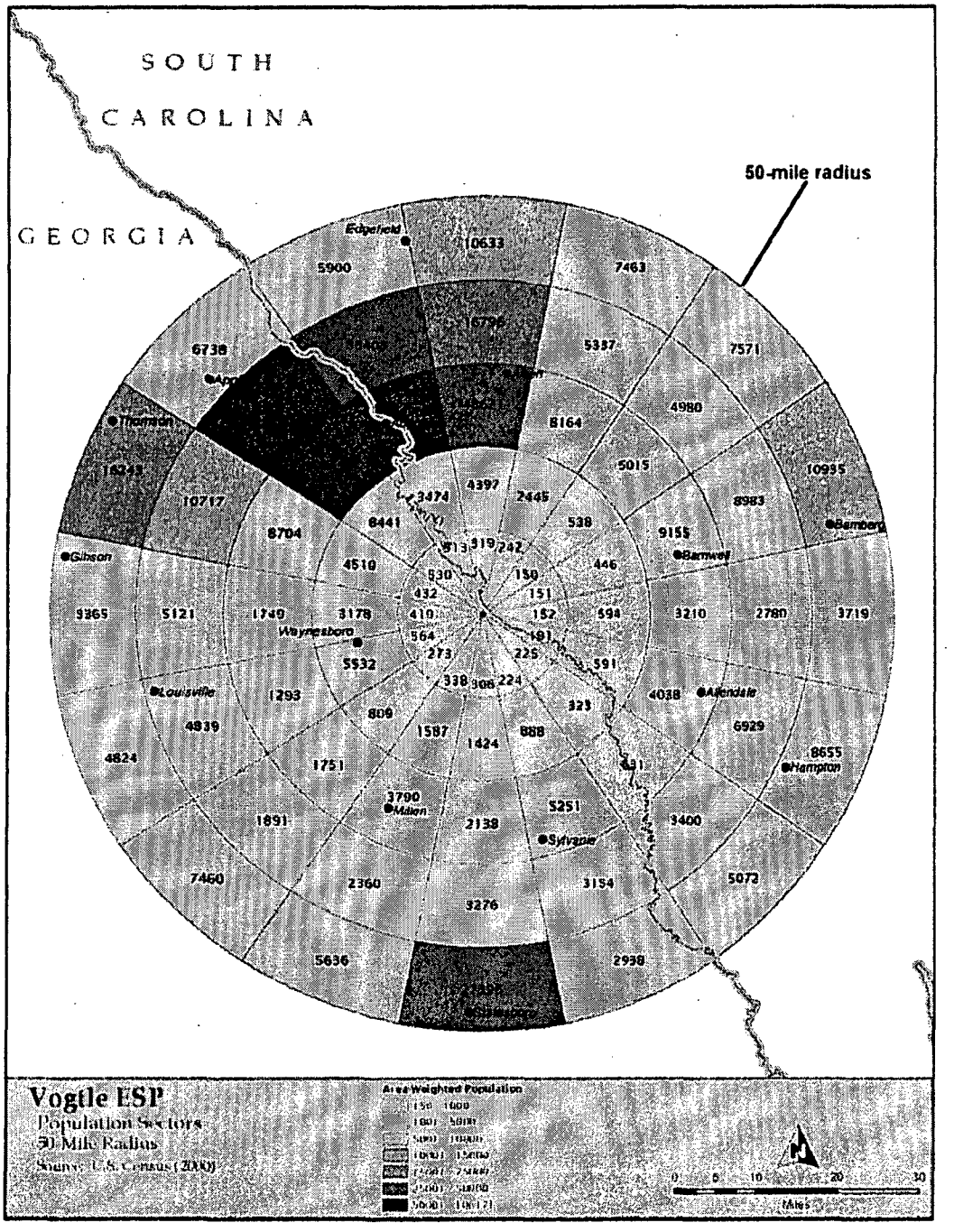

Figure 2-15. Estimated Population in 2000 within 80 km (50 mi) of the VEGP Site (USCB 2000)

population projection methodology used for the sector population analysis is provided in Section 2.5 of Southern's ER (Southern 2008a).

Table 2-12. Population Growth in Burke, Columbia, and Richmond Counties (1970 to 2015)[(a)]

	Burke County		Richmond County		Columbia County		Georgia	
Year	Pop	Annual Percent Growth	Pop	Annual Percent Growth	Pop	Annual Percent Growth	Pop	Annual Percent Growth
1970	18,255	–	162,437	–	22,327	--	4,589,575	N/A
1980	19,349	0.6	181,629	1.1	40,118	6.0	5,463,105	1.8
1990	20,579	0.6	189,719	0.4	66,031	5.1	6,478,216	1.7
2000	22,243	0.8	199,775	0.5	89,288	3.1	8,186,453	2.4
2010 (est.)	24,561	1.0	193,914	-0.3	116,642	2.7	9,864,970	1.9
2015 (est.)	25,765	1.0	191,563	-0.2	132,303	2.6	10,813,573	1.9

Source: Southern 2008a

Historic population numbers come from U.S. Census data and future population projections were developed by Georgia Office of Planning and Budget Policy (GOPBP 2005).

2.8.1.2 Transient Population

Transients include people who work in or visit large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels, and at recreational areas or special events where there may be seasonal and workday variations in population. With the exception of the Savannah River Site, no significant industrial or commercial facilities are located within a 16-km (10-mi) radius of the VEGP site. Transient population estimates up to a 16-km (10-mi) radius around the VEGP site are included in Table G-3, of Appendix G. The Savannah River Site employs approximately 11,000 people and maintains its own emergency plan; thus, Savannah River Site employees are excluded from VEGP's analysis of transient populations for emergency planning (Southern 2008a).

Workplace transients within the 80-km (50-mi) radius of the plant are found primarily in Fort Gordon, several industries along the Savannah River, hospitals and nursing homes in the region, schools and colleges, correctional facilities, and numerous hotels. In addition, recreational parks in the area attract thousands of visitors each year. Magnolia Springs, the state park nearest the VEGP site, had 120,500 visitors in 2004. Redcliffe Plantation, the next closest state park, had 2500 visitors in 2004. During the 2004 hunting season, 3100 hunters visited Crackerneck Wildlife Management Area on the Savannah River Site (see Figure 2-16, Recreational Areas within 80 km [50 mi] of the VEGP site) (Southern 2008a).

Figure 2-16. Recreational Areas within 80 km (50 mi) of the VEGP Site (Southern 2008a)

2.8.1.3 Migrant Labor

The U.S. Census Bureau defines a migrant laborer as someone who is working seasonally or temporarily and moves one or more times from one place to another to perform seasonal or temporary employment. During the VEGP scheduled refueling outages, there is an influx of construction migrant labor to the area who are hired by VEGP to carry out fuel reloading activities, equipment maintenance, and other projects associated with the outage. VEGP employs approximately 800 workers for one month during every refueling outage, which occurs every 18 months for each unit. Southern considers this migrant population as part of its VEGP emergency planning.

Because of the seasonal fluctuation of labor, the agricultural sector can be another source of migrant laborers. The 2002 Census of Agriculture indicates the migrant population related to agricultural work is low within 80 km (50 mi) of the proposed site, and only McDuffie County has a substantial number of farms that raise relatively labor-intensive crops that employ migrant labor (Southern 2008a).

2.8.2 Community Characteristics

The VEGP site sits in a quiet, rural area with several small towns located within 32 km (20 mi) of the plant. With the exception of Aiken County, about half of the population in any county around the VEGP site is minority (primarily African American). Between one-fifth and one-third of the households in these counties have median incomes below the poverty level. Burke County and the five counties closest to the site are described in terms of racial characteristics and income level in Table 2-13.

Table 2-13. Minority and Low-Income Populations (2000 U.S. Census)

	Percentage Minority	Percentage Below Poverty
United States	30.9	12.4
Georgia	34.9	12.6
Burke	53.5	28.7
Richmond	55.6	19.6
Screven	46.8	20.1
South Carolina	32.8	14.1
Aiken	29.6	13.8
Allendale	73.0	34.5
Barnwell	45.2	20.9

Source: USCB 2007a

Further discussion of the demographic composition of the analytical area can be found under "Environmental Justice" in Section 2.10. The remainder of this section addresses community characteristics including the regional economy, transportation networks and infrastructure, taxes, aesthetics and recreation, housing, community infrastructure and public services, and education.

2.8.2.1 Economy

The principal economic centers in Burke, Columbia, and Richmond Counties include Augusta (Richmond County), Martinez (Columbia County), Evans (Columbia County), and Waynesboro (Burke County). The U.S. Bureau of Economic Analysis reports service industries in Augusta, Martinez, Evans, and Waynesboro (Burke County) employ the most workers (28.5 percent of employment) of any sector in the region. Other important sectors of employment include government (24.4 percent); retail trade (18 percent); manufacturing (10.3 percent), and construction (5.9 percent). In the last decade, the transportation and utilities sectors and service industries had the largest growth rates, while mining, wholesale trade, farming, and construction declined during these same years (Southern 2008a).

Although no single employer dominates the region, two of the largest employers in the area are the U.S. Army's Fort Gordon, employing 12,000 military and 5000 civilian workers, and DOE's Savannah River Site, which employs 11,000 workers. Augusta is home to a large medical school and medical complex that is a major source of employment and also fosters affiliated industries such as pharmaceuticals, diagnostic equipment, and medical supplies (Southern 2008a).

Approximately 860 full-time employees currently are employed on the VEGP site, with an additional 1000 contract workers onsite during maintenance outages. Southern is the largest employer in Burke County. Approximately 80 percent of the employees live in three counties: Burke (20 percent), Richmond (26 percent), and Columbia (34 percent). The staff used the distribution of VEGP's employees as the basis for several demographic assumptions in its economic impact assessment discussed in Chapters 4 and 5 of this EIS. Table 2-14 shows where the VEGP site's employees lived in 2006.

Burke, Columbia, and Richmond Counties have a diversified, expanding industry base. Manufacturing firms in the three counties produce a variety of products from disposable diapers to golf carts. The area has two natural resource assets: wood and kaolin. Forestry companies manufacture wood products including paper products, pulpwood, furniture, and flooring. There are several textile firms in the area that manufacture fabrics and apparel. Although manufacturing is a large employment sector, no single manufacturing firm ranks among the top 10 employers in the region (Southern 2008a).

Table 2-14. Residence Locations of the Workforce at the VEGP Site (June 2006)

County	Workforce Number	Percent of Workforce
Columbia	289	34
Richmond	224	26
Burke	170	20
Screven	58	7
Aiken	37	4
Jenkins	16	2
Jefferson	13	2
Emanuel	12	1
Bulloch	10	1
Other Counties	33	3
Total	**862**	**100.0**

Source: Southern 2006d

Table 2-15 shows the number of workers employed and the unemployment rates for Burke, Columbia, and Richmond Counties and the State of Georgia for 1995 and 2005. These data show the number of employed workers in Burke County increased between 1995 and 2005 by more than 24 percent. The number of employed workers has also increased significantly in Columbia County in approximately the same proportion as the county's population growth. During the same time period, the unemployment rate in Burke County decreased from 13.7 percent to 7.7 percent while the unemployment rate in Richmond and Columbia Counties remained relatively unchanged (USBLS 2007).

Table 2-15. Employment Changes in Burke, Columbia, and Richmond Counties (1995 to 2005)

Region	Workers Employed[a] 1995	Workers Employed[b] 2005	Percentage Change in Workers Employed 1995-2005	Percentage Unemployment Rate 1995	Percentage Unemployment Rate 2005
Burke County	7516	9374	24.7	13.7	7.7
Columbia County	38,567	53,098	37.7	4.1	4.4
Richmond County	75,814	84,793	5.0	7.1	7.1
County Totals	**121,897**	**147,265**	**20.8**		
Georgia	*3,522,905*	*4,384,030*	*24.4*	*4.8*	*5.2*

Source: USBLS 2007 (available at http://data.bls.gov/PDQ/servlet/SurveyOutputServlet)
(a) Employed workers includes both part-time and full-time employment
(b) Unemployed workers includes all workers without employment who are available for, and seeking employment

2.8.2.2 Taxes

Counties, municipalities, and boards of education may impose sales taxes in addition to the state sales tax. Burke County has its own 2 percent sales tax in addition to the Georgia state sales tax of 4 percent. Richmond and Columbia Counties assess an additional 3 percent sales and use tax (Southern 2008a). Counties and municipalities are authorized by the state constitution to levy and collect a general ad valorem ("according to value") property tax.

Georgia law generally requires tangible real and personal property be assessed at 40 percent of its fair market value.[a] The tax rate is stated in terms of "mills," with 10 mills equal to 1 percent of a property's assessed value. County and city governing authorities set the property tax (millage) rate (Southern 2008a).

Southern and the VEGP site's co-owners pay annual property taxes to Burke County. Table 2-16 presents information on the total property taxes the VEGP site pays to Burke County, the total property taxes collected by the county, and the percentage of the total property taxes that are paid by the VEGP site, and the portion of Burke County's tax revenues that is disbursed to the Burke County School District. For the 5 years between 2000 and 2004, the VEGP site paid about 80 percent of the property tax collected in Burke County (Southern 2008a).

Table 2-16. Property Tax Information for Burke County (2000-2004)

Year	Total Burke County Property Tax Revenue	Burke County Tax Revenue Disbursed to the Burke County School District	Property Tax Paid by Southern ($)	Percent of Total Property Taxes
2000	30,329,024	19,119,331	24,930,927	82.2
2001	30,758,563	18,691,850	25,276,404	82.2
2002	29,713,972	18,022,492	23,699,476	79.8
2003	30,029,880	18,160,393	24,341,247	81.1
2004	29,805,738	17,838,847	24,358,042	81.7

Source: Southern 2008a

Tax bases differ between counties in Georgia because of differences in taxable properties. Counties that have power plants or large manufacturing plants have much greater revenue-raising potential than purely agricultural counties. In terms of revenue-generating capacity per capita (including all forms of local tax revenues), Burke County has one of the highest revenues per capita in the state. Columbia County revenues per capita are close to the state average, and Richmond County is somewhat below the average relative to all other counties in the state (Matthews 2005).

2.8.2.3 Transportation

The VEGP site's transportation network includes an interstate and state highway system, two primary freight rail carriers (CSX in South Carolina and Georgia and Norfolk Southern in Georgia), and 16 regional airports. Augusta Bush Field Airport is the only airport that supports commercial carrier service. Interstate 20 runs east-west through Augusta, connecting Columbia, South Carolina, with Atlanta, Georgia. I-520 serves as a beltway around Augusta, connecting I-20 with several north-south highways throughout the region, including U.S.

(a) Exceptions apply to special types of property such as historic property, conservation use property, some agricultural use property, and standing timber.

Route 25, connecting Augusta with Waynesboro, and State Routes 56 and 23, which also connect Augusta with rural towns to the south (Southern 2008a).

Figure 2-17 presents the major road networks throughout the region, and highlights the most likely employee commuter routes to and from the VEGP site (as reflected by residential and commuter patterns of current VEGP employees). Most of the roads in Columbia and Richmond Counties are designated "urban," and all of the roads in Burke County are "rural." The level of use and congestion on roadways is the highest in and around Augusta where annual average daily traffic counts exceed 25,000 in certain sections of I-20 and I-520. In Burke County annual average daily traffic counts are highest around Waynesboro where traffic can range from 5000 to 15,000. Outside of Waynesboro annual average daily traffic counts in Burke County are less than 5000 (GDOT 2007).

Rail

There is no passenger rail service in Burke, Columbia, or Richmond Counties. Two primary freight rail carriers service the three counties, CSX and Norfolk Southern. From Augusta, CSX has three lines leading to Atlanta, Georgia; Greenwood, South Carolina, and Savannah, Georgia (through South Carolina). From Augusta, Norfolk Southern has a rail line that goes through Waynesboro to points south and west. Both rail lines have the capacity to run additional trains. A 32-km (20-mi) rail spur line runs from the VEGP site to the Norfolk and Southern line, connecting north of Waynesboro. Southern recently upgraded the spur to support the transfer of heavy equipment to the VEGP site (Southern 2008a).

Waterway

The VEGP site is located at rkm 243 (RM 151) of the Savannah River. The Savannah River is part of the U.S. Inland Waterway System and an authorized navigation channel exists from the mouth of the Savannah River in Savannah, Georgia, to Augusta, Georgia. All of the major components for VEGP Units 1 and 2 were delivered to the site by barge using the Savannah River navigation channel.

2.8.2.4 Aesthetics and Recreation

State parks and wildlife management areas (WMA) within 80 km (50 mi) of the VEGP site and are listed in Table 2-17 and are shown in Figure 2-16. The Yuchi WMA, a 3160-ha (7800-ac) site adjacent to the VEGP site, and the Crackerneck WMA, a 4237-ha (10,470-ac) site on the South Carolina side of the Savannah River adjacent to the west boundary of the Savannah River Site, are closest to the VEGP site. Both WMAs are within a 10-km (6-mi) radius of the VEGP site, although Crackerneck is approximately 80 km (50 mi) from the site by road. Mead Farm WMA is about 13 km (8 mi) from the VEGP site, and Alexander WMA is about 20 km (12 mi) from the VEGP site. The closest State parks are Magnolia Springs, in Jenkins County,

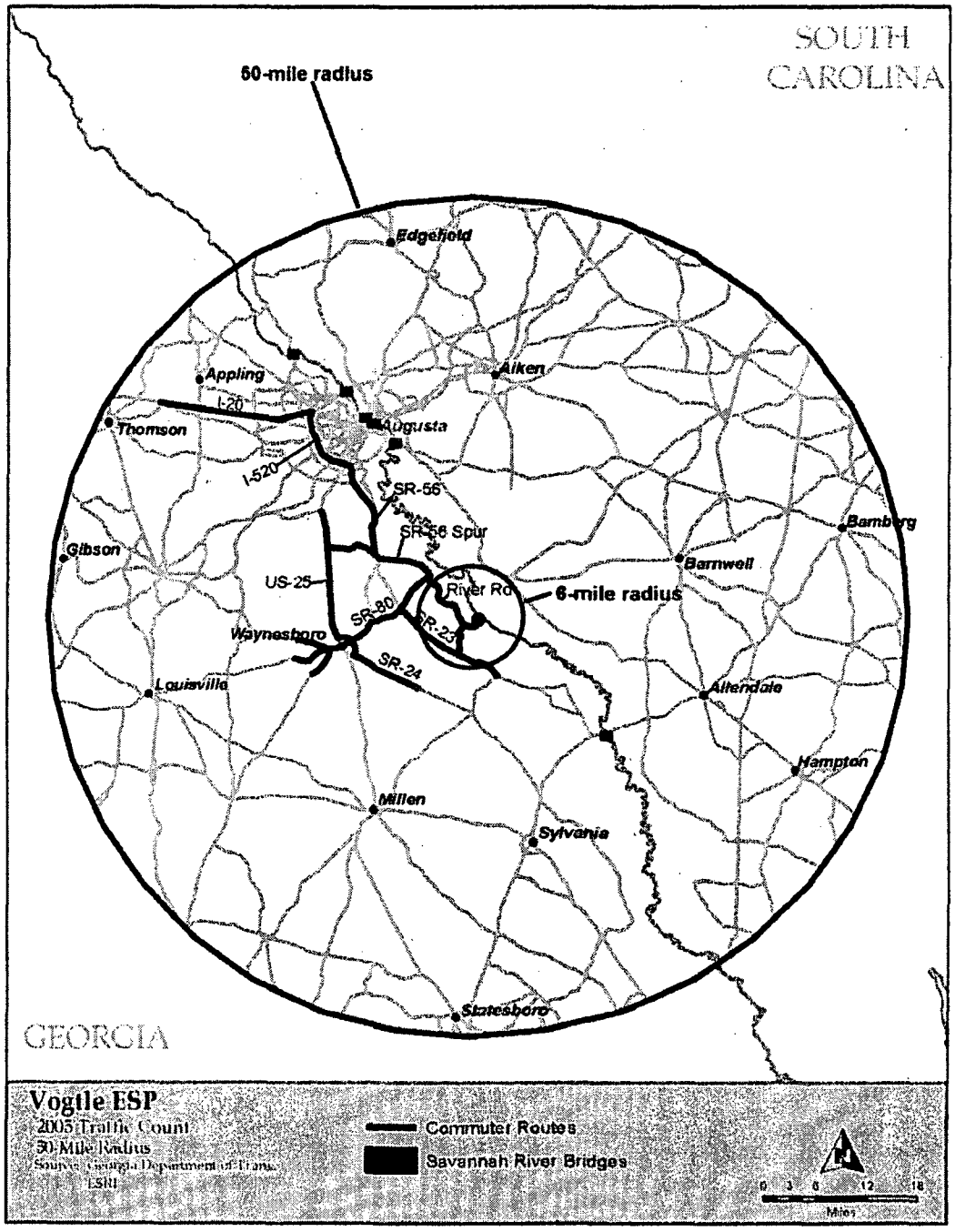

Figure 2-17. Major Commuter Routes in Burke, Columbia, and Richmond Counties (GDOT 2007)

Georgia (approximately 32 km (20 mi) from the VEGP site), and Redcliffe Plantation State Park in Aiken County, South Carolina (approximately 32 km [20 mi] by air from VEGP). J. Strom Thurmond Dam and reservoir, formerly named Clarks Hill Lake, are within 80 km (50 mi) of the VEGP site. The lake is a major recreation area for the Central Savannah River Area (Southern 2008a). There are numerous locations and opportunities to hunt and fish in the area on public and private land.

Festivals and sporting events throughout the region bring in tourists for several days to a week. Major sporting events in the Augusta area are the Masters Golf Tournament, the Cutting Horse Futurity, the Invitational Rowing Regatta, the Southern National Boat Races, and the Aiken Triple Crown. Redcliffe Plantation hosts annual Heritage Days. Burke County hosts the Redbreast Festival and the Georgia Bird Dog Field Trials (Southern 2008a).

VEGP Units 1 and 2 have natural draft cooling towers, which stand approximately 168 m (550 ft) high and are the tallest structures at the site. On the Georgia side of the Savannah River, trees and terrain provide barriers to viewing the containment, turbine buildings, and support structures from the road or river, but the towers can be seen from Highways I-520 and 56, River Road, and parts of the Savannah River. The only structures fully visible from the river are the intake canal, intake structure, and pumphouse (Southern 2008a).

The terrain along the Savannah River allows the plumes and, in a few cases, the towers to be visible from the vicinity of Highway 125 in Allendale and Barnwell Counties, South Carolina; the southern outskirts of Aiken County, and parts of I-520 in South Carolina. Across the river from the VEGP site's intake are three intake canals and a barge facility for the Savannah River Site (Southern 2008a).

2.8.2.5 Housing

Approximately 80 percent of the current VEGP site employees reside in three counties in Georgia: Burke (20 percent), Richmond (26 percent), and Columbia (34 percent). An additional 11 percent live in either Screven or Aiken County (South Carolina) and the remaining 9 percent are distributed across 22 other counties (see Table 2-18). Within 80 km (50 mi) of the proposed site there are residential areas in and near cities and towns, smaller communities, and farms.

Rental property is scarce in the rural areas, but is available in the larger municipalities such as Waynesboro, Augusta, Martinez, and Evans. In the vicinity of the VEGP site, housing units are generally isolated, older single-family homes, manufactured homes, or mobile homes. New residential developments are primarily located in the cities and suburbs around Augusta (Southern 2008a)

Table 2-17. Recreation Areas Within 80 km (50 mi) of the VEGP Site

Name	Acreage	Location	Annual Visitors	Overnight Facilities? (Yes/No)
Wildlife Management Areas (WMA)[a]				
Georgia				
Phinizy Swamp	1500	Richmond County	NA	No
Alexander	1300	Burke County	NA	No
DiLane	8100	Burke County	NA	No
Yuchi	7800	Burke County; less than 16 km from the VEGP site	NA	No
Mead Farm	200	Burke County; less than 16 km from the VEGP site	NA	No
Hiltonia Tract	500	Hiltonia, Screven County	NA	No
Tuckahoe	15,100	Sylvania, Screven County	NA	No
South Carolina				
Crackerneck	10,470	Aiken County; less than 10 air miles from the VEGP site	3100	No
Gopher Tortoise Heritage Preserve	1395	Aiken County	NA	No
State Parks				
Georgia				
Magnolia Springs	1071	Millen, Jenkins County	120,500	Yes
George L. Smith	1634	Twin City, Emanuel County	44,136	Yes
Mistletoe State Park	1920	Appling, Columbia County	132,314	Yes
Wildwood Park	975	Columbia County	132,314	Yes
South Carolina				
Hamilton Branch	731	Plum Branch, McCormick County	117,200	Yes
Aiken Natural Area	1067	Windsor, Aiken County	42,645	Yes
Redcliffe Plantation	369	Beech Island, Aiken County	2400	Yes
Barnwell	300	Blackville, Barnwell County	76,845	Yes
Rivers Bridge	390	Ehrhardt, Bamberg County	6027	Yes
Lake Warren	440	Hampton, Hampton County	49,962	Yes

Sources: Southern (2008a)
NA: Not Available
(a) Visitor records for WMAs not kept except for Crackerneck WMA, which is part of Savannah River Site land area.

Table 2-18. Regional Housing Information by County for the Year 2000

County	Total Housing Unit	Occupied	Owner Occupied	Renter Occupied	Vacant Housing	Percent Vacancy
Burke	8842	7934	6030	1904	908	10.3
Columbia	33,321	31,120	25,557	5563	2201	6.6
Richmond	82,312	73,920	42,840	31,080	8392	10.2
Screven	6853	5797	4513	1284	1056	15.4
Aiken (SC)	61,987	55,587	42,036	13,551	6400	10.3
Total	**193,315**	**174,355**	**120,976**	**53,382**	**18,957**	**9.8**

Source: Southern 2008a; USCB 2007a

Table 2-18 provides the number of housing units and vacancies for the five counties where most VEGP site employees reside: Columbia, Richmond, Burke, Screven, and Aiken. In 2000, there were a total of 193,315 housing units in the five-county region, with an average vacancy rate of 9.8 percent. The vacancy rate in Screven County is significantly higher than the average rate of this five-county region, while the vacancy rate in Columbia County is lower than the average (USCB 2000). Richmond County has more rental property than any other county. Of the 8392 vacant housing units in Richmond County, 3739 were for rent and 1160 were for sale. In Columbia County, of the 2201 vacant housing units, 560 units were available for rent and 760 were for sale.[a] Of 908 vacant housing units in Burke County in 2000, 167 were for rent and 77 were for sale (Southern 2008a).

2.8.2.6 Public Services

Water Supply and Waste Treatment

The VEGP site consumes approximately 3.8 million L/d (1 MGD) of water from three onsite groundwater wells. One well generally supplies all necessary water for normal plant operation, leaving two wells on standby. The VEGP site has permits to withdraw 20.8 million L/d (5.5 MGD) from the three wells (Southern 2008a).

In the Central Savannah River Area, municipal water sources can be surface water (such as rivers, lakes, and streams), or groundwater. Columbia County lies north of the Fall Line, a geomorphic boundary between the Piedmont and the Coastal Plain. It is characterized by a limited groundwater supply because of the dense, crystalline rock underlying the area. Like most of the large municipal systems above the Fall Line, Columbia County obtains its water from the Savannah River or one of its impoundments (Southern 2008a).

In the Coastal Plains of Georgia and South Carolina, two major regional aquifer systems supply about 11 million L/d (3 MGD) of water: the lower Cretaceous aquifer system and upper Tertiary aquifer system. The VEGP site withdraws groundwater primarily from the Cretaceous aquifer. Most counties in the Coastal Plain, including Burke and Richmond Counties, obtain their water from these aquifers, and some municipalities use the Savannah River to supplement their supply. Tables 2-19 and 2-20 identify water supplies in Burke, Columbia, and Richmond Counties, their permitted capacities, and their average daily production levels (Southern 2008a).

According to local planning officials, water supply in the three counties is not a concern. Local communities are adequately served by the existing water supplies and planners estimate that the counties have adequate supply to support growth in the region (Southern 2008a).

(a) U.S. Census classifications of vacant homes includes the following: for rent, rented but not yet occupied, for sale only, sold but not yet occupied, vacation home, migrant housing, other.

Local governments provide wastewater treatment and each municipality decides which treatment method to use based on its needs and the technology and funds available. Currently, municipalities in the three counties can meet their current and projected wastewater treatment needs. Table 2-21 details public wastewater treatment systems, their permitted capacities, and their average daily processed wastewater volume. The rural areas of each county use individual septic systems (Southern 2008a).

Table 2-19. Water Supply System Usage and Capacity for Groundwater Withdrawals

System Name	Permitted Annual Average Withdrawal, Million L/d (MGD)	Reported Annual Average Withdrawal, Million L/d (MGD)	Population Served
Burke County			
Waynesboro	13.25 (3.50)	2.99 (0.79)	5813
Sardis	1.51 (0.40)	0.26 (0.07)	1152
Columbia County			
Columbia County[a]	2.20 (0.58)	0.00 (0.00)	77,280
Grovetown	3.41 (0.90)	0.49 (0.13)	5500
Harlem	0.95 (0.25)	0.08 (0.02)	4290
Richmond County			
Augusta-Richmond County Water System	65.87 (17.40)	31.80 (8.40)	200,000
Hephzibah	4.54 (1.20)	1.29 (0.34)	3011

Source: Southern 2008a
(a) Columbia County system is withdrawn primarily from surface-water systems.

Table 2-20. Water Supply System Usage and Capacity for Withdrawals from Surface Water

System Name	Permitted Monthly Average Withdrawal, Million L/d (MGD)	Reported Monthly Average Withdrawal, Million L/d (MGD)	Population Served
Burke County			
Waynesboro	3.8 (1.0)	0.38–0.72 (0.10–0.19)	5813
Sardis[a]	--	--	--
Columbia County			
Columbia County	147.6 (39.0)	31.60–67.30 (8.35–17.78)	77,280
Grovetown[a]	--	--	--
Harlem[a]	--	--	--
Richmond County			
Augusta-Richmond County Water System	227.12 (60.00)	92.36–167.85 (24.40–44.34)	200,000
Hephzibah[a]	--	--	--

Source: Southern 2008a
(a) Systems do not withdraw surface water.

Police, Fire, and Medical

Burke County's Sheriff's Department and Fire Department have jurisdiction over the immediate area around the VEGP site. According to a 2005 draft planning report produced by the Central Savannah River Area Regional Development Center, planning officials consider the current level of police and fire protection adequate in the region (Southern 2008a).

Table 2-21. Wastewater System Usage and Capacity

System Name	Average Daily Wastewater Processed million L/d (MGD)	Permitted Maximum Sewer Capacity million L/d (MGD)	Current System Usage as a Percent of Permitted Capacity (%)
Burke County			
Waynesboro	3.8 (1.0)	7.6 (2.0)	50
Sardis	0.0163 (0.043)	0.76 (0.20)	2
Columbia County			
Kiokee Creek	0.08 (0.02)	1.14 (0.30)	7
Crawford Creek	3.8 (1.0)	5.68 (1.50)	67
Little River	9.46 (2.50)	11.4 (3.0)	83
Reed Creek	12.49 (3.30)	17.41 (4.60)	72
Richmond County			
Augusta-Richmond-J.B. Messerly Plant	117.3 (31.0)	174.89 (46.20)	67

Source: Southern 2008a

Richmond County serves as a regional medical hub for most of the region's hospitals and medical services, with four general hospitals, one military hospital, one mental and psychiatric hospital, one rehabilitation hospital, and two Federal hospitals. Burke County has one general hospital and Columbia County has no hospitals. Table 2-22 presents hospital and medical practitioner data by county. All three counties have health departments, which provide several basic medical services and are available to residents regardless of their ability to pay. Social services in Georgia are overseen by the State Department of Human Resources through four main divisions: family and children services; public health; mental health, developmental disabilities, addictive diseases; and aging services (Southern 2008a).

2.8.2.7 Education

A total of 96 public primary and secondary schools are in Burke, Columbia, and Richmond Counties, supporting a 2004 to 2005 student enrollment of 57,704 (see Table 2-23) (GOSA 2007). In addition, there are 24 private primary and secondary schools with a 2006 enrollment of 5070 students. There are six four-year colleges and seven two-year colleges within an 80-km (50-mi) radius of the VEGP site (Southern 2008a).

Table 2-22. Hospitals and Physicians in Burke, Columbia, and Richmond Counties

County	Hospital beds per 1000 population	Physicians per 1000 population
Burke	1.7	0.6
Columbia	0	0.5
Richmond	10.1	6.1

Source: Southern 2008a

Table 2-23. Number of Public Schools, Students, and Student Capacity in Burke, Columbia, and Richmond Counties

County	Number of Schools	Student Population (2005)
Burke	6	4365
Columbia	30	20,181
Richmond	60	33,158
Total	**96**	**57,704**

Source: GOSA 2007

Richmond County School District is the largest of the three school districts, with more than 30,000 students enrolled in the public school system. After struggling with over-crowding issues for several years, the district now meets the Georgia Department of Education-mandated student-teacher ratios. The Columbia County School District services some of the highest growth residential developments around Augusta. Of the three school districts, Columbia County has experienced the highest rate of student enrollment growth in recent years and has continually struggled to meet state student-teacher ratios for pre-K through fifth grade. During the 2005 to 2006 school year, enrollment increased by more than 1000 students and was expected to increase by approximately 800 students during the 2007 to 2008 school year. New school construction is a high priority for the Columbia County Board of Education.[(a)] Burke County School District is the smallest of the three and has excess capacity. The Burke County School District office estimates a current (2006 to 2007 school year) excess capacity of about 17 percent, meaning the district could support an additional 700 to 800 students.[(b)]

2.9 Historic and Cultural Resources

In accordance with 36 CFR 800.8(c), the NRC staff is using the NEPA process to comply with the obligations imposed under Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA). The NRC has determined that the Area of Potential Effect (APE) for the ESP

(a) Data provided by Columbia County School District office in e-mail from Pam Zgutowicz, March 5, 2007. Accession No. ML072290140.

(b) Data provided by Burke County School District office in e-mail from Wilbert Roberts, Assistant District Superintendent, March 6, 2007. Accession No. ML072290177.

review is the area at the power plant site and the immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of a new transmission line that may be constructed to connect the new VEGP units with the existing electrical grid.

This section discusses the historic and cultural background in the VEGP site region. It also details the efforts that have been taken to identify cultural resources in the APE and the resources that were identified. A description of the consultation efforts accomplished to date is also provided. The assessments of effects from the proposed construction and operation are found in Sections 4.6 and 5.6, respectively.

2.9.1 Cultural Background

The area in and around the VEGP site has a rich cultural history and a substantial record of significant prehistoric and historic resources (NSA 2006a,b). The Savannah River system flows through the area and influenced settlement in the area. The record indicates that prehistoric occupation of the area was as follows:

- Paleoindian (Prior to 7800 B.C.) – Minimal evidence from this time period has been found. Of particular interest is speculation that the Topper site, located approximately 40 km (25 mi) downstream in South Carolina, may document the presence of human settlement as far as 50,000 years ago.
- Archaic (7800 B.C. to 1050 B.C.) – During this period, people appear to have become more sedentary and particularly adept at exploiting resources found within their environment. The period is characterized by fine-tempered pottery and shell middens.
- Woodland (1050 B.C. to 800 A.D.) – Settlement size increased as the people developed agricultural methods. Evidence of food preservation and storage is found.
- Mississipian (800 A.D. to 1450 A.D.) – The period is characterized by ceremonial mounds, along with large agriculturally based settlements, generally considered to have been controlled by chiefdoms.
- Post-1450 A.D. – Chiefdoms dissolved and the settlement in the area dispersed. As Euro-Americans moved into the area, the area was further depopulated, while some intermarriage between the Euro- and Native Americans occurred.

