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Final Environmental Impact Statement for Combined Licenses for Virgil C. Summer Nuclear Station Units 2 and 3

Final Report

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

Regulatory Division
Special Projects Branch
Charleston District
U.S. Army Corps of Engineers
Charleston, SC 29403-5107

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Abstract

This environmental impact statement (EIS) has been prepared to satisfy the requirements of the National Environmental Policy Act of 1969, as amended (NEPA). The EIS has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by South Carolina Electric and Gas (SCE&G), acting for itself and for Santee Cooper (the State-owned electric and water utility, formally called the South Carolina Public Service Authority) for combined construction permits and operating licenses (combined licenses or COLs). The proposed actions related to the SCE&G application are (1) NRC issuance of COLs for two new nuclear power reactor units (Units 2 and 3) at the V.C. Summer Nuclear Station (VCSNS) site in Fairfield County, South Carolina, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army (DA) Individual Permit application to perform certain activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the analysis by the NRC and USACE staff that considers and weighs the environmental impacts of building and operating two new nuclear units at the VCSNS site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. The EIS also addresses Federally listed species, cultural resources, and essential fish habitat issues.

The EIS includes the evaluation of the proposed project's impacts to waters of the United States pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. The USACE will base its evaluation of the DA Individual Permit application on the requirements of USACE regulations, the Clean Water Act Section 404(b)(1) Guidelines, and the USACE public interest review process.

After considering the environmental aspects of the proposed NRC action, the staff's recommendation to the Commission is that the COLs be issued as requested. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by SCE&G; (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; (5) the NRC staff's consideration of comments on the draft EIS; and (6) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The USACE permit decision will be made following issuance of the final EIS.

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Contents

Abstract..iii
Executive Summary..xxxi
Abbreviations/Acronyms..xxxv
1.0 Introduction..1-1
1.1 Background..1-1
1.1.1 Applications and Reviews..1-2
1.1.1.1 NRC COL Application Review..1-2
1.1.1.2 USACE Permit Application Review..1-4
1.1.2 Preconstruction Activities..1-5
1.1.3 Cooperating Agencies..1-6
1.1.4 Concurrent NRC Reviews..1-7
1.2 The Proposed Federal Action..1-8
1.3 The Purpose and Need for the Proposed Action..1-9
1.3.1 The NRC's Proposed Action..1-9
1.3.2 The USACE Permit Action..1-9
1.4 Alternatives to the Proposed Action..1-10
1.5 Compliance and Consultations..1-11
1.6 Report Contents..1-12
1.7 References..1-12
2.0 Affected Environment..2-1
2.1 Site Location..2-1
2.2 Land Use..2-5
2.2.1 VCSNS Site and Vicinity..2-5
2.2.2 Transmission-Line Corridors..2-8
2.2.3 The Region..2-14
2.3 Water..2-14
2.3.1 Hydrology..2-15
2.3.1.1 Surface-Water Hydrology..2-15
2.3.1.2 Groundwater Hydrology..2-21

2.3.2 Water Use 2-27
2.3.2.1 Surface-Water Use 2-28
2.3.2.2 Groundwater Use 2-29
2.3.3 Water Quality 2-30
2.3.3.1 Surface-Water Quality 2-30
2.3.3.2 Groundwater Quality 2-36
2.3.4 Water Monitoring 2-37
2.3.4.1 Surface-Water Monitoring 2-37
2.3.4.2 Groundwater Monitoring 2-38
2.4 Ecology 2-38
2.4.1 Terrestrial and Wetlands Ecology 2-39
2.4.1.1 Terrestrial Resources – Site and Vicinity 2-39
2.4.1.2 Terrestrial Resources – Transmission Lines 2-45
2.4.1.3 Important Terrestrial Species and Habitats 2-46
2.4.1.4 Terrestrial Ecology Monitoring 2-59
2.4.2 Aquatic Ecology 2-60
2.4.2.1 Aquatic Resources – Site and Vicinity 2-60
2.4.2.2 Aquatic Resources – Transmission Lines 2-71
2.4.2.3 Important Aquatic Species 2-74
2.4.2.4 Aquatic Monitoring 2-92
2.5 Socioeconomics 2-92
2.5.1 Demographics 2-93
2.5.1.1 Resident Population 2-94
2.5.1.2 Transient Population 2-94
2.5.1.3 Migrant Labor 2-97
2.5.2 Community Characteristics 2-97
2.5.2.1 Economy 2-98
2.5.2.2 Taxes 2-101
2.5.2.3 Transportation 2-105
2.5.2.4 Aesthetics and Recreation 2-106
2.5.2.5 Housing 2-107
2.5.2.6 Public Services 2-108
2.5.2.7 Education 2-117
2.6 Environmental Justice 2-120
2.6.1 Methodology 2-121
2.6.2 Scoping and Outreach 2-126
2.6.3 Subsistence and Communities with Unique Characteristics 2-126

2.6.4 Migrant Populations 2-126
2.6.5 Environmental Justice Summary 2-127
2.7 Historic and Cultural Resources....2-127
2.7.1 Cultural Background....2-128
2.7.2 Historic and Cultural Resources at the Site 2-129
2.7.3 Historic and Cultural Resources Within Transmission-Lines....2-142
2.7.4 Consultation 2-144
2.8 Geology 2-144
2.9 Meteorology and Air Quality....2-145
2.9.1 Climate....2-146
2.9.1.1 Wind 2-147
2.9.1.2 Atmospheric Stability 2-148
2.9.1.3 Temperature 2-148
2.9.1.4 Atmospheric Moisture 2-149
2.9.1.5 Severe Weather....2-150
2.9.2 Air Quality 2-150
2.9.3 Atmospheric Dispersion 2-151
2.9.4 Meteorological Monitoring 2-152
2.10 Nonradiological Environment 2-153
2.10.1 Public and Occupational Health 2-153
2.10.1.1 Air Quality 2-153
2.10.1.2 Occupational Injuries 2-154
2.10.1.3 Etiological Agents 2-155
2.10.2 Noise....2-156
2.10.3 Transportation....2-156
2.10.4 Electromagnetic Fields....2-157
2.11 Radiological Environment 2-158
2.12 Related Federal Project Activities and Consultations 2-159
2.13 References 2-160
3.0 Site Layout and Plant Description 3-1
3.1 External Appearance and Plant Layout....3-1
3.2 Proposed Plant Structures....3-4
3.2.1 Reactor Power Conversion System....3-4
3.2.2 Structures with a Major Environmental Interface 3-4