When Euro-Americans arrived in the area in the 17th and 18th centuries, the area was occupied by American Indian groups descended from the earlier chiefdoms that populated the southeastern United States. New South Associates (2006a) identifies American Indians in the general VEGP area as ancestors of groups later called Creeks and Seminoles.

The European colonization of Georgia began in the early 1700s. Burke County was formed in 1777. A 1780 map shows two settlements in the VEGP site area: Telfare's Plantation and Mathew's Bluff. These and others settlements appear on maps into the 20th century. Limited activities associated with the Civil War occurred in Burke County. Following the war, plantations evolved into large farms, an economic strategy that continues today. Since the 1920s, farming acreage has shifted from cotton to corn and more recently to soybeans and wheat (NSA 2006a).

2.9.2 Historic and Cultural Resources at the VEGP Site

To identify the historic and cultural resources at the VEGP site and associated transmission lines, the following information was used:

- Original FES – An archaeological assessment was conducted in the early 1970s before the construction of the original unit (Honerkamp 1973). Seven sites were identified (9BK21, 9BK22, 9BK1/20, 9BK23, 9BK24, 9BK25, 9BK26). None of the resources were considered important enough to further investigate before construction of the first VEGP plant (AEC 1974, NRC 1985).
- VEGP ER – Southern's contractor, TetraTech, subcontracted with New South Associates (NSA), a cultural resource contractor to identify and evaluate cultural resource sites in the area (NSA 2006a,b; 2007, 2008).
- Transmission Line Right-of-Way Study – A study of possible transmission line rights-of-way was conducted to address cultural resource issues (GPC 2007).
- NRC Audit – NRC staff conducted a records search at the Georgia Archaeological Site Files and also conducted an on-the-ground visit of the VEGP site.

To comply with NRC guidance, National Register-eligible archaeological sites, structures, buildings, and districts located within 16 km (10 mi) of the VEGP site and within set distances of the transmission lines were identified (NSA 2006a,b). Twenty-six sites and 14 buildings were identified. Most of the areas within 16 km (10 mi) of the VEGP site or transmission lines have not been systematically surveyed; therefore, this information does not reflect the general cultural sensitivity of the area.

To identify on-plant resources within the APE, NSA identified and evaluated cultural resources located within the proposed construction areas at the plant. NSA performed its surveys and shovel tests in 2006 in 16 areas (NSA 2006a). Ten new archaeological sites were located. Site forms were completed for the sites and submitted to the Georgia Office of Historic Preservation. New South Associates recommended that two of the sites (9BK416 and 9BK423) were eligible for listing in the National Register, six sites were not eligible (9BK414, 9BK415, 9BK417, 9BK418, 9BK419, 9BK420), and two sites required additional information before an evaluation could be completed (9BK421, 9BK422) (NSA 2006a,b) (Table 2-24). The Georgia State Historic Preservation Office (SHPO) concurred with this assessment (GDNR 2006c).

Table 2-24. Archaeological Sites Identified Within the VEGP Site

Site Number[a]	Eligibility[b]	Description
9BK414	Not Eligible	Historic homesite
9BK415	Not Eligible	Historic homesite
9BK416	Eligible	Large multicomponent prehistoric site
9BK417	Not Eligible	Liquor still
9BK418	Not Eligible	Undiagnostic lithic scatter
9BK419	Potentially Eligible	Woodland prehistoric site
9BK420	Potentially Eligible	Undiagnostic lithic scatter
9BK421	Not Eligible	Undiagnostic lithic scatter
9BK422	Not Eligible	Historic and prehistoric scatter
9BK423	Eligible	Multicomponent prehistoric site
9BK459	Not Eligible	Undiagnostic lithic scatter
9BK460	Not Eligible	Woodland prehistoric site
9BK461	Not Eligible	Undiagnostic lithic scatter
9BK462	Not Eligible	Undiagnostic lithic scatter
9BK463	Not Eligible	Undiagnostic lithic scatter
9BK464	Not Eligible	Undiagnostic lithic scatter
9BK465	Not Eligible	Undiagnostic lithic scatter

Sources: Southern 2008a; New South Associates 2006b; GDNR 2007f
(a) The Smithsonian numbering system for archaeological sites.
(b) Eligibility for listing in the National Register of Historic Places maintained by the National Park Service, U.S. Department of Interior)

Subsequent to the initial work, NSA returned to complete surveys in one additional area (NSA 2006b). Seven new sites were identified (9BK459 through 9BK465), all of which NSA recommended as not eligible for listing in the National Register of Historic Places (NSA 2006b). Concurrence was received from the Georgia (GDNR 2008 - an additional reference 7/3/08 letter).

In June 2007, additional testing was conducted due to modifications of the water pipeline associated with the proposed water intake structure. NSA conducted a Phase 1 archaeological survey of approximately 2500 feet of proposed pipeline corridor, which included site 9BK416. No new sites were identified during this survey. The results of the Phase 1 survey support the original findings that site 9BK416 is a multicomponent prehistoric site that is eligible to be listed in the NRHP (NSA 2007). NSA recommended that site 9BK416 be avoided; however, if avoidance was not possible, further excavations would be necessary to mitigate the project's adverse effects.

Southern determined that it would not be feasible to avoid site 9BK416 during the water pipeline construction. As requested by the Georgia SHPO (GDNR 2008e), additional field investigation was performed by NSA in 2008 (NSA 2008). Field investigations consisted of block excavations designed to locate subsurface archaeological features and artifact distribution patterns. Results

of the investigations were minimal, suggesting that the area to be impacted by the water pipeline does not contain significant archaeological deposits.

Previous investigations did not discover any human remains in the proposed project areas. To date, literature reviews and consultations with regional American Indian Tribes have not identified any traditional cultural properties in the vicinity of the proposed construction area of the ESP units.

No analysis of historic and cultural resources was conducted for the transmission line rights-of-way. The full extent of potential land-use impacts in the transmission line rights-of-way can be estimated only after a specific route is defined. However, a study produced by the GPC (2007) examined potential impacts that would result should certain transmission line rights-of-way be selected for the new transmission line. The report included information on the recorded archaeological sites and historic buildings located within each right-of-way.

During construction of VEGP Units 1 and 2, an important fossilized whale skeleton was unearthed. The fossil (*Georgiacetus vogtlensis*) was found at a depth of 30 feet below ground surface in a stratum known as the Blue Bluff Marl. Excavations associated with the new plant are not expected to encounter the Blue Bluff Marl stratum, and therefore, no fossil discoveries are anticipated (Southern 2008a).

2.9.3 Consultation

In October 2006, the NRC initiated consultations on the proposed action by writing the Georgia SHPO, the Alabama SHPO, and the Advisory Council on Historic Preservation. Also in October 2006, the NRC initiated consultations with 25 tribes (See Appendix C for complete listing). In the letters, the NRC provided information about the proposed action, indicated that review under the National Historic Preservation Act of 1966 would be integrated with the NEPA process in accordance with 36 CFR 800.8, invited participation in the identification and possible decisions concerning historic properties, and invited participation in the scoping process.

On October 19, 2006, NRC conducted a public scoping meeting in Waynesboro, Georgia. No comments or concerns regarding historic and cultural resources were received at this meeting. The NRC did receive letters in response to its earlier communications (Appendix F). The Miccosukee Tribe indicated that it restricts itself to those matters within the State of Florida and would defer to other tribes with a more direct cultural affiliation with the VEGP site. The Alabama Historical Commission indicated that it would look forward to reviewing the project if any alternative site located in Alabama is selected.

Following the issuance of the Vogtle DEIS, the Georgia SHPO responded to NRC (GDNR 2007f). The only concerns expressed related to archaeological sites identified in the

DEIS for which the Georgia SHPO had no record. There have been subsequent discussions between Georgia SHPO and Southern, which are summarized in Section 4.6.

2.10 Environmental Justice

Environmental justice refers to a Federal policy 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 region surrounding the site. The characterization in this section forms the analytical baseline from which potential environmental justice effects would be identified. The characterization of populations of interest includes an assessment of "populations of particular interest or unusual circumstances," such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements.

2.10.1 Analysis

The staff first examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of the VEGP site, employing a geographic information system and the 2000 Census to identify minority and low-income populations. The staff verified its analysis by field inquiries to numerous agencies and groups (see Appendix B for listing of contacts).

The staff's environmental justice methodology examines each census block group that is fully or partially included within the analytical area to determine for each minority or low-income population group, whether:

1. the population of interest exceeds 50 percent of the total population for the block group
2. the percentage of the population of interest is 20 percent (or more) greater than the same population's percentage in the block group's state.

(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.

If any Census block area meets either of the above criteria, then the staff must investigate further in that Census block area before determining whether or not the potential for a disproportionate adverse effect exists.

Census data for Georgia (USCB 2007b) characterizes 28.7 percent of the state population as Black races; 0.3 percent American Indian or Alaskan Native; 2.1 percent Asian; 0.1 percent Native Hawaiian or other Pacific Islander; 2.4 percent all other single minorities; 1.4 percent multiracial; 34.9 percent aggregate of minority races; and 5.3 percent Hispanic ethnicity. For South Carolina, the USCB reports 29.5 percent of the state population as Black races; 0.3 percent American Indian or Alaskan Native; 0.9 percent Asian; 0.04 percent Native Hawaiian or other Pacific Islander; 1.0 percent all other single minorities; 1.0 percent multi-racial; 32.8 percent aggregate of minority races; and 2.4 percent Hispanic ethnicity.

Minority Populations: Of the 491 census block groups within 80 km (50 mi) of the VEGP site, 175 have Black races populations that exceed the state average by 20 percent or more and 171 of which have Black races populations of 50 percent or more. One census block group within the 80-km (50-mi) radius has Hispanic ethnicity populations exceeding the state average by 20 percent or more, but no block had a Hispanic population greater than 50 percent. No census block group within the 80-km (50-mi) radius had any other minority classification that met either of the two selection criteria. One hundred sixty-eight census block groups have aggregate minority population percentages that exceed the state average by 20 percentage points or more. One hundred and eighty-three census block groups have aggregate minority population percentages that exceed 50 percent.[(a)] The geographic locations of block groups that meet any of the minority criteria are shown in Figure 2-18.

Low-Income Populations: The staff used Census data to identify low-income households within the analytical area. The data indicate 12.6 percent of Georgia and 14.1 percent of South Carolina households are low income (USCB 2000). Seventy-two census blocks within an 80-km (50-mi) radius of the proposed site exceed the state average for low-income population households by 20 percent or more. Of those 72 block groups, 14 have 50 percent or more low-income households. Figure 2-19 displays the geographic location of disproportionately high populations of low-income families in census block groups.

(a) Note that because Georgia and South Carolina have relatively large percentages of aggregate minority populations, 34.0 and 32.8 percent, respectively, adding 20 percentage points to these averages equates to 54.9 and 52.8, respectively. Therefore, there are more census block groups that meet the "50-percent" threshold criteria than the "20 percentage-points-greater" threshold.

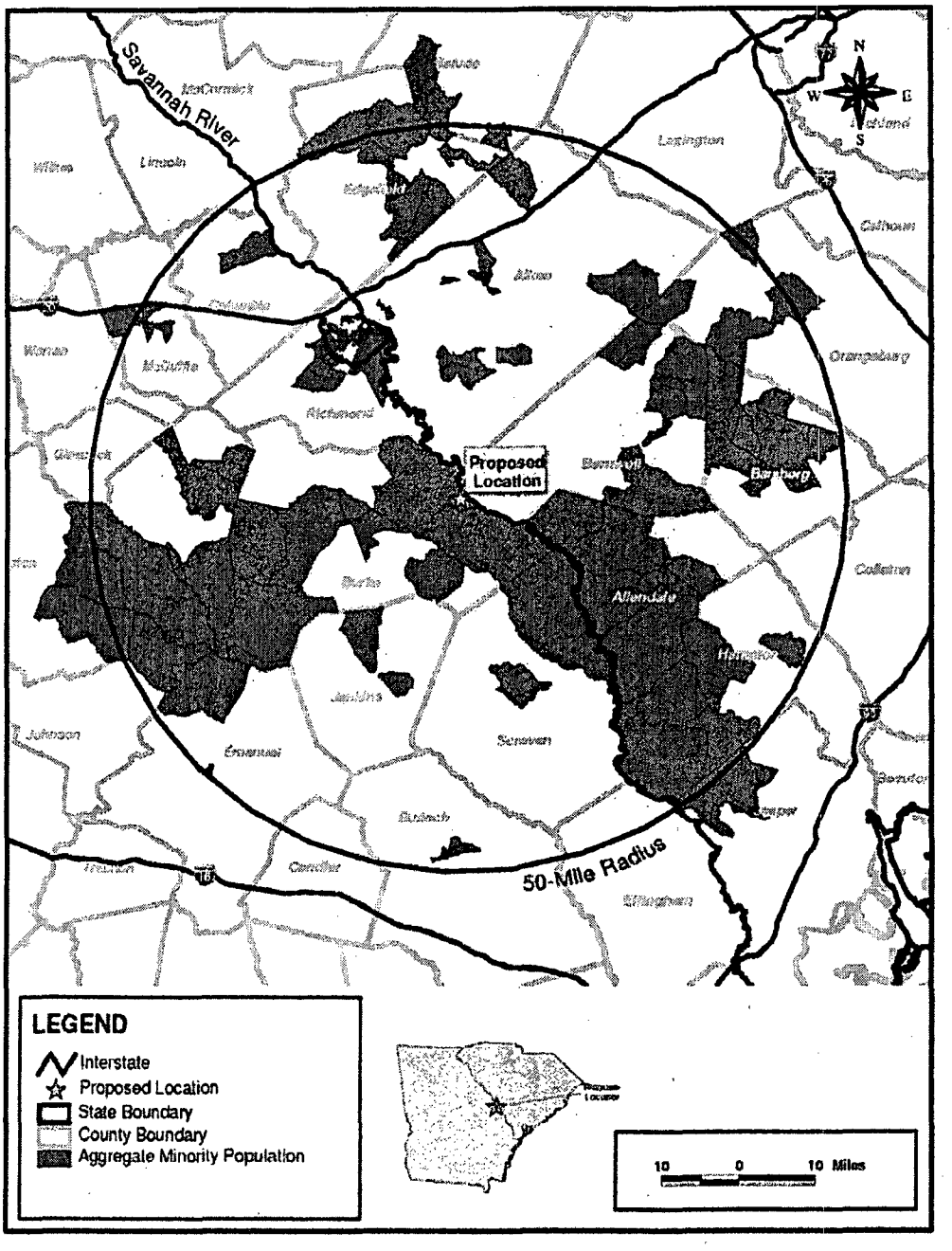

Figure 2-18. Aggregate Minority Populations in Block Groups Meeting Environmental Justice Selection Criteria (Southern 2008a)

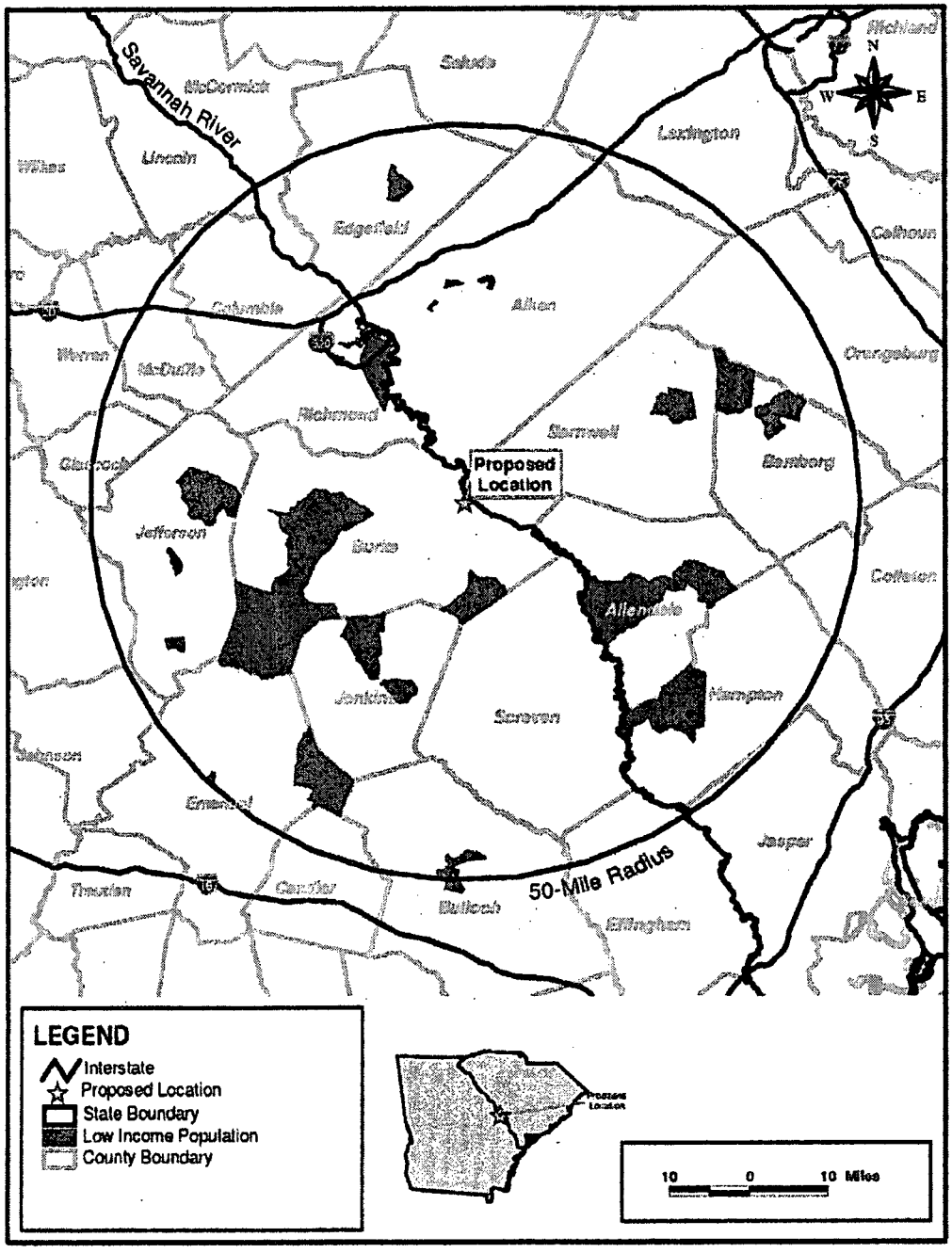

Figure 2-19. Aggregate Low Income Populations in Block Groups Meeting Environmental Justice Selection Criteria (Southern 2008a)

2.10.2 Scoping and Outreach

During the development of its ER, Southern interviewed community leaders of the minority populations within the analytical area. The staff built on this base and performed additional interviews within the analytical area that had the potential for the greatest socioeconomic effects. Advanced notice of public hearings for the EIS scoping purposes was provided by the staff in accordance with its guidance.[(a)] The staff was successful in its outreach effort to minority and low-income populations, as evidenced by public comments from Black community leaders at the October 19, 2006, public meeting in Waynesboro, Georgia. The activities did not identify any additional groups of minority or low-income persons not already identified in the geographic information system analysis of census data.

2.10.3 Health Preconditions and Special Circumstances of the Minority and Low-Income Populations

The staff's outreach and scoping activity identified several special socioeconomic and health circumstances and potential pathways for disproportionate health and environmental impacts, which are analyzed in Sections 4.8, 4.9, 5.8, and 5.9. The staff gathered data on mortality statistics of the total and Black/African American populations in Burke County and Georgia's East Central Health District (ECHD), which includes 11 counties within the 80-km (50-mi) radius of the VEGP site. Data are shown in Table 2-25. Local mortality rate data are not available by income level.

Mortality rates for all causes of death are slightly higher in Burke County than in the state for both total population and for Blacks/African Americans. The age-adjusted mortality rate for all cancer-related deaths for the total population in Burke County is slightly higher than the state average. When examining cancer deaths for African-Americans, however, the mortality rate in Burke County is slightly lower than mortality rates for the ECHD and for the State of Georgia. In Burke County, the Black/African American population has a lower cancer-related mortality rate than the total population in this county; however, in many other places in the ECHD and in the state, the cancer-related mortality rate for Blacks/African Americans is higher relative to total population averages. Burke County has slightly higher age-adjusted mortality rates for respiratory and cardiovascular diseases for the total population and for Black/African American populations when compared to the same rates for the ECHD and the state.

(a) "Management Directive 3.5, Attendance at NRC Staff Sponsored Meetings," NRR Office Instruction COM-202 Rev1. Accession No. ML0518800110.

Table 2-25. Selected Health and Mortality Statistics for Minority and Total Population in Burke County, the ECHD, and the State of Georgia

	Burke County		East Central Health District[a]		Georgia	
	Total Population	Black/African-American Population	Total Population	Black/African-American Population	Total Population	Black/African-American Population
	Selected Causes of Death (age adjusted rates[b] per 100,000 population)					
All Causes	1190	1175	1034	1169	923	1072
Cancer	221	212	223	248	196	225
Respiratory Diseases	141	111	107	89	90	65
Major Cardiovascular Diseases	448	454	358	411	326	401

Source: Georgia Department of Human Resources 2007

(a) Includes the following Georgia counties: Burke, Columbia, Emanuel, Glascock, Jefferson, Jenkins, Lincoln, McDuffie, Richmond, Screven, Taliaferro, Warren, and Wilkes

(b) Age adjusted death rates are weighted averages of the age-specific mortality rates, where weights are the proportion of persons in the corresponding age groups of a standard population.

For each location (Burke County, ECHD, and the State of Georgia) examined, the respiratory disease-related mortality rates are lower for the Black/African-American populations than for total populations while the cardiovascular disease-related mortality rates were higher for African-American population than the total populations.

There is no evidence the Black/African-American population in Burke County is less healthy than other population subgroups, and would appear to be less likely to die of cancer than Black/African-American populations living in other parts of the state. There is no evidence in the health and mortality statistics of any environmental conditions that make the Black/African-American population exceptionally vulnerable in Burke County.

2.10.4 Migrant Populations

Migrant workers can be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers.

The U.S. Census Bureau 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. From an environmental justice perspective, there is a potential for such groups in some circumstances to be disproportionately affected by emissions in the environment. However, agricultural activities within the analytical area have traditionally

been concentrated on tobacco, corn, soy beans, and cotton. None of these products require the intensive application of migrant labor. In addition, none of the interviews produced any mention of migrant workers. Consequently, the staff determined there were no significant concentrations of migrant workers within the analytical area.

2.10.5 Environmental Justice Conclusion

The staff found low-income, Black, Hispanic, and aggregated minority populations that exceed the percentage criteria established for environmental justice analyses. Consequently, the staff performed additional analyses before making a final environmental justice determination. These analyses can be found in Chapter 4 of this EIS for construction effects, and in Chapter 5 for operational effects.

2.11 Related Federal Projects and Consultation

The staff reviewed the possibility that activities (e.g., dam construction) of other Federal agencies might impact the issuance of an ESP to Southern. 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 (10 CFR 51.10(b)(2)).

Federal lands within an 80-km (50-mi) radius of the VEGP site include the Savannah River Site, Sumter National Forest, and the U.S. Army Signal Center Fort Gordon. There are no wilderness areas or wild and scenic rivers within the region. Several Georgia and South Carolina State parks exist within the region. The closest Native American tribal reservations are more than 80 km (50 mi) from the VEGP site.

After reviewing the Federal activities in the vicinity of the VEGP site, the staff determined that there were no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparation of this EIS. By letter dated June 27, 2007, Southern submitted a license renewal application for VEGP Units 1 and 2 (Southern 2007f). The NRC staff has prepared a separate EIS (NRC 2008) for that licensing action. Federal actions related to this ESP include permits and licenses that may be required at the time of the construction permit (CP) or combined license (COL) application. Southern submitted a COL application to NRC on March 31, 2008 (Southern 2008d). Other Federal projects may become necessary at the CP or COL stage, such as transmission-related studies by FERC. However, these activities do not relate to the ESP. In summary, no other Federal activities or projects are associated with the proposed ESP for of the VEGP site.

The NRC is required under Section 102(2)(C) of NEPA to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EIS. During the course of preparing

this EIS, NRC consulted with the FWS and NOAA Fisheries. Contact correspondence is included in Appendix F.

2.12 References

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

36 CFR Part 297. Code of Federal Regulations, Title 36, *Parks, Forests and Public Property*, Part 297, "Wild and Scenic Rivers."

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."

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3.0 Site Layout and Plant Description

The site for the proposed Southern Nuclear Operating Company, Inc. (Southern) early site permit (ESP) is located in Burke County in rural Georgia, within the current Vogtle Electric Generating Plant (VEGP) boundary. The site is situated approximately 42 km (26 mi) southeast of Augusta, Georgia. This chapter describes the key site characteristics needed to assess the environmental impacts of the proposed action. The site layout and existing facilities are discussed in Section 3.1. The plant design and power transmission system are discussed in Sections 3.2 and 3.3, respectively, and the list of references cited is in Section 3.4.

3.1 External Appearance and Plant Layout

The existing VEGP site consists of two Westinghouse pressurized water reactors, a turbine building, a switchyard, water intake and discharge structures, and support buildings. The site is located on the Savannah River, about 241 river km (150 river mi) from the mouth of the Savannah River. Plant Wilson, a six-unit, oil-fueled combustion turbine facility built in 1974 and owned by the Georgia Power Company (GPC) is also located on the site. A radioactive waste disposal system, a fuel-handling system, the auxiliary structures, and other onsite facilities required for a complete nuclear power station are located on the VEGP site. The existing VEGP site development is shown in Figure 2-1. The existing VEGP Units 1 and 2 would not be changed. The ESP site is located in a previously disturbed area adjacent to the existing two units.

Southern states (Southern 2008) that the two new Westinghouse AP1000 reactors would share a river intake structure and certain support structures such as office buildings and water, wastewater, and waste-handling facilities. Each proposed Westinghouse AP1000 reactor would have a rated thermal power level of 3400 megawatts thermal (MW(t)) (Southern 2008). For the cooling system, Southern proposed natural draft cooling towers, in addition to mechanical draft service water system (SWS) cooling towers.

3.2 Plant Description

Southern has proposed adding two additional nuclear generating units at the VEGP site. The Westinghouse AP1000 NRC-certified plant design (Title 10 of the Code of Federal Regulations [CFR] Part 52, Appendix D) (Westinghouse 2003, 2005) was selected by Southern for the VEGP ESP application (Southern 2008). The planned location for the proposed Westinghouse AP1000 reactors, referred to as VEGP Units 3 and 4, would be west of and adjacent to the existing VEGP Units 1 and 2 (see Figure 3-1) (Southern 2008).

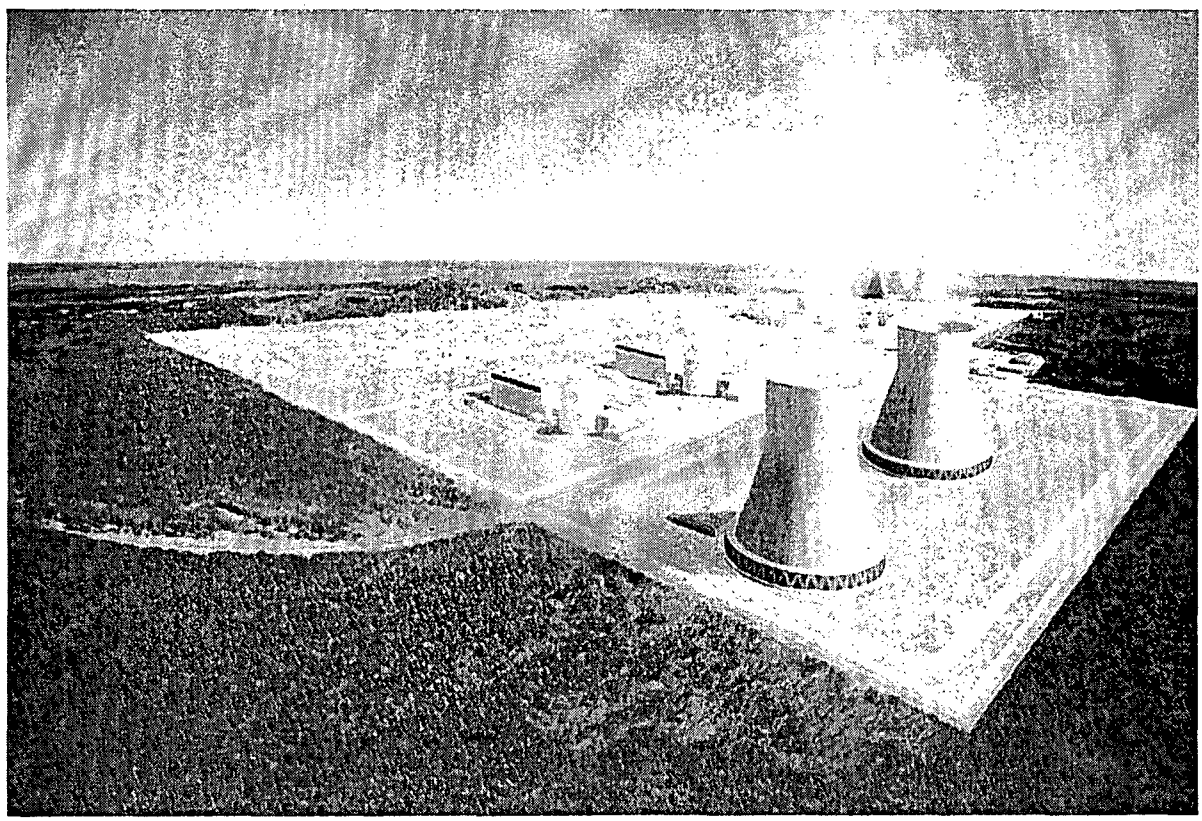

Figure 3-1. Artist's Conception of New Westinghouse AP1000 Units 3 and 4 (foreground) Located Adjacent to Existing VEGP

The AP1000 reactor design, which is based on Westinghouse pressurized water reactor technology, includes a single reactor pressure vessel, two steam generators, and four reactor coolant pumps for converting reactor thermal energy into steam. One high-pressure turbine and three low-pressure turbines drive a single electric generator. Figure 3-2 shows a flow diagram of the reactor power conversion system (Southern 2008). Each Westinghouse AP1000 unit is based on a "standalone" concept and consists of five principal generation structures: (1) the nuclear island, (2) the turbine building, (3) the annex building, (4) the diesel generator building, and (5) the radwaste building. Structures that make up the nuclear island include the containment building, the shield building, and the auxiliary building.

The Westinghouse AP1000 reactor has a thermal power rating of 3400 MW(t), with a net output of 1117 megawatts electrical (MW(e)). It uses uranium dioxide with a uranium enrichment of approximately 2.35 to 4.45 weight percent uranium-235 for the initial reactor core load and 4.51 weight percent uranium-235 for core reloads (Southern 2007a). The total fuel capacity is approximately 84.5 metric tons (93.1 tons) of uranium.

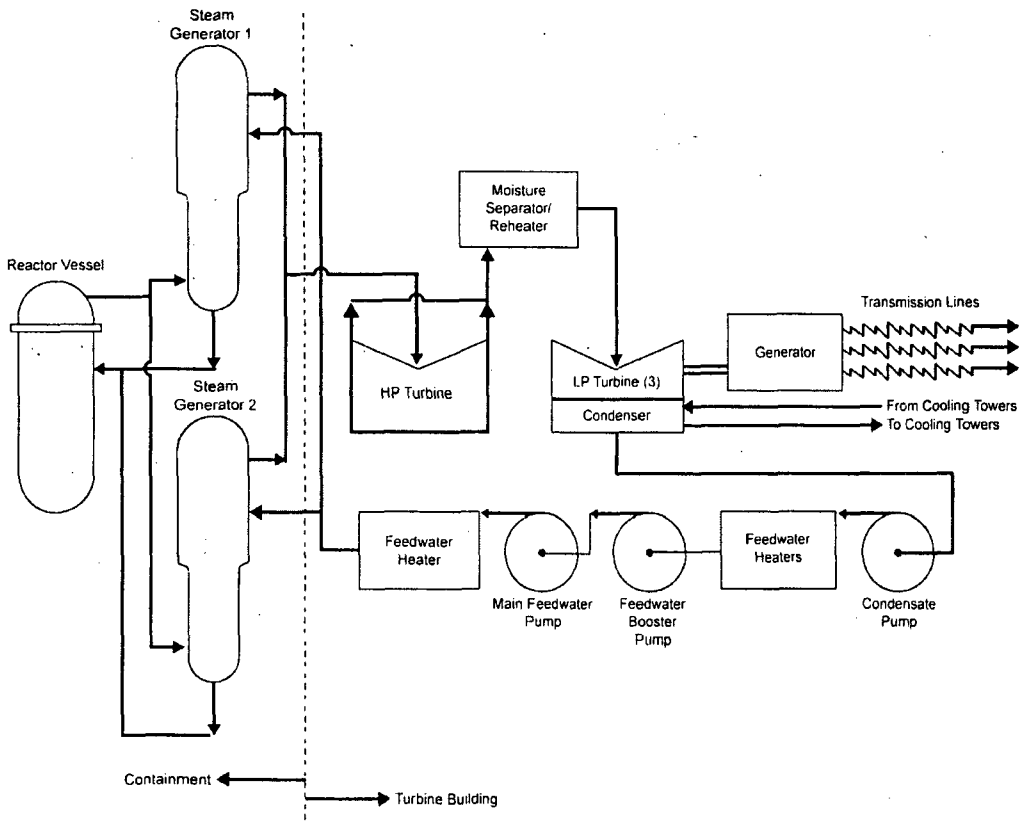

Figure 3-2. Simplified Flow Diagram of the Reactor Power Conversion System (Southern 2008)

The proposed cooling system for the new units includes one concrete natural draft hyperbolic cooling tower for each unit (see Figure 3-1). Each tower, which would be approximately 183 m (600 ft) tall, would be able to reject about 7.55×10^9 Btu/hr (2208 MW(t)) of waste heat to the atmosphere. Together, the two towers and their supporting facilities would require an area of 28.04 ha (69.3 ac). In addition to the natural draft cooling towers, the new units also would have SWS cooling towers. These mechanical draft cooling towers would be approximately 18 m (60 ft) high, would require an area of approximately 0.2 ha (0.5 ac) per unit, and would be located within the powerblock area. The unit thermal efficiency of the complete cycle would be approximately 35 percent. The new units would share common intake and discharge structures and certain support structures such as office buildings and water, wastewater, and waste-handling facilities (Southern 2008).

As noted in Southern's comments on the draft environmental impact statement (EIS) (Southern 2007a), Westinghouse, the AP1000 reactor vendor, has submitted a revision to the

AP1000 design to NRC for review (Westinghouse 2007; NRC 2008). The NRC staff is reviewing that design revision separately from the Vogtle ESP application. Changes in the reactor design that might have affects the environment different from the currently referenced certified design are noted in several locations in this EIS. However, the NRC staff has not completed its technical review of the requested design changes or completed a site-specific analysis of the revised design at the Vogtle site.

3.2.1 Plant Water Use

This section of the EIS describes plant water use based on the design parameter values provided by Southern in its Environmental Report (ER) (Southern 2008) and supplemented by additional information (Southern 2007a). At the ESP stage, the staff's review of the design parameters is limited to an evaluation of whether the parameter values are reasonable. At the construction permit (CP) or combined license (COL) stage, an applicant referencing the ESP is required to demonstrate that the specific plant design would fall within the design parameters in the ESP. The following sections describe both the consumptive and non-consumptive water uses of the proposed VEGP Units 3 and 4 and the associated plant water treatment systems.

3.2.1.1 Plant Water Consumption

This section describes power plant make-up water/water use consumption demands, and excludes those demands that are part of the normal cooling system (e.g., circulating water system [CWS]). Consumptive water demands associated with the normal cooling systems are discussed in Section 3.2.2 of this EIS.

The proposed VEGP Units 3 and 4 would have demands for demineralized, potable, and fire protection system water. Southern (2008) states that the normal combined water demands for these systems are as follows: demineralized water demand of 9.5 L/s (150 gpm), potable water demand of 2.65 L/s (42 gpm), fire suppression water demand of 0.6 L/s (10 gpm), and miscellaneous water demands (e.g., rinse water for the demineralization system filters) of 0.82 L/s (13 gpm). Southern (2008) also states that the maximum combined water demands for these systems are a demineralized water demand of 38 L/s (600 gpm), potable water demand of 8.8 L/s (140 gpm), fire-suppression water demand of 0.76 L/s (12 gpm), and miscellaneous water demands of 2.21 L/s (35 gpm). The fire suppression system would also provide a backup water supply for other systems, including the passive containment cooling system (Southern 2008). Following publication of the draft EIS, Southern advised NRC staff (Southern 2007c) that based on changes between Revision 15 and Revision 16 of the AP1000 DCD, some of these water demand values would change. The staff's evaluation of the effect of these changes on the staff's environmental impact conclusions is provided in Sections 5.3.3.2 and 7.3.1.2 of this EIS.

3.2.1.2 Plant Water Treatment

Southern discusses plant water treatment systems in its ER (Southern 2008). The water quality of effluents from any water treatment system would be regulated by the Georgia Department of Natural Resources (GDNR) via a National Pollutant Discharge Elimination System (NPDES) permit.

The potable water system would be supplied from groundwater wells, and one system may supply both VEGP Units 3 and 4. A disinfection system would be used; however, it is not known at this time if additional treatment systems, such as filtration or corrosion control, would be needed (Southern 2008).

Water for the demineralized water system would be drawn from groundwater wells. The groundwater would be treated via both reverse osmosis and an electro-deionization/mixed-bed system to remove solids, salts, organic compounds, dissolved gaseous carbon dioxide, and the majority of the ions in the water. These treatment processes would produce a stream of purified water that would then be distributed to a number of plant systems.

Groundwater supplying the fire protection system would be filtered through strainers, as needed, to prevent system fouling. Southern anticipates that the groundwater would be of sufficient quality to not require straining, disinfection, or other treatment; however, treatment needs would be evaluated and implemented as appropriate (Southern 2007a, 2008).

3.2.2 Cooling System

The following sections provide detailed descriptions of the operational modes and the components of the cooling water systems for the proposed VEGP Units 3 and 4. These descriptions were determined from the Westinghouse *AP1000 Design Control Document* (Westinghouse 2005), and included site-specific characteristics (Southern 2008).

3.2.2.1 Description of Operational Modes

The following sections describe the cooling systems under normal operating conditions and emergency/shutdown conditions for the proposed VEGP Units 3 and 4. A general diagram of the cooling water flow is shown in Figure 3-3.

Circulating Water System

Waste heat is a by-product of normal power generation at a nuclear power plant. During normal plant operation, the CWS of each unit would dissipate up to 7.55×10^9 Btu/hr of waste heat (Southern 2008). The CWS comprises a closed-cycle wet cooling system to transfer heat from the main condenser, the turbine building closed-cycle cooling water heat exchangers, and the condenser vacuum pump seal water heat exchangers to one natural draft cooling tower per unit.

Excess heat in the cooling water is then transferred to the atmosphere by evaporative and conductive cooling in the cooling tower. During the heat dissipation process, evaporation of water increases the concentration of dissolved solids in the cooling water system. To limit the concentration of dissolved solids, a portion of the water is continuously discharged from the system as blowdown. In addition to blowdown and evaporative losses, a small percentage of water is also lost in the form of droplets (drift) from the cooling towers.

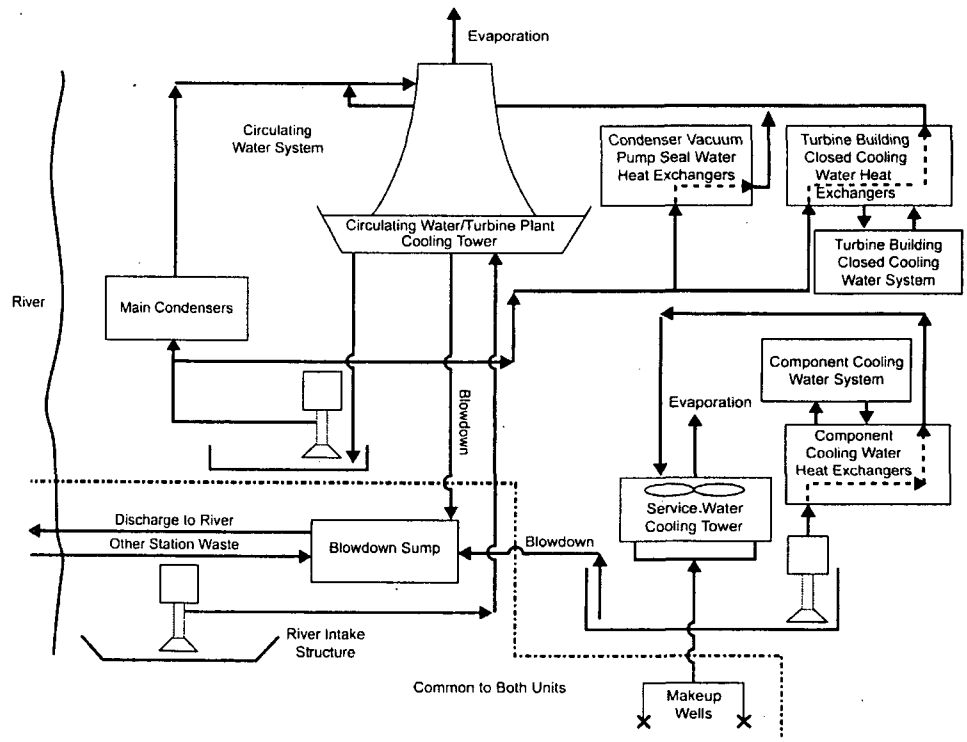

Figure 3-3. General Cooling System Flow Diagram (Southern 2008)

Southern (2008) states that water pumped from the Savannah River would be used to make up water lost to the system by evaporation, blowdown, and drift. Blowdown water would be directed to a common CWS blowdown sump. Water from the blowdown sump would be retained for a brief holdup period to allow dechlorination before the water is discharged to the Savannah River (Southern 2008). Consistent with Vogtle Units 1 and 2 operation, no significant total suspended solids impact is foreseen in cooling tower blowdown (Southern 2007a). Southern (2008) provided the following normal operation water fluxes for the CWS (all values assume two reactor units):

- The normal make-up water flow rate would be 2348.47 L/s (37,224 gpm).
- The normal consumptive water use rate (evaporation and drift) would be 1761.73 L/s (27,924 gpm).

- The normal blowdown rate would be 586.74 L/s (9,300 gpm).

Southern (2008) also provided the following bounding water fluxes for the CWS (all values assume two reactor units):

- The maximum make-up water flow rate would be 3645.60 L/s (57,784 gpm).
- The maximum consumptive water use rate (evaporation and drift) would be 1823.56 L/s (28,904 gpm).
- The maximum blowdown rate would be 1822.04 L/s (28,880 gpm).

Following publication of the draft EIS, Southern advised NRC staff (Southern 2007c) that based on changes between Revision 15 and Revision 16 of the AP1000 DCD, some of these water flux values would change. The staff's evaluation of the effect of these changes on the staff's environmental impact conclusions is provided in Sections 5.3.3.1 and 7.3.1.1 of this EIS.

Service Water System

The non-safety-related SWS provides cooling water to the component cooling water heat exchangers located in the turbine building (Southern 2008). The closed-cycle cooling system uses mechanical draft cooling towers to dissipate waste heat during normal operations, refueling, shutdown, and other operational events. Excess heat in the cooling water is then transferred to the atmosphere. During the heat dissipation process, evaporation of water increases the concentration of dissolved solids in the cooling water system. To limit the concentration of dissolved solids, a portion of the water is continuously discharged from the system as blowdown.

Southern (2008) states that groundwater would be used to make up water lost by the SWS to evaporation, blowdown, and drift. Blowdown water would be directed to a common blowdown sump, and water from the sump ultimately would then be discharged to the Savannah River. An option also exists to discharge the SWS blowdown to the CWS basin (Southern 2008). Southern provided the following normal operation water fluxes for the SWS (Southern 2008) (all values assume two reactor units):

- The normal make-up water flow rate from groundwater would be 33.88 L/s (537 gpm).
- The normal consumptive water-use rate (evaporation and drift) would be 25.43 L/s (403 gpm).
- The normal blowdown rate would be 8.45 L/s (134 gpm).

Southern also provided the following bounding water fluxes for the SWS (Southern 2008) (all values assume two reactor units):

- The maximum make-up water flow rate from groundwater would be 148.5 L/s (2353 gpm).

- The maximum consumptive water-use rate (evaporation and drift) would be 76.26 L/s (1177 gpm).
- The maximum blowdown rate would be 74.19 L/s (1176 gpm).

Following publication of the draft EIS, Southern advised NRC staff (Southern 2007c) that based on changes between Revision 15 and Revision 16 of the AP1000 DCD, some of these water demand values would change. The staff's evaluation of the effect of these changes on the staff's environmental impact conclusions is provided in Sections 5.3.3.2 and 7.3.1.2 of this EIS.

Ultimate Heat Sink

The ultimate heat sink (UHS) cooling system is a tank filled with approximately 3.55 million L (780,000 gal) of demineralized water (Southern 2008). The tank is situated on top of the containment structure, so the water can be released to form a water film over the containment dome and side walls should an accident occur. The water from the tank flows passively; therefore, an active external safety-related UHS system is not needed to achieve safe shutdown of the reactor. The tank has no other plant function and, once filled, requires only minimal additions of demineralized water to compensate for minor evaporative losses.

3.2.2.2 Component Descriptions

The following sections describe the intake, cooling water treatment, discharge, and heat dissipation systems for the proposed VEGP Units 3 and 4. Pursuant to Section 316(a) and 316(b) of the Clean Water Act (33 USC 1251), an applicant for a CP or COL who references an ESP for the site would be required to obtain approval from the GDNR by documenting the plant design and conducting a site-specific analysis regarding impacts of the thermal discharges and operation of the intake system on the aquatic environment of the Savannah River.

Intake System

The proposed VEGP Units 3 and 4 would use a common river intake structure to obtain make-up water for the CWS. The proposed location of the intake structure, which is shown in Figure 2-1, is located on the southeast bank of the Savannah River, just upstream of the existing river intake. The intake canal would be approximately 73 m (240 ft) long and 52 m (170 ft) wide, and would have an earthen bottom at an elevation of 21 m (70 ft) above mean sea level (MSL) (Southern 2008). The intake structure would be located at the end of the intake canal and would contain three pump bays for each unit. The maximum total pump rate for all six pump bays would be 3645.6 L/s (57,784 gpm) (Southern 2008). The normal operation total pump rate for all bays would be 2348.47 L/s (37,224 gpm) (Southern 2008). Each pump bay

would contain one traveling screen and trash rack to prevent debris from entering the intake pumps. Diagrams of the proposed intake structure are shown in Figures 3-4 and 3-5.

Following publication of the draft EIS, Southern advised NRC staff (Southern 2007c) that based on changes between Revision 15 and Revision 16 of the AP1000 DCD, some of these water demand values would change. The staff's evaluation of the effect of these changes on the staff's environmental impact conclusions is provided in Sections 5.3.3.1 and 7.3.1.1 of this EIS.

Cooling Water Treatment System

Southern states in its ER that make-up water used in the CWS would be treated to control biofouling, corrosion, scaling, and deposition of solids (Southern 2008). Biocides would be injected at the intake structure, and other chemicals may be added to the cooling water basins. Likewise, the SWS make-up water may also be treated; however, because this water originates from groundwater sources, significant water treatment may not be necessary (Southern 2007a, 2008). The water quality of the effluents from either the CWS or SWS would be regulated by the State of Georgia via an NPDES permit.

Discharge System

A common sump would collect wastewater from the CW blowdown, the SWS blowdown, and the treated sanitary waste systems (Southern 2008). The collected waste would then be discharged to the Savannah River approximately 120 m (400 ft) downstream of the existing discharge pipe terminus (Southern 2008). Figure 2-1 shows the location of the discharge pipe; diagrams of the discharge pipes are shown in Figures 3-6 and 3-7.

The normal operation flow rate from the new discharge pipe to the Savannah River would be 606.17 L/s (9608 gpm), with the CWS blowdown contribution being 586.74 L/s (9300 gpm) (Southern 2008). The maximum flow rate from the new discharge pipe to the Savannah River would be 1940.72 L/s (30,761 gpm) (Southern 2008). The CWS blowdown water would be the major contributor to the total discharge with a maximum flow rate of 1822.04 L/s (28,880 gpm) (Southern 2008) and a maximum calculated discharge temperature to the Savannah River would be 33.1°C (91.5°F) (Southern 2008). The water quality of all effluents discharged to the Savannah River would be regulated by the State of Georgia via an NPDES permit, and would need to meet established discharge limits on both the quantity of the waste and the quality/ concentration of each constituent pollutant.

Following publication of the draft EIS, Southern advised NRC staff (Southern 2007c) that based on changes between Revision 15 and Revision 16 of the AP1000 DCD, some of these flow rate values would change. The staff's evaluation of the effect of these changes on the staff's environmental impact conclusions is provided in Sections 5.3.3.1 and 7.3.1.1 of this EIS.

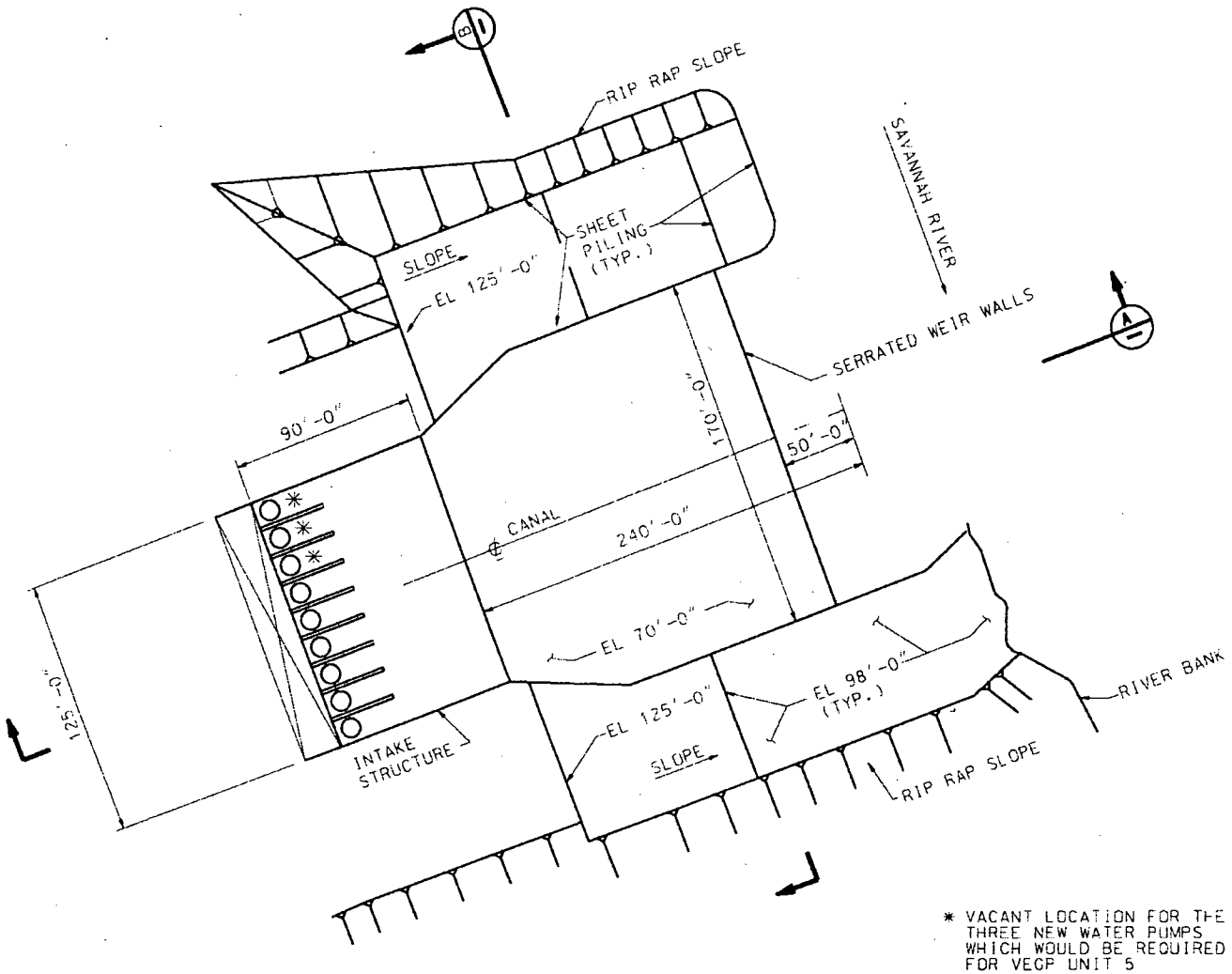

Figure 3-4. Plan View of River Intake System (Southern 2008)

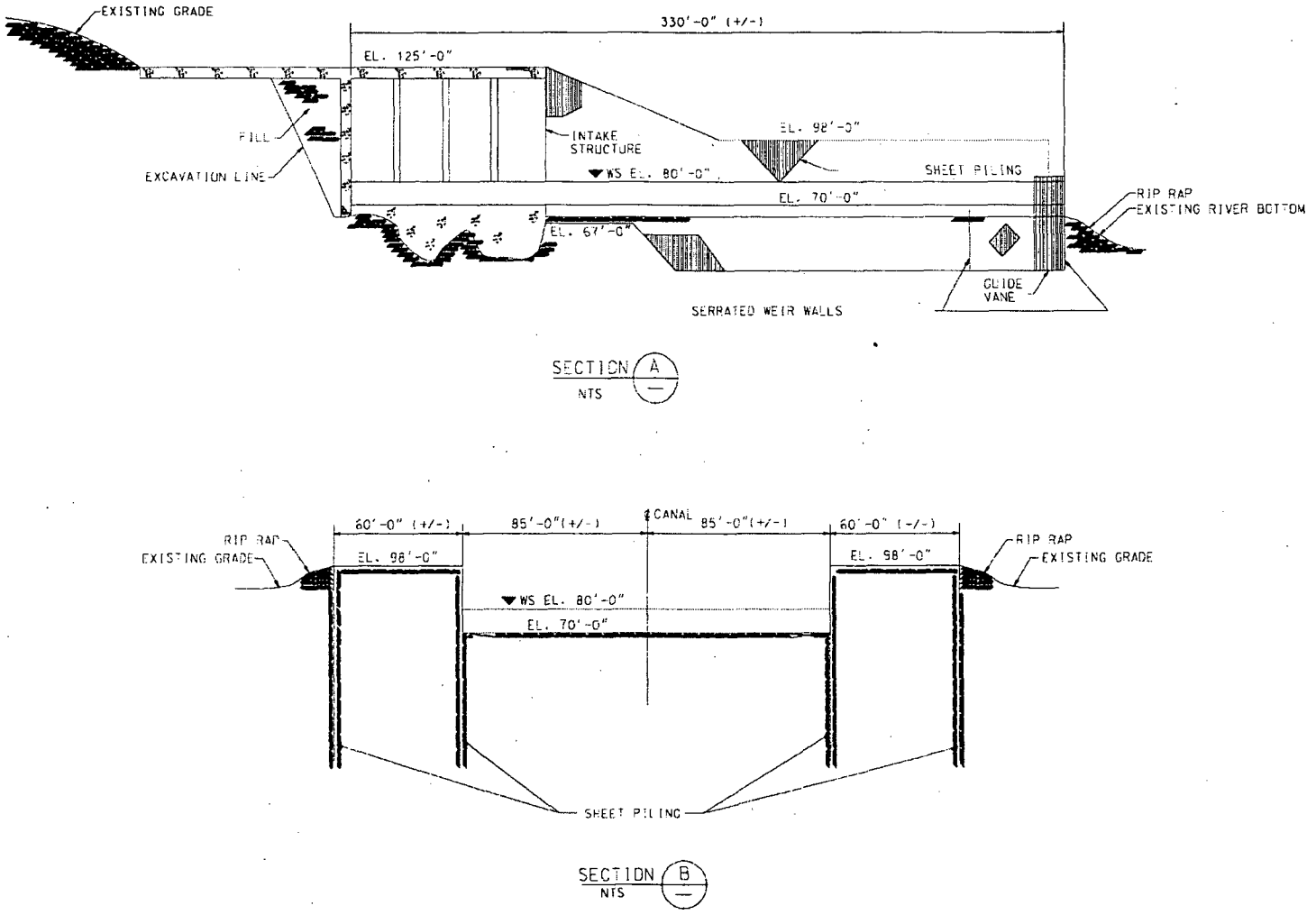

Figure 3-5. Section View of River Intake System (Southern 2008)

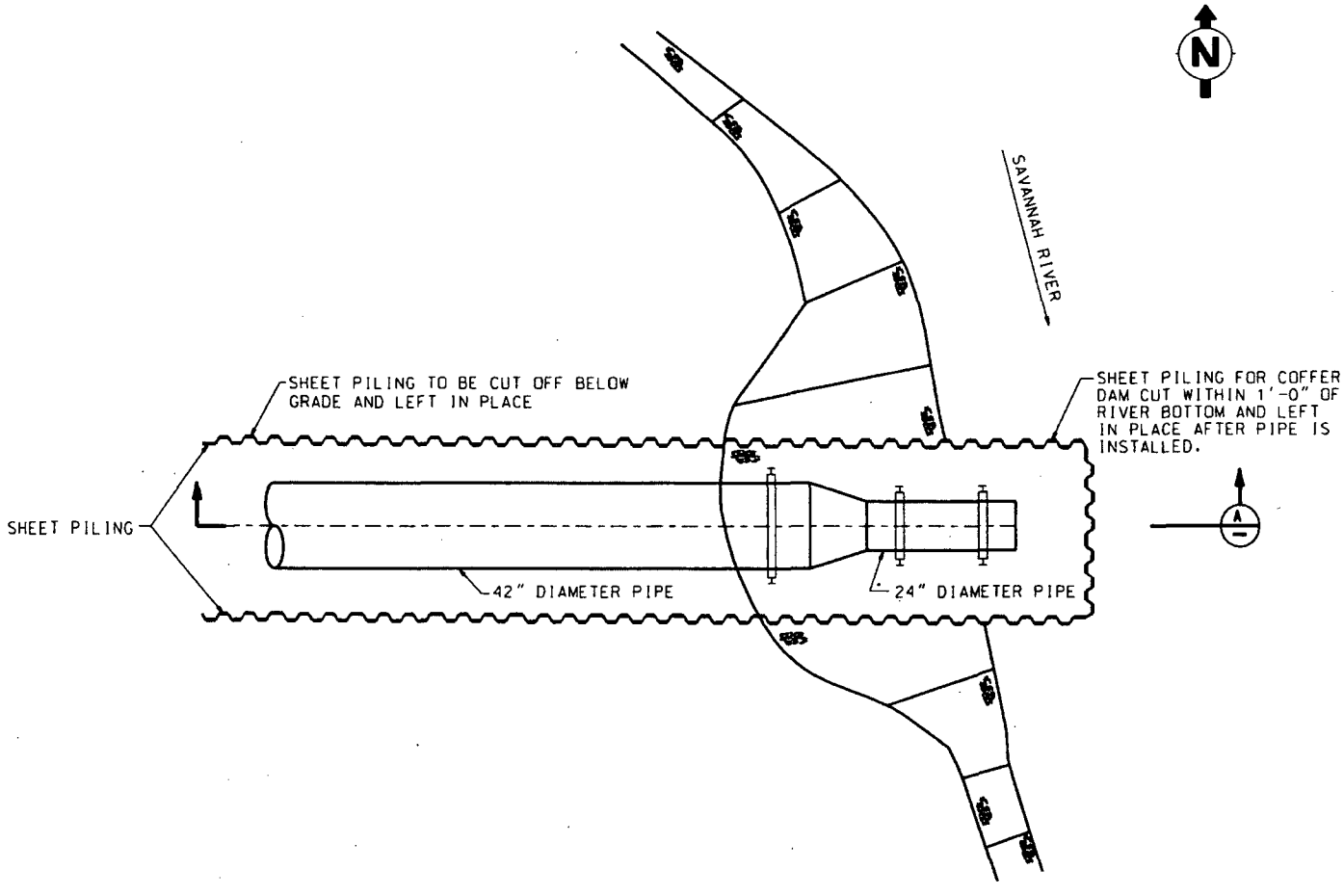

Figure 3-6. Plan View of New Discharge Outfall for the Discharge System (Southern 2008)

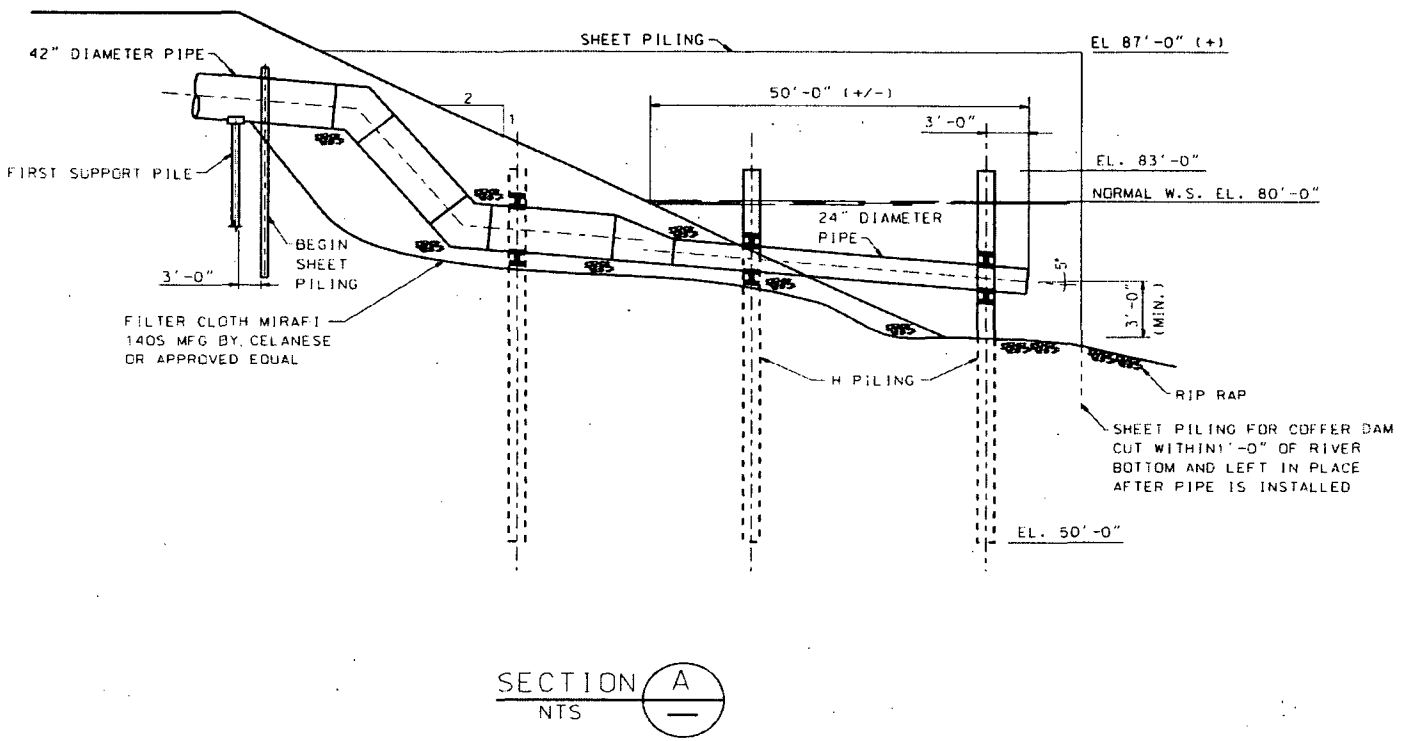

Figure 3-7. Section View of New Discharge Outfall for the Discharge System (Southern 2008)

Heat Dissipation System

The proposed VEGP Units 3 and 4 would have several different heat dissipation systems. The largest heat load would be dissipated by the normal heat sink that cools the CWS. The heat dissipation system would consist of one natural draft hyperbolic cooling tower per unit (i.e., two cooling towers would be constructed for the proposed VEGP plant). The SWS waste heat would be dissipated using mechanical draft cooling towers. The UHS for the proposed ESP plant incorporates a passive design, so it does not require a cooling tower. Instead, evaporated water exits the containment through a plenum located between the steel containment and concrete wall of the shield building, and eventually exhausts to the atmosphere via a shield building chimney (Southern 2008).

3.2.3 Radioactive Waste-Management System

Liquid, gaseous, and solid radioactive waste-management systems would be used to collect and treat the radioactive materials produced as by-products of operating the proposed VEGP Units 3 and 4. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as reasonably achievable 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 light-water 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 escape the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system would also be responsible for coolant contamination.

The description of the radioactive waste management system provided in the ER is sufficient for an environmental review of the ESP application; however, Southern did not identify specific radioactive waste-management systems for the new units on the VEGP site, thus deferring analysis of the radioactive waste-management system to the CP or COL stage. The description provided by Southern is based on information in the *AP1000 Design Control Document* (Westinghouse 2005). Solid radioactive wastes produced from operating the proposed VEGP Units 3 and 4 would be either dry or wet solids. The solid-waste-management system would receive, collect, and store solid wastes prior to onsite storage or shipment offsite. Bounding liquid and gaseous effluent releases were not provided by Southern; however, Southern did provide information on normal liquid and gaseous effluent releases along with solid waste activities (Southern 2008). The bounding total annual volume of solid radioactive waste shipped

is estimated at 162 m^3/yr (5717 ft^3/yr) with an expected total amount of radioactive material activity of 6.527×10^{13} Bq/yr (1764 Ci/yr) (Southern 2008a).

3.2.3.1 Liquid Radioactive Waste-Management System

The liquid radioactive waste-management system functions to control, collect, process, handle, store, and dispose of liquids containing radioactive material. This is managed using several process trains consisting of tanks, pumps, ion exchangers, and filters. The system is designed to handle both normal and anticipated operational occurrences. Normal operations include processing of (1) reactor coolant system effluents, (2) floor drains and other wastes with potentially high suspended solid contents, (3) detergent wastes, and (4) chemical wastes. In addition, the radioactive waste-management system can handle effluent streams that typically do not contain radioactive material, but that may, on occasion, become radioactive (e.g., steam generator blowdown as a result of steam generator tube leakage). With two exceptions, liquid effluents processed through the liquid radioactive waste-management system are discharged to the environment. The exceptions are steam generator blowdown that is normally returned to the condensate system after processing and reactor coolant that can be degassed prior to reactor shutdown and returned to the reactor coolant system.

3.2.3.2 Gaseous Radioactive Waste-Management System

The gaseous radioactive waste-management system functions to collect, process, and discharge radioactive or hydrogen-bearing gaseous wastes. This is managed using a once-through, ambient-temperature, activated-carbon delay system. 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 and subsequently decay to stable isotopes, are released to the environment via plant ventilation, or are captured and then released by the gaseous radioactive waste-management system. In addition, various gaseous activation products, such as argon-41, are formed directly in the reactor coolant during operation. The gaseous radioactive waste-management system is typically active only when gaseous concentrations are observed to reach a given threshold. The gaseous system cannot collect noble gases, so if noble gases are monitored to reach a threshold value, the reactor coolant system is diverted to the liquid radioactive waste-management system that can collect noble gases using the degasifier.

3.2.3.3 Solid Radioactive Waste-Management System

The solid radioactive waste-management system functions to treat, store, package, and dispose of dry or wet solids. This is managed with the same process used to treat, store, and dispose of solid radioactive waste at currently operating VEGP Units 1 and 2. The solid radioactive wastes include spent ion exchange resins, deep bed filtration media, spent filter cartridges, dry active wastes, and mixed wastes. The system is designed to handle both normal and anticipated

operational occurrences (Southern 2008). There are no onsite facilities for permanent disposal of solid wastes. Prior to being shipped to a licensed disposal facility, packaged wastes would be temporarily stored in a radioactive waste storage facility planned for construction east of the existing cooling towers (Southern 2007a).

3.2.4 Nonradioactive Waste Systems

The following sections provide descriptions of the nonradioactive waste systems proposed for the VEGP site, including systems for chemical, biocide, sanitary, and other effluents.

3.2.4.1 Effluents Containing Chemicals or Biocides

Water withdrawn from the Savannah River for use in the CWS would be treated with both biocides and chemicals (Southern 2008). The biocides would be used to control biofouling of the CWS, and chemicals would be added to control scaling, corrosion, and solids deposition (Southern 2008). Depending on the intended use, groundwater would be treated with chemicals and/or biocides (Southern 2008). Southern provided a representative list of chemicals or biocides that may be used in the proposed VEGP Units 3 and 4. These chemicals include sodium hypochlorite, sodium bromide, ammonium bisulfite, tolytriazole, and polymers that control corrosion or that act as a dispersant (Southern 2007b). Southern states that a GDNR-issued NPDES permit for the VEGP site would limit the volume and concentration of these discharges (Southern 2008).

3.2.4.2 Sanitary System Effluents

A treatment system for sanitary waste currently is operated on the VEGP site to dispose of waste from the VEGP site. This treatment system would be expanded to accommodate the additional waste stream associated with the proposed VEGP Units 3 and 4 (Southern 2008). Discharges from this plant would be controlled in accordance with a GDNR-issued NPDES permit. Southern states that the normal sanitary-waste discharge rate would be 2.65 L/s (42 gpm), and the maximum discharge rate would be 8.8 L/s (140 gpm) (Southern 2008).

3.2.4.3 Other Effluents

Nonradioactive gaseous emissions result from testing and operating the standby diesel generators. Emissions from the generators include particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides. Gaseous releases would comply with levels permitted by the GDNR (Southern 2008).

Nonradioactive liquid effluents from laboratory drains, equipment decontamination, and chemical additives would be collected in liquid waste sumps or approved chemical storage units. Oily waste would be removed via an oil/water separator and sent to a waste storage tank prior to shipment offsite for disposal (Southern 2008). Liquid effluent not containing oily waste

would be monitored, treated, and discharged to the Savannah River as allowed under an NPDES permit issued by the GDNR (Southern 2008). No liquid waste would be discharged to groundwater (Southern 2008).