3.2.2.1 Landscape and Stormwater Drainage 3-6
3.2.2.2 Cooling System 3-6
3.2.2.3 Other Structures with a Permanent Environmental Interface 3-14
3.2.2.4 Other Structures with a Temporary Environmental Interface 3-18
3.2.3 Structures with a Minor Environmental Interface 3-19
3.2.3.1 Nuclear Island and Annex Building 3-19
3.2.3.2 Cranes and Footings 3-19
3.2.3.3 Pipelines 3-19
3.2.3.4 Support, Laydown, and Spoils Areas 3-19
3.2.3.5 Parking 3-20
3.2.3.6 Miscellaneous Buildings 3-20
3.3 Construction and Preconstruction Activities 3-20
3.3.1 Major Affected Areas 3-22
3.3.2 Summary of Resource Commitments During Construction and Preconstruction 3-25
3.4 Operational Activities 3-27
3.4.1 Description of Operational Modes 3-27
3.4.2 Plant-Environment Interfaces During Operation 3-27
3.4.2.1 Intake Structures 3-27
3.4.2.2 Cooling Towers 3-28
3.4.2.3 Discharge Structure 3-29
3.4.2.4 Power Transmission System 3-32
3.4.2.5 Emergency Diesel Generators 3-33
3.4.3 Radioactive Waste-Management System 3-33
3.4.3.1 Liquid Radioactive Waste-Management System 3-34
3.4.3.2 Gaseous Radioactive Waste-Management System 3-34
3.4.3.3 Solid Radioactive Waste Management System 3-35
3.4.4 Nonradioactive Waste-Management Systems 3-35
3.4.4.1 Effluents Containing Chemicals or Biocides 3-35
3.4.4.2 Sanitary System Effluents 3-36
3.4.4.3 Other Effluents 3-36
3.4.5 Summary of Resource Commitments During Operation 3-37
3.5 References 3-39
4.0 Construction Impacts at the VCSNS Site 4-1
4.1 Land-Use Impacts 4-4
4.1.1 The Site and Vicinity 4-4
4.1.2 Transmission-Line Corridors and Other Offsite Areas 4-7

4.1.3 Summary of Land-Use Impacts During Construction and Preconstruction 4-12
4.2 Water-Related Impacts 4-12
4.2.1 Hydrologic Alterations 4-13
4.2.2 Water-Use Impacts 4-15
4.2.2.1 Impacts on Surface-Water Use 4-15
4.2.2.2 Impacts on Groundwater Use 4-16
4.2.3 Water-Quality Impacts 4-17
4.2.3.1 Impacts on Surface-Water Quality 4-17
4.2.3.2 Summary of Impacts on Groundwater Quality 4-18
4.2.4 Water Monitoring 4-18
4.3 Ecological Impacts 4-19
4.3.1 Terrestrial and Wetland Impacts 4-19
4.3.1.1 Terrestrial Resources – Site and Vicinity 4-19
4.3.1.2 Terrestrial Resources – Transmission Lines 4-24
4.3.1.3 Important Terrestrial Species and Habitats 4-29
4.3.1.4 Terrestrial Monitoring 4-30
4.3.1.5 Potential Mitigation Measures for Terrestrial Impacts 4-30
4.3.1.6 Summary of Impacts on Terrestrial Resources 4-30
4.3.2 Aquatic Impacts 4-31
4.3.2.1 Aquatic Resources – Site and Vicinity 4-32
4.3.2.2 Aquatic Resources – Transmission Lines 4-34
4.3.2.3 Important Aquatic Species and Habitats 4-39
4.3.2.4 Aquatic Monitoring During Site Preparation 4-43
4.3.2.5 Summary of Impacts on Aquatic Resources 4-44
4.4 Socioeconomic Impacts 4-45
4.4.1 Physical Impacts 4-46
4.4.1.1 Impacts on Workers and the Local Public 4-46
4.4.1.2 Noise Impacts 4-47
4.4.1.3 Impacts on Air Quality 4-48
4.4.1.4 Impacts on Buildings 4-50
4.4.1.5 Transportation Impacts 4-50
4.4.1.6 Impacts on Aesthetics 4-51
4.4.1.7 Summary of Physical Impacts 4-51
4.4.2 Demographic Impacts on the Community 4-51
4.4.3 Economic Impacts on the Community 4-54
4.4.3.1 Economy 4-54
4.4.3.2 Taxes 4-56

4.4.3.3 Summary of Economic Impacts on the Community 4-57
4.4.4 Infrastructure and Community Service Impacts 4-57
4.4.4.1 Transportation Impacts 4-57
4.4.4.2 Impacts on Recreation 4-59
4.4.4.3 Housing Impacts 4-60
4.4.4.4 Impacts on Public Services 4-61
4.4.4.5 Impacts on Education 4-63
4.4.4.6 Summary of Infrastructure and Community Service Impacts.......4-63
4.4.5 Summary of Socioeconomic Impacts During Construction and Preconstruction 4-64
4.5 Environmental Justice Impacts 4-64
4.5.1 Health Impacts 4-65
4.5.2 Physical and Environmental Impacts 4-66
4.5.2.1 Soil-Related Impacts 4-66
4.5.2.2 Water-Related Impacts 4-66
4.5.2.3 Air Quality Impacts 4-67
4.5.2.4 Noise Impacts 4-67
4.5.3 Subsistence and Special Conditions 4-68
4.5.4 Socioeconomics 4-68
4.5.5 Summary of Environmental Justice Impacts During Construction and Preconstruction 4-69
4.6 Historic and Cultural Resources 4-70
4.6.1 Onsite Cultural and Historic Resources Impacts 4-71
4.6.2 Offsite Cultural and Historic Resource Impacts 4-73
4.7 Meteorological and Air Quality Impacts 4-74
4.7.1 Construction and Preconstruction Activities 4-74
4.7.2 Transportation 4-75
4.7.3 Summary of Meteorological and Air Quality Impacts 4-77
4.8 Nonradiological Health Impacts 4-77
4.8.1 Public and Occupational Health 4-77
4.8.1.1 Public Health 4-77
4.8.1.2 Construction Worker Health 4-78
4.8.2 Noise Impacts 4-79
4.8.3 Impacts of Transporting Construction Materials and Construction Personnel to the Proposed Site 4-80
4.8.4 Summary of Nonradiological Health Impacts 4-83