Nonradioactive solid wastes would be disposed of in accordance with applicable regulations. At present, a private industrial landfill permitted by GDNR is located on the VEGP site near the location of the proposed switchyard for VEGP Units 3 and 4. During construction, the landfill would either be relocated onsite, or the material would be removed and disposed in an offsite permitted facility (Southern 2008). Nonradioactive resins and sludge would be disposed of in a permitted industrial landfill, and putrescible wastes would be disposed of in a permitted offsite facility (Southern 2008). Recyclable solid waste materials generated on the VEGP site, such as scrap metal, used oil and antifreeze, office paper, and aluminum cans, would be collected for recycling or recovery (Southern 2008).

Nonradioactive hazardous wastes would be stored temporarily onsite and periodically disposed of at a permitted disposal facility (Southern 2008). These wastes are regulated under the Resource Conservation and Recovery Act, and all hazardous wastes activities would be performed in compliance with all applicable regulations (Southern 2008).

3.3 Power Transmission System

As discussed in Section 2.2.2 of this EIS, the VEGP site is connected to the regional power grid via two 500-kV transmission lines and four 230-kV transmission lines in four rights-of-way. Information on the dimensions of each existing transmission line right-of-way is provided in Section 2.2.2. The transmission lines are operated by the GPC, which is a wholly owned subsidiary of Southern Company. Southern Nuclear Operating Company, Inc. also is a wholly owned subsidiary of Southern Company.

One new 500-kV transmission line would be constructed to handle the power generated by the proposed VEGP Units 3 and 4. The proposed new transmission line would be routed from the VEGP site to the Thomson-Vogtle substation west of Augusta, Georgia. This substation would be upgraded to contain a 500-kV bus by the time the connection is made (Southern 2008). Although the precise route of the new transmission line had not yet been determined, GPC prepared a routing study (GPC 2007). Routing information, transmission line dimensions, and land-use characteristics in the planned route are discussed in Section 4.1.2 of this EIS. In conjunction with selecting a final route, the GPC would consult with appropriate State and Federal agencies, including the Georgia State Historic Preservation Officer, the U.S. Fish and Wildlife Service, the GDNR, and the U.S. Army Corps of Engineers (Southern 2008).

Currently, all of the GPC's 500-kV transmission lines are supported by steel, lattice-type towers designed to provide clearances consistent with the National Electrical Safety Code and the

GPC's engineering standards. At a minimum, all clearances would equal or exceed 13.7 m (45 ft) phase-to-ground. For 500-kV transmission lines, the GPC uses a three-subconductor-per-phase system with two overhead ground wires. All towers are grounded with either ground rods or a counterpoise system. Any new transmission lines would be constructed using the same standards. No transmission line tower would be higher than 60 m (200 ft) above the ground surface (Southern 2008).

3.4 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

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Westinghouse Electric Company, LLC (Westinghouse). 2005. *AP1000 Design Control Document.* AP1000 Document. APP-GW-GL-700, Revision 15, Westinghouse Electric Company, Pittsburgh, Pennsylvania.

Westinghouse Electric Company, LLC (Westinghouse). 2007. *AP1000 Design Control Document.* AP1000 Document. APP-GW-GL-700, Revision 16, May 26, 2007, Westinghouse Electric Company, Pittsburgh, Pennsylvania.

4.0 Construction Impacts at the Proposed Site

This chapter examines the environmental issues associated with potential site-preparation activities and construction of proposed new Units 3 and 4 at the Vogtle Electric Generating Plant (VEGP) as described in the application for an early site permit (ESP) submitted by Southern Nuclear Operating Company, Inc. (Southern). As part of its application, Southern submitted an Environmental Report (ER) and a site redress plan (Southern 2008a). The ER provides information used as the basis for the environmental review. The site redress plan allows for specific construction activities to be conducted with approval of an ESP. Those construction activities evaluated for the proposed site, designated the VEGP site, are those defined by Title 10 of the Code of Federal Regulations (CFR), 50.10(a). In the event that the ESP is approved and Southern conducts those construction activities but does not build the new units, Southern would be required to implement its site redress plan.

As mentioned above, the staff analyzes the impacts of construction and operation of the proposed action in Chapters 4 and 5, and discusses cumulative impacts in Chapter 7. As a result of the NRC's recent new rule on the limited work authorizations for nuclear power plants (see 72 FR 57416), the definition of construction activities in 10 CFR 50.10 has changed to more clearly reflect the NRC's jurisdiction. The staff's draft EIS for the VEGP ESP review was published prior to the issuance of the final rule. To reflect the effects of the new rule, site preparation and preconstruction activities would most appropriately be analyzed in the staff's EIS as cumulative impacts rather than as impacts of construction or operation of the proposed facility. However, in this instance, to ensure appropriate consideration of public comments on the draft EIS and avoid confusion from reorganizing the document following those comments, the staff will keep discussions of such impacts (e.g., those no longer defined by regulation as construction activities) in the chapters in which they were discussed in the draft EIS. While the staff's analysis of construction activities in the draft EIS and its discussion of cumulative impacts are different, they are generally at a similar depth of analysis. The staff believes this approach will allow effective consideration of public comments while still ensuring that impacts relevant to the NEPA analysis are disclosed and fully evaluated.

In Sections 4.1 through 4.9 of this chapter, the U.S. Nuclear Regulatory Commission (NRC) staff evaluates the potential impacts on land use; meteorology and air quality; water use and quality; terrestrial and aquatic ecosystems; socioeconomics; historic and cultural resources; environmental justice; nonradiological and radiological health effects; and applicable measures and controls that would limit the adverse impacts of station construction. In accordance with 10 CFR Part 51, impacts have been analyzed, and a significance level – SMALL, MODERATE or LARGE – of potential adverse impacts has been assigned to each analysis. In the socioeconomic area where the impacts of taxes are assessed, the impacts may be considered

beneficial and are stated as such. Possible mitigation of adverse impacts, where appropriate, is presented in Section 4.10, followed by a description of Southern's site redress plan in Section 4.11. A summary of the construction impacts is presented in Section 4.12. Full citations for the references cited in this chapter are listed in Section 4.13. As noted above, cumulative impacts of construction and operation are discussed in Chapter 7. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 10 and 11.

The staff relied on the mitigation measures and the required Federal, State, and local permits and authorizations presented in the ER in reaching its conclusion on the significance level of the adverse impacts. The staff relied on the infrastructure upgrades planned by the counties, cities, and towns, such as road and school expansions, in assigning significance levels to the impacts. Failure to implement such infrastructure upgrades may result in larger impact levels.

4.1 Land-Use Impacts

This section provides information on land-use impacts associated with site-preparation activities and construction of the proposed Units 3 and 4 at the VEGP site. Topics discussed include land-use impacts at the VEGP site and in the vicinity of the site and land-use impacts in transmission line rights-of-way and offsite areas.

4.1.1 The Site and Vicinity

The VEGP site is located entirely within the existing VEGP site where no zoning regulations currently apply.

All site-preparation and construction activities for the proposed VEGP Units 3 and 4, including ground-disturbing activities, would occur within the existing VEGP site boundary (Southern 2008a). The area that would be affected on a long-term basis as a result of permanent facilities at the site is approximately 131 ha (324 ac). An additional approximately 94 ha (232 ac) would be disturbed for temporary facilities and spoils storage (Southern 2008b). The 12.5-ha (31-ac) potential borrow area would be adjacent to and northwest of the proposed road to the Unit 3 and 4 intake structure (Southern 2008b).

No new railroad lines to support the construction of VEGP Units 3 and 4 are planned; however, three new roads would be constructed. A heavy-haul road would be constructed from the barge slip on the Savannah River to the construction site. A construction access road would be constructed from River Road near the rail spur crossing. A third new road would be constructed to the new intake structure (Southern 2008a). The 500-kV Thalmann transmission line would be rerouted on the VEGP site to avoid the footprint of the planned new units. An existing landfill on the VEGP site (Landfill #3) would be relocated onsite or the materials would be removed and disposed in an offsite disposal facility.

Clearing and removal of trees growing within the VEGP site would be required. No agricultural lands would be directly affected by construction activities. Borrow material would be taken from the excavation for the powerblock and switchyard for the proposed VEGP Units 3 and 4 (Southern 2007a). Areas for soil storage are shown in Figure 2-1.

A few small wetland areas and three small unnamed streams exist on the VEGP site (Figure 2-1). Southern intends to avoid watercourses and wetlands to the extent possible during construction. Any work that has the potential to impact a wetlands area would be performed in accordance with applicable State and Federal regulatory requirements.

The cooling water intake structure (CWIS) and discharge structure for the proposed VEGP Units 3 and 4 (Figure 2-1) would be located in the Savannah River floodplain. The barge slip, also located in the Savannah River floodplain, would be expanded. All other construction activities would be outside the 500-year floodplain (Southern 2008a). Some dredging in the Savannah River would be needed for a passage from the main channel of the river to the barge slip to accommodate movement of heavy equipment and components to the site by barge. Dredging would also be needed to enlarge the barge slip. Dredge material would be removed and transported to a spoils area, as shown in Figure 2-1, for disposal. Dredging activities for the barge slip would require a permit from the U.S. Army Corps of Engineers (USACE).

A few offsite land-use changes in the vicinity of the VEGP site would be expected as a result of construction activities. For example, a recreational vehicle park and store within 10 km (6 mi) of the VEGP site operated during construction of VEGP Units 1 and 2 and could reopen during construction of VEGP Units 3 and 4. Additional information on roads, housing, and construction-related infrastructure impacts can be found in Sections 4.5.1.3, 4.5.4.3, and 4.5.4 respectively.

Based on information provided by Southern, the site redress plan, and NRC's own independent review, the staff concludes that there are no significant environmental impacts related to land use that would influence the granting of an ESP to Southern for the VEGP site. The staff concludes that the land-use impacts of construction would be SMALL, and further mitigation is not warranted.

4.1.2 Transmission Line Rights-of-Ways and Offsite Areas

Southern and Georgia Power Company (GPC) plan a new 500-kV transmission line to serve the proposed new units at the VEGP site. VEGP Units 3 and 4 would use the new transmission line or some combination of the new and existing transmission lines. The new transmission line right-of-way would be routed northwest from the VEGP site, passing west of Fort Gordon, a U.S. Army facility west of Augusta, Georgia, and then north to the Thomson substation. The Thomson substation is located about 32 km (20 mi) west of Augusta, Georgia. The transmission line right-of-way would be approximately 46 m (150 ft) wide and approximately

97 km (60 mi) long (Southern 2007b). The new transmission line would require approximately 390 towers (Southern 2008a). Each tower would require foundation excavations.

Transmission line siting in Georgia is regulated under Title 22 of the Georgia Code. Although the precise route for the planned new transmission line has not yet been determined, the area where the new transmission line right-of-way would be sited is shown in Figure 4-1. Land use for a representative route within the approximate right-of-way is shown in Table 4-1 (GPC 2007).

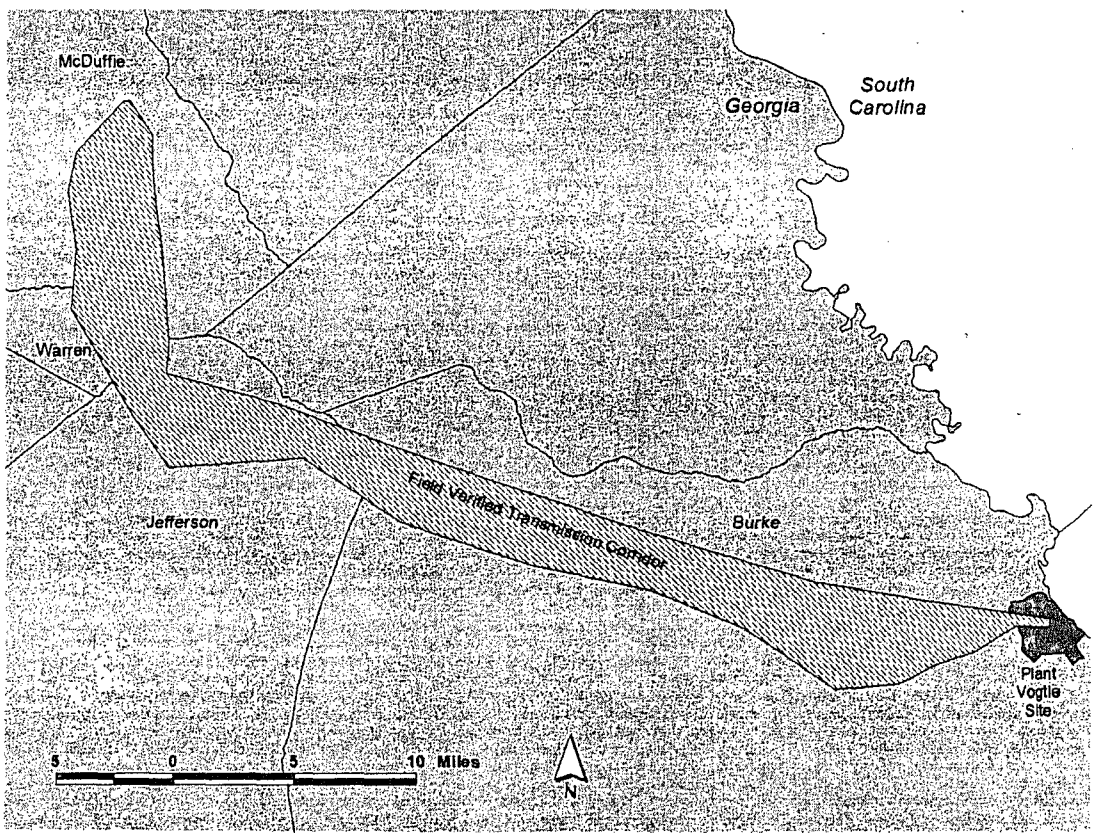

Figure 4-1. Approximate Siting of the Planned New Transmission Line Right-of-Way (GPC 2007)

Table 4-1. Existing Land Uses in Planned New Transmission Line Right-of-Way

Land Use	Percentage
Forested	23.3
Open land	15.3
Open water	0.6
Planted pine	32.0
Mine/Quarry	1.0
Residential	0.5
Transportation	5.6
Utility	7.1
Row crop	14.6

Source: GPC 2007

In siting the new transmission right-of-way, the GPC would consult with the Georgia State Historic Preservation Officer (SHPO), the U.S. Fish and Wildlife Service (FWS), the Georgia Department of Natural Resources (GDNR), and the USACE (Southern 2008a). In siting new transmission lines, GPC has indicated a number of areas to be avoided, if possible, including buildings, mines, airports, military facilities, park and wetlands (GPC 2007). In the event that wetlands are disturbed, construction would be conducted in accordance with necessary State and Federal permits to protect wetland areas (Southern 2008a).

Based on information provided by Southern and the GPC and NRC's own independent review, the staff concludes that the land-use impacts of constructing an additional transmission line to serve the VEGP site would be MODERATE.

4.2 Meteorological and Air-Quality Impacts

Sections 2.3.1 and 2.3.2 describe the meteorological characteristics and air quality of the site. The primary impacts of construction of a new unit on local meteorology and air quality would be from dust from construction activities, open burning, emissions from equipment and machinery used in construction, concrete batch plant operations, and emissions from vehicles used to transport workers and materials to and from the site.

4.2.1 Construction Activities

Construction of the proposed VEGP Unit 3 and 4 would result in temporary impacts to local air quality as a result of emissions associated with construction activities. Similar to any large-scale construction 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 Air Protection Branch of the GDNR Environmental Protection Division, which regulates air-quality control for the State of Georgia, does not require a permit for dust generated by construction activities (GDNR 2004). However, Southern stated in its ER (Southern 2008a) that it would develop a dust-control plan prior to construction that would include specific dust mitigation measures. Techniques such as imposing speed limits on unpaved construction roads, minimizing material handling, covering haul trucks, wetting of potential source areas during dry periods, limiting grading and excavation activities during high winds or periods of poor air quality, and stabilizing bare ground areas are possible mitigation actions that would be considered (Southern 2008a).

Exhaust emissions from construction vehicles and equipment would also generate smaller amounts of particulate matter. In addition, these emissions would contain carbon monoxide, oxides of nitrogen, and volatile organic compounds. As was discussed in Section 2.3.2, Burke County is in attainment or is unclassified for all criteria pollutants for which National Ambient Air Quality Standards have been established (40 CFR 81.314). As a result, a conformity analysis on direct and indirect emissions is not required (58 FR 63214). If construction activities include the burning of debris, refuse, or residual construction materials, a permit would need to be secured from the State, and Southern would need to contact local county officials to determine which local ordinances, if any, must be followed.

In general, emissions from construction activities 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. The staff therefore concludes that the impacts from construction activities on air quality at the VEGP site would be SMALL, and additional mitigation beyond the actions stated above is not warranted.

4.2.2 Transportation

In the ER, Southern estimates that during peak construction there would be 3500 workers divided equally into four shifts, or 875 workers per shift (Southern 2008c). Additional information on work shifts is presented in Section 4.5.4.1. Using a conservative assumption of one worker per vehicle in its transportation analysis, Southern estimates that an additional 1750 vehicles would be added to the roadway system during a shift change (Southern 2008c). The majority of the construction workers would likely reside in Burke, Richmond, and Columbia Counties in a proportion comparable to the existing workforce (Southern 2008a) and use primary roadways to commute to the VEGP site. In addition to construction workers, Southern estimates increased traffic from approximately 100 daily truck deliveries would occur at the site (Southern 2008a).

Depending on the actual residency location of workers, roadways leading to the site would experience increased traffic volume. NRC staff believes that vehicle occupancy rate would likely be higher than Southern's conservative estimate, and would range between 1.5 to

2.0 occupants per vehicle. This would result in 33 to 50 percent fewer construction worker vehicles than conservatively estimated by Southern. Nevertheless, River Road, the primary access road to the VEGP site, would still experience a significant increase in traffic during shift changes that could lead to periods of congestion. Stopped vehicles with idling engines would lead to increased emissions beyond what would occur from normal vehicle operation alone. However, the overall impact caused by increased traffic volume and congestion is difficult to estimate because timing of construction activities, shifts, and exact worker residence locations are largely unknown.

In its ER, Southern has committed to develop mitigation measures that would be included in a construction management traffic plan prior to the start of construction (Southern 2008a). Numerous measures, such as installing turn lanes near the construction entrance, encouraging car pools, establishing central parking and shuttling services to and from the construction site, and scheduling shift changes for operating personnel, outage workers, and construction workers would be considered to mitigate the impact of vehicular traffic on air quality. Based on Southern's commitment to develop and implement a traffic management plan and NRC's own independent review, the staff concludes that the impact on the local air quality from the increase in vehicular traffic related to construction activities would be temporary and SMALL, and additional mitigation beyond the actions stated above is not warranted.

4.3 Water-Related Impacts

Water-related impacts involved in the construction of a nuclear power plant are similar to impacts that would be associated with any large industrial construction project, and not much different than those seen during the construction of VEGP Units 1 and 2. Prior to initiating construction, including any site-preparation work, Southern would be required to obtain the appropriate authorizations regulating alterations to the hydrological environment. These authorizations would likely include:

- Clean Water Act Section 404 Permit. This permit would be issued by the USACE, which governs impacts of construction activities on wetlands or waters of the United States and management of dredged material.
- Clean Water Act Section 401 Certification. This certification would be issued by the GDNR and would ensure that the project does not conflict with State water-quality management programs.
- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) construction and industrial stormwater permits. These permits would regulate point source stormwater discharges. The U.S. Environmental Protection Agency's (EPA's) stormwater regulations have established requirements for stormwater discharges from various activities including construction activities. The EPA has delegated the authority for administering the NPDES program in the State of Georgia to the GDNR.

- Section 10 of the Rivers and Harbors Act of 1899. This section prohibits the obstruction or alteration of navigable waters of the United States without a permit. Appropriate USACE permits would be obtained for construction in the Savannah River.

4.3.1 Hydrological Alterations

Construction of VEGP Units 3 and 4 would potentially affect several surface waterbodies as well as the aquifers underlying the site. Potentially affected surface waterbodies include Mallard Pond and the associated downstream unnamed creek, several of the onsite debris/sediment basins and their associated drainage areas, and the Savannah River.

Dewatering of the foundation excavations would occur for 18 months during construction of VEGP Units 3 and 4 (Southern 2008a). Dewatering systems would potentially depress the water table in the vicinity of the construction excavation; however, these systems would not dewater the confined aquifers (i.e., Tertiary or Cretaceous aquifer systems) underlying the water table because the Blue Bluff Marl acts to provide a hydraulic separation. Southern has stated that water continued to discharge from Mallard Pond throughout the dewatering activity associated with construction of VEGP Units 1 and 2 (Southern 2007b). The powerblock dewatering program persisted for almost 7 years, from June 1976 through March 1983 (Southern 2003a). Southern states in its ER that water pumped from the excavation would be discharged into a settling basin if necessary before being released through a NPDES permitted outfall (Southern 2008a).

Southern has proposed construction of a 73-m (240-ft) long and 52-m (170-ft)-wide intake canal along the shoreline of the Savannah River to support cooling system water demands for VEGP Units 3 and 4 (see Figures 3-4 and 3-5). The CWIS for VEGP Units 3 and 4 will be located at the end of the intake canal, and will be approximately 27.4 m (90 ft) long and 38.1 m (125 ft) wide. It will include nine pump bays. The bottom of the canal would be constructed at an elevation of 21.3 m (70 ft) above mean sea level (MSL), and vertical sheet piles would be driven into the river bottom along the sides of the canal that extend upwards to an elevation of about 29.9 m (98 ft) above MSL (Southern 2008a).

A discharge pipe would extend approximately 15.2 m (50 ft) into the Savannah River from the normal water surface shoreline (an elevation of 24 m (80 ft) above MSL). The centerline elevation of the pipe would be approximately 0.9 m (3 ft) above the river bottom, and rip-rap material would be placed around the pipe outfall to resist erosion (Southern 2008a). A cofferdam would be built using sheet piles before installation of the pipe. The sheet piling would be cut to within 0.3 m (1 ft) of the river bottom grade and left in place after installation of the pipe (Figures 3-6 and 3-7).

Southern would construct a barge slip to support delivery of heavy equipment and components associated with construction of VEGP Units 3 and 4 (Southern 2008a). Southern states in its

ER that Savannah River at the VEGP site may need to be dredged to provide access to the barge slip (Southern 2008a) but current bathymetry suggests that no dredging is needed at this time (NRC 2007).

Activities supporting construction of the barge slip, the new intake structure, and the new discharge outfall would involve dredging adjacent to the VEGP site in the Savannah River, and Southern is required to obtain permits from the USACE prior to construction. Southern states in its ER that dredge materials would be removed from the river and deposited in an area pre-approved for dredge spoils (Southern 2008a). Because of the possibility of dredging the Federal Navigation Channel to allow the transport of large components, the potential impacts of large-scale dredging from Savannah Harbor to the VEGP site are discussed in Section 7.5, "Cumulative Impacts."

Southern states in its ER that new debris basins would be constructed, and that debris basins built for construction of the existing facilities would not be reused (Southern 2008a). The new debris basins would serve as sedimentation basins for surface-water runoff and water pumped from the powerblock excavation (Southern 2008a).

Wetlands delineations and jurisdictional determinations of the sites impacted by construction, including the equipment laydown areas and associated infrastructure such as roads and stormwater drainage, would be required for Southern to submit an application for a Section 404 Permit to the USACE. Southern has made preliminary wetlands delineations and jurisdictional determinations and has initiated consultation with the USACE (Southern 2007b). These determinations are discussed in Section 2.7.1.1. The USACE permitting process would ensure that construction impacts to wetlands are avoided or minimized by implementation of appropriate best management practices (BMPs).[(a)]

Southern has not obtained a Section 401 certification from the State of Georgia for ESP-related site-preparation and preliminary construction activities at the VEGP site. The USACE would require that Southern obtain a certification from the State of Georgia, which is required pursuant to Section 401 of the Clean Water Act, before issuing a Section 404 permit. In accordance with the Clean Water Act, a Section 401 certification must therefore be obtained before ESP-permitted limited construction activities can commence.

The impacts of hydrological alterations resulting from construction activities would be localized and temporary, and the NPDES stormwater permits, 401 Certification, and USACE Section 404 and Section 10 permit processes would minimize impacts. The staff

(a) Best management practices are recommended site management, maintenance, or monitoring activities that have been shown to work effectively to mitigate impacts. Government agencies sometimes use BMPs to specify standards of practice where a regulation may not be sufficiently descriptive.

concludes that the impacts of hydrological alterations would be SMALL and further mitigation beyond the actions stated is not warranted.

4.3.2 Water-Use Impacts

Other than a small quantity of surface water that may be used to wash construction equipment or spray roads for dust abatement, Southern generally does not plan to use surface water during construction of the proposed VEGP Units 3 and 4 (Southern 2008a). Southern states in its ER that groundwater wells placed in the Cretaceous aquifer would provide water needed during construction of the proposed VEGP Units 3 and 4 for standard construction purposes including dust abatement, mixing concrete, and all potable water required by the construction workforce (Southern 2008a).

Among the proposed construction activities, dewatering would potentially impact the groundwater environment temporarily in the immediate vicinity of the VEGP site. Construction of the proposed VEGP Units 3 and 4 would employ a dewatering method similar to the method used when VEGP Units 1 and 2 were constructed (Southern 2007b). That experience is summarized in Section 2.6.2.2 of this Environmental Impact Statement (EIS). Dewatering during construction of VEGP Units 1 and 2 involved the same aquifer at a nearby location and employed four pumps, each with a 32 L/s (500 gpm) capacity (thus, a maximum capacity of 126 L/s [2000 gpm]). There were instances when greater capacity was needed for brief periods because of storm events (Southern 2003a).

Data from observation wells monitored during construction of VEGP Units 1 and 2 suggest a variable response in the Water Table aquifer near the excavation (Southern 2008a). The most distant well in the vicinity of the excavation for which a record exists (well #804), which is located approximately 300 m (1000 ft) southwest of the excavation, was not substantially impacted (0.6 m [2 ft] decline and subsequent recovery). Southern states that the stream discharging from Mallard Pond and the west branch of the drainage below the pond are perennial streams (Southern 2008a). The applicant stated that water continued to discharge from Mallard Pond throughout the dewatering activity for VEGP Units 1 and 2, which lasted from mid-1976 until mid-1983 (Southern 2007b). Monitoring data from the period of VEGP Unit 1 and 2 construction indicate recovery from dewatering within 2 years (Southern 2008a). The Blue Bluff Marl is believed to substantially isolate the Water Table aquifer from the underlying confined Tertiary aquifer. Locally, the existing downward hydraulic gradient from the Water Table aquifer toward the Tertiary aquifer would be maintained as downward directed but be somewhat less during the dewatering period. Southern has committed to protect the aquifer from impact during the construction process. Southern states they will "...visually monitor Mallard Pond...use best management practices...(and) In the event a significant impact to the groundwater resource is discovered...this information would be evaluated as potentially new and significant information and provided to the NRC for review as appropriate" (Southern 2007b). Therefore, the staff determined a dewatering activity conducted in the

Water Table aquifer would be localized and temporary, and not impact substantially local groundwater users in the vicinity of the VEGP site.

The Water Table aquifer in the vicinity of the VEGP site may also experience a change in net infiltration (i.e., recharge from precipitation) because of the clearing of land, the construction of facilities including a stormwater drainage system, and the temporary disturbance of vegetated areas. The staff reviewed hydrographs of the water table elevation provided in the ER for wells in the immediate vicinity of VEGP Units 1 and 2 (Southern 2008a). These graphical data illustrate the water table change over the 20-year period since construction of VEGP Units 1 and 2. The net change is variable, but all changes appear to range between 1.5 and 2.4 m (5 and 8 ft) in magnitude.

Southern proposes to supply water for construction from the confined aquifer system under its existing groundwater permit for which there is unused groundwater capacity. Southern estimates current pumping at 46.1 L/s (730 gpm) to operate VEGP Units 1 and 2, a maximum of 26.5 L/s (420 gpm) during construction of VEGP Units 3 and 4, and 47.44 L/s (752 gpm) to operate the two new units when they begin operations. This maximum water usage rate during construction is small compared to the deep aquifer baseflow rate of 5210 L/s (5.21 m^3/s, 184 cfs, 119 MGD) (see Section 2.6.1.2).

In this analysis well MU-2A, the deep confined aquifer well nearest the VEGP site property boundary (1740 m [5700 ft] distant) is assumed to supply all of the water. Three pumping rates are of interest.

1. A drawdown in the year 2015 associated with a baseline for VEGP Units 1 and 2 operation; the total rate would be 46.1 L/s (730 gpm).
2. A drawdown in the year 2015 associated with operation of VEGP Units 1 and 2 and maximum construction pumping; the total rate would be 72.55 L/s (1150 gpm).
3. A drawdown in the year 2017 associated with operation of VEGP Units 1, 2, and 3, and construction of VEGP Unit 4; the total rate would be 83.03 L/s (1316 gpm).

The projected annual average groundwater resource use during construction of VEGP Units 3 and 4 is shown in Table 4-2 as outlined in the three cases above. These three cases examine the construction period including the time when VEGP Unit 3 is in operation and VEGP Unit 4 is still under construction.

Conservative models are employed by Southern and the staff to estimate drawdown in the confined Cretaceous aquifer as a result of groundwater withdrawal. A simplified form of the Theis equation (Theis 1935; Cooper and Jacob 1946) for estimating drawdown in a confined aquifer was used to estimate drawdown in the Cretaceous aquifer. The assumptions of this

model are described in Section 5.3.2.2. Conservatism in this analysis also comes from the use of a single well to produce the water and from that well being closest to the VEGP site boundary.

Table 4-2. Drawdown Due to Groundwater Withdrawal During VEGP Unit 3 and 4 Construction

Water Withdrawal Scenario	Time Period (yr)	Pumping Rate L/s	(gpm)	Drawdown at 5700' m	(ft)	Drawdown at 3500' m	(ft)
Aquifer response 2015							
Units 1 and 2 Operation	30	46.1	(730)	1.75	(5.75)	1.91	(6.26)
Aquifer Response 2015							
Units 1 and 2 Operation	30	46.1	(730)	1.75	(5.75)	1.91	(6.26)
Units 3 and 4 Construction	6[a]	26.5	(420)	0.86	(2.82)	0.95	(3.11)
		72.6	(1150)	2.61	(8.56)	2.86	(9.38)
Aquifer Response 2017							
Units 1 and 2 Operation	32	46.1	(730)	1.75	(5.78)	1.92	(6.30)
Units 3 and 4 Construction	8	26.5	(420)	0.88	(2.90)	0.98	(3.20)
Unit 3 Operation	2	10.5	(166)	0.30	(0.98)	0.34	(1.10)
		83.0	(1316)	2.95	(9.67)	3.23	(10.60)

(a) Assume construction period of 6 years
Source: (Falls and Powell 2001)

Estimated drawdown for the three water withdrawal scenarios are shown in Table 4-2. The resulting drawdown levels are estimated as 1.8 m (5.8 ft), 2.6 m (8.6 ft), and 2.9 m (9.7 ft), respectively, for the three events. Increased drawdown over that of VEGP Unit 1 and 2 operation at the property boundary in the Cretaceous aquifer during construction of VEGP Units 3 and 4 is estimated to be 0.85 m (2.8 ft). Similarly, increased drawdown for startup of VEGP Unit 3 and continued construction of VEGP Unit 4 is estimated to be 1.1 m (3.9 ft). These estimates reflect the potential impact at the property boundary, which is 1740 m (5700 ft) from the production well. The closest users of the Cretaceous aquifer are a municipal well 23.3 km (14.5 mi) away, an industrial well 13.7 km (8.5 mi) away, and wells located 6.4 km (4 mi) away in the D Area of the Savannah River Site. At these distances, the change in drawdown resulting from the supply of water during the construction period is estimated as less than 0.9 m (3.5 ft) for these wells in 2017. These drawdowns are small relative to the 120 m (400 ft) of confining hydraulic head in the Cretaceous aquifer.

The staff also estimated drawdown impacts if all groundwater demand was drawn from the proposed well location approximately 1070 m (3500 ft) from the property boundary. The estimated drawdowns for a neighboring water user on the VEGP site property boundary were approximately 10 percent greater. The more distant users are not influenced by this relatively minor change in well location.

The staff's conclusion is based on the existing water-use permit (i.e., State of Georgia, Groundwater Use Permit No. 017-003) being of adequate capacity for construction water demand, on a deep aquifer with a baseflow much greater than construction groundwater demand, and the forgoing analysis of the change in groundwater drawdown. Because water-use impacts during construction would be localized and temporary, and recovery from construction activity would be short term, the staff concludes that water-use impacts caused by construction activities would be SMALL, and mitigation is not warranted.

4.3.3 Water-Quality Impacts

During construction of VEGP Units 3 and 4 and their associated infrastructure, a potential exists for soil erosion to degrade the water quality of surface-waterbodies such as Mallard Pond, Telfair Pond, and the Savannah River. Southern would be required to obtain a NPDES construction stormwater permit before the start of construction, which would ensure that BMPs are followed. Southern states in its ER that they would also develop an Erosion, Sedimentation and Pollution Control Plan (Southern 2008a).

Construction activities in and along the shoreline of the Savannah River would disturb river sediments, thus increasing turbidity both near and downstream of the construction sites. To limit the downstream effects of these activities, Southern states in its ER that cofferdams would be constructed around the sites to limit downstream distribution of the river sediments (Southern 2008a).

The VEGP site is served by a private wastewater treatment facility sized for the workforce of the existing units (see Section 3.2.4.2). During construction, the temporary office and warehouse facilities would use the existing waste treatment facility. Portable toilets or other approved supplemental means of sanitary waste treatment would be employed on the construction area (Southern 2008a).

Because the impacts of hydrological alterations resulting from the above construction activities would be localized and temporary, and the NPDES stormwater permits, 401 Certification, and the USACE permits require the implementation of BMPs to minimize impacts, the staff concludes that the impacts on water quality during construction would be SMALL, and further mitigation beyond the actions stated is not warranted.

4.4 Ecological Impacts

This section describes the potential impacts to ecological resources from construction of VEGP Units 3 and 4 including the construction of a new transmission line to connect the units to the grid. The section is divided into three subsections: terrestrial impacts, aquatic impacts, and impacts to threatened and endangered species.

4.4.1 Terrestrial Impacts

This section provides information on the site-preparation activities and construction of VEGP Units 3 and 4 at the VEGP site and the impacts on the terrestrial ecosystem. Topics discussed include terrestrial resource impacts at the VEGP site and terrestrial ecosystem impacts associated with the expansion of the transmission system to include a new 500-kV transmission line right-of-way. Southern stated that "BMPs used to minimize impacts during preconstruction and construction activities begin with a programmatic construction Environmental Control Plan" (Southern 2007b). This plan would address BMPs that would be used to minimize impacts. The plan would cover topics such as erosion and sedimentation control, sensitive resources, spill prevention and response, noise and vibration, air emissions, and general site maintenance. In addition, the applicant states that regular environmental compliance inspections of construction activities would be performed to ensure that site activities are in compliance with all applicable environmental requirements (Southern 2007b).