4.9 Radiological Health Impacts 4-83
4.9.1 Direct Radiation Exposures 4-83
4.9.2 Radiation Exposures from Gaseous Effluents 4-85
4.9.3 Radiation Exposures from Liquid Effluents 4-85
4.9.4 Total Dose to Construction Workers 4-85
4.9.5 Summary of Radiological Health Impacts 4-86
4.10 Nonradioactive Waste Impacts 4-86
4.10.1 Impacts on Land 4-86
4.10.2 Impacts on Water 4-87
4.10.3 Impacts on Air 4-88
4.10.4 Summary of Nonradioactive Waste Impacts 4-88
4.11 Measures and Controls to Limit Adverse Impacts During Construction 4-89
4.12 Summary of Construction and Preconstruction Impacts 4-94
4.13 References 4-96
5.0 Operational Impacts at the VC Summer Site 5-1
5.1 Land-Use Impacts 5-1
5.1.1 The Site and Vicinity 5-1
5.1.2 Transmission-Line Corridors and Offsite Areas 5-2
5.2 Water-Related Impacts 5-2
5.2.1 Hydrologic Alterations 5-3
5.2.2 Water-Use Impacts 5-4
5.2.2.1 Impacts on Surface-Water Use 5-4
5.2.2.2 Impacts on Groundwater Use 5-8
5.2.3 Water-Quality Impacts 5-8
5.2.3.1 Impacts on Surface-Water Quality 5-9
5.2.3.2 Impacts on Groundwater Quality 5-12
5.2.4 Water Monitoring 5-13
5.3 Ecological Impacts 5-13
5.3.1 Terrestrial and Wetland Impacts Related to Operation 5-13
5.3.1.1 Terrestrial Resources – Site and Vicinity 5-13
5.3.1.2 Terrestrial Resources – Transmission Lines 5-16
5.3.1.3 Important Terrestrial Species and Habitats 5-18
5.3.1.4 Terrestrial Monitoring During Operation 5-20
5.3.1.5 Potential Mitigation Measures for Operations-Related Terrestrial Impacts 5-21

5.3.1.6 Summary of Operational Impacts on Terrestrial Resources 5-21
5.3.2 Aquatic Impacts Related to Operation 5-21
5.3.2.1 Aquatic Resources – Site and Vicinity 5-21
5.3.2.2 Aquatic Resources – Transmission Lines 5-32
5.3.2.3 Important Aquatic Species and Habitats 5-33
5.3.2.4 Aquatic Monitoring During Operation 5-34
5.3.2.5 Summary of Operational Impacts on Aquatic Resources 5-34
5.4 Socioeconomic Impacts 5-34
5.4.1 Physical Impacts 5-35
5.4.1.1 Impacts on Workers and the Local Public 5-35
5.4.1.2 Impacts on Buildings 5-36
5.4.1.3 Impacts on Transportation 5-36
5.4.1.4 Impacts on Aesthetics 5-37
5.4.1.5 Summary of Physical Impacts 5-38
5.4.2 Demography 5-38
5.4.2.1 Demographic Impacts 5-38
5.4.2.2 Summary of Demographic Impacts 5-39
5.4.3 Economic Impacts on the Community 5-39
5.4.3.1 Economy 5-39
5.4.3.2 Taxes 5-40
5.4.3.3 Summary of Economic and Tax Impacts 5-42
5.4.4 Infrastructure and Community Services 5-42
5.4.4.1 Transportation 5-43
5.4.4.2 Recreation 5-43
5.4.4.3 Housing 5-43
5.4.4.4 Public Services 5-44
5.4.4.5 Education 5-46
5.4.4.6 Summary of Impacts on Infrastructure and Community Services 5-46
5.4.5 Summary of Socioeconomic Impacts 5-46
5.5 Environmental Justice 5-47
5.5.1 Health Impacts 5-47
5.5.2 Physical Impacts 5-48
5.5.2.1 Soil-Related Impacts 5-48
5.5.2.2 Water-Related Impacts 5-48
5.5.2.3 Air Quality-Related Impacts 5-49
5.5.3 Socioeconomic Impacts 5-49
5.5.4 Subsistence and Special Conditions 5-50