4.4.1.1 Wildlife Habitat

The VEGP Site

The VEGP site includes land developed for industrial use, previously disturbed land, and undeveloped land. Southern stated that approximately 210 ha (520 ac) would be disturbed by construction of VEGP Units 3 and 4 (Southern 2008b). The acreage did not include the area for the potential borrow area (Southern 2008b) or the acreage associated with the simulator building, which was previously identified by Southern as being part of the disturbance footprint (Southern 2007b). Therefore, the staff included 1.6 ha (4.0 ac) for the simulator building (Southern 2007b RAI response E4.3-1b) and 31 acres for the potential borrow area (Southern 2008b). The total acreage of potential disturbance used in the staff's analysis was 225 ha (556 ac), including 131 ha (324 ac) that could be permanently disturbed and an additional 94 ha (232 ac) could be temporarily disturbed. The total number of acres needed for each major construction activity and the associated habitat types that would be disturbed is provided in Table 4-3. Southern stated that "it is unlikely that each activity will disturb the entire area identified, and where possible, efforts will be made to minimize disturbance" (Southern 2007b).

Approximately 11 ha (27.1 ac) of habitat onsite would be permanently removed for construction of the new 500-kV transmission line (Southern 2008b). The new transmission line would originate in the new switchyard and would be routed west across the south end of Mallard Pond. It would follow the existing Vogtle-Scherer 500-kV right-of-way west until it exits the site boundary. The right-of-way would be 46 m (150 ft) wide, and six transmission tower structures would be located onsite. Transmission towers would be located to free span Mallard Pond and minimize habitat impacts. The area near Mallard Pond that would be crossed by the line is approximately 0.6 ha (1.4 ac) and is composed of pond and bottomland hardwood habitat. The remaining 10.4 ha (25.7 ac) is a mixture of planted loblolly pine, previously disturbed industrial areas, and open fields (Southern 2007a, 2008b).

Table 4-3. Habitat Types and Acreage Associated with Permanent and Temporary Construction Areas Associated with Construction of VEGP Units 3 and 4

Construction Area	Hectares (Acres) Affected	Dominant Habitat Type
Permanent		
Powerblock	30.4 (75.2)	Planted loblolly pine/previously disturbed
Cooling Tower	28.0 (69.3)	Previously disturbed/industrial
Switchyard	26.2 (64.7)	Open fields/planted loblolly pine
Cooling Water Intake	4.4 (10.8)	Bottomland hardwoods/wetlands
Barge Slip/Discharge structure	4.2 (10.3)	Bottomland hardwoods/wetlands
500-kV transmission line (onsite)	11.0 (27.0)	Planted pine, previously disturbed industrial, open fields, pond, and bottomland hardwood
Debris basin	6.0 (14.8)	Planted pine, grasses, herbaceous groundcover
Buried Pipe and Electrical to/from River	4.8 (11.8)	Planted pine, grasses, herbaceous groundcover
Simulator building	1.6 (4.0)	Mixed hardwoods and pine
Onsite Roads	14.7 (36.3)	Open fields, planted pine, previously disturbed
Temporary		
Parking	19.7 (48.8)	Planted longleaf pine
Batch Plant	6.5 (16.1)	Planted longleaf pine
Warehouse, Office, and Laydown	38.4 (94.9)	Previously disturbed/planted loblolly/longleaf pine
Spoils Areas	16.9 (41.7)	Mixed planted loblolly/longleaf pine
Borrow Area	12.5 (31.0)	Planted longleaf pine/mixed pine/hardwood

Source: Southern (2007a, 2007b, 2008b)

Temporary impacts on approximately 81 ha (201 ac) associated with spoils areas, parking lots, warehouses, offices, and laydown yards would occur in planted longleaf and loblolly pine habitats and in previously disturbed areas. Southern has identified 12.5 ha (31 acres) that would be set aside for borrow material. Southern plans to first use borrow material from the powerblock and switchyard excavations, and will only use the set aside borrow area if insufficient borrow is recovered from the powerblock and switchyard excavations. Habitat on the set aside borrow area consists of planted longleaf pine and mixed pine/hardwood. There are no identified wetlands in this potential borrow area (Southern 2008b). The staff assumed impacts associated with the borrow area would be temporary. Of the 131 ha (324 acres) that would be permanently disturbed (including the onsite portion of the new transmission line) approximately 120 ha (297 acres) would be composed of previously disturbed, open fields or planted pine habitats. About 1.6 ha (4 ac) of mixed hardwoods and pine would be permanently removed for the simulator building (Southern 2007b).

About 8.5 ha (21.0 ac) of wetlands would be directly affected by Unit 3 and 4 construction activities including approximately 4.5 ha (11 ac) during construction of the CWIS and 4 ha

(10 ac) during the construction of the barge facility and discharge structure (Southern 2008b). Most of the acreage involved would be along the Savannah River (Southern 2007b). Southern estimates that the actual intake structure and canal would be located on about 1.2 ha (3 ac) of wetlands. Impacts to the remaining construction area associated with the CWIS would be temporary (Southern 2007b). The applicant stated that "Temporary construction ramps at the canal and CWIS area would be removed and disturbed areas around the intake structure would then be stabilized and re-vegetated to preclude future erosion. Erosion and sediment controls would remain in place and would be maintained as long as necessary" (Southern 2007b). One hundred twenty-two meters (400 ft) of shoreline would be disturbed at the CWIS, 27 m (90 ft) would be disturbed at the barge facility, and 6.1 m (20 ft) would be disturbed at the discharge structure (Southern 2007b; NRC 2007).

Southern has committed to minimize impacts to adjacent wetland areas and the Savannah River during the construction process. Construction of the CWIS, barge facility, and discharge structure would be conducted under a Section 404 permit issued by the USACE, and appropriate wetland mitigation requirements would be developed as part of the 404 permitting process. In early 2007, Southern submitted the Request for Jurisdictional Determination Form to the USACE and began the Section 404 permitting process (Southern 2007b). The Section 404 permit would also require a Water Quality Certification issued by the GDNR Environmental Protection Division to control discharge of water from the construction process to the Savannah River (Southern 2007b). A Section 10 permit under the Rivers and Harbors Act would be required prior to any in-stream construction activities in the Savannah River. This project would also require a Georgia General Stormwater Permit for Construction (Southern 2007b).

The CWIS houses the river water make-up pumps, traveling screens, screen wash pumps, and associated equipment. To minimize dewatering and potential for impact to the Savannah River and adjacent wetlands, Southern may perform the excavation of the intake structure primarily from land rather than working on the water. Prior to cut-and-fill operations associated with the building of the access road, silt fences and other erosion and sediment controls would be installed in drainage areas and at the perimeters of the disturbed areas. Southern stated, "The access road would be built incorporating erosion and sediment control measures and road drainage systems consistent with the requirements of the Georgia stormwater permit for the upland portions of the project. Additional controls required by the USACE Section 404 permit would be applied in wetland areas" (Southern 2007b).

Southern plans to excavate the intake canal and intake area to just above the high water mark. The excavated material would be stored in an upland area onsite. These materials may be reused in the canal banks. Southern stated, "Erosion and sediment control measures would be installed, and BMPs would be employed, as necessary, for this upland storage area" (Southern 2007b).

Final construction of the CWIS would be conducted from a barge located in the Savannah River. Southern stated that "appropriate environmental controls would be used for this phase of the operation to prevent spills and minimize environmental impact to the river and adjacent wetlands" (Southern 2007b).

At this time, Southern anticipates only having to dredge during construction of the barge facility (Southern 2007b). The dredge material associated with construction of the barge facility (approximately 230 m^3 [300 yd^3]) would be transported and placed in an uplands spoils area. Fill activity in the area would primarily be limited to that associated with barge facility construction. Construction of the barge facility would require an over-excavation approximately 0.9 m (3 ft) deep to allow for placement of a 0.9-m (3-ft)-thick gravel bed (approximately 1990 m^3 [2600 yd^3]). Southern stated that after construction of the barge facility "the site will be stabilized and re-vegetated in accordance with permit requirements after all construction activity is complete at the barge facility. Erosion and sediment controls would remain in place as long as necessary and would be removed only after vegetation is well established and controls are no longer necessary" (Southern 2007b).

Southern does not anticipate having to conduct sediment characterization of the material dredged in support of the new barge facility (Southern 2007b). In addition, based on a bathymetry survey conducted in 2006, the need for dredging from the end of the barge facility to connect with the Federal navigation channel is not anticipated at this time. However, dredging may be required in the future due to natural movement of sediment in the river (Southern 2007b, NRC 2007).

The discharge structure would consist of a buried pipe with a submerged discharge outlet into the Savannah River. Impacts related to construction and placement of the discharge structure would include the removal of native vegetation, grading, and cut-and-fill activities. Southern stated that "the disturbed area would be re-vegetated to prevent erosion and allowed to revert to its native condition once the discharge pipe is in place and covered. Once installed, the discharge pipe is expected to permanently disturb less than 0.04 ha (0.1 ac)" (Southern 2007b). A small amount of rip-rap material would also be placed in the river at the end of the discharge pipe to "armor" the bottom in the immediate area of the discharge to minimize scour (Southern 2007b).

Southern has not discussed specific mitigation activities related to wetlands with the USACE. If mitigation for wetlands is required, Southern stated that sufficient areas are available within the VEGP site for potential mitigation actions (Southern 2007b).

There is the potential for other construction activities associated with the proposed VEGP Units 3 and 4 to have indirect impacts to wetlands at the VEGP site. Indirect impacts to the debris basins, Mallard Pond, Telfair Pond, and Beaverdam Creek could occur as a result of construction activities (e.g., sedimentation).

Construction Impacts at the Proposed Site

Construction of the heavy-haul road and the new switchyard could result in sediment transport into Mallard Pond after heavy rainfall events (Southern 2007b). Additionally, excavated soil placed in the proposed spoils and overflow storage areas south of the Main Plant Access Road could move with runoff into Telfair Pond or Beaverdam Creek along one of the small intermittent unnamed streams in the area (Southern 2008a). Southern stated that it would implement the necessary erosion and sediment controls and BMPs to ensure runoff does not negatively indirectly impact wetlands associated with the heavy haul road (Southern 2007b).

New upland retention ponds would be constructed and used to accept surface-water runoff and water from the dewatering process. These new retention ponds would function as sedimentation basins. The existing debris basins would not be used for trapping sediment generated by construction, but they would be used for stormwater management and would likely receive the outflow from the new retention basins (NRC 2007).

Excavation for the powerblock would extend below the normal water table in the unconfined (i.e., Water Table) aquifer, and a dewatering system (described in Section 4.3.2) would be installed to remove groundwater from the excavation during the construction process (Southern 2007b). Excavation is expected to take place over a 6-month period, and operation of the dewatering system would occur over an 18-month period (Southern 2008a). Mallard Pond, which is located a short distance to the north of the excavation, is fed by a spring believed to originate in Utley Cave, a karst formation that intercepts groundwater from the unconfined (Water Table) aquifer. Southern recently conducted an evaluation of the potential to indirectly dewater Mallard Pond and the stream that drains Mallard Pond through the removal of groundwater as part of the excavation process. Based on the evaluation, Southern believes there may be a short-term reduction in recharge flow to Mallard Pond during the dewatering of the powerblock excavation. This evaluation showed the pond level would not be substantially affected and the stream below the pond may experience a reduction in flow, but it is not expected that this reduction would significantly alter the stream habitat, beyond what might be experienced during a drought period (Southern 2007b). Southern stated they would visually monitor Mallard Pond to determine "if activities produce changes in pond level or flow reductions in the drainage below the pond" (Southern 2007b). It is expected that dewatering would impact the fringe vegetation surrounding Mallard Pond and in the stream below Mallard Pond, but these impacts would be temporary and not beyond that of a typical drought. Therefore, the impacts should be negligible. If the excavation process extends beyond 18 months or the dewatering results in a drop in flow that is lower than the flow expected during a drought year, impacts to Mallard Pond and the wetlands in the stream below Mallard Pond could be greater than negligible. Southern stated "if a significant impact to the groundwater resource is discovered, this information will be evaluated as potentially new and significant information and provided to the NRC for review, as appropriate" (Southern 2007b).

In summary, an estimated 8.5 ha (21 ac) of wetlands habitat on the VEGP site would be altered to construct permanent structures and facilities associated with construction of the proposed VEGP Units 3 and 4 at the VEGP site. This represents about 12.5 percent of the total 69 ha (170 ac) of wetlands that have been identified onsite. Within 16 km (10 mi) of the site there are approximately 41,092 ha (101,538 ac) of wetlands, including about 33,369 ha (82,455 ac) of wetlands along the Savannah River (FWS 2004a,b). Wetlands habitat that would be altered is less than 0.03 percent of the total wetlands acreage in the vicinity. An estimated 120 ha (297 ac) of upland habitat including planted pines, previously disturbed areas, and open fields would be removed during construction of permanent structures and facilities (including the onsite portion of the new transmission line), representing about 17 percent of the total 700 ha (1730 ac) of planted pine and open areas currently available onsite. An estimated 1.6 ha (4 ac) of mixed hardwood and pine habitat would be lost to permanent structures and facilities, representing less than 1 percent of the total 247.7 ha (612 ac) of hardwood habitat available onsite. Approximately 0.57 ha (1.4 ac) of land, composed of pond and bottomland hardwood would be crossed by the new transmission line onsite.

Habitats associated with temporary impacts to 81 ha (201 ac) resulting from construction of parking areas, the batch plant, warehouses, offices, laydown yards, and spoils areas would be re-vegetated following construction activities. The staff assumed that habitat on the 12.5 ha (31 ac) potential borrow area would be revegetated if the borrow from this area is needed. However, Southern will only use this area if insufficient borrow is recovered from the powerblock and switchyard excavations (Southern 2008b).

Upland hardwood forests and bottomland wetlands have much greater plant species and structural diversity than upland fields, planted pines, and previously disturbed areas, and are thus assumed to be much more important as wildlife habitat. The combined onsite upland hardwood forest and bottomland wetlands lost to permanent structures and facilities represent a small percentage of the combined total of these available onsite and in the vicinity of the VEGP site. Therefore, the staff finds the impact would be negligible.

Proposed 500-kV Transmission Line Right-of-Way

The extent and type of wildlife habitat within the proposed new transmission line right-of-way is not known. Currently, Southern and the GPC are evaluating the actual right-of-way alternatives for the transmission line within the Representative Delineated Corridor (RDC). It is anticipated that the transmission line would cross primarily Burke, Jefferson, McDuffie and Warren Counties in Georgia and would be 46 m (150 ft) wide and 97 km (60 mi) long. There are no U.S. Forest Service Wilderness Areas, Wild/Scenic Rivers or Wildlife Refuges, or State or National Parks within the RDC (GPC 2007). Construction activities would avoid wetlands to the extent practicable. In the event that wetlands are encountered, construction would be conducted in accordance with the necessary permits to protect wetland areas (GPC 2007).

Construction Impacts at the Proposed Site

A hypothetical transmission line right-of-way that represents what GPC believes is a feasible route within the RDC was identified as part of the 2007 right-of-way study (GPC 2007). Habitats within the hypothetical right-of-way include approximately 97 ha (240 ac) of forested habitat, 133.1 ha (329 ac) of planted pine, 2.6 ha (6.4 ac) of open water, and 63.9 ha (158 ac) of open land. Other land-use categories that were identified as potentially being impacted such as quarry mine, pecan orchard, row crop, transportation, and utility provide little value as wildlife habitat. Southern stated that wetlands would not be impacted by construction of the new right-of-way (NRC 2007). In the region (identified in the original GPC study area as approximately 117,359 ha [290,000 ac]) surrounding the RDC and any new transmission line, there are approximately 18,085 ha (44,688 ac) of forest, 1354 ha (3346 ac) of open water, and 17,262 ha (42,656 ac) of open land (GPC 2007). Assuming the actual routing is similar to the hypothetical route, the number of acres of forested habitat, open water, open land, and planted pine that would be impacted represent a very small portion of the available habitat, and thus impacts on wildlife habitat would be minimal. However, if the actual routing differs from the hypothetical route, impacts on wildlife habitat could be greater.

Wildlife Habitat Summary

Construction of the Units 3 and 4 at the VEGP site and the new 500-kV transmission line would follow Federal and State regulations, permit conditions, established construction procedures, and established BMPs. Waterways and wetlands would be avoided to the extent possible (Southern 2008a). Therefore, the staff concludes construction impacts to wildlife habitat on the VEGP site would be negligible. Because of the uncertainty regarding the actual routing of the new transmission line right-of-way, impacts to wildlife habitat caused by construction of the transmission line could be greater than small.

4.4.1.2 Wildlife

During construction of VEGP Units 3 and 4 and the new 500-kV transmission line, wildlife may be destroyed or displaced, primarily as a result of operating heavy equipment (e.g., during land clearing). Less mobile animals, such as reptiles, amphibians, and small mammals, are expected to incur greater mortality than more mobile animals, such as birds. Although undisturbed forested and wetlands habitat would be available for displaced animals during construction, increased competition for available space during construction activities may result in increased predation and decreased fecundity, ultimately leading to a temporary reduction in population size. Species that can adapt to disturbed or developed areas may readily re-colonize portions of the disturbed area where suitable habitat remains or is replanted or restored. The above discussion also applies to offsite disturbances in forest habitat that would result as land is cleared for the new transmission line. As construction activities end and habitats are restored naturally or through mitigation activities, habitats would again become available to wildlife.

Noise from construction can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it may disrupt communications required for breeding or defense (Larkin 1996). However, it is not unusual for wildlife to habituate to such noise (Larkin 1996). Construction activities that would generate noise include operation of equipment such as jack hammers, pile drivers, and heavy construction vehicles. In addition, construction noise results from the movement of workers, materials, and equipment. Short-term noise levels from construction activities onsite could be as high as 110 dBA. These noise levels would not extend far beyond the boundaries of the project site. At 120 m (400 ft) from the construction site, the construction noise would range from 60 to 80 dBA (Southern 2008a). The threshold at which birds and small mammals are startled or frightened is 80 to 85 dBA (Golden et al. 1980). The staff expects that noise levels associated with construction of the transmission line right-of-way would be similar to noise levels associated with construction at the VEGP site and would be below threshold levels for startle or frightening of wildlife at 120 m (400 ft). Wildlife can also be affected by the masking of important sounds when there is increased noise from the construction site. While animals may habituate to higher noise, they may not be able to distinguish a critical sound in the presence of noise. In some sense their habituation may make them more vulnerable if their survival is a function of ability to detect certain sounds. Thus, while behavioral impacts on wildlife from construction noise caused by startle response are expected to be negligible, it is expected that masking, particularly if accompanied by habituation to higher noise levels, may increase exposure to risks that require detection of specific sounds for avoidance (risk management) (Dooling 2002). Nevertheless, the loss of individuals due to this phenomenon would be localized and would be expected to have a minimal impact on overall population health.

The use of natural draft cooling towers for VEGP Units 3 and 4 as well as the addition of transmission towers for the new transmission line introduces additional tall structures, and therefore increases the potential for avian collisions. Avian collisions with man-made structures are a result of numerous factors such as flight behavior, age, habitat use, seasonal habits, and diurnal habits; and to environmental characteristics such as weather, topography, land use, and orientation of the structures. Most authors on the subject of avian collisions with utility structures agree that collisions are not a significant source of mortality for thriving populations of birds with good reproductive potential (EPRI 1993). In the *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants*, the NRC reviewed monitoring data concerning avian collisions at nuclear power plants with large cooling towers and determined that overall avian mortality is low (NRC 1996). Southern has not quantitatively assessed the number of bird collisions with construction equipment or new structures. However, avian collisions with existing structures at the VEGP site have been infrequent and transmission line maintenance personnel have not reported any dead birds from collisions or contact with the existing transmission lines for VEGP Units 1 or 2 (Southern 2006a). The additional number of bird collisions, if any, would not be expected to cause a measurable reduction in local bird populations. Consequently, the number of construction-related bird collisions with structures is expected to be negligible.

Construction Impacts at the Proposed Site

Workers commuting to the VEGP site take one of three routes to access the site. All three routes converge on River Road. Southern estimates the current peak traffic rate on River Road nearest to the site is currently 1200 vehicles per hour (see Section 4.5.4.1). This number is projected to increase during construction of VEGP Units 3 and 4 to a maximum of 2950 vehicles per hour at peak traffic times (see Section 4.5.4.1). This would likely increase traffic-related wildlife mortalities. Local wildlife populations could suffer declines if road-kill rates were to exceed the rates of reproduction and immigration. However, while road kills are an obvious source of wildlife mortality, except for special situations not applicable to the VEGP site (e.g., ponds and wetlands crossed by roads where large numbers of migrating amphibians and reptiles would be susceptible), traffic mortality rates rarely limit population size (Forman and Alexander 1998). Consequently, the overall impact on local wildlife populations from increased vehicular traffic on the VEGP site during construction would be expected to be undetectable.

The staff has determined that the construction-related impacts of habitat loss, noise, collisions with elevated structures, and increased traffic may adversely affect onsite wildlife. However, these impacts would be temporary, minor, and mitigable.

4.4.1.3 State-Listed Species

The VEGP Site

The bay star-vine (*Schisandra glabra*), State-listed as Threatened in Georgia, is the only state-listed plant species known to occur on the VEGP site. It was recorded on the wooded bluffs above the floodplain in the vicinity of the proposed CWIS during the 2005 threatened and endangered species survey (TRC 2006). Its habitat preferences are such that it could occur in the floodplain forest as well. No other Georgia or South Carolina State-listed plant or animal species are known to occur within 3.2 km (2 mi) of the VEGP site (GDNR 2007). However, mounds suggestive of the Georgia State-threatened southeastern pocket gopher (*Geomys pinetis*) were recorded on property just north of the VEGP site boundary (Southern 2007a). This species was not targeted in the 2005 threatened and endangered surveys by Third Rock Consultants LLC. Similar habitat occurs on the nearby VEGP site. The southeastern pocket gopher is found in upland areas of dry, sandy soil or well-drained, fine-grained gravely soil (GDNR 2000). There are no known records of the pocket gopher in Burke County (GDNR 2007). No mounds similar to those made by the southeastern pocket gopher have been reported from the VEGP site, although suitable habitat appears to be present. Southern does not expect the disturbance footprint to encompass such habitat (Southern 2008c). Southern stated that it would work with the GDNR to ensure that any species of concern are protected during construction (Southern 2007a).

Four Georgia State-listed plant species have been recorded in Burke County within 16 km (10 mi) of the VEGP site: Ocmulgee skullcap (*Scutellaria ocmulgee*), Georgia plume (*Elliottia racemosa*), sweet pitcherplant (*Sarracenia rubra*), and Indian olive

(*Nestronia umbellula*). All are listed as State threatened except for the Indian olive, which is listed as rare. Because the VEGP site is located along the Savannah River, which forms the boundary between Georgia and South Carolina, State-listed species occurring across the river but within 16 km (10 mi) of the VEGP site (Aiken and Barnwell Counties in South Carolina) also were examined (SCDNR 2007). The smooth coneflower (*Echinacea laevigata*) is listed in both Georgia and South Carolina as State-endangered; and 29 other plant species are of regional and local concern within 16 km (10 mi) of the site in South Carolina. None of these State-listed species occur on the VEGP site or within the areas affected by construction. No impacts to these species are expected.

Three Georgia State-listed bird species, the bald eagle (*Haliaeetus leucocephalus*), wood stork (*Mycteria americana*), and red-cockaded woodpecker (*Picoides borealis*), have potential to occur in suitable habitats within Burke County (FWS 2004c). The wood stork and red-cockaded woodpecker are also Federally endangered. Impacts on these species are discussed in Section 4.4.3.

Although no reptile or amphibian species of concern have been recorded in Georgia within 16 km (10 mi) of the VEGP site, seven species have been recorded within this distance of the site in South Carolina (SCDNR 2007). Recorded were the South Carolina endangered and Georgia rare gopher frog (*Rana capito*) and six species of various levels of concern in one or both states: eastern tiger salamander (*Ambystoma tigrinum tigrinum*), southern hognose snake (*Heterodon simus*), bird-voiced treefrog (*Hyla avivoca*), eastern coral snake (*Micrurus fulvius*), pine or gopher snake (*Pituophis melanoleucus*), and black swamp snake (*Seminatrix pygaea*). These species have not been reported on the VEGP site. Impacts to these species are not expected.

In summary, the impact on State-listed species from construction of Units 3 and 4 at the VEGP site is expected to be negligible.

Proposed 500-kV Transmission Line Right-of-Way

Three State-listed species have been documented by the GDNR to occur within the RDC: the bald eagle, silky camellia (*Stewartia malacodendron*), and sandhill rosemary (*Ceratiola ericoides*). GPC has committed to establishing a 180-m (600 ft) buffer around the active eagle nest to minimize any potential impacts from transmission line construction (GPC 2007).

The impact on common wildlife within the new transmission line right-of-way resulting from land-clearing, noise, and bird collisions is expected to be negligible. The impact on State-listed wildlife species in the transmission line right-of-way is not known at this time. Impacts to State protected species are likely to be minimal provided that adequate surveys are conducted prior to commencement of transmission line construction and consultation with

GDNR is initiated, as needed. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

4.4.1.4 Terrestrial Ecosystems Impact Summary

The impact of construction on wildlife habitat within the VEGP site (including permanent and temporary losses of upland hardwood forest and bottomland forested wetlands) would be minimal. Southern is required to comply with conditions of the 404 permit from USACE including any specified wetland mitigation. The onsite impact on wildlife populations, including State-listed species, would be minimal, and Southern stated it would consult with the GDNR to ensure that any species of concern would be protected during construction. Southern would implement construction mitigation at the VEGP site and within the transmission line right-of-way including BMPs for erosion and dust control, proper equipment maintenance, and adherence to all applicable permit conditions. The staff reviewed the potential impacts of constructing Units 3 and 4 on terrestrial ecological resources on the VEGP site, including the loss of habitat and wetlands, noise, traffic mortality, and avian collisions. Based on NRC's independent review and the BMPs identified in the ER and in Southern's responses to NRC's Requests for Additional Information (RAIs), the staff concludes that the overall impact of construction-related activities on terrestrial ecological resources in the vicinity of the VEGP site would be SMALL, and further mitigation beyond the actions stated above is not warranted.

The staff reviewed the potential impacts of constructing the new 500-kV transmission line right-of-way on terrestrial ecological resources, including noise, avian collisions, and the loss of habitat and wetlands. The impact on State-listed wildlife species in the right-of-way is not precisely known. GPC would site the transmission line in accordance with Georgia Code Title 22, Section 22-3-161. GPC's procedures for implementing this code include consultation with GDNR as well as an evaluation of impacts to special habitats (including wetlands) and threatened and endangered species. In addition, the GPC would comply with all applicable laws, regulations, and permit requirements, and would use good engineering and construction practices (Southern 2008a). If the actual transmission line route is similar to the hypothetical route proposed by GPC, and adequate threatened and endangered surveys are conducted prior to commencement of construction, consultation with GDNR is initiated as needed, and appropriate mitigation is implemented, impacts to terrestrial resources along the transmission line are likely to be minimal. Based on this independent review, the potential BMPs identified in the ER, and Southern's responses to NRC's RAIs, the staff concludes that the overall impact of construction-related activities on terrestrial ecological resources in the vicinity of the new transmission line would likely be SMALL. However, due to the uncertainty regarding the actual transmission line route, as well as the uncertainty regarding the distribution of State-protected species along and within the right-of-way, impacts could be MODERATE. Mitigation actions would be dependent on the exact location and nature of environmental impacts associated with construction within the transmission line right-of-way.

4.4.2 Aquatic Impacts

Impacts on the aquatic ecosystem from construction of VEGP Units 3 and 4 would mainly be associated with impacts to the Savannah River from the construction of a new CWIS, a new cooling water discharge line, and a barge slip. Also, ponds and streams on the site could be impacted by soil-disturbing activities that lead to soil erosion during site preparation and construction of VEGP Units 3 and 4. In addition, there could potentially be impacts to streams or other waterbodies during the construction of the new Thomson-Vogtle 500-kV transmission line.

4.4.2.1 Impacts of Construction on Aquatic Ecosystem in the Savannah River

The construction of the intake and discharge structures and a new barge facility would result in the loss of aquatic habitat, both temporary and permanent, in the Savannah River (Southern 2008a). All work would be conducted in accordance with a Clean Water Act Section 404 permit, a Rivers and Harbors Act Section 10 permit issued by the USACE, and a Section 401 Water Quality Certification issued by the GDNR Environmental Protection Division. This project would also require a Georgia General Stormwater Permit for Construction (Southern 2007b).

Cooling Water Intake Structure

The proposed location of the new CWIS is upstream of the existing intake structure for VEGP Units 1 and 2. The intake structure and canal are sized for three Westinghouse AP1000 reactors at the VEGP site; however, only the mechanical components supporting the proposed VEGP Units 3 and 4 would be installed (Southern 2007b). A schematic of the intake structure and canal are shown in Figures 3-4 and 3-5. The intake canal would be approximately 73 m (240 ft) long by 52 m (170 ft) wide with an earthen bottom at 21 m (70 ft) MSL and vertical sheet pile sides extending to 29.9 m (98 ft) MSL (Southern 2008a). The new intake structure and canal construction would affect approximately 5 ha (12.5 ac) with most of it in the Savannah River floodplain (Southern 2007b). Southern indicated that it is anticipated that the construction on the intake structure would occur in the summer, fall, and early winter to minimize the potential for unwanted flooding of the construction area (Southern 2007b). This timing would also minimize the impact to fish and other aquatic organisms that move into the floodplain with the high-water conditions that typically occur during the months of February, March, and April.

Southern has indicated that to minimize turbidity entering the river, excavation would begin at the west end of the canal cofferdam face and proceed toward the river (Southern 2007b). Permanent sheet piles forming the north and south banks of the intake canal would be driven using a vibratory or diesel hammer to form the north and south walls of a cofferdam. Temporary sheet piling would be driven around the perimeter of the intake structure and across the east and west face of the intake canal to complete the cofferdam. The piling installations would be

completed from the land side (Southern 2007b). Material within the intake area cofferdam would be excavated followed by the excavation of material within the intake structure cofferdam. The interior of the cofferdam would be dewatered to 6 m (20 ft) below water level and excavated (Southern 2007b). Southern has indicated that the excavation process would include controls to manage erosion and sediment and, as necessary, controls to ensure that runoff from the excavation process does not create environmental or aesthetic problems (Southern 2007b). The discharge from the dewatering system, and potentially from a hydraulic dredge, would be managed in accordance with the Section 401 Water Quality Certification to be issued by the GDNR Environmental Protection Division in support of the USACE Section 404 permit (Southern 2007b) to control discharge of water from the construction process to the Savannah River. This typically includes the use of BMPs to prevent spills of oils or hazardous materials associated with the excavation equipment operation as well as controls on turbidity (Southern 2007b). A tethered and floating silt curtain would also be used during excavation of the canal interior down to an elevation of 21 m (70 ft) above MSL. The installation of the inner serrated weir wall and the outer serrated wall and guide vanes at the mouth of the intake would occur from a barge located in the Savannah River. Southern has also committed to using appropriate environmental controls during this process to prevent spills and minimize environmental impact to the river and adjacent wetlands (Southern 2007b).

Barge Slip

The existing barge unloading facility is located between the existing VEGP Units 1 and 2 intake canal and the ring crane foundation. A new barge slip would be constructed along the west bank of the Savannah River, downstream of the intake structure for VEGP Units 1 and 2 (Southern 2007c) to support the unloading of the Westinghouse AP1000 reactor components and modules at the VEGP site (Southern 2008a). The downstream sheet pile wall would be removed and the slope excavated to extend the barge slip 27 m (90 ft) along the shoreline (Southern 2008a). The downstream sheet pile wall would be reconstructed and the shoreline stabilized (Southern 2008a). The barge slip is currently on fill that was put into place during the initial construction of VEGP Units 1 and 2 (Southern 2007b). A tethered, floating silt curtain would be at the entrance to the barge slip prior to excavating below 27 m (90 ft) MSL (Southern 2007a). Excavation would begin at the west end of the barge slip and move toward the river, thus minimizing turbidity entering the river (Southern 2007b).

Southern estimated that approximately 230 m^3 (300 yd^3) of sediment would be dredged or excavated from the Savannah River at the east end of the barge slip where the barge slip enters the river. The depth of dredging is approximately 20.4 m (67 ft) MSL (normal water elevation is 24 m [80 ft] MSL) (Southern 2007b). In addition, construction of the barge slip would require approximately 1988 m^3 (2600 yd^3) of stone fill within the barge slip basin (most of which is not in the Savannah River) to provide a stable foundation for grounding the loaded barges (Southern 2008a). Some of this fill would be placed in the area that is currently a part of the river.

Based on a bathymetry survey conducted in 2006, the need for dredging from the end of the barge slip to connect with the Federal navigation channel is not anticipated (Southern 2007b). However, river bathymetry may change and dredging to the Federal navigation channel may be necessary in the future (NRC 2007). A permit for this activity would be needed from the USACE to dredge this small portion of the river. The permit would typically contain restrictions related to the type of dredging, time of year that in-river work could be performed, turbidity and possible requirements for relocation of important benthic macroinvertebrates.

USACE, as authorized by Section 107 of the Rivers and Harbors Act, has the responsibility for maintaining a 27.4-m wide by 2.74-m deep (90-ft wide by 9-ft deep) channel in the Savannah River for navigational purposes. The Federal navigation channel was last used for a commercial shipment in 1979 and has not been maintained since that time. Recent measurements by the USACE indicate that depending on the level of water flow, most areas of the Federal navigation channel above rkm 56 (RM 35) would likely need to be dredged to allow barge traffic during normal river flow as discussed in Section 4.4.2. A description of the impacts associated with this action is provided in the cumulative impacts in Chapter 7.

Because the Rivers and Harbors Act assigns the responsibility of maintaining the navigation canal to the USACE, prior to any authorization for dredging in the Savannah River, the USACE would be required by the National Environmental Policy Act of 1969 (NEPA) to assess the impact of dredging on the river biota. A detailed assessment of impacts to river biota by the NRC staff is not possible at this time. Currently, the dredging project, if it should occur, is incompletely defined, the amount of material to be removed is unknown, and the location of the spoils dredge area has not been identified. Specifics of the project including any time-of-year restrictions or mitigation to protect aquatic resources would be provided in the Corps' assessment to fulfill the NEPA requirement.

Discharge Structure

The proposed discharge structure would be placed near the southwest bank of the Savannah River, extending about 15 m (50 ft) into the river (Southern 2008a). The discharge pipe would be approximately 1.07 m (3.5 ft) in diameter, narrowing to 0.6 m (2 ft) in diameter before the discharge point (Southern 2008a). The anticipated centerline elevation of the discharge pipe is 0.9 m (3 ft) above the river bottom elevation (Southern 2008a). Construction would involve the installation of a temporary sheet pile cofferdam (installed using a vibratory or diesel hammer) (Southern 2008a) and a dewatering system. The interior of the cofferdam would be excavated to support pipe installation to a grade of approximately 0.9 m (3 ft) below the invert elevation of the discharge piping and contoured up the river bank. H-piles that would be used for piping supports would be driven to 15 m (50 ft) MSL. After the pipe is laid, the dewatering system would be removed, and the pipe trench would be backfilled and graded to the required river bank slope contours. The cofferdam would be removed and rip-rap material would be installed to stabilize the river bank and the river bottom in the vicinity of the discharge point.

Construction Impacts at the Proposed Site

Summary of Impacts

The construction activities previously described are expected to have minimal impacts on the aquatic ecology of the Savannah River. The amount of benthic habitat altered during the construction of the intake canal would be small because most of the activity would occur in the floodplain during the dry season when the floodplain is not flooded. There would be approximately 122 m (400 ft) of shoreline disturbance at the intake structure, 27 m [90 ft] at the barge facility, and 6.1 m (20 ft) at the discharge structure (NRC 2007). A greater amount of river habitat would be disturbed during the barge slip construction activities; however, the amount of benthic habitat, open water, shoreline, and benthic fauna that would be lost is a small fraction of the total present in this area of the Savannah River. During the construction process, fish inhabiting the river in the vicinity of the construction activities may leave temporarily as a result of noise from pile driving or other construction activities. However, after construction is completed, fish would be expected to return to the area. Most of the habitat loss would be temporary and is a minor percentage of the total fish habitat in this area of the Savannah River. In addition, none of the species specifically mentioned as species of interest, concern, or listed are known to spawn specifically in the areas where construction would occur; thus, the activities would not disturb major spawning areas. Disruption of silt and debris during construction is expected to be minor based on the use of siltation curtains and other BMPs. Based on this review, the staff concludes that the overall impact of construction-related activities on aquatic ecological resources of the Savannah River would be minor, and further mitigation beyond the actions identified above is not warranted. This conclusion would also be reached even if dredging between the Federal navigation channel and the barge unloading facility is needed.

4.4.2.2 Impacts to Ponds and Streams Onsite from Site-Preparation and Construction Activities

Construction activities could also result in indirect impacts to wetlands on the VEGP site (Southern 2008a). Although the construction activities for the powerblock and the cooling towers are in areas of the site where no wetlands are present, the stormwater drainage from these areas is routed to Debris Basin #2 (Southern 2007b). No runoff from areas disturbed by construction is expected to be received by Debris Basin #1. If Debris Basin #2 is determined to be a jurisdictional wetlands area, the basin would be left as it currently exists. If additional stormwater retention volume is required, Southern has committed to construct additional storage in an upland area in accordance with applicable regulatory requirements (Southern 2008a). It is not anticipated that there would be any significant construction-related impacts to Telfair Pond and Beaverdam Creek or the aquatic biota in these waterbodies.

Mallard Pond and its feeder stream would potentially be affected during construction activities (Southern 2008a). Construction of the new switchyard and a proposed heavy-haul road could convey stormwater into the head of Mallard Pond (Southern 2008a). However, Southern has committed to plan and conduct these construction activities in accordance with applicable

regulations and BMPs to prevent erosion that could impact the aquatic biota in Mallard Pond (Southern 2008a). Based on this review, the staff concludes that the overall impact of construction-related activities on the aquatic ecological resources of the onsite ponds and streams would be minor, and further mitigation beyond the actions identified above is not warranted.

4.4.2.3 Impacts to the Aquatic Ecosystem from Construction of the Thomson-Vogtle 500-kV Transmission Line

Currently, Southern and the GPC are evaluating the actual right-of-way alternatives for the Thomson-Vogtle transmission line within a larger RDC. It is anticipated that the transmission line would cross Burke, Jefferson, McDuffie, and Warren Counties (Southern 2008a). The GPC performed a routing study to identify potential rights-of-way for the proposed transmission line in relation to existing land uses, including wetlands (GPC 2007). The field-verified right-of-way for the Thomson-Vogtle 500-kV transmission line would potentially cross several waterbodies. The right-of-way study proposed a feasible route within a field-verified right-of-way that was hypothetically produced to represent potential impacts to land use. The feasible route contained slightly more than 2.6 ha (6.4 ac) of open water, including various streams (GPC 2007). This is not the actual transmission line routing, but provides an estimate of the likelihood of stream and water-body crossings. Southern has stated that wetlands would be avoided in the routing if at all possible (Southern 2007a). In the event that wetlands are encountered, construction would be conducted in accordance with the necessary permits to protect wetland areas (GPC 2007). The GPC sites new transmission lines in accordance with Georgia Code Title 12, Section 12-2-8, and complies with all applicable laws, regulations, permit requirements, good engineering, and construction practices (GPC 2007). In accordance with Georgia Sediment and Erosion Control Act BMPs, a 7.6-m (25-ft) vegetative buffer would be maintained along all waters of the state that need to be crossed for new transmission line rights-of-way. Southern has committed that no structures would be placed in the buffer (Southern 2008a). In addition, no State or Federally threatened and endangered aquatic species occur in the field-verified RDC as indicated in the corridor study dated January 2007 (GPC 2007) and the State of Georgia's Natural Heritage database (GDNR 2007) As a result, the staff concludes that the overall impact of construction-related activities from the Thomson-Vogtle 500-kV transmission lines on aquatic biota are minor, and further mitigation beyond the actions identified above is not warranted.

4.4.2.4 Impacts to State-Listed Species

Three State-listed species occur in the vicinity of the VEGP site. The robust redhorse (*Moxostoma robustum)* is found in the Savannah River; however, the only known spawning area is 40 river kilometers (60 river miles) upstream from the site (Grabowski and Isley 2006). In addition, during their migrations, the robust redhorse appears to stay within the channel,

entering the floodplains only during high-water events. Thus, it is anticipated that they would not be adversely affected by construction activities.

The Georgia State-endangered Atlantic pigtoe mussel (*Fusconaia masoni*), was tentatively identified in surveys by the USFWS (The Catena Group 2007) as being in the Savannah River. However, the specimens were located at a considerable distance (84 km [52 mi]) upstream of the VEGP site and, thus, would not be adversely affected by construction activities at the VEGP site. The Savannah darter (*Etheostoma fricksium*) is a Georgia State species of concern with no legal protective status. The Savannah darter may at times enter the Savannah River, however its preferred habitat is shallow creeks such as Beaverdam Creek. It is unlikely that Beaverdam Creek would be adversely affected by construction of VEGP Units 3 and 4.

Nine South Carolina mussel species of concern (Table 2-9) are known to occur in the Savannah River near the VEGP site. Because these species have been found in multiple locations, as documented in recent surveys, there is a potential for impact during construction activities. The State of South Carolina (Price 2007) has expressed concern over the potential for impacts to freshwater mussels from dredging activities (specifically from removal and disposal of sediment containing mussels and the use of heavy equipment or other construction practices that could crush mussels), and has recommended that sampling for freshwater mussels be conducted in areas where dredging would occur to determine the impact on the population. Although the area of disruption for mussels during construction of the intake, discharge, and barge slip is small relative to the extent of the Savannah River benthic habitat at this location, further discussions between the applicant and the State of South Carolina related to mitigative actions, such as sampling for and moving mussels, would be appropriate prior to dredging and construction activities. Because of the possibility that future dredging of the Federal navigation channel in the Savannah River may be necessary for barge transport of large components, the staff identifies the potential impacts of that activity on mussels in Chapter 7, Cumulative Impacts.

The area of disruption for mussels during construction of the intake, discharge and barge slip, and potential dredging between the barge slip and the Federal navigation channel is small relative to the extent of the Savannah River benthic habitat at this location and the impact would be temporary and largely mitigable. Thus, the impacts to these mussel species are likely to be minor.

4.4.2.5 Summary of Impacts to Aquatic Ecosystems

The staff has reviewed the proposed construction activities for VEGP Units 3 and 4 and the potential impacts to aquatic biota in the onsite waterbodies and the Savannah River. Based on this review, the staff has determined that the impacts resulting from the proposed construction activities, including the potential dredging from the Federal navigation channel to the barge slip, would be SMALL. Any impacts that would occur would be temporary and largely mitigable.

4.4.2.6 Aquatic Monitoring During Construction

Southern does not plan to perform any formal construction-related monitoring. Southern bases this decision on "...the fact that any ground- or river-disturbing activities would be of relatively short duration, permitted and overseen by State and Federal regulators, guided by an approved Stormwater Pollution Prevention Plan, and that any small spills would be mitigated according to the existing VEGP Spill Prevention Control and Countermeasures Plan, and that there are no sensitive habitats or species of interest at the proposed location...." (Southern 2008a). Although the shortnose sturgeon (*Acipenser brevirostrum*), a Federally listed endangered species, is located in the Savannah River, the known spawning areas are not near the VEGP site, and the timing of spawning coincides with high water levels, during which time construction activities would likely not occur. Other fish species also would avoid construction activities.

Southern also does not plan any formal construction-related monitoring of aquatic ecosystems during construction of the transmission line. If construction of the new transmission line would result in crossings of intermittent and perennial streams, the construction would be conducted in accordance with the necessary permits to protect wetland areas (GPC 2007). The GPC has stated that it sites new transmission lines in accordance with Georgia Code Title 12, Section 12-2-8, and it complies with all applicable laws, regulations, permit requirements, good engineering, and construction practices (GPC 2007). In addition, the proposed right-of-way for the new transmission line does not cross areas with known populations of Federally listed or State-listed aquatic species (Southern 2008a).

4.4.3 Federally Listed Species

This section describes the potential impacts to Federally listed or proposed threatened and endangered aquatic and terrestrial species and associated designated and proposed critical habitat resulting from construction of new units on the VEGP site, and the Thomson-Vogtle transmission lines. The biology of these species is presented in Sections 2.7.1 and 2.7.2.

The staff prepared biological assessments (see Appendix F) documenting potential impacts to the Federally listed threatened and endangered aquatic and terrestrial species as a result of the site preparation and preliminary construction of the nonsafety-related structures, systems, or components in advance of issuance of a combined operating license. The staff's impact determinations are reiterated in this section.

4.4.3.1 Terrestrial Species

The potential impacts of construction activities on Federally listed terrestrial species are described below.

Construction Impacts at the Proposed Site

Red-Cockaded Woodpecker – Endangered

The VEGP Site

The endangered red-cockaded woodpecker (*Picoides borealis*) is listed as having the potential to occur in the vicinity of the VEGP site in Burke County, Georgia; and Aiken and Barnwell Counties, South Carolina (FWS 1999, 2004c). However, there are no known occurrences in Burke County, Georgia, and no active colonies within 16 km (10 mi) of the VEGP site in South Carolina (GDNR 2007; SCDNR 2007). Surveys were conducted for red-cockaded woodpeckers in February 2006 in support of a safe harbor agreement and on 675.4 ha (1669 ac) of the site in support of this ESP application. However, the red-cockaded woodpecker has never been documented onsite (TRC 2006; Southern 2007b). The closest active red-cockaded woodpecker group is located on the Savannah River Site approximately 16 km (10 mi) from the VEGP site (Wike et al. 2006).

Suitable habitat for foraging and nesting occurs within the VEGP site, but does not occur in the proposed construction footprint. The types of habitat that would be disturbed during construction mainly consist of previously disturbed areas, planted pines, hardwoods, wetlands along the Savannah River, and open fields. Red-cockaded woodpeckers are found mainly in large stands of old longleaf pine, and this type of habitat would not be disturbed. Based on the distance to the closest known active colony, and the fact that red-cockaded woodpeckers have not been recorded on the VEGP site or in the general vicinity of the site, it is unlikely red-cockaded woodpeckers would be affected during construction activities.

Proposed 500-kV Transmission Line Right-of-Way

The red-cockaded woodpecker is listed on the FWS website as potentially occurring in Burke and Jefferson Counties, Georgia (FWS 2004c). The red-cockaded woodpecker has been recorded on Fort Gordon in Richmond County (GDNR 1999), but there are no known occurrences of red-cockaded woodpeckers in the vicinity of the RDC. Impacts to red-cockaded woodpeckers are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

Wood Stork – Endangered

The VEGP Site

The endangered wood stork (*Mycteria americana*) is listed as having the potential to occur in the vicinity of the VEGP site, Burke County, Georgia, as well as in Aiken and Barnwell Counties, South Carolina (FWS 1999; 2004c). Wood storks were not identified in threatened and

endangered species surveys in 2005, and have not been documented onsite (TRC 2006; Southern 2006a). The closest known colony of wood storks is more than 40 km (25 mi) away. Foraging on the VEGP site may occur from June through September in suitable habitat. During construction of the CWIS, discharge structure and the barge facility, suitable foraging habitat may be affected. However, this species is highly mobile; hence any onsite impacts associated with construction on the VEGP site would be minimal.

Proposed 500-kV Transmission Line Right-of-Way

Wood storks have the potential to occur in Burke and Jefferson Counties (FWS 2004c). There are no known nesting colonies in these counties, with the nearest being 43 km (27 mi) away in Screven County. Wood storks have also been seen foraging on the U.S. Army's Fort Gordon installation in Richmond County adjacent to the RDC (Mitchell 1999). At this time, it is not known if these individuals use habitat along or in the RDC. Impacts to wood storks are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

Flatwoods Salamander – Threatened

The VEGP Site

The Federally threatened flatwoods salamander (*Ambystoma cingulatum*) has the potential to occur in Burke County, Georgia. The last record for breeding flatwoods salamanders in Burke County was in the 1940s (FWS 2004c). There are no known historical occurrences of flatwoods salamanders on the VEGP site, and flatwoods salamanders were not identified in the 2005 threatened and endangered species survey (Southern 2006a; TRC 2006). There are no recorded occurrences within 16 km (10 mi) of the site (GDNR 2007). Suitable habitat for the flatwoods salamander may occur onsite, but suitable habitat is not found within the construction area footprint. The types of habitat that would be disturbed during construction consist mainly of previously disturbed areas, planted pine, hardwoods, wetlands along the Savannah River, and open fields. Flatwoods salamanders are not likely to be encountered during construction at the VEGP site, and adverse impacts are unlikely.

Proposed 500-kV Transmission Line Right-of-Way

Flatwoods salamanders have the potential to occur only in the Burke County portion of the RDC (FWS 2004c). There are no known populations of flatwoods salamanders in the vicinity of the RDC, with the nearest occurrence 35 km (22 mi) away in Screven County, Georgia (GDNR 2007). Impacts to flatwood salamanders are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation

with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

American Alligator – Threatened Based on Similarity of Appearance

In 1967, the American alligator (*Alligator mississippiensis*) was classified by FWS as Federally endangered throughout its range, including Georgia. By 1987, following several reclassification actions in other states, it was reclassified to "threatened based on similarity of appearance" to the American crocodile (*Crocodylus acutus*) in the remainder of its range, including Georgia (52 FR 21059). The alligator is no longer biologically imperiled in Georgia. Its populations are considered disjunct (i.e., limited to suitable habitat) and stable. The reclassification helps prevent excessive take of the alligator and protects the American crocodile (52 FR 21059).

During surveys of the VEGP site made by Third Rock Consultants, LLC, in the summer of 2005, an alligator was observed in Mallard Pond (TRC 2006). Alligators appear to be relatively common in the Savannah River near and on the VEGP site (Wike et al. 2006). Alligators in the Savannah River floodplain may be temporarily displaced, but there is ample wetlands habitat in the region. The alligators may be minimally affected by construction at the VEGP site; impacts on alligators would be considered negligible. Potentially, alligators could be encountered during construction of the new transmission line, but it is likely that GPC would avoid alligators or alligator nests for safety reasons.

Canby's Dropwort – Endangered

<u>The VEGP Site</u>

The Federally endangered Canby's dropwort (*Oxypolis canbyi*) has the potential to occur in Burke County, Georgia (FWS 2004c). Canby's dropwort was not found on the VEGP site during the 2005 threatened and endangered species surveys, and there are no historical records of it occurring onsite (Southern 2006a; TRC 2006). There are two historical records in Burke County around Waynesboro, Georgia (51 FR 6690), and these populations are currently thought to be extirpated (FWS 1990). There are no recorded occurrences within 16 km (10 mi) of the VEGP site (GDNR 2007).

It is unlikely that the VEGP site contains suitable habitat for Canby's dropwort. Because of the lack of suitable habitat, it is unlikely there would be construction-associated impacts to this species at the VEGP site.

Proposed 500-kV Transmission Line Right-of-Way

Canby's dropwort occurs in Burke County (GDNR 2007). However, there are no known populations within the RDC. The nearest known occurrence is about 5.6 km (3.5 mi) from the RDC. Impacts to Canby's dropwort are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

Smooth Coneflower – Endangered

The VEGP Site

The smooth coneflower (*Echinacea laevigata*) is listed as Federally endangered and is known to occur in Stephens County, Georgia (Patrick et al. 1995). The smooth coneflower is found in Aiken and Barnwell Counties, South Carolina, more than 8 km (5 mi) from the VEGP site (SCDNR 2007). There are no known occurrences of smooth coneflower in Burke County, no historical occurrences on the VEGP site, and it was not recorded in the 2005 threatened and endangered species survey (TRC 2006; FWS 2004c; Southern 2006a). It appears unlikely that there is suitable onsite habitat. Therefore, there would be no impacts to this species from construction at the VEGP site.

Proposed 500-kV Transmission Line Right-of-Way

The smooth coneflower has not been recorded within any of the counties that may be crossed by the new transmission line. No impact to this species is expected from transmission line construction activities.

Relict Trillium – Endangered

The VEGP Site

The relict trillium (*Trillium reliquum*) was listed as Federally endangered in 1988. Relict trillium is known to occur in Aiken County, South Carolina. Known populations in Aiken County are more than 16 km (10 mi) from the VEGP site (SCDNR 2007).

The relict trillium was not observed during the 2005 or 2007 threatened and endangered species onsite surveys, and it has not been recorded by either the FWS or the GDNR in Burke County, Georgia (TRC 2006; FWS 2004c; GDNR 2007; Patrick 2007). Therefore, there would be no impacts to this species from construction at the VEGP site.

Construction Impacts at the Proposed Site

Proposed 500-kV Transmission Line Right-of-Way

The relict trillium has not been recorded within any of the counties that may be crossed by the transmission line, and the nearest known location is more than 122 km (76 mi) away in Jones County, Georgia. No impact to this species is expected from transmission line construction activities.

Georgia Aster – Candidate

The VEGP Site

The Georgia aster (*Symphyotrichum georgianum)* is a candidate for Federal listing. However, it has not been recorded within Burke County, Georgia, and was not observed during the 2005 threatened and endangered onsite species survey (TRC 2006). Therefore, no impact to this species is expected from VEGP Units 3 and 4 construction activities.

Proposed 500-kV Transmission Line Right-of-Way

Georgia aster is known to occur in McDuffie County, Georgia about 9 km (5.5 mi) from the RDC (FWS 2004c; GDNR 2007). Impacts to Georgia aster are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

Terrestrial Threatened and Endangered Species Summary

Based on the threatened and endangered species surveys, historical records, life history information, known threatened and endangered species locations, and information provided by Southern in its ER and Request for Additional Information (RAI) responses, the staff concludes the impacts on terrestrial Federally listed threatened and endangered species from construction activities on the VEGP site would be SMALL.

The GPC would site the new 500-kV transmission line in accordance with Georgia Code Title 22, Section 22-3-161. GPC procedures for implementing this code include consultation with FWS and an evaluation of impacts to special habitats and threatened and endangered species. In addition, the GPC would comply with all applicable laws, regulations, and permit requirements, and would use good engineering and construction practices (Southern 2008a). Surveys for threatened and endangered species have not yet been conducted in the RDC. The staff has determined that impacts to Federally protected species within the proposed 500-kV transmission line right-of-way would likely be SMALL. However, without adequate surveys, consultation, and appropriate mitigation, the impact to Federally protected species could be MODERATE.

4.4.3.2 Aquatic Species

As described in Section 2.7.2.2 the only Federally listed aquatic species is the shortnose sturgeon. The species was identified through correspondence with NMFS (NMFS 2006). Construction of the proposed CWIS, discharge structure, and the barge slip would temporarily disturb the river bank environment. This disturbance would include the potential for some turbidity and river bottom alteration and noise from pile-driving activities. However, Southern has committed to using BMPs to avoid increased turbidity (Southern 2008a), and noise impacts would be transient.

As discussed in Section 2.7.2.2, the suspected spawning sites for shortnose sturgeon that have been reported are at rkm 179 to 190 (RM 111 to 118) and rkm 275 to 278 (RM 171 to 172) (Hall et al. 1991) and rkm 179 to 228 (RM 111 to 142) (Collins and Smith 1993) (Figure 2-14). The VEGP site is located at rkm 241 to 244 (RM 150 to 152). The spawning areas are characterized by fast-flowing river bends that provide substrate suitable for attachment for the highly adhesive sturgeon eggs. These areas include submerged timber, scoured sand, clay, and gravel as a substrate. Hall et al. (1991) also reports that the spawning depth is considered to be 6 to 9 m (20 to 30 ft). In contrast, the Savannah River adjacent to the VEGP site is relatively straight with very few bends. The maximum depth of the water in the vicinity of the proposed intake structure is approximately 3.7 to 4.0 m (12 to 13 ft) (Southern 2008a). The substrate in the deep sections of the Savannah River in the vicinity of the site ranged from "...brown poorly graded gravel with sand..." to "...poorly graded gravel...." (Southern 2006a).

As mentioned previously, the USACE, as authorized by the Rivers and Harbors Act, has the responsibility for maintaining a channel in the Savannah River for navigational purposes. The impacts on the shortnose sturgeon from the potential dredging of the navigation canal are identified in Chapter 7, Cumulative Impacts.

Based on the staff's review, it appears highly unlikely that shortnose sturgeon would spawn in the vicinity of the VEGP site. It is most probable that sturgeon moving through the area would avoid the construction on their way upstream as spawning adults or downstream as larvae, and would not be impacted by construction activities. As a result, the staff concludes that the overall impact of construction-related activities at the VEGP site, on the shortnose sturgeon would be SMALL, and further mitigation beyond the actions stated above is not warranted.

4.5 Socioeconomic Impacts

Construction activities can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of construction-related activities and of the construction workforce on the region. Unless otherwise specified, the primary source of information for this section is the ER (Southern 2008a).

Construction Impacts at the Proposed Site

The planned onsite construction-related activities would differ significantly from those activities required to construct VEGP Units 1 and 2.[a] Although many activities would be similar, VEGP Units 1 and 2 were constructed almost entirely onsite. For VEGP Units 3 and 4, many of the components of the Westinghouse AP 1000 nuclear units would be made at dedicated fabrication facilities outside the VEGP site region and would be delivered to the ESP site ready to assemble, thus reducing onsite construction labor requirements. The peak workforce for VEGP Units 1 and 2 was around 14,000 construction workers.[b] Southern estimates the peak onsite construction requirements for VEGP Units 3 and 4 to be 3500 workers (specific assumptions discussed in following sections). Because approximately 75 percent fewer onsite workers would be needed to construct VEGP Units 3 and 4 than were needed for VEGP Units 1 and 2, the staff expects the construction-related physical, social, and economic impacts on the region, both beneficial and adverse, would be smaller than the impacts associated with the construction of VEGP Units 1 and 2 (Southern 2008b).

Although the staff considered the entire region within an 80-km (50-mi) radius of the VEGP site when assessing socioeconomic impacts, the primary region of interest for physical impacts is the area within a 16-km (10-mi) radius. The region of interest with regard to social and economic impacts encompasses the entire 80-km (50-mi) radius, but primarily includes Burke, Columbia, and Richmond Counties in Georgia. Based on commuter patterns and the distribution of residential communities in the area, the NRC staff found *de minimis* impacts on other counties within the 80-km (50-mi) radius in Georgia and South Carolina. While Barnwell County borders the VEGP site on the South Carolina side of the Savannah River, this county is primarily occupied by the Savannah River Site, which has no permanent residents. Furthermore, there are no bridges near the VEGP site for commuters to cross into South Carolina. Consequently, South Carolina is more isolated from the proposed site than it appears and has been excluded from much of the socioeconomic analysis pertaining to construction and operation at the VEGP site.

4.5.1 Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odors, vehicle exhaust, and dust. Vibration and shock impacts are not expected because of the strict control of blasting and other shock-producing activities. This section addresses potential construction impacts that may affect people, buildings, and roads.

(a) The construction on VEGP Unit 1 was completed in 1987, and Unit 2 was completed in 1989 (Southern Website at http://www.southerncompany.com/Southernnuclear/Vogtle.asp).

(b) Taken from *The Blazer*, which is a weekly newsletter serving the "Plant Vogtle Community." The specific article is entitled "The Vogtle Report," June 7, 1986. Volume 5, Number 12.

4.5.1.1 Workers and the Local Public

The VEGP site is located in an area used for industrial purposes and is bounded by agricultural and forested land. No significant industrial or commercial facilities other than the VEGP site exist or are planned in the vicinity. The recreational areas closest to the plant include the Yuchi Wildlife Management Area (WMA) and the Crackerneck WMA, which are both adjacent to the plant site (Figure 2-21). These recreational areas could be affected by construction on the VEGP site because of an increase in traffic, noise, and dust from construction activities (Southern 2008a). However, Crackerneck WMA is on the South Carolina side of the Savannah River approximately 80 km (50 mi) from the VEGP site by road and would probably experience little or no traffic-related effects.

All construction activities would occur within the VEGP site boundary and would be performed in compliance with all Occupational Safety and Health Administration (OSHA) standards, BMPs, and other applicable regulatory and permit requirements. Offsite areas supporting construction activities (e.g., borrow pits, quarries, and disposal sites) are already permitted and operational. Therefore, the staff expects the incremental construction-related impacts on those facilities to be small. While approximately 3500 people live within 16 km (10 mi) of the VEGP site (see Section 2.8.1), the people most vulnerable to noise, fugitive dust, and gaseous emissions resulting from construction activities include construction workers and personnel working onsite, people working or living immediately adjacent to the site, and transient populations such as recreational visitors, tourists, or temporary employees (Southern 2008a).

Construction workers would have adequate training and personal protective equipment to minimize the risk of potentially harmful exposures. Emergency first-aid care would be available at the construction site, and regular health and safety monitoring would be conducted during construction. People working onsite or living near the VEGP site would not experience any construction-related physical impacts greater than those that would be considered an annoyance or nuisance. Construction activities would be performed in compliance with Federal, State, and local regulations, and site-specific permit conditions (Southern 2008a).

Burke County is part of the Augusta-Aiken Interstate Air Quality Control Region, which is classified as in attainment of the National Ambient Air Quality Standards[(a)] (40 CFR 81.114) for all criteria pollutants. The nearest non-attainment area to the proposed site is in Columbia, South Carolina, which is a non-attainment area under the 8-hour ozone standard. Columbia is approximately 130 km (80 mi) northeast of the proposed VEGP site. Temporary and minor effects on local ambient air quality may occur as a result of normal construction activities. Emissions of fugitive dust and particulate matter smaller than 10 micrometers (PM_{10}) in size are generated during earth-moving and material-handling activities. Construction equipment and

(a) Areas of the United States having air quality as good as or better than the National Ambient Air Quality Standards are designated by the EPA as "in attainment areas."

offsite vehicles also produce emissions during construction. The pollutants of primary concern include PM_{10} fugitive dust, reactive organic gases, oxides of nitrogen, carbon monoxide, and, to a lesser extent, sulfur dioxides. Mitigation measures (e.g., paving or stabilizing disturbed areas, water suppression, reduced material handling) would minimize such emissions. Odors could result from exhaust emissions, but odors dissipate onsite and would have no discernible impact on the local air quality. All equipment would be serviced regularly and all construction activities would be conducted in accordance with Federal, State, and local emission requirements.

Construction activities are inherently noisy, but the VEGP site's relative isolation from populated areas and the wooded areas surrounding the site would provide natural noise abatement. If exceptionally noisy construction activities would be necessary, Southern would provide public announcements or notifications. All construction activities would be subject to regulations stemming from the Noise Control Act of 1972, Federal regulations for noise from construction equipment (40 CFR Part 204), and OSHA regulations (29 CFR 1910.95).

Sportsmen using the Yuchi WMA and the GPC boat landing on the Savannah River would be the transient population most affected by construction-related activities. Southern would inform transient populations of such activities and potential impacts to recreational activities by posting signs in the area.

Specific mitigation measures to control fugitive dust would be identified in a dust-control plan, or a similar document, prepared prior to project construction in accordance with all applicable State and Federal permits and regulations. These mitigation measures could include but are not limited to the following:

- stabilizing construction roads and spoils piles
- limiting speeds on unpaved construction roads
- periodically watering unpaved construction roads to control dust
- performing housekeeping (e.g., remove dirt spilled onto paved roads)
- covering haul trucks when loaded or unloaded
- minimizing material handling (e.g., drop heights, double-handling)
- ceasing grading and excavation activities during high winds and during periods of extreme air pollution
- phasing grading to minimize the area of disturbed soils
- re-vegetating road medians and slopes.

4.5.1.2 Buildings

Construction activities would not affect any offsite buildings. Onsite buildings have been constructed to safely withstand any possible impact, including shock and vibration, from activities associated with construction at the VEGP site (10 CFR Part 50, Appendix A). Except

for the existing structures on the VEGP site, no other industrial, commercial, or recreational structures would be directly affected by the construction of the new facility.

4.5.1.3 Roads

Public roads and railways would transport construction materials and equipment. Burke County has a well-developed transportation system and would not be significantly impacted as a result of Southern's proposed construction activities. No significant alterations or construction of roads would be needed, but some roads may need minor repairs or upgrades to allow safe access to the plant site. Southern would repair any damage to public roads, markings, or signs caused by construction activities to pre-existing conditions or better. Southern plans to build a new private access road to the construction site, a heavy-haul route from the VEGP site barge facility on the Savannah River, and a new road from the new intake structure to the construction site. These roads would be fully contained within the existing site boundary. The railway spur that connects the VEGP site to the main spur north of Waynesboro has recently been upgraded and would be used to transfer heavy equipment to the site.

Construction workers would use a dedicated construction access road rather than the primary VEGP site access road. This road would be marked clearly with signs and maintained clear of debris. Southern would select hauling routes based on equipment accessibility, existing traffic patterns, and noise restrictions, logistics, distance, costs, and safety. Impacts to the surrounding region would be minimized by avoiding routes that could adversely affect sensitive areas, such as residential neighborhoods, hospitals, schools, and retirement communities. Southern also would restrict activities and delivery times as much as possible to daylight hours.

4.5.1.4 Aesthetics

Approximately 224 ha (555 ac) on the VEGP site would need to be cleared and excavated to construct VEGP Units 3 and 4. Most of the clearing would be at the VEGP site; however, approximately 5.06 ha (12.5 ac) of river shoreline would be cleared, excavated, and graded for the CWIS, and approximately 4 ha (10 ac) would be cleared and graded for the barge facility and discharge pipe. In addition, temporary roads and a barge facility would need be constructed, and heavy equipment would have to be brought to the site. The two construction sites would be approximately 460 m (1500 ft) apart. The clearing and excavation for the new units and adjacent support facilities would not be visible from offsite roads. However, clearing and construction activities for the river-front facilities would be visible from the river. Southern would use BMPs to prevent erosion and sedimentation, including seeding bare earth, but the affected river front would be exposed during construction of the barge dock and CWIS and discharge structures.

Construction Impacts at the Proposed Site

The proposed site is bounded by agricultural and forested land. Some construction activities may be visible from the Savannah River and parts of River Road, but most of the construction activity would be masked by woods and the bluff along the river. The VEGP site is already aesthetically altered by its existing nuclear power plant and 180 m (600 ft) high cooling towers. Because construction-related impacts would be temporary, the staff expects any construction-related adverse aesthetic impacts to the site and vicinity would also be temporary and SMALL. The new transmission lines, however, would be constructed offsite and aesthetic impacts are likely to be MODERATE.

4.5.1.5 Summary of Physical Impacts

The proposed footprint for VEGP Units 3 and 4 is in an industrial area, surrounded by forested land. All construction activities would occur within the construction site boundary. Based on the information provided by Southern in its ER (Southern 2008a) and the NRC's own independent review, the staff concludes that the overall physical impacts of construction on workers and the local public, buildings, roads, and aesthetics near the VEGP site would be SMALL as long as the mitigative actions identified above are undertaken. Aesthetic impacts along the new transmission line are likely to be MODERATE.

4.5.2 Demography

The following assessment of population impacts is based on Southern's estimated peak construction workforce of 3500 workers.[(a)] The proposed construction schedule assumes 18 months for site preparation and 66 months of construction, for a total construction duration of 84 months. Southern estimates approximately 1000 workers already live within commuting distance of the plant (Southern 2008a). From NRC's own interviews of local building trade leaders, the staff believes it may be possible that the number of locally available skilled crafts workers might be considerably greater. However, an assessment of negative impacts from in-migrating skilled crafts workers provides a more conservative (worst-case) scenario. The staff assumes 2500 workers would likely in-migrate to the region (PNNL 2006). Of these, 2000 jobs would last two or more years and the remainder would be for less than two years (Southern 2008a).

Based on information collected by the Tennessee Valley Authority (TVA) in 2003 related to the construction workforce in-migrant patterns at the Brown's Ferry Nuclear Plant, the staff estimated the in-migrating workers who stay for more than two years would bring families, increasing the number of in-migrants by approximately 3000, for a total increase of the

(a) This estimate was based on Bechtel historical construction data for a proposed construction schedule for two Westinghouse AP1000 reactors, considering total estimated net generation output and total number of job hours necessary to install and start up the two units (Southern 2007b). These numbers were further refined based on information provided by Westinghouse and NUSTART (Southern 2008b; 2008c).

population of approximately 5500. Of the additional 3000 in-migrating workforce dependants, approximately 1100 would be school-age children (Southern 2006a).[(a)]

To approximate the commuting patterns of the in-migrating workers, Southern assumed all workers would find housing in the same proportions as the current operations and maintenance workforce at the VEGP site. Therefore, the staff likewise assumes a residential distribution for the long-term construction workers that resembles the residential distribution of the current VEGP site workforce (see Table 2-14), and that over 90 percent of the in-migrating workers would live in Columbia, Richmond, Burke, Screven, or Aiken County. Consequently, there would be net population increases of approximately 1100 in Burke County, 1430 in Richmond County, 1870 in Columbia County, 390 in Screven County, and 220 in Aiken County, and 500 in all other counties in the 80-km (50-mi) radius. These numbers represent a 5 percent increase in the year 2000 Census population of Burke County, a 3 percent increase in Screven County, a 2 percent increase in Columbia County, a 1 percent increase in Richmond County, and less than 1 percent in Aiken County. Given the magnitude of the estimated population increases, the staff determined the influx of workers because of VEGP construction activities would only impose SMALL and temporary, unnoticeable demographic impacts to the more populous counties. However, depending on where these workers choose to reside, Burke County would likely experience MODERATE and temporary impacts because of the increases in population. The staff expects any impacts to all other counties within 80 km (50 mi) of the VEGP site would be SMALL and temporary.

4.5.3 Economic Impacts to the Community

This section evaluates the social and economic impacts on the area within 80 km (50 mi) of the VEGP site as a result of constructing VEGP Units 3 and 4. The evaluation assesses the impacts of construction and demands placed by the larger workforce on the surrounding region.

4.5.3.1 Economy

The impacts of construction on the local and regional economy depend on the region's current and projected economy and population. The VEGP site, if approved, would be available for 20 years after approval, and construction could begin anytime in that 20 years assuming issuance of a construction permit (CP) or combined license (COL). For this analysis, the staff assumes site-preparation would be completed by 2010 and construction of the new reactors would have a start date of 2010, with a commercial operation date of 2016 for VEGP Unit 3 and 2017 for VEGP Unit 4 (Southern 2008b).

(a) TVA assumes 65 to 85 percent of the long-term, in-migrating construction workers bring families, with an average of 1.762 dependents per worker. Approximately half of the dependents are assumed to be children, and 74 percent of the children are school age. Thus, 2000 × 0.85 × 1.762 = 2995 total additional in-migrants and 2995 × 0.5 × 0.74 = 1108 school-age children.