5.5.5 Summary of Environmental Justice Impacts 5-50
5.6 Historic and Cultural Resource Impacts from Operation 5-51
5.7 Meteorological and Air Quality Impacts 5-53
5.7.1 Cooling-Tower Impacts 5-53
5.7.2 Air Quality Impacts 5-54
5.7.3 Summary of Meteorological and Air Quality Impacts 5-56
5.8 Nonradiological Health Impacts 5-56
5.8.1 Etiological (Disease-Causing) Agents 5-57
5.8.2 Noise Impacts 5-58
5.8.3 Acute Effects of Electromagnetic Fields 5-59
5.8.4 Chronic Effects of Electromagnetic Fields 5-59
5.8.5 Occupational Health 5-60
5.8.6 Impacts of Transporting Operations Personnel to and from the VCSNS Site and Alternative Sites 5-61
5.8.7 Summary of Nonradiological Health Impacts 5-62
5.9 Radiological Impacts of Normal Operations 5-62
5.9.1 Exposure Pathways 5-62
5.9.2 Radiation Doses to Members of the Public 5-65
5.9.2.1 Liquid Effluent Pathway 5-65
5.9.2.2 Gaseous Effluent Pathway 5-67
5.9.3 Impacts on a Member of the Public 5-69
5.9.3.1 Maximally Exposed Individual 5-69
5.9.3.2 Population Dose 5-71
5.9.3.3 Summary of Radiological Impacts on Members of the Public 5-72
5.9.4 Occupational Doses to Workers 5-72
5.9.5 Impacts on Biota Other Than Humans 5-72
5.9.5.1 Liquid Effluent Pathway 5-73
5.9.5.2 Gaseous Effluent Pathway 5-73
5.9.5.3 Impact of Estimated Biota Doses 5-74
5.9.6 Radiological Monitoring 5-75
5.10 Nonradioactive Waste Impacts 5-76
5.10.1 Impacts on Land 5-76
5.10.2 Impacts on Water 5-77
5.10.3 Impacts on Air 5-77

5.10.4 Mixed-Waste Impacts....5-77
5.10.5 Summary of Nonradioactive Waste Impacts....5-78
5.11 Environmental Impacts of Postulated Accidents....5-79
5.11.1 Design Basis Accidents....5-80
Summary of DBA Impacts....5-83
5.11.2 Severe Accidents....5-83
5.11.2.1 Estimated Risks of Releases to the Air Pathway....5-85
5.11.2.2 Estimated Risks of Releases to Surface-Water Pathways....5-89
5.11.2.3 Estimated Risks of Releases to the Groundwater Pathway....5-90
5.11.2.4 Estimated Risks of Releases Related to External Events....5-91
5.11.3 Summary of Severe Accident Impacts....5-92
5.11.4 Severe Accident Mitigation Alternatives....5-92
5.11.5 Summary of Postulated Accident Impacts....5-96
5.12 Measures and Controls to Limit Adverse Impacts During Operation....5-96
5.13 Summary of Operational Impacts....5-100
5.14 References....5-102
6.0 Fuel Cycle, Transportation, and Decommissioning....6-1
6.1 Fuel-Cycle Impacts and Solid-Waste Management....6-1
6.1.1 Land Use....6-9
6.1.2 Water Use....6-9
6.1.3 Fossil Fuel....6-9
6.1.4 Chemical Effluents....6-10
6.1.5 Radiological Effluents....6-11
6.1.6 Radiological Wastes....6-13
6.1.7 Occupational Dose....6-16
6.1.8 Transportation....6-16
6.1.9 Conclusions....6-17
6.2 Transportation Impacts....6-17
6.2.1 Transportation of Unirradiated Fuel....6-19
6.2.1.1 Normal Conditions....6-19
6.2.1.2 Radiological Impacts of Transportation Accidents....6-25
6.2.1.3 Nonradiological Impacts of Transportation Accidents....6-25
6.2.2 Transportation of Spent Fuel....6-27
6.2.2.1 Normal Conditions....6-28
6.2.2.2 Radiological Impacts of Accidents....6-34

6.2.2.3 Nonradiological Impact of Spent-Fuel Shipments........................6-38
6.2.3 Transportation of Radioactive Waste Other Than Spent Fuel....................6-38
6.2.4 Conclusions 6-40
6.3 Decommissioning Impacts...6-41
6.4 References 6-43
7.0 Cumulative Impacts 7-1
7.1 Land Use 7-6
7.2 Water Use and Quality..7-8
7.2.1 Water-Use Impacts 7-8
7.2.1.1 Surface-Water-Use Impacts..7-8
7.2.1.2 Groundwater-Use Impacts 7-10
7.2.2 Water-Quality Impacts...7-12
7.2.2.1 Surface-Water-Quality Impacts 7-12
7.2.2.2 Groundwater-Quality Impacts 7-13
7.3 Ecology...7-14
7.3.1 Terrestrial Ecology and Wetlands...7-14
7.3.1.1 Site-Preparation and Site-Development Impacts.........................7-15
7.3.1.2 Operational Impacts...7-16
7.3.1.3 Summary of Terrestrial Impacts 7-16
7.3.2 Aquatic Ecosystem Impacts 7-17
7.3.2.1 Summary of Aquatic Ecology Impacts..7-22
7.4 Socioeconomics and Environmental Justice 7-23
7.4.1 Socioeconomics 7-23
7.4.2 Environmental Justice 7-24
7.5 Historic and Cultural Resources...7-26
7.6 Air Quality 7-28
7.6.1 Criteria Pollutants 7-28
7.6.2 Greenhouse Gas Emissions..7-29
7.6.3 Summary...7-30
7.7 Nonradiological Health...7-31
7.8 Radiological Impacts...7-33
7.9 Postulated Accidents 7-34

7.10 Fuel Cycle, Transportation, and Decommissioning 7-35
7.10.1 Fuel Cycle 7-35
7.10.2 Transportation 7-36
7.10.3 Decommissioning 7-38
7.11 Staff Conclusions 7-38
7.12 References 7-40
8.0 Need for Power 8-1
8.1 Description of the Power System 8-2
8.1.1 SCE&G Relevant Service Area 8-2
8.1.2 Santee Cooper Relevant Service Area 8-4
8.1.3 Regional Reliability 8-4
8.1.4 South Carolina Regulatory Framework 8-6
8.1.4.1 SCE&G's Certificate of Public Convenience and Necessity 8-6
8.1.4.2 South Carolina Public Service Authority (Santee Cooper) 8-7
8.1.5 Description of the South Carolina Analytical Process 8-9
8.2 Power Demand 8-11
8.2.1 SCE&G 8-11
8.2.1.1 Factors Affecting Demand 8-11
8.2.2 Santee Cooper 8-14
8.2.2.1 Factors Affecting Demand 8-14
8.2.3 Demand Forecast 8-16
8.3 Power Supply 8-17
8.3.1 SCE&G 8-17
8.3.1.1 Present and Planned Generating Capacity 8-18
8.3.1.2 Need for Baseload Capacity 8-18
8.3.1.3 Fuel Diversity 8-19
8.3.2 Santee Cooper 8-20
8.3.2.1 Present and Planned Generating Capacity 8-21
8.3.2.2 Purchased Power 8-21
8.3.2.3 Renewable Resources 8-22
8.3.2.4 Need for Baseload Capacity 8-22
8.3.3 Supply Forecast 8-24
8.4 Assessment of Need for Power and NRC Findings 8-24
8.5 References 8-26
9.0 Environmental Impacts of Alternatives 9-1

9.1 No-Action Alternative 9-2
9.2 Energy Alternatives...9-2
9.2.1 Alternatives Not Requiring New Generating Capacity 9-3
9.2.1.1 Purchased Power 9-3
9.2.1.2 Extending the Service Life of Existing Plants or Reactivating Retired Plants 9-4
9.2.1.3 Energy Conservation 9-5
9.2.1.4 Conclusions 9-5
9.2.2 Alternatives Requiring New Generating Capacity..9-6
9.2.2.1 Coal-Fired Power Generation 9-7
9.2.2.2 Natural-Gas-Fired Power Generation...9-15
9.2.3 Other Alternatives 9-20
9.2.3.1 Oil-Fired Power Generation 9-20
9.2.3.2 Wind Power 9-20
9.2.3.3 Solar Power 9-22
9.2.3.4 Hydropower 9-22
9.2.3.5 Geothermal Energy..9-23
9.2.3.6 Wood Waste 9-23
9.2.3.7 Municipal Solid Waste 9-23
9.2.3.8 Other Biomass-Derived Fuels 9-24
9.2.3.9 Fuel Cells 9-25
9.2.4 Combinations of Alternatives..9-25
9.2.5 Summary Comparison of Alternatives 9-28
9.3 Alternative Sites...9-31
9.3.1 Alternative Site-Selection Process 9-32
9.3.1.1 SCE&G Alternative Site-Selection Process................................9-34
9.3.1.2 Santee Cooper Alternative Site-Selection Process 9-38
9.3.1.3 Conclusions About the Alternative Site-Selection Process..........9-42
9.3.2 NRC/USACE Alternative Site Evaluation..9-43
9.3.3 The FA-1 Site..9-44
9.3.3.1 Land Use and Transmission-Line Corridors 9-49
9.3.3.2 Water Use and Quality...9-52
9.3.3.3 Terrestrial and Wetland Resources..9-55
9.3.3.4 Aquatic Resources...9-62
9.3.3.5 Socioeconomics 9-70
9.3.3.6 Environmental Justice..9-77
9.3.3.7 Historic and Cultural Resources...9-81
9.3.3.8 Air Quality..9-83

9.3.3.9 Nonradiological Health Impacts 9-84
9.3.3.10 Radiological Impacts of Normal Operations 9-86
9.3.3.11 Postulated Accident Impacts....................9-87

9.3.4 The Cope Generating Station Site....................9-88
9.3.4.1 Land Use and Transmission-Line Corridors 9-90
9.3.4.2 Water Use and Quality....................9-93
9.3.4.3 Terrestrial and Wetland Resources....................9-96
9.3.4.4 Aquatic Resources....................9-101
9.3.4.5 Socioeconomics 9-106
9.3.4.6 Environmental Justice....................9-113
9.3.4.7 Historic and Cultural Resources....................9-116
9.3.4.8 Air Quality....................9-118
9.3.4.9 Nonradiological Health Impacts 9-119
9.3.4.10 Radiological Impacts of Normal Operations 9-121
9.3.4.11 Postulated Accident Impacts....................9-122

9.3.5 The Saluda Site....................9-123
9.3.5.1 Land Use and Transmission-Line Corridors 9-127
9.3.5.2 Water Use and Quality....................9-131
9.3.5.3 Terrestrial and Wetland Resources....................9-133
9.3.5.4 Aquatic Resources....................9-139
9.3.5.5 Socioeconomics 9-145
9.3.5.6 Environmental Justice....................9-152
9.3.5.7 Historic and Cultural Resources....................9-155
9.3.5.8 Air Quality....................9-157
9.3.5.9 Nonradiological Health Impacts 9-158
9.3.5.10 Radiological Impacts of Normal Operations 9-160
9.3.5.11 Postulated Accident Impacts....................9-161

9.3.6 The Savannah River Alternative Site....................9-162
9.3.6.1 Land Use and Transmission-Line Corridors 9-166
9.3.6.2 Water Use and Quality....................9-168
9.3.6.3 Terrestrial and Wetland Resources....................9-171
9.3.6.4 Aquatic Resources....................9-176
9.3.6.5 Socioeconomics 9-183
9.3.6.6 Environmental Justice....................9-189
9.3.6.7 Historic and Cultural Resources....................9-193
9.3.6.8 Air Quality....................9-195
9.3.6.9 Nonradiological Health Impacts 9-196
9.3.6.10 Radiological Impacts of Normal Operations 9-198
9.3.6.11 Postulated Accident Impacts....................9-199