Construction Impacts at the Proposed Site

The in-migration of approximately 2500 workers would create new indirect jobs in the area through a process called the spending/income multiplier effect, which explains how each dollar spent on goods and services by one person becomes income to another, who saves some money but re-spends the rest. In turn, this re-spending becomes income to someone else, who in turn saves a portion and re-spends the rest, and so on. The percentage by which the sum of all spending exceeds the initial dollar spent is called the "multiplier." The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides regional multipliers for industry jobs and earnings (BEA 2005). For every construction worker, BEA estimates an additional 0.70 jobs would be created in the area near the VEGP site. Considering this multiplier effect, the construction activities at the VEGP site could create approximately 3400 additional (direct plus indirect) jobs in the 80-km (50-mi) region during the construction phase.[a]

The employment of such a large workforce over a 7-year period would have positive economic impacts on the surrounding region. Even if these workers earned no more than average construction wage rates, this large pool of jobs would inject millions of dollars into the regional economy, thus reducing unemployment and creating business opportunities for housing and service-related industries. The largest economic impacts would most likely be felt in Burke County, particularly in the town of Waynesboro, Georgia, since it may house the largest percentage of permanent and temporary employees. Although the staff expects a relatively small population increase in Screven County, relative to its small base population and economy; this increase could produce a noticeable upsurge in the local economy.

The NRC staff concludes that beneficial economic impacts could be experienced throughout the region. In Burke County and possibly Screven County, MODERATE potentially beneficial economic impacts would occur as a result of construction activities at the VEGP site. Economic impacts elsewhere would be SMALL.

4.5.3.2 Taxes

Several tax revenue categories would be affected by the construction of VEGP Units 3 and 4. These include taxes on wages, salaries, and corporate profits; sales and use taxes on construction-related purchases; workforce expenditures; property taxes related to the new units; and personal property taxes on owned real property.

(a) Only the in-migrating workers that are expected to work over 2 years at the site are considered here (2000 total). With the multiplier effect, the total number of direct and indirect jobs would be approximately 3400 (2000 + (2000 × 0.70) = 3400).

Personal and Corporate Income Taxes

Georgia has personal and corporate income taxes. Construction workers would pay taxes to the State of Georgia on their wages and salaries if their residence is in Georgia or if they are nonresidents working in Georgia and have Georgia income that exceeds 5 percent of income from all sources. The staff considers the wages of Georgia residents who would work at the proposed site to be a net transfer with no analytical worth. For in-migrating workers, the staff considers the full value of their VEGP-based earnings as applicable to this analysis. While the exact amount of income taxes the project would generate for the State of Georgia cannot be known, assuming in-migrating workers earn a representative annual construction salary of approximately $64,000 per year,[(a)] the income from in-migrating workers could generate millions of dollars of additional revenue over the 7-year pre-construction and construction period.[(b)] However, this revenue would be paid into the general fund to the State of Georgia. Therefore, the impact of additional income tax revenues would be relatively small for the counties within 80 km (50 mi) of the proposed site (Southern 2008a). Similarly, contractors building the new units at the VEGP site would pay corporate income taxes on the net income earned from the construction activity, which would be paid to the State general fund.

Sales and Use Taxes

The area around the proposed site would experience an increase in sales and use taxes generated by retail expenditures (e.g., restaurants, hotels, merchant sales, food, etc.) by the construction workforce. The region would also experience an increase in the sales and use taxes collected from construction materials and supplies purchased for the project. Given its proximity to the proposed site and relatively small population and economic base, Burke County would probably receive the largest benefit from sales tax revenues. Columbia and Richmond Counties may also experience an increase in sales and use tax revenues; however, it would likely be a much smaller percentage because of the larger sales and use tax base in these counties. Screven County has limited services and shopping; thus, any impact on sales and use tax revenues would likely be small.

Property Taxes

The VEGP site's current property tax payments represent approximately 80 percent of Burke County's total county property tax revenues (see Table 2-16). Although an exact property tax revenue estimate is not available, during construction the new units would be assessed at some negotiated valuation that would likely range from $1.2 to $2.6 million, based on net electrical output of 1117 MW(e)(Southern 2006a). It is likely that this negotiated value would be no more

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(a) Personal communication with Charles Hardegree, Business Manager, Plumbers and Steamfitters Local Union #150, Augusta, GA. June 20, 2007. (Accession No. ML072290212)

(b) Impact and sensitivity analysis provided by Southern in RAI response letter (Southern 2006a).

than 50 percent of the invested capital each year. VEGP would pay Burke County some taxes on VEGP Units 3 and 4 during the 5-year construction period.

A second source of revenue from property taxes would be housing purchased by the long-term construction workforce. In-migrating workers may construct new housing, which would add to the counties taxable property base, or these workers could purchase existing houses, which would drive housing demand and housing prices up, thus slightly increasing values (and property taxes levied). The increased housing demand would have little effect on tax revenues in the more heavily populated jurisdictions.

Summary of Tax Impacts

The amount of income taxes collected over a potential 7-year preconstruction/construction period could be large in absolute terms, but small when compared to the total amount of taxes that Georgia collects in any given year or in a 7-year period. In absolute terms, the amount of sales and use taxes collected over a potential 7-year construction period could be large, but small when compared to the total amount of taxes collected by Georgia, South Carolina, and the governmental jurisdictions within the region. However, given the smaller economic bases, sales and use tax impacts in Burke County could be MODERATE. The construction site-related property taxes collected and distributed to Burke County would likely be MODERATE when compared to the total amount of taxes Burke County collects in any given year over the 7-year construction term, depending on the terms of the *ad valorem* tax revenue payments made for VEGP Units 3 and 4. Burke, Richmond, Columbia, and Screven Counties may also benefit from small property tax revenue increases stemming from changes in house values and increased inventory from the influx of the long-term construction workforce.

4.5.3.3 Summary of Economic Impacts to the Community

Based on the information provided by Southern, NRC staff interviews with local public officials, and NRC's own independent review of data on the regional economy and taxes, the staff concludes that, for most of the region within an 80-km (50-mi) radius of the proposed site, the revenue-derived impacts on the regional economy from constructing VEGP Units 3 and 4 would be SMALL, with a possible MODERATE beneficial impact on Burke County.

4.5.4 Infrastructure and Community Service Impacts

Infrastructure and community services include transportation, recreation, housing, public services, and education.

4.5.4.1 Transportation

Impacts of the proposed construction on transportation and traffic would be most obvious on the rural roads of Burke County, particularly River Road, a two-lane highway that provides the only

access to VEGP's main gate and the proposed new access road for construction personnel. Construction-related impacts on traffic are determined by five elements:

1. the number and timing of construction worker vehicles on the roads per shift
2. the number of shift changes for the construction workforce per day
3. the number and timing of truck deliveries to the construction site per day
4. the projected population growth rate in Burke County
5. the capacity and usage of the roads.

Southern's analysis assumed four construction shifts, with each comprising 25 percent of the total construction workforce[(a)] made up of two shifts working 10-hour days Monday through Thursday (day shift and swing shift), and two additional crews working 12-hour days Friday through Sunday (day shift and graveyard shift). To assess the maximum impact on the local road network, Southern assumed one worker per vehicle and no staggered shifts, so construction and operations schedules would overlap. Southern also estimated 100 truck deliveries would be made daily to the construction site. Truck deliveries and construction worker vehicles would enter the site via the construction access road. The construction and operations workforces would access the VEGP site via River Road. Beyond River Road, construction traffic from the VEGP site is dispersed in several directions, and road capacities increase as the roads approach Richmond and Columbia Counties. Therefore, the focus of the staff's impact analysis is on River Road.

The Georgia Department of Transportation estimates road capacity on two lane highways at 1700 cars per hour for one direction and 3200 cars per hour for both directions. The 2004 Average Annual Daily Traffic report measured traffic on River Road north of the VEGP as 1277 cars per day in one direction. Because the Average Annual Daily Traffic does not consider hourly traffic volume, Southern estimated maximum peak hourly traffic on River Road by assuming the peak would occur during the afternoon shift change, and that the majority of traffic on the road results from plant employees commuting to and from work. Based on these assumptions, Southern's ER estimated hourly peak traffic on River Road at about 1200 cars per hour in both directions (Southern 2008a). The current capacity of River Road is 3200 cars per hour. Therefore, Southern determined River Road has sufficient capacity for an additional 2000 cars per hour beyond its current rate.

Given the construction schedule presented in Southern's ER, and assuming approximately 1200 cars per hour as the current peak hourly traffic, congestion on River Road would increase considerably during the second year of construction and continue through year 5; however, the

(a) This analysis uses simplified, conservative assumptions. In reality, Southern already employs staggered operations shifts and would employ varied and staggered construction shifts to mitigate congestion (Southern 2006a).

traffic on River Road appears to remain within the road's designed capacity.[a] Table 4-4 presents the analysis of traffic impacts to River Road. More detail regarding the assumptions and calculations made to complete this analysis can be found in Section 4.4 of Southern's ER (Southern 2008a).

In addition to the construction workforce analyzed above, Southern employs an average outage[b] workforce of approximately 800 workers for approximately 1 month during every refueling outage. During outages most of the plant staff and outage workforce are on 12-hour shifts, 2 shifts per day, 7-days a week. Their additional pressure on River Road could conceivably push hourly traffic counts over its capacity for 1 or 2 months each year from years 1 through 5 of the construction period.

Traditionally, traffic not associated with VEGP activities along River Road consists of a small number of local commuters, local school buses, and sports hunters and fishermen seeking access to the Savannah River or nearby hunting lands. Southern determined the impact of construction worker traffic on these groups can be mitigated in several ways. Considering that River Road is not the only access to major highways for the area, to the extent possible, Southern could try to reroute non-VEGP traffic to other traffic corridors (Southern 2008a).

The staff concludes construction workers would impose a SMALL to MODERATE impact on the two-lane highways in Burke County, particularly River Road and the highways that feed into it. Traffic impacts could also be felt to a lesser degree on other rural roads and major commuter routes to Columbia and Richmond Counties. To mitigate these impacts, it may be necessary to accommodate the additional vehicles on Burke County roads, particularly River Road, by developing a traffic management plan prior to the start of construction. The traffic management plan should include such mitigating measures as installing turn lanes at the construction entrance, establishing a centralized parking area away from the site, and shuttling construction workers to the site in buses or vans, using incentive programs to encourage car-pooling, and staggering construction shifts so they do not coincide with operational shifts. Southern could also establish a shuttle service from the central Augusta area or another area where a concentration of construction workers reside.

(a) Table 4-4 is based on the traffic analysis presented in Southern's ER (Southern 2008a) and adjusted for changes in construction workforce estimates as provided by Southern (Southern 2008c).

(b) Each of the current VEGP units undergoes a scheduled refueling outage every 18 months. A typical outage consists of fuel reloading activities, equipment maintenance, and special projects, such as major equipment replacements and refurbishment (Southern 2006a).

Table 4-4. Number of Construction Workforce Cars per Hour on River Road during Peak Shift Changes

Construction Phase	Number of Construction Workers	Number of Construction Workforce cars on River Road during shift changes, both directions	"Current" assumed hourly traffic peak plus construction impact	River Road Capacity
First month of "preconstruction"/ (18 months before Year 1 of "Construction Phase")	64	32	1232	3200
Final month of "preconstruction"/ (1 month before Year 1 of "Construction Phase")	1740	870	2070	3200
Year 1/Month 5	2436	1218	2418	3200
Year 2/Month 17	3200	1600	1800	3200
Year 3/Month 28-36	3500	1750	2950	3200
Year 5/Month 49-50	3200	1600	2800	3200
Year 6/Month 62	2400	1200	2400	3200
Month 64	1600	800	2000	3200
Month 65	800	400	1600	3200
Month 66	400	200	1400	3200

Source: Southern 2008a, 2007c

Rail and Waterways

CSX Transportation, Inc. (CSX) and Norfolk Southern Corp. operate the two primary freight rail carriers servicing Burke, Richmond, and Columbia Counties. From Augusta, CSX has three lines leading to Atlanta, Georgia; Greenwood, South Carolina, and Savannah, Georgia. The line to Savannah runs through South Carolina and comes to within 6.9 km (4.3 mi) of the VEGP site at its closest point. Each line runs approximately 12 to 20 freight trains a day. Also from Augusta, Norfolk Southern has a rail line that goes through Waynesboro, Georgia, to points south and west, running approximately 12 to 20 freight trains a day. Both rail lines have the capacity to run additional trains. A 32-km (20-mi) rail spur runs from the VEGP site to the Norfolk Southern line, connecting north of Waynesboro. Southern recently upgraded the spur to support the transfer of heavy equipment to the VEGP site, and it is likely that this spur would be used to transfer equipment during the construction of Units 3 and 4 at the VEGP site. Since a number of new residential subdivisions have been developed near the rail spur in Waynesboro, it may be necessary to upgrade rail crossings with additional safety features.

Construction Impacts at the Proposed Site

Southern plans to use the Savannah River navigation channel to support delivery of large components and modules for construction of VEGP Units 3 and 4. A barge slip was installed approximately 90 m (100 yd) downstream of the CWIS for VEGP Units 1 and 2 to support the unloading of major equipment. The Savannah River navigation channel is operated and maintained by the Savannah District of the USACE. Southern has contacted the USACE and would work with them to develop a strategic plan to support the transport of equipment on the Savannah River.

Based on the information provided by Southern, interviews with local planners and officials, and the NRC's own independent review, the staff concludes that the offsite impacts of construction of VEGP Units 3 and 4 on transportation could be MODERATE during the peak construction period, particularly during outage periods; however, mitigating activities such as those discussed above could reduce impacts to a SMALL level when implemented.

4.5.4.2 Recreation

Construction of the reactors would require a 76-m (250-ft)-tall crane tower that may be visible from River Road and the Savannah River. There is very little recreational boating or fishing near the VEGP site. Hunters or fishers seeking access to the Savannah River or nearby hunting or fishing areas may be impacted by the construction worker traffic to the site. However, Southern would attempt to mitigate these impacts by posting signs and re-routing traffic. Because the aesthetic impacts of construction would be localized and only limited recreational boating takes place on this reach of the river near the site, the staff anticipates that the impacts on local recreation from construction activities would be SMALL.

4.5.4.3 Housing

The assumptions behind the NRC staff's estimated in-migration of workers were established in Section 4.5.2 of this chapter. If the entire construction workforce required to construct VEGP Units 3 and 4 originated within a reasonable commuting distance of the VEGP site, there would be no impact on housing demand. However, the NRC staff expects that approximately 2500 construction workers would migrate into the region; 2000 of these workers would reside in the area for two or more years and would require long-term housing, and 500 workers would need temporary housing (e.g., hotels, motels, rooms in private home) or they would live in their own campers or mobile homes.

Although rental properties are limited in Burke and Screven Counties, they are in plentiful supply in the larger municipalities such as Augusta, Martinez, and Evans in Georgia; and Aiken and North Augusta in South Carolina. Table 2-18 provides information on housing in Burke, Columbia, Richmond, and Screven Counties in Georgia, and Aiken County in South Carolina.

The staff's assumptions in Section 4.5.2 indicate long-term workers would require approximately 400 housing units in Burke County, 520 in Richmond County, 680 in Columbia County, 140 in Screven County, and 80 in Aiken County. All of these counties have enough housing units available to absorb the influx of workers. For example, Richmond County had over 10,000 vacant housing units in 2005. Therefore, the staff expects housing impacts would be SMALL.

Some relocating construction workers might bring campers or mobile homes for the duration of their employment. There are a limited number of recreational vehicle (RV) parks available near the VEGP site. When VEGP Units 1 and 2 were constructed, numerous mobile home parks operated on private property throughout Burke and Screven Counties to support the influx of workers. There were no zoning restrictions in place at the time in either county. By the time construction begins for VEGP Units 3 and 4, Burke County would have established zoning regulations to restrict RV and trailer park developments in the county.[(a)] However, temporary RV parks would likely provide housing to a number of construction workers during the construction of VEGP Units 3 and 4.

Based on the information provided by Southern, interviews with local real estate agents and city and county planners, and NRC's own independent review, the staff expects the housing-related impacts of construction of VEGP Units 3 and 4 would be SMALL.

4.5.4.4 Public Services

This section describes the public services available and discusses the impacts of construction at the VEGP site on water supply and waste treatment, police, fire and medical services, education, and social services in the region.

Water Supply Facilities

A detailed description of construction-related water requirements and its impact is presented in Section 4.3 of this document. The VEGP site does not use water from a municipal system. Onsite wells provide potable water, and would provide the water for the construction project as well. Therefore, water usage by the workforce, while onsite, would not impact municipal water suppliers. Southern estimated the total daily groundwater usage at the VEGP site during construction to be approximately 6.8 million L/d (1.8 million gpd), which is well within Southern's permitted limits and, therefore, the construction-related impacts to the VEGP site groundwater use would likely be SMALL.

(a) Interview on October 18, 2006 with Bill Owens, Building Official, Department of Planning, Permits, and Inspections, Burke County, Georgia. Part of meeting with Burke County officials held in Waynesboro, Georgia.

Municipal water suppliers in the region have excess capacity (see Table 2-20; 2-21). The impact to the local water supply systems from construction-related population growth can be estimated by calculating the amount of water that would be required by total population increase. According to a 2003 EPA report on potable water usage, the average person in the United States uses about 340 L/d (90 gpd) (EPA 2003). For an assumed construction-related population increase of 5500 people, the estimated 1.90 million L/d (495,000 gpd) increase in water consumption amounts to about 13 percent of Burke County's excess capacity. Therefore, the staff expects construction-related impacts on municipal water supplies would be SMALL.

Wastewater Treatment Facilities

The VEGP site has a private wastewater treatment facility sized for VEGP Units 1 and 2. As part of the construction project, the facility would be expanded to support the increased capacity that would be needed for VEGP Units 3 and 4. During construction, temporary office and warehouse facilities would be tied to the existing facility. In addition, portable toilets would be provided in the construction area. Therefore, additional wastewater associated with construction activities would not impact the existing the VEGP site wastewater treatment facility.

Section 2.8.2.6 describes the public wastewater treatment systems in Burke, Richmond, and Columbia Counties, their permitted capacities, and current demands. Wastewater treatment facilities in the three counties have excess capacity. Assuming that 100 percent of the water consumed by in-migrating workers would be disposed of through the wastewater treatment facilities, the construction-related population increase of 5500 people could require 1.90 million L/d (495,000 gpd) of additional wastewater treatment capacity. Given a reported excess treatment capacity of over 60 million L/d (16 million gpd) in Burke, Richmond, and Columbia counties the staff expects the impacts on wastewater treatment from the in-migrating construction workforce in the region would be SMALL.

Police, Fire, and Medical Facilities

A temporary increase in population from the construction workforce for a new nuclear facility can increase the burdens on local fire and police departments, but this increase is transitory in nature. Once the project has been completed, many of the construction workers would leave the area, relieving those burdens. During construction, the temporary increase in demand for community resources could be mitigated in several ways. Larger communities would have an easier time assimilating the influx of new people because the additional new population comprise a smaller percentage of the communities' base populations. Likewise, the more communities that host new workers, the less pressure each community would experience on its infrastructure. Consequently, any incentives Southern can provide its employees to move into the area in a planned manner would mitigate (but not remove) this short-term demand. Next, communities can avoid the long-term commitment to the maintenance and operation of infrastructure purchases to fulfill short-term demand increases. Instead of purchasing new fire

or police equipment, affected communities could lease vehicles or building space. Additional tax revenues from the influx of construction workers would help offset the cost to expand local police and fire departments.

In 2001, the citizen-to-police-officer ratios in Burke, Richmond, and Columbia Counties were 271:1, 998:1, and 992:1, respectively (Southern 2008a). Burke County has the largest police force relative to the size of its population. According to a 2005 draft planning report produced by the Central Savannah River Area Regional Development Center, planning officials consider police and fire protection adequate in the region (Southern 2008a). Southern would retain its own security force at the VEGP site during construction of VEGP Units 3 and 4.

Assuming current staffing levels, the assumed population increases in Burke (1100), Richmond (1430), and Columbia (1870) Counties would increase the citizen-to-police-officer ratio to 284:1 (a 5 percent increase) in Burke County, 1005:1 (a 1 percent increase) in Richmond County, and 1013:1 (a 2 percent increase) in Columbia County. Therefore, the NRC staff concludes that the potential impacts of construction on police services in Richmond and Columbia Counties would be SMALL.

Burke County, Georgia, was the county most affected during construction of VEGP Units 1 and 2. Consequently, it has three distinct advantages over other affected counties when responding to construction-related effects.

1. Southern has a history of working closely with Burke County and the city of Waynesboro on many safety and security issues, and already shares certain assets with these governments (e.g., buses for public transport). Consequently, Burke County and the city of Waynesboro have sufficient excess capacity in their existing programs to accommodate a much greater increase in demand for services than the staff has assumed for its analysis.
2. Burke County and the city of Waynesboro have the benefit of experience. During the construction of the VEGP Units 1 and 2, Waynesboro and Burke County incurred the greatest impact from the construction workforce. That experience has compelled community leaders to plan ahead and mitigate anticipated problems to a much greater extent than a similar community could without such historic lessons to rely upon.
3. Burke County is the beneficiary of the tax revenue stream that flows from the VEGP site. Consequently, it has an excellent bond rating and has existing excess capacity in many of its community services.

Therefore, despite the much larger anticipated effect on its police and fire infrastructure in Burke County, the NRC staff has determined that the construction-related impact on these services for Burke County would also be SMALL.

Construction Impacts at the Proposed Site

The region is well supplied with hospitals and medical services, as Richmond County serves as a regional medical hub, with four general hospitals, one military hospital, one mental and psychiatric hospital, one rehabilitation hospital, and two Federal hospitals. Burke County also has one general hospital. The extensive medical complex in the city of Augusta could treat most any injury. Southern expects minor construction-related injuries incurred during the construction of VEGP Units 3 and 4 would be treated onsite. More serious injuries would be treated at one of the hospitals in the region. Based on the size and availability of medical services in the region, temporary construction workers would not overburden existing medical services and the staff expects the adverse impact on medical services near the proposed site would be SMALL.

Social Services

Social services in Georgia are overseen by the Georgia Department of Human Resources through four main divisions: (1) Aging Services; (2) Public Health; (3) Mental Health, Developmental Disabilities, and Addictive Diseases; and (4) Family and Children Services. In addition to government-provided services, there are a number of private, philanthropic, and religious organizations who provide social services within the 80-km (50-mi) radius of the VEGP site. To the extent Southern's contractors hire individuals who use the services provided by the Department of Human Resources or nonprofit organizations, construction of VEGP Units 3 and 4 could reduce the burden on social service providers. However, new families moving into a community would bring new demand for both state-provided and privately provided social services. Overall, while the counterbalancing effects of new jobs and new families cannot be fully quantified, the staff believes the overall impact of construction on social services should be SMALL.

Summary of Impacts to Public Services

Assuming 1000 of the 3500 construction workers already reside in the region and most of the in-migrating workers would choose to live in the larger cities of the region, the impacts on public services from construction activities would be dispersed and SMALL. The NRC staff expects no demand beyond capacity limits for regional water and wastewater treatment systems; police, fire and medical services; or social services. Although Burke County would experience some of the largest impacts on a per capita basis, its cooperative relationship with Southern would mitigate adverse impacts, and therefore, the staff expects the adverse impact in Burke County would also be SMALL.

4.5.4.5 Education

The staff expects a net construction-related increase of about 1100 school-age children (see Section 4.5.2) distributed throughout the region. Approximately 220 would reside in Burke County, 290 in Richmond County, and 510 in Columbia County. The remaining

220 school-age children would be distributed throughout the remaining counties in the region but in such small numbers that they are not considered in this analysis.

The Burke County School District currently operates with an excess capacity of about 800 students.[(a)] In addition, the Burke County School District plans on expanding school facilities to accommodate any possible construction-related influx of students (PNNL 2006). Although Richmond and Columbia County school districts do not operate with excess capacity, the expected number of additional students at each school is relatively small. In Columbia County, school capacity issues are driven by the rapid residential growth in the area. Between 2004 and 2006, enrollment in Columbia County schools increased by more than 800 students each year. The additional school-aged children that might move to the area as a result of construction of VEGP Units 3 and 4 would be absorbed as part of the rapid growth in this area.[(b)] Although the Richmond School District has not experienced a high growth rate in recent years, it is the largest of the three district school districts, and the total number of students expected to enroll in the Richmond School District would constitute less than 1 percent increase in total enrollment. Thus, the impacts on the Richmond School District would be expected to be SMALL.

4.5.4.6 Summary of Infrastructure and Community Services Impacts

Based on the information provided by Southern, interviews with city and county planners, social service providers, and school district officials in Burke, Columbia, Screven, and Richmond Counties, the NRC staff concludes that the overall construction impacts on regional infrastructure and community services would be SMALL. The estimated workforce of 3500 would have a MODERATE temporary impact on traffic on River Road next to the plant; however, these impacts could be reduced with proper planning and mitigation measures. The impact on other road networks in the region would be dispersed and SMALL. The site is relatively isolated, industrial in nature, and well masked by forest in most directions; therefore adverse recreational impacts would also be SMALL. The impacts on public service infrastructure would be SMALL throughout the region, unless less populated counties draw a substantial share of the in-migrating construction workforce, which is not expected. In that case, the impacts on housing and public services in these counties may be MODERATE.

These conclusions are predicated on the specific assumptions about the size, composition, and behavior of the construction workforce discussed in detail in Section 4.5.2 of this EIS.

(a) Data provided by Burke County School District office in e-mail from Wilbert Roberts, Assistant District Superintendent, March 6, 2007 (Burke County School District 2007). (Accession No. ML072290177)

(b) Data provided by Columbia County School District office in e-mail from Pam Zgutowicz, March 5, 2007 (Columbia County Schools 2007). (Accession No. ML072290140)

4.5.5 Summary of Socioeconomic Impacts

Based on information supplied by Southern, staff interviews conducted with public officials in Burke, Screven, and Richmond Counties, and the current availability of services and additional taxes that would likely compensate the need for additional services, the staff concludes the construction impacts on the affected local economies would be beneficial and SMALL in the 80-km (50-mi) radius region centered on the proposed site. The effect on tax revenues would be beneficial and SMALL, except for property tax receipts in Burke County, which would be beneficial and MODERATE. The temporary (7-year) impact on transportation could be MODERATE on River Road next to the VEGP site, but likely SMALL elsewhere. The site is relatively isolated, industrial in nature, and well masked by forest in most directions so the construction-related aesthetic and recreational impacts near the VEGP site would be SMALL, but aesthetic impacts along the new transmission line could be MODERATE. The impacts on public services would be SMALL throughout the region. The staff expects the overall impact on infrastructure and community services would be SMALL.

4.6 Historic and Cultural Resources

The National Environmental Policy Act of 1969 (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 (NHPA), as amended through 2000, also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (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 coordinated NHPA Section 106 compliance with NEPA compliance.

Construction, operation, and decommissioning of new power units can affect either known or undiscovered cultural resources. Therefore, in accordance with the provisions of NHPA and NEPA, the NRC is required to make a reasonable and good faith effort to identify historic properties in the area of potential effect (APE) and, if present, determine if any significant impacts are likely to occur. Identification is to occur in consultation with the State Historic Preservation Officer (SHPO), American Indian 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, if no historic properties (i.e., places eligible for listing on the National Register of Historic Places) are present or affected, the NRC is required to notify the SHPO before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve adverse effects of the undertaking.

For specific historic and cultural information on the VEGP site, see Section 2.9.2. As explained in Section 2.9.2, previous cultural resource identification efforts indicated the presence of

17 archaeological sites. Two are eligible for listing in the National Register of Historic Places. Two other sites are potentially eligible (9BK419 and 9BK420). The two eligible sites (9BK416 and 9BK423) are located adjacent to the proposed facilities. Southern has been in consultation with the Georgia SHPO concerning protective actions to be taken for 9BK423 and agreement has been reached (GDNR 2006; Southern 2007a). Because 9BK416 would be impacted by construction of utilities associated with the water intake structure, New South Associates (NSA) conducted a Phase 1 archaeological survey in the proposed construction area. The results of this survey support the original findings that site 9BK416 is a multicomponent prehistoric site that is eligible to be listed in the NRHP (NSA 2007). Site 9BK416 has the potential to yield significant information on prehistory for the area (NSA 2007).

Southern determined that it would not be possible to avoid disturbing site 9BK416 when the water pipeline is constructed. As a result, the Georgia SHPO requested that Southern conduct additional work to establish the character and integrity of subsurface archaeological deposits (GDNR 2008a). In response, Southern contracted with NSA to conduct additional investigations within the waterline corridor. Three 2-m by 2-m test units were excavated in February 2008 within the proposed intake water line corridor (NSA 2008). Based on the results of the excavation, the Georgia SHPO determined that the proposed project will affect, but not adversely affect, site 9BK416 (GDNR 2008b). Southern and the Georgia SHPO will enter into a Memorandum of Understanding (MOU) to preserve the balance of site 9BK416 from disturbance and to conduct further investigations as directed by Georgia SHPO (Southern 2008d).

There will be no activity in the areas where sites 9BK419 and 9BK420 are located, and therefore there will be no effect to these resources (GDNR 2006).

During construction, Southern would implement procedures that identify the actions that should be taken if archaeological or historical materials are encountered. Southern has agreed to follow these procedures. Procedures that would be in place prior to construction would identify measures that need to be taken if historic or cultural resources are discovered during construction (Southern 2008a).

Archaeological surveys of the new transmission line right-of-way that would be needed were not conducted. However, an analysis of potential impacts in historic and cultural resources was conducted for possible transmission line rights-of-way (GPC 2007). The full extent of impacts cannot be determined until a specific route is defined. Once this process is completed, the appropriate cultural resource studies would be undertaken to ensure that resources are identified and addressed before construction. In addition, consultation by Southern with the State of Georgia would establish requirements to follow should archaeological, historical, or other cultural resources be uncovered during construction (Southern 2008a).

Based on (1) the effect that the construction of the water intake structure and supporting infrastructure likely would have on the integrity of 9BK416, (2) the increased risk of inadvertent discoveries and impacts to archaeological deposits of 9BK416 and possibly 9BK423 during construction, (3) the preconstruction and construction measures that Southern would take to mitigate adverse impacts to significant cultural resources as outlined in the MOU, and (4) the staff's cultural resource analysis and consultation, it is the staff's conclusion that the potential impacts on historic and cultural resources would be MODERATE.

4.6.1 Cultural Resource Monitoring During Construction

Cultural resource monitoring may be required during construction, depending on the outcome of ongoing consultation between with the Georgia SHPO and Southern concerning impacts to 9BK416. As called for in plant procedures, construction workers would be given cultural resource training so they would be aware of the types of artifacts that might be encountered. If archaeological materials are discovered during construction, work would stop while an assessment is conducted, following plant procedures.

4.7 Environmental Justice Impacts

The staff evaluated whether the health or welfare of minority and low-income populations at those census blocks identified in Section 2.10 of this EIS could be disproportionately affected by the potential impacts of constructing VEGP Units 3 and 4 at the proposed site. To perform this assessment, the staff (1) identified all potentially significant pathways for human health and welfare effects, (2) determined the impact of each pathway for individuals within the identified census blocks, and (3) determined whether or not the characteristics of the pathway or special circumstances of the minority and low-income populations would result in a disproportionate impact on minority or low-income people within each census block.

4.7.1 Health and Environmental Impacts

Construction of a nuclear power plant is very similar in environmental effects to the construction of any other large-scale industrial project. There are three primary exposure media in the environment: soil, water, and air. Discussions of the potential impacts to each of these pathways follow.

4.7.1.1 Soil

Construction activities at the VEGP site represent the largest source of soil-related environmental impacts. However, while construction activities would disrupt large volumes of soil, the effects are primarily localized and have little migratory ability. Furthermore, BMPs at the construction site and a new construction strategy would mitigate these effects (Southern 2008a). Because Southern plans to ship in prefabricated pieces and assemble them

onsite, proposed construction activities would involve roughly a third of the peak number of workers employed during construction of VEGP Units 1 and 2.[(a)] Therefore, the disruption of soils during construction would be mitigated by smaller workforces and a lower level of onsite activity, relative to historic levels. In addition, the soil disruption within those communities that would host in-migrating workers and their families would also be reduced, relative to historic levels. The staff interviewed community leaders in towns surrounding the proposed site and discovered there is a much greater state of preparedness now than in the past. Old problems of overcrowded trailer parks and vehicle dust have been addressed through local legislation, and sewer and septic systems now must meet stricter environmental standards.[(b)] Given these mitigating factors, the staff concludes soil-related environmental impacts during the construction of Units 3 and 4 at the VEGP site would pose little or no impacts on any populations within the region of interest (Southern 2008a).

4.7.1.2 Water

Water-related environmental impacts include erosion-related surface-water degradation and the introduction of anthropogenic substances into surface and groundwater. The staff expects no impact on the Savannah River from sediments and contaminants because of Southern's commitment to implementing BMPs at the construction site (Southern 2008a).

As described in Section 4.3, the staff expects construction-related impacts on the Water Table aquifer would be completely mitigated at a distance equal to that of the nearest person to the proposed site (about 1.6 km [1 mi]). Construction-related activities are not of sufficient magnitude to impact the Cretaceous or Tertiary aquifers beneath the proposed site. Therefore, the staff determined the potential negative environmental effects from impacts to water sources would be small; and, consequently, there are no water-related impacts on minority and low-income populations to consider.

4.7.1.3 Air

Based on the findings in Section 4.2, motor vehicle exhaust and construction dust would cause minor and localized adverse impacts to air quality but would not extend as far as the site boundary. Therefore, the staff determined the negative environmental effects from construction-related reductions in air quality would be small, localized, and short-lived for any population in the region of interest. Consequently, the staff found no disproportionate and adverse impacts on minority and low-income populations because of changes in air quality.

(a) Taken from *The Blazer* newsletter – a weekly newsletter serving the "Plant Vogtle Community." The specific article is entitled "The Vogtle Report," June 7, 1986, Volume 5, Number 12.

(b) Interview on October 18, 2006 with Bill Owens, Building Official, Department of Planning, Permits, and Inspections, Burke County, Georgia. Part of meeting with Burke County officials held in Waynesboro, Georgia.

Construction Impacts at the Proposed Site

4.7.1.4 Noise

Noise levels during construction may be as high as 110 dBA within the construction site, but noise levels diminish according to the inverse square rule, which says that if you double the distance from the source, the noise level diminishes by a factor of four. Because the loudest construction noise would register 60 to 80 dBA 120 m (400 ft) from the source and the VEGP site exclusion area boundary is more than a half mile from the construction site in all directions, the staff determined impacts from the noise of construction activities would be small and not require mitigation.

4.7.2 Socioeconomic Impacts

As described in Section 4.5.4, the staff expects traffic to increase beyond the capacity of River Road during the construction phase. However, Southern plans to mitigate any negative impacts from such increases by encouraging car pooling, providing van pools, and/or staggering work shifts (Southern 2008a). The staff finds no disproportionate adverse impacts on minority and low-income populations because of changes in traffic and other community services.

4.7.3 Subsistence and Special Conditions

NRC's environmental justice methodology includes an assessment of populations of particular interest or unusual circumstances, such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements.