9.3.7 Comparison of the Impacts of the Proposed Action and the Alternative Sites....................9-200
9.3.7.1 Comparison of Cumulative Impacts at the Proposed and Alternative Sites....................9-201
9.3.7.2 Environmentally Preferable Sites....................9-203
9.3.7.3 Obviously Superior Sites....................9-206
9.4 System Design Alternatives....................9-206
9.4.1 Heat-Dissipation Systems....................9-207
9.4.1.1 Wet Natural Draft Cooling Towers....................9-207
9.4.1.2 Once-Through Cooling....................9-207
9.4.1.3 Cooling Pond....................9-208
9.4.1.4 Spray Ponds....................9-208
9.4.1.5 Dry Cooling Towers....................9-209
9.4.1.6 Combination Wet/Dry Cooling-Tower System....................9-209
9.4.1.7 Mechanical Draft with Plume Abatement....................9-210
9.4.2 Circulating-Water Systems....................9-210
9.4.2.1 Intake Alternatives....................9-210
9.4.2.2 Discharge Alternatives....................9-211
9.4.2.3 Water Supplies....................9-212
9.4.2.4 Water Treatment....................9-213
9.4.3 Summary....................9-213
9.5 U.S. Army Corps of Engineers Alternatives Evaluation....................9-214
9.5.1 Onsite Alternatives....................9-214
9.5.2 SCE&G Alternative Sites....................9-214
9.6 References....................9-216
10.0 Conclusions and Recommendations....................10-1
10.1 Impacts of the Proposed Action....................10-4
10.2 Unavoidable Adverse Environmental Impacts....................10-4
10.2.1 Unavoidable Adverse Impacts During Construction and Preconstruction Activities....................10-4
10.2.2 Unavoidable Adverse Impacts During Operation....................10-9
10.3 Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment....................10-12
10.4 Irreversible and Irretrievable Commitments of Resources....................10-13
10.4.1 Irreversible Commitments of Resources....................10-13
10.4.1.1 Land Use....................10-13
10.4.1.2 Water Use....................10-13

10.4.1.3 Aquatic and Terrestrial Biota....10-13
10.4.1.4 Socioeconomic Resources....10-14
10.4.1.5 Historic and Cultural Resources....10-14
10.4.1.6 Air and Water....10-14
10.4.2 Irretrievable Commitments of Resources....10-14
10.5 Alternatives to the Proposed Action....10-15
10.6 Benefit-Cost Balance....10-16
10.6.1 Benefits....10-17
10.6.1.1 Societal Benefits....10-17
10.6.1.2 Regional Benefits....10-19
10.6.2 Costs....10-20
10.6.2.1 Internal Costs....10-21
10.6.2.2 External Costs....10-26
10.6.3 Summary of Benefits and Costs....10-26
10.7 Staff Recommendation....10-27
10.8 References....10-28
Appendix A – Contributors to the Environmental Impact Statement....A-1
Appendix B – Organizations Contacted....B-1
Appendix C – Chronology of NRC and USACE Environmental Review Correspondence....C-1
Appendix D – Scoping Comments and Responses....D-1
Appendix E – Draft Environmental Impact Statement Comments and Responses....E-1
Appendix F – Key Combined License Consultation Correspondence Regarding the Virgil C. Summer Nuclear Station Units 2 and 3 Combined License Application; and Biological Assessments....F-1
Appendix G – Supporting Documentation for Radiological Dose Assessment....G-1
Appendix H – Authorizations, Permits, and Certifications....H-1
Appendix I – U.S. Army Corps of Engineers Public Interest Review Factors....I-1
Appendix J – Carbon Dioxide Footprint Estimates for a 1000-MW(e) Reference Reactor....J-1

Figures

2-1 SCE&G's Proposed Location for VCSNS Units 2 and 3 2-2
2-2 The Location of the VCSNS Site in Relationship to the Counties, Cities, and Towns Within a 50-mi Radius of the Site 2-3
2-3 Map of the VCSNS Site and Vicinity Within the 6-mi Radius 2-4
2-4 Existing VCSNS Unit 1 Transmission Lines 2-9
2-5 VCSNS Units 2 and 3 Expected New Transmission-Line Routes 2-10
2-6 Major Hydrologic Features Within the 6-mi Radius of VCSNS Units 2 and 3 2-16
2-7 Major Hydrologic Features Within the 50-mi Radius of VCSNS Units 2 and 3 2-17
2-8 Broad River Basin Upstream of the VCSNS Site, Showing the Nearest Stream-Flow Gauging Stations 2-18
2-9 Physiographic Provinces of South Carolina and Hydrogeologic Provinces of the Southeastern United States Showing the VCSNS Site Location 2-22
2-10 Diagram of Regolith and Fractured Bedrock Groundwater Zones in the Piedmont Physiographic Province of the Southeastern United States 2-23
2-11 Conceptual Model of Groundwater Flow in the Piedmont Physiographic Province of the Southeastern United States 2-24
2-12 The SCDHEC Water-Quality Sampling Locations near the VCSNS Site 2-31
2-13 Historical Photos Showing How the VCSNS Site Has Changed Since 1938 2-40
2-14 Map of the Cover Types on the VCSNS Site 2-41
2-15 Threatened and Endangered Species Survey Locations at the VCSNS Site 2-48
2-16 Broad River Basin and Impoundments 2-63
2-17 Existing Portion of Santee Cooper VCSNS-Flat Creek Line Crossing of Carolina Heelsplitter Critical Habitat 2-90
2-18 Aggregate Minority Populations in Block Groups That Meet the Environmental Justice Selection Criteria 2-124
2-19 Low-Income Populations in Block Groups That Meet the Environmental Justice Selection Criteria 2-125
2-20 Area of Potential Effect for the VCSNS Site Units 2 and 3 2-130
3-1 VCSNS Site Layout 3-2
3-2 Conceptualization of Proposed Units 2 and 3 Superimposed on the VCSNS Site 3-3
3-3 AP1000 Power Conversion Diagram 3-5

3-4 VCSNS Site Layout Showing Major Structure and Activity Areas for Proposed Units 2 and 3 3-7
3-5 Site Layout Closeup 3-8
3-6 Plan View of the Circulating-Water System Intake Structure 3-10
3-7 Cross-Section View of the Circulating-Water System Intake Structure 3-11
3-8 Plan and Cross-Section Views of the Outfall Discharge System 3-12
3-9 Plan and Cross-Section Views of the Outfall Discharge Ports 3-13
3-10 Water-Use Summary Diagram 3-31
4-1 Habitats and Areas that Would Be Disturbed by the Development of the VCSNS Site 4-6
4-2 Streams and Wetlands, Including a 50-ft Buffer, on the VCSNS Site 4-21
4-3 Proposed SCE&G and Santee Cooper Transmission-Line Corridors in Relation to Crossings of Major Waterbodies 4-36
5-1 Diagram of the Broad River, Parr Reservoir, and Monticello Reservoir System 5-5
5-2 Artist Rendering of Proposed VCSNS Unit 2 and Unit 3 Cooling-Tower Plumes as Viewed from Monticello Reservoir 5-37
5-3 Exposure Pathways to Man 5-64
5-4 Exposure Pathways to Biota Other Than Man 5-66
6-1 The Uranium Fuel Cycle: No-Recycle Option 6-6
6-2 Illustration of Truck Stop Model 6-31
8-1 The Combined Service Territory of SCE&G and Santee Cooper 8-3
8-2 The SERC Service Territory 8-5
9-1 Potential Site Locations 9-35
9-2 Santee Cooper Region of Interest 9-40
9-3 FA-1 Alternative Site Region 9-50
9-4 Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the FA-1 Site 9-78
9-5 Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the FA-1 Site 9-79
9-6 The CGS Alternative Site Region 9-91
9-7 Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the CGS Site 9-114
9-8 Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the CGS Site 9-115

9-9 Saluda Alternative Site Region..9-128

9-10 Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Saluda Site..9-153

9-11 Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Saluda Site..9-154

9-12 Savannah River Alternative Site Region 9-165

9-13 Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Savannah River Alternative Site 9-191

9-14 Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Savannah River Alternative Site 9-192

Tables

2-1 Land Use and Land Cover in the Vicinity and Region of the VCSNS Site 2-7
2-2 Land Use and Land Cover in Affected SCE&G Transmission-Line Corridors 2-12
2-3 Land Use in Affected Santee Cooper Transmission-Line Corridors 2-13
2-4 Special Farmland Designations in Proposed Transmission-Line Corridors 2-14
2-5 Summary of Reservoir Characteristics 2-19
2-6 Broad River Flow Characteristics at Three Gauges Near the VCSNS Site 2-20
2-7 Broad River Flow Characteristics Calculated by the Review Team (cfs) 2-20
2-8 Annual Water Use Within South Carolina 2-28
2-9 Local and Downstream Surface-Water Users Reported by SCE&G for 2004 2-28
2-10 Surface-Water-Quality Data for 2004 2-32
2-11 Surface-Water-Quality Data for 2005 2-33
2-12 Monticello Reservoir Water-Quality Data for 2006 2-34
2-13 Mayo Creek Water-Quality Data for 2008 and 2009 2-36
2-14 USGS Flow and Temperature Monitoring on the Broad River 2-37
2-15 Avian Species Observed on the VCSNS Site 2-44
2-16 Federally and State-Listed Terrestrial Species Occurring Within and in the Vicinity of the VCSNS Site 2-49
2-17 Federally and State-Listed Terrestrial Species in Counties Crossed by the Proposed Transmission-Line Corridors 2-53
2-18 Fish Species Sampled from 2006-2009 Survey Efforts in Mayo Creek and Parr and Monticello Reservoirs 2-65
2-19 VCSNS Onsite Stream Characteristics 2-70
2-20 Aquatic Species Designated as Threatened, Endangered, Proposed for Federal Listing, or Species of Concern in Counties Crossed by Transmission-Line Corridors 2-73
2-21 Summary of Recreational Fish Species Known to Occur in Parr or Monticello Reservoirs 2-76
2-22 Aquatic Invasive Species Documented to Occur in the Vicinity of the VCSNS Site 2-79
2-23 Historical and Projected Populations for Counties in the VCSNS Region 2-95
2-24 Selected 2007 Population Centers in the VCSNS Region 2-96
2-25 2000 Age Distribution Near the VCSNS Site 2-96

2-26 High-Capacity Recreation Areas in the Region 2-96
2-27 Minority and Low-Income Populations....2-98
2-28 VCSNS Unit 1 Operations Employment by County and State....2-99
2-29 Employment Trends in the Region 2-100
2-30 2007 Employment by Industry in the Economic Impact Area 2-102
2-31 2006-2009 Construction Industry Occupational Employment in the Columbia Metropolitan Area 2-103
2-32 Annual Median Family Income by County for the Four-County Economic Impact Area 2-104
2-33 2003-2008 Property Tax Revenue Trends Related to VCSNS Unit 1 2-104
2-34 2008 Annual Average Daily Traffic for Selected Routes in the Vicinity of the VCSNS Site 2-105
2-35 2000 Census Housing Characteristics in the Four-County Area 2-108
2-36 Public Groundwater Supply Resources 2-110
2-37 Public Surface-Water Supply Resources by County 2-111
2-38 Public Wastewater-Treatment Systems by County 2-112
2-39 Law Enforcement Personnel 2005 by County 2-113
2-40 Fire Protection Personnel by County 2-114
2-41 2007 Arrests per 1000 for Fairfield, Lexington, Newberry, and Richland Counties 2-116
2-42 Hospital Data for Fairfield, Lexington, Newberry, and Richland Counties 2-116
2-43 School Characteristics in the Four-County Area....2-119
2-44 Fairfield County Public School Free and Reduced Meal Eligibility 2-119
2-45 Colleges and Universities in the VCSNS Region....2-120
2-46 Regional Minority and Low-Income Populations by Census Blocks Meeting Environmental Justice Criteria 2-121
2-47 VCSNS Archaeological Sites Identified – Phase I/II Investigations 2-133
2-48 Maximum Annual Atmospheric Dispersion and Deposition Factors for the Dose Evaluation Periphery, Nearest Residence, Nearest Meat Animal, Nearest Milk Animal, and Nearest Vegetable Garden 2-152
3-1 Summary of New 230-kV Transmission Lines for Proposed VCSNS Units 2 and 3....3-16
3-2 Descriptions and Examples of Activities Associated with Building Proposed Units 2 and 3....3-21
3-3 Summary of Resource Commitments Associated with Proposed Units 2 and 3 Construction and Preconstruction 3-26