Subsistence

The presence of subsistence fishing practices along the Savannah River adjacent to the proposed site has been well documented in the literature (Burger et al. 1999). The primary contaminant of concern for the Savannah River is mercury, which among other heavy metals contaminating the waters of the Savannah River, has been traced to activities at the Savannah River Site and not to the VEGP site (Burger et al. 2001; Makhijani and Boyd 2004). Because they are not a by-product of any construction activities related to the proposed two new reactors, heavy metals cannot be considered a source of any environmental degradation attributable to the proposed VEGP site. Therefore, the staff determined there are no disproportionate adverse impacts on the subsistence activities of minority and low-income populations along the Savannah River that can be linked to the construction of Units 3 and 4 at the proposed VEGP site.

High-Density Communities

There are no Native American communities within the area of interest, and while some existing communities within the area exhibit disproportionately high percentages of minority (primarily

Black races) and low-income populations, most of the higher percentages of minority and low-income populations can be attributed to the sparseness of the rural population in general. This was reinforced for the staff through a series of interviews with minority leaders and social service agency representatives in the affected counties, all of whom described the lower income and minority communities as "scattered" throughout the counties with no heavy concentrations in any one particular area.[(a)] Therefore, the staff determined there were no environmental justice effects to consider with respect to densely populated minority or low-income peoples.

4.7.4 Summary of Environmental Justice Impacts

The staff expects the impacts of plant construction on minority and low-income populations in the region of interest would be SMALL because no environmental pathways or preconditions exist that can lead to adverse and disproportionate impacts. The adverse socioeconomic impacts on minority and low-income populations are also expected to be in proportion with the impacts discussed in Section 4.5 and SMALL because of the mitigation strategies employed by nearby communities. Depending on how each community participates in the distribution of construction-generated income and tax revenues, the impacts on minority and low-income communities would likely be beneficial impacts. There is no evidence that any particular demographic group would be excluded or limited in its access to those benefits. Therefore, based on the underlying assumptions of its analysis, the staff concludes that the adverse impacts on minority and low-income populations resulting from construction of Units 3 and 4 at the VEGP site would be SMALL.

4.8 Nonradiological Health Impacts

The area around the VEGP site is predominantly rural with a population of approximately 3560 people within 16 km (10 mi) of the site (Southern 2008a). The following sections discuss the results of the staff's assessment of nonradiological health impacts for the VEGP site. Southern (2008a) indicated that the physical impacts of construction, including public health, occupational health, and noise, would be small and were discussed qualitatively by the applicant in Sections 4.4 and 4.7 of the ER (Southern 2008a).

4.8.1 Public and Occupational Health

This section includes a discussion of public health impacts from construction and site-preparation (construction) worker health.

(a) Personal communication (phone interview) on October 9, 2006 with Reverend Robert Lynch, pastor of Bethel Apostolic Church, Waynesboro, Georgia, and head of the Burke County Citizens Hunger Action Committee (affiliated with the Golden Harvest Food Bank). Also confirmed in interviews with Screven County Family Services (with Mr. Bill Hillis), October 18, 2006, and Burke County Family Services (with Ms. Alane Hickman), October 19, 2006.

Construction Impacts at the Proposed Site

4.8.1.1 Air Quality

Southern stated in its ER that the physical impacts to the public from construction at the VEGP site might include dust and vehicle exhaust as sources of air pollution during site preparation and construction (Southern 2008a). Southern stated that operational controls would be imposed to mitigate dust emissions, employing such methods as stabilizing construction roads and spoils piles, periodically watering unpaved roads, and re-vegetating road medians and slopes (Southern 2008a).

Engine exhaust would be minimized by maintaining fuel-burning equipment in good mechanical order. Southern (2008a) stated that applicable Federal, State, and local emission requirements would be adhered to as they relate to open burning or the operation of fuel-burning equipment. The appropriate Federal, State, and local permits and operating certificates would be obtained as required.

The public would not be close to the construction site. The nearest accessible area is greater than 0.8 km (0.5 mi) from the construction site for VEGP Units 3 and 4, and the nearest residence is approximately 1.6 km (1 mi) from the construction site (Southern 2008a). Based on the mitigation measures identified by Southern in its ER, the permits and authorizations required by State and local agencies, and NRC's own independent review, the staff concludes that the nonradiological health impacts to the public from construction activities would be SMALL and that additional mitigation beyond the actions identified above is not warranted.

4.8.1.2 Site Preparation and Construction Worker Health

In general, human health risks for construction workers and personnel working onsite are expected to be dominated by occupational injuries (e.g., falls, electrocution, asphyxiation) to workers engaged in activities such as construction, maintenance, and excavation. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. According to the U.S. Bureau of Labor Statistics (USBLS), injury rates drop significantly for large construction projects such as nuclear power plants (e.g., for the years 2003 to 2005 the overall injury-only rate for utility system construction ranged from 5.4 to 6.7 percent compared to 2.0 to 3.0 percent for similar projects with 1000 or more workers) (USBLS 2007a). Southern (2008a) reports the average construction workforce for proposed VEGP Units 3 and 4 would be 3152 during an 84-month period.

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks associated with construction. The staff assumes that the applicant would adhere to NRC, OSHA, and State safety standards, practices, and procedures during construction activities.

The USBLS reports occupational injuries and illnesses as total recordable cases, which includes those that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. Southern (2008a) provided a range of estimates for the annual number of total recordable cases (154 to 271) that might be expected to occur during construction of proposed VEGP Units 3 and 4. These estimates for the annual number of recordable cases are based on U.S. and State of Georgia total recordable case rates for the year 2003 (6.9 and 4.9 percent, respectively) and the actual rates experienced during construction of VEGP Units 1 and 2 in 1984 and 1985 (10.5 and 6.7 percent, respectively). The VEGP total recordable case rates for construction during 1984 and 1985 appear high; however, rates for the construction industry have been decreasing steadily and rates from the 1980s are not comparable to rates from the 2000s. A review of total recordable cases reported for the United States from 1994 to 2005 for heavy construction indicated a steady decline from 10.2 percent in 1994 to a low of 5.6 percent in 2005 (USBLS 2007b). Similarly, total recordable cases reported for the State of Georgia for heavy construction declined from 9.8 percent in 1996 to a low of 4.4 percent in 2005 (USBLS 2007c). A review of data published by the USBLS (2007a) for the period from 2003 to 2005 indicates the rate of total recordable cases for utility system construction is similar to that for heavy construction. Year 2003 was the first with separate results reported by the USBLS for utility system construction.

Other nonradiological impacts to construction workers discussed in this section include noise, fugitive dust, and gaseous emissions resulting from construction activities. Mitigation measures discussed throughout Section 4.8.1 for the public would also help limit exposure to construction workers. Onsite impacts to construction workers would also 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 construction personnel could also be undertaken.

Based on mitigation measures identified by Southern in its ER, on permits and authorizations required by State and local agencies, and on the staff's independent review, the staff concludes that the nonradiological health impacts to workers from construction activities would be SMALL and additional mitigation beyond the actions stated above is not warranted.

4.8.1.3 Noise Impacts

Construction of a nuclear power plant is similar to other large construction projects. It involves many noise-generating activities. Regulations governing noise from construction 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. Neither the State of Georgia nor Burke County has specific noise regulations.

Construction Impacts at the Proposed Site

The ER (Southern 2008a) indicates that activities associated with construction of a new unit at the VEGP site would have peak noise levels in the 100- to 110-dBA range. A 10-dBA decrease in noise level is generally perceived as cutting the loudness in half. At a distance of 15 m (50 ft) from the source these noise levels would generally decrease to the 80- to 95-dBA range and at distance of 120 m (400 ft), the noise levels would generally be in the 60- to 80-dBA range. For context, Tipler (1982) lists the sound intensity of a quiet office as 50 dBA, normal conversation as 60 dBA, busy traffic as 70 dBA, and a noisy office with machines or an average factory as 80 dBA. Construction noise (at 3 m [10 ft]) is listed as 110 dBA, and the pain threshold is 120 dBA.

The ER (Southern 2008a) states that the exclusion area boundary of the VEGP site would be greater than 0.8 km (0.5 mi) from construction activities for new units. A 100-dBA noise level at 15 m (50 ft) from an activity would be expected to decrease to about 65 dBA at the exclusion area boundary. There are no major roads, public buildings, or residences within the exclusion area. Similarly, a 100-dBA noise level would be expected to decrease to less than 60 dBA at the nearest residence, which is approximately 1.6 km (1 mi) from the construction area. These estimates do not include the noise attenuation associated with vegetation and topography.

Construction activities would be expected to take place 24 hours per day, 7 days per week. However, the ER (Southern 2008a) lists a number of measures that could be taken to mitigate the potential adverse effects of construction noise. Among the mitigation measures are compliance with Federal and State regulations, use of hearing protection, inspection and maintenance of equipment, restriction of noise-related activities to daylight hours, and restriction of delivery times to daylight hours.

According to NUREG-1437 (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. 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 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.

Considering the temporary nature of construction activities and the location and characteristics of the VEGP site, the staff concludes that the noise impacts on human health from construction would be SMALL and that further mitigation beyond that discussed above is not warranted.

4.8.2 Impacts of Transporting Construction Materials and Construction Personnel to the VEGP Site

The general approach used to calculate nonradiological impacts to human health of fuel and waste shipments is the same as that used for transportation of construction materials and construction personnel to and from the VEGP site. However, preliminary estimates are the only data available to estimate the demand for these transportation services. The assumptions made to fill in reasonable estimates of the data needed to calculate nonradiological impacts are discussed below.

Construction material requirements are based on information taken from the ER (Southern 2008a) and a previous ESP applicant's ER (Dominion 2006). Dominion (2006) stated that constructing a new 1000-MW(e) unit requires up to 150,000 m^3 (200,000 yd^3) of concrete and 14,000 MT (15,000 tons) of structural steel. These quantities would be doubled to account for a two-unit plant. Southern's ER estimates that an additional 1.98 million m (6.5 million lineal ft) of cable for a single unit and up to 83,800 lineal m (275,000 lineal ft) of piping greater than 5 cm (2.5 in.) in diameter per unit would be required.

- It was assumed that shipment capacities are 10 m^3 (~13 yd^3) of concrete per shipment, 10 MT (11 tons) of structural steel, and 300 lineal m (1000 lineal ft) of piping and cable per shipment.

- The number of construction workers was estimated to peak at 3500 (Southern 2008a). This value represents the peak workforce for construction of two units simultaneously. At an average of 1.8 persons/vehicle, there would be about 980 vehicles per day per unit (NRC 2006). Each person was assumed to travel to and from the VEGP site 250 days per year. A 6.5-year construction period for each unit was assumed in the ER (Southern 2008a).

- Average shipping distances for construction materials were assumed to be 80 km (50 mi) one way. The average commute distance for construction workers was assumed to be 32 km (20 mi) one way.

- Accident, injury, and fatality rates for construction materials were taken from Table 4 in ANL/ESD/TM-150 *State-level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Rates for the State of Georgia were used for construction material shipments, typically conducted in heavy-combination trucks. The data in 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). However, a single source that provided all three rates to estimate the impacts from worker transportation to/from the site was not available. To develop representative commuter traffic impacts, a source was located that provided a Georgia-

specific fatality rate for all traffic for the years 2001 to 2006 (DOT 2008). The average fatality rate for the 2001 to 2006 period in Georgia was used as the base for estimating Georgia-specific injury and accident rates. Adjustment factors were developed using national-level traffic accident statistics in *National Transportation Statistics 2007* (DOT 2007). The adjustment factors are the ratio of the national injury rate to the national fatality rate and the ratio of the national accident rate to the national fatality rate. These adjustment factors were multiplied by the Georgia-specific fatality rate to approximate the injury and accident rates for commuters in the State of Georgia.

The estimated nonradiological impacts of transporting construction materials to the proposed VEGP site and of transporting construction workers to/from the site are shown in Table 4-5. The estimates would be doubled for construction of 2 units at the VEGP site. Note that the nonradiological impacts are dominated by transport of construction workers to/from the VEGP site. The total annual construction fatalities represents about a 2 percent increase above the 12 traffic fatalities that occurred in Burke County in 2006 (DOT 2008). This represents a small increase relative to the current traffic fatality risks in the area surrounding the proposed VEGP site. Therefore, the staff concludes that the impacts of transporting construction and personnel to the VEGP site would be SMALL, and no mitigation is warranted.

Table 4-5. Impacts of Transporting Workers and Construction Materials to/from the VEGP Site

	Accidents per Year Per Unit	Injuries per Year Per Unit	Fatalities per Year Per Unit
Workers	2.1×10^{1}	9.5×10^{0}	1.4×10^{-1}
Materials			
Concrete	2.5×10^{-1}	1.7×10^{-1}	7.3×10^{-3}
Rebar	2.2×10^{-2}	$1{,}5 \times 10^{-2}$	6.5×10^{-4}
Cable	3.3×10^{-2}	2.2×10^{-2}	9.5×10^{-4}
Piping	1.4×10^{-3}	9.5×10^{-4}	4.0×10^{-5}
Total - Construction	2.1×10^{1}	9.7×10^{0}	1.5×10^{-1}

4.8.3 Summary of Nonradiological Health Impacts

The staff reviewed the information provided by Southern (Southern 2008a and 2007c) and concludes that nonradiological health impacts to construction workers at the VEGP site, workers at the VEGP site, and the local population from fugitive dust, occupational injuries, noise, and transport of materials and personnel would be SMALL, and additional mitigation is not warranted.

4.9 Radiological Health Impacts

The sources of radiation exposure for construction workers include direct radiation exposure, exposure from liquid radioactive waste discharges, and exposure from gaseous radioactive

effluents from the existing VEGP Units 1 and 2 during the site-preparation and construction phase. For the purposes of this discussion, construction and site-preparation workers are assumed to be members of the public; therefore, the dose estimates are compared to the dose limits for the public, pursuant to 10 CFR Part 20, Subpart D. Southern (2008a) noted that all major construction activities are expected to occur outside the VEGP site protected area boundary, but inside the restricted area boundary.

4.9.1 Direct Radiation Exposures

In its ER (Southern 2008a), Southern identified two sources of direct radiation exposure from the VEGP site: (1) the current reactor buildings for VEGP Units 1 and 2, and (2) the planned Independent Spent Fuel Storage Installation (ISFSI). In addition, Southern identified the proposed VEGP Unit 3 as a source of direct radiation exposure to proposed VEGP Unit 4 construction workers. The planned ISFSI is identified as a source of direct radiation exposure only to proposed VEGP Unit 3 construction workers. Southern identified a low-level waste storage facility to be constructed east of the existing cooling towers (Southern 2007c). The staff did not identify any additional sources of direct radiation during the site visit or during document reviews.

Southern used fenceline thermoluminescent dosimeters (TLDs) and environmental TLDs to measure direct radiation levels at locations in and around the VEGP protected area (Southern 2004a). Sixteen fenceline TLDs are located along the protected area fence. Environmental TLDs are located in two rings around the VEGP site, an inner ring near the site boundary, and an outer ring about 8 km (5 mi) from the plant (Southern 2004a). Environmental TLDs are read quarterly and fenceline TLDs are read semiannually and measure the contribution to dose from any source, either natural or anthropogenic, including the current reactor buildings and planned ISFSI.

The average annual reading for the environmental TLDs was 0.49 mSv (49 mrem) (Southern 2008a). Southern concluded that these results were not significantly different from control locations and showed no increase in environmental gamma radiation levels resulting from plant operations at the VEGP site. Similar results were observed for the past several years (Southern 2002, 2003b, 2004b, 2005).

Southern estimated direct radiation exposure to construction workers by using protected area fenceline TLD measurements (Southern 2008a). The average annual readings for the six fenceline TLDs nearest the proposed construction site was 1.159 mSv (115.9 mrem) with a 95 percent plant capacity factor (Southern 2007a). Subtracting the average annual result for the environmental TLDs and scaling up to assume a 100 percent plant capacity factor yields 0.704 mSv (70.4 mrem), the annual dose at the VEGP Unit 3 and 4 construction site attributable to operating VEGP Units 1 and 2. Southern (2008a) estimated the annual direct radiation contribution at the construction site from the planned ISFSI to be 0.15 mSv (15 mrem),

applicable for the VEGP Unit 3 construction workforce and negligible for the VEGP Unit 4 workforce. This corresponds to an annual dose rate at the VEGP Unit 3 construction site of 0.854 mSv (85.4 mrem) per year. Southern (2007a) also estimated that, in addition to the 0.704 mSv (70.4 mrem) per year contribution from VEGP Units 1 and 2, that VEGP Unit 4 construction site would receive an additional 0.352 mSv (35.2 mrem) from operation of VEGP Unit 3. This corresponds to an annual dose rate at the VEGP Unit 4 construction site of 1.056 mSv (105.6 mrem). This higher dose rate (i.e., 105.61 mrem) corresponds to a dose rate of about 0.121 μSv/hr (12.1 μrem/hr). A construction worker present for 2080 hours per year in a dose rate field of about 0.121 μSv/hr (12.1 μrem/hr) would receive an annual dose of 0.251 mSv (25.1 mrem).

4.9.2 Radiation Exposures from Gaseous Effluents

The VEGP site releases gaseous effluents via the common station heating, ventilating, and air conditioning stack; the condenser air injector; the steam packing exhaust system; the Radwaste Processing Facility; and the Dry Active Waste Building. Releases from the waste gas decay tanks are through the VEGP Unit 1 plant vent, and containment purges are released through the VEGP Unit 1 and 2 plant vents (Southern 2008a). Southern estimated construction worker dose from gaseous effluents using release data for the year 2002, which resulted in the highest public exposure for the period from 2001 to 2004 (Southern 2008a). The annual total effective dose equivalent to a construction worker from gaseous effluents was 0.0116 mSv (1.16 mrem) (based on an occupancy of 2000 hr/yr) (Southern 2008a). Adjusting this dose for the expected occupancy of a construction worker (i.e., 2080 hours per year), the annual dose from gaseous effluent releases becomes 0.0121 mSv (1.21 mrem). A review of annual effluent release reports for the past several years showed this dose to be typical (Southern 2002, 2003b, 2004b, 2005). The dose to construction workers from the gaseous effluent releases would be negligible compared to the dose from direct radiation exposure.

4.9.3 Radiation Exposures from Liquid Effluents

Southern confirmed radiation exposures from liquid effluents to be a negligible contribution to construction-worker dose (Southern 2008a). Southern estimated the annual dose to a construction worker from liquid effluents to be 0.00034 mSv (0.034 mrem) (Southern 2008a). This estimate was based on an occupancy of 2000 hr/yr and assumed that construction workers would consume locally caught fish and drink surface water. Adjusting this dose for the expected occupancy of a construction worker (i.e., 2080 hr/yr) and assuming a 100 percent plant capacity factor yields an annual dose of 0.00037 mSv (0.037 mrem) per year. Using liquid effluents release data for the year 2001 (Southern 2002) resulted in the highest public exposure for the period from 2001 to 2004. A review of radioactive effluent release reports for the past several years confirmed these releases to be typical (Southern 2002; 2003b; 2004b; 2005). The dose to construction workers from the liquid effluent releases would be negligible compared to the dose from direct radiation exposure.

4.9.4 Total Dose to Site-Preparation Workers

Southern (2007a) estimated an annual dose to a site-preparation worker of 0.229 mSv (22.9 mrem) from the direct radiation pathway assuming an occupancy of 2000 hr/yr and a 95 percent plant capacity factor. Doses from liquid and gaseous effluent releases add an additional 0.0119 mSv (1.19 mrem) per year. The total annual dose estimate for the site-preparation workers, based on an occupancy of 2000 hr/yr, would be approximately 0.241 mSv (24.1 mrem) (Southern 2008a). Adjusting this dose for the expected occupancy of a construction worker (i.e., 2080 hr/yr) and assuming a 100 percent plant capacity factor yields an annual dose of 0.263 mSv (26.3 mrem), which is less than the 1 mSv (100 mrem) annual exposure limit for an individual member of the public found in 10 CFR 20.1301. If the dose estimate had exceeded 100 mrem annually, the site-preparation workers would need to be treated as radiological workers and would be subject to monitoring requirements and the annual occupational dose limit of 0.05 Sv (5 rem) found in 10 CFR 20.1201.

The maximum estimated annual collective dose to site-preparation workers, based on an annual individual dose of 0.263 mSv (26.3 mrem) and an estimated workforce of 3500 workers, is 0.92 person-Sv (92 person-rem).

4.9.5 Summary of Radiological Health Impacts

Having reviewed the Southern estimate of dose to site-preparation workers during construction activities, the staff found the doses to be well within NRC annual exposure limits (i.e., 1 mSv [100 mrem]) designed to protect the public health, even if workers exceeded an occupancy rate of 2080 hr/yr. Assuming the proposed location of VEGP Units 3 and 4 does not change, the staff concludes that the impacts of radiological exposures to site-preparation workers would be SMALL.

4.10 Measures and Controls to Limit Adverse Impacts During Site-Preparation Activities and Construction

The following measures and controls would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emissions, noise control, stormwater management, spill response and cleanup, hazardous material management)
- compliance with applicable requirements of existing permits and licenses (e.g., the NPDES permit and the operating license) for the existing units and other permits or licenses required for construction of the new units (e.g., USACE Section 404 Permit)

- compliance with existing Southern processes and/or procedures applicable to construction environmental compliance activities for the VEGP site (e.g., solid waste management, hazardous waste management, and spill prevention and response)
- incorporation of environmental requirements into construction contracts.
- identification of environmental resources and potential impacts during the development of the ER and during the ESP process.

Table 4-6 lists a summary of measures and controls proposed by Southern to limit adverse impacts during construction of Units 3 and 4 at the VEGP site (Southern 2008a).

Table 4-6. Summary of Measures and Controls Proposed by Southern to Limit Adverse Impacts during Construction of Units 3 and 4 at the VEGP Site (Southern 2008a)

Impact Category	Specific Measures and Control
Land-Use Impacts	
The Site and Vicinity	• Conduct ground-disturbing activities in accordance with regulatory and permit requirements. Use adequate erosion controls and stabilization measures to minimize impacts. • Limit vegetation removal to the area within the site designated for construction activities. • Minimize potential impacts to wetlands through avoidance and compliance with applicable permitting requirements. • Restrict soil stockpiling and reuse to designated areas on the site. • Restrict construction activities to the VEGP site.
Transmission Line Right-of-Way and Offsite Areas	• Site new right-of-way to avoid critical or sensitive habitats/species as much as possible. • Restrict sites of access of construction equipment to the right-of-way. • Minimize potential impacts through impact avoidance and compliance with permitting requirements and BMPs.
Air Quality	• Develop a dust mitigation plan prior to the start of construction to minimize fugitive dust emissions from plant construction. • Develop a traffic management plan prior to the start of construction to mitigate vehicular emissions associated with plant construction.
Historic Properties and Cultural Resources	• Follow established Southern procedures to stop work if a potential historic or cultural or paleontological resource is discovered. • Follow established Southern procedure to contact appropriate regulatory agencies if a potential historic or cultural or paleontological resource is discovered.

Table 4-6. (contd)

Impact Category	Specific Measures and Control
Water-Related Impacts	
Hydrologic Alterations	• Adhere to applicable regulations and permits. • Install drainage controls to direct dewatering runoff. • Wells in area are in deep aquifer that should not be affected by construction.
Water-Use Impacts	Southern did not propose any additional measures or controls.
Water-Quality Impacts	• Install cofferdams in Savannah River. • Install stormwater drainage system at construction sites and stabilize disturbed soils. • Use BMPs to minimize erosion and sedimentation. • Use good construction practices to maintain equipment, and prevent spills and leaks. • Invoke Southern's existing Spill Prevention Control and Countermeasure Plan (SPCC) for construction activities
Ecological Impacts	
Terrestrial Ecosystems	Southern did not propose any additional mitigation or controls.
Aquatic Ecosystems	• Develop and implement a construction Stormwater Pollution Prevention Plan (SWPPP). • Invoke the existing Southern SPCC plan for construction activities. • Implement erosion and sediment control plans that incorporates recognized BMPs. • Install appropriate barriers in river prior to construction.
Socioeconomic Impacts	
Physical Impacts	• Train and appropriately protect Southern employees and construction workers to reduce the risk of potential exposure to noise, dust, and exhaust emissions. • Provide onsite services for emergency first aid, and conduct regular health and safety monitoring. • Provide appropriate job training to construction workers. • Make public announcements or prior notification of atypically loud construction activities. • Use dust-control measures (such as watering, stabilizing disturbed areas, covering trucks). • Manage concerns from adjacent residents or visitors on a case-by-case basis through a Southern Concerns Resolution Program. • Post signs near construction entrances and exits to make the public aware of potentially high construction traffic areas. • Develop traffic control mitigation plan.

Table 4-6. (contd)

Impact Category	Specific Measures and Control
Social and Economic Impacts	• Stagger shifts, encourage car or van pooling; time deliveries to avoid shift change or commute times. • Erect signs alerting drivers of the construction and the potential for increased construction traffic. • Mitigation of any housing shortage would be through new construction in anticipation of arrival of construction workforce. • Increased tax revenues as a result of the large construction project would fund additional community services.
Environmental Justice Impacts	Southern did not propose any additional measures or controls beyond those listed above.
Radiation Exposure to Construction Workers	Southern did not propose any additional measures or controls.
Nonradiological Health Impacts	• Provide job-training and implement procedures to ensure a safe working environment. • Provide first-aid capabilities at the construction site.

4.11 Site Redress Plan

In October 2007, after publication of the draft EIS, NRC issued its final rule covering limited work authorizations (LWAs) for nuclear power plants (72 FR 57416). The final rule modified the scope of activities that are considered construction for which an LWA is necessary. In response to NRC's October 2007 rule, Southern submitted a revised site redress plan that is part of its current ESP application (Southern 2008a). This section of the EIS has been revised to reflect NRC's October 2007 LWA rule and Southern's revised site redress plan.

Southern requested that it be allowed to conduct site-preparation activities at the VEGP site as authorized by 10 CFR 52.17(c) and 10 CFR 50.10. If granted an LWA, Southern stated that it might choose to perform some or all of the activities described in Section 1.4 of the site redress plan (Southern 2008a). The objective of the site redress plan is to ensure that the VEGP site would be returned to an environmentally stable and aesthetically acceptable condition if the proposed VEGP Units 3 and 4 were not fully developed to provide new nuclear power generation. Under the site redress plan, areas that were permanently disturbed by construction activities would be stabilized and contoured to conform to surrounding areas. Re-vegetation of disturbed lands would be conducted.

Prerequisites to LWA activities that must be fulfilled before performing such activities include:

- Documentation of existing site conditions within the VEGP site by way of photographs, surveys, listings of existing facilities and structures, or other documentation. This record

would serve as the baseline for redressing the site in the event LWA activities were terminated as a result of project cancellation or expiration of the ESP.

- Coordination of agreements between the site's co-owners and Southern. This agreement would allow Southern to carry out LWA activities.

- Coordination of the movement of the existing VEGP site protected area boundary, as required. These activities would be coordinated with the current VEGP units to accomplish the movement of structures reflected in the VEGP licensing basis in a manner consistent with its operating license and the applicable regulations governing that license.

- Movement, demolition, or ownership transfer of existing VEGP site buildings and structures within the VEGP site. These activities would be coordinated with VEGP to accomplish the movement, demolition, or ownership transfer of structures reflected in the VEGP licensing basis in a manner consistent with its operating license and the applicable regulations governing that license.

- Obtaining the necessary permits to perform preconstruction activities, such as local building permits, NPDES permit, Clean Water Act permit, General Stormwater Permit, etc.

- Obtaining the necessary permits to perform LWA activities, such as local building permits, and any permits required under the Clean Water Act

After these prerequisites were completed, planned LWA activities could proceed and might include some or all of the activities allowed by 10 CFR 50.10(d)(1). In Section 1.4 of its site redress plan included in the ESP application, Southern stated that if granted an LWA it might undertake any of the following activities at the VEGP site, any of which may be for a structure, system, or component for which a CP or COL would otherwise be required (Southern 2008a):

- Driving of piles
- Subsurface preparation
- Placement of backfill, concrete, or permanent retaining walls within an excavation
- Installation of a foundation, including placement of concrete
- Installation of engineered backfill
- Installation of retaining walls (mechanically stabilized earth walls)
- Installation of lean concrete backfill
- Installation of mudmats
- Installation of waterproof membrane
- Installation of formwork for the nuclear island base slab
- Installation of reinforcing steel and embedments for the nuclear island base slab.

Construction Impacts at the Proposed Site

During site redress activities Southern would implement various controls to mitigate adverse impacts including noise control; traffic control; erosion and sediment controls; air quality controls; and best management practices to ensure protection of soils, groundwater, and surface water from accidental spills or releases of pollutants.

The staff considers the environmental impacts of LWA activities allowed pursuant to 10 CFR 50.10(d,e) to be bounded by environmental impacts for construction of the proposed new AP1000 reactors at the VEGP site. In many cases, the impacts of LWA activities and construction may be similar, but the impacts resulting solely from LWA activities would be of a shorter duration. In the preceding sections in this chapter, the staff has presented impacts of construction that bound the impacts of LWA activities. If the ESP expires or the project is cancelled before an application for a CP or COL is received under 10 CFR Part 52, Subpart C, the site redress plan would be activated to return the VEGP site to an environmentally stable and aesthetically acceptable condition suitable for future alternative use (presumably non-nuclear) that conforms to local zoning laws, thus minimizing the long-term environmental impacts.

Southern provided a site redress plan as part of its ESP application in the event that site-preparation work did not proceed to full construction (Southern 2008a). The plan identifies the overall objective as to "...reverse, mitigate or stabilize environmental impacts incurred during LWA activities." In its plan, Southern states that redress activities would reflect applicable land-use and zoning requirements and identifies the following two general redress activities for consideration:

- topographic approaches that accomplish the objective and preserve the potential of the site for future industrial use.
- completion or addition of site development features that enhance the value of the site for potential future industrial use.

The staff reviewed the list of Southern's proposed LWA activities in the event that the ESP and LWA are granted and reviewed the full site redress plan submitted by Southern. As a result of NRC's own independent review, the staff, in accordance with 10 CFR 52.10(e), concludes that the potential LWA activities described in Southern's site redress plan would not result in any significant adverse environmental impacts that could not be redressed.

In accordance with 10 CFR 50.10(g), if construction is terminated by Southern or its successor, the underlying ESP or COL application is withdrawn by Southern or denied by the NRC, or the LWA is revoked by the NRC, Southern would need to begin implementation of the redress plan in a reasonable time and complete the redress of the site within 18 months of the action triggering the need for redress.

4.12 Summary of Construction Impacts

Impact level categories are denoted in Table 4-7 as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. A brief statement explains the basis for the impact level. Some impacts, such as the addition of tax revenue from Southern for the local economies, are likely to be beneficial impacts to the community.

Table 4-7. Characterization of Impacts from Construction of New Units at the VEGP Site

Category	Comments	Impact Level
Land-Use Impacts		
Site and Vicinity	Construction activities would take place within existing site boundaries.	SMALL
Transmission Line and Offsite Areas	New right-of-way would be developed.	MODERATE
Air-Quality Impacts		
Construction Activities	Construction activities would be conducted in accordance with applicable State requirements. Dust emissions would be minimized through a dust-control plan.	SMALL
Transportation	A traffic management plan will be developed to mitigate vehicular emissions associated with construction. Air quality would not be degraded sufficiently to be noticeable beyond the immediate vicinity.	SMALL
Water-Related Impacts		
Hydrological Alterations	Impacts localized and temporary. CWA Section 401 and other permit processes would be adequate to ensure impacts would be SMALL.	SMALL
Water Use	Dewatering may cause localized temporary declines in the water table.	SMALL
Water Quality	Construction would be conducted using BMPs to control spills and stormwater runoff.	SMALL
Ecological Impacts		
Terrestrial Ecosystems		
Site	Construction activities would have minimal impact to terrestrial ecological resources and habitat in the vicinity of the VEGP site.	SMALL
Transmission Line Rights-of-Way	Impact would depend on specific routing of transmission line right-of-way.	SMALL to MODERATE
Aquatic Ecosystems	Construction activities would have minimal impact to aquatic ecological resources and habitat.	SMALL
Threatened and Endangered Species		
Site	Construction impacts to Federally listed species are expected to be negligible.	SMALL
Transmission Line Rights-of-Way	Impact would depend on specific routing of transmission line right-of-way.	SMALL to MODERATE

Table 4-7. (contd)

Category	Comments	Impact Level
Socioeconomic Impacts		
Physical Impacts		
Workers/Local Public	Construction would take place within existing site boundaries, so impact on the public would be minimal. Impact on workers would be mitigated with training and protective equipment.	SMALL
Buildings	Construction would not affect any offsite buildings, and onsite buildings were constructed to withstand vibration from construction activities.	SMALL
Roads	Growth would put pressure on local road systems, but traffic control and management measures would protect any local roads during construction.	SMALL
Aesthetics	Construction activities would be temporary and would occur on a site already occupied by a nuclear power facility, resulting in SMALL onsite aesthetic impacts. Construction of the new transmission line will likely result in MODERATE impacts.	SMALL to MODERATE
Demography	Percentage of construction workers relocating to the region likely would be SMALL relative to the existing population base except in Burke County where the impact could be MODERATE.	SMALL to MODERATE
Economic Impacts to Community		
Economy	Economic impact of construction overall would be beneficial to local economies. In Burke County beneficial impacts would likely be MODERATE while impacts elsewhere would be SMALL.	SMALL to MODERATE Beneficial
Taxes	Degree of impact depends on the distribution of tax revenues to county or state; generally impact is beneficial, especially for property taxes. Under current tax laws, the beneficial impact of additional taxes would be MODERATE in Burke County.	SMALL to MODERATE Beneficial
Impacts to Community - Infrastructure and Community		
Transportation	Traffic impacts on River Road could be MODERATE during peak construction period and during outage periods for Units 1 and 2; however if properly planned and managed, impacts could be reduced with specified mitigation measures to deal with temporary construction impacts.	MODERATE
Recreation	Visual impact of construction would be limited to those boating on the Savannah River. Congestion during peak construction could interfere with hunting and fishing in area.	SMALL
Housing	Adequate housing is available in the greater Augusta area to handle construction workers. If workers concentrate in Burke County, the impact could be moderate.	SMALL
Public Services	Public services are adequate for any temporary influx of workers resulting from construction at the VEGP site.	SMALL

Table 4-7. (contd)

Category	Comments	Impact Level
Education	Excess capacity in Burke County School District ensures adequate infrastructure exists to support the temporary influx of workers.	SMALL
Historic and Cultural Resources	Adverse effects were expected at one site (9BK416) and Southern worked with Georgia SHPO to address these impacts and to effect protective measures for another site (9BK423). Southern has committed to develop procedures to manage cultural resources in the event of an inadvertent discovery.	MODERATE
Environmental Justice	Physical impacts would be SMALL. Economic impacts would likely be beneficial.	SMALL
Nonradiological Health Impacts	Emission controls and remote location of the VEGP site would keep nonradiological health impacts small. Adherence to Federal and State Regulations assumed to protect occupational workers.	SMALL
Radiological Health Impacts	Exposures would be below NRC annual occupational and public dose limits.	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."

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."

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."

51 FR 6690. February 25, 1986. "Endangered and Threatened Wildlife and Plants: Determination of *Oxypolis Canbyi* (Canby's Dropwort) To Be an Endangered Species." *Federal Register*, U.S. Department of the Interior.

52 FR 21059. June 4, 1987. "Endangered and Threatened Wildlife and Plants: Reclassification of the American Alligator to Threatened Status Due to Similarity of Appearance Throughout the Remainder of its Range." *Federal Register*, U.S. Department of the Interior.

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