3-4 Water Quality of Proposed Units 2 and 3 Blowdown Effluent 3-30
3-5 Waste Stream Concentration of Water-Treatment Chemicals from Two Units 3-36
3-6 Resource Commitments Associated with Units 2 and 3 Operation 3-38
4-1 Land-Use Impacts of the Proposed New Transmission-Line Corridors........................4-10
4-2 Detailed Land-Use Impacts of New/Expanded Corridors 4-11
4-3 Summary of Forest and Wetland Impacts in Proposed Transmission-Line Corridors 4-26
4-4 Stream Crossings, Open Water, Linear Feet of Stream, and Stream Area Associated with the SCE&G and Santee Cooper Transmission Lines.........................4-37
4-5 Expected Distribution of In-Migrating Construction Workers in the Region at Peak of Construction..4-53
4-6 Annual Nonradiological Impacts of Transporting Workers and Construction Materials to and/or from the VCSNS Site for a Single AP1000 Reactor 4-83
4-7 Measures and Controls to Limit Adverse Impacts when Building Proposed VCSNS Units 2 and 3..4-90
4-8 Summary of Impacts from Construction and Preconstruction of Proposed VCSNS Units 2 and 3..4-94
5-1 Impacts of Proposed VCSNS Units 2 and 3 Water Use on Broad River Flow................5-6
5-2 Estimated Spring and Summer Blowdown Plume Temperatures with Assumed Plume Thickness Equal to 50 Percent of Water Depth 5-11
5-3 Estimated Blowdown Plume Temperature Rise Above Ambient Water for Spring and Summer with Assumed Plume Thickness Equal to 50 Percent of Water Depth.....5-11
5-4 Abundance and Biomass of Biota Sampled During the 2005-2006 Geosyntec VCSNS Unit 1 Impingement Study...5-26
5-5 Expected Annual Property Tax Payments to Fairfield County from Operation of VCSNS Units 2 and 3 5-41
5-6 Expected Corporate Income Tax Payments to Affected Jurisdictions from Operation of VCSNS Units 2 and 3 5-42
5-7 Regulated Source Emissions 5-55
5-8 Nonradiological Impacts of Transporting Operations Workers to and from the VCSNS Site and Alternative Sites for a Single AP1000 Reactor 5-62
5-9 Annual Doses to the Maximally Exposed Individual for Liquid Effluent Releases from a New Unit 5-67
5-10 Annual Doses to the Maximally Exposed Individual from Gaseous Effluent Releases for a New Unit 5-68

5-11 Comparisons of MEI Dose Estimates from Liquid and Gaseous Effluents for a Single New Nuclear Unit to 10 CFR Part 50, Appendix I Dose Design Objectives 5-70
5-12 Comparison of Maximally Exposed Individual Dose Rates with 40 CFR Part 190 Criteria 5-70
5-13 Biota Doses for Proposed VCSNS Units 2 and 3 5-73
5-14 Comparison of Biota Doses from Proposed VCSNS Units 2 and 3 to IAEA Guidelines for Biota Protection........5-74
5-15 Atmospheric Dispersion Factors for the VCSNS Site DBA Calculations........5-81
5-16 DBA Doses for an AP1000 Reactor for Proposed VCSNS Units 2 and 3 5-82
5-17 Mean Environmental Risks from an AP1000 Reactor Severe Accident at the VCSNS Site 5-86
5-18 Comparison of Environmental Risks for an AP1000 Reactor at the VCSNS Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG-1150 and the AP1000 at Four Early Site Permit Sites 5-87
5-19 Comparison of Environmental Risks from Severe Accidents Initiated by Internal Events for an AP1000 Reactor at the VCSNS Site with Risks Initiated by Internal Events for Current Plants Undergoing Operating License Renewal Review and Environmental Risks of the AP1000 Reactor at Other Sites 5-88
5-20 Comparison of VCSNS SAMDA Site Characteristics with Site Parameters Specified in AP1000 DCD, Appendix 1B 5-94
5-21 Design Alternatives Considered for SAMDA in the AP1000 DCD........5-95
5-22 Summary of Measures and Controls Proposed by SCE&G to Limit Adverse Impacts During Operation of Proposed Units 2 and 3 at the VCSNS Site 5-97
5-23 Characterization of Operational Impacts at the VCSNS Site 5-100
6-1 Table of Uranium Fuel Cycle Environmental Data........6-2
6-2 Comparison of Annual Average Dose Received by a U.S. Resident from All Sources 6-14
6-3 Number of Truck Shipments of Unirradiated Fuel for the Reference LWR and the Westinghouse AP1000 Reactor 6-20
6-4 RADTRAN 5.6 Input Parameters for Unirradiated Fuel Shipments........6-22
6-5 Radiological Impacts Under Normal Conditions of Transporting Unirradiated Fuel to the VCSNS Site and Alternative Sites 6-23
6-6 Nonradiological Impacts of Transporting Unirradiated Fuel to the VCSNS Site and Alternative Sites, Normalized to the Reference LWR 6-27

6-7 Transportation-Route Information for Shipments from the VCSNS Site and Alternative Sites to the Proposed Geologic HLW Repository at Yucca Mountain, Nevada 6-29
6-8 RADTRAN 5.6 Normal Exposure Parameters 6-29
6-9 Normal Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the VCSNS Site and Alternative Sites to the Proposed High-Level Waste Repository at Yucca Mountain 6-32
6-10 Radionuclide Inventories Used in Transportation-Accident Risk Calculations for the Westinghouse AP1000 Reactor 6-35
6-11 Annual Spent-Fuel Transportation Accident Impacts for a Westinghouse AP1000 Reactor at the VCSNS Site and Alternative Sites, Normalized to the Reference 1100-MW LWR Net Electrical Generation 6-37
6-12 Nonradiological Impacts of Transporting Spent Fuel from the VCSNS Site and Alternative Sites to the Proposed Geologic Repository at Yucca Mountain, Nevada, Normalized to the Reference LWR 6-38
6-13 Summary of Radioactive Waste Shipments from the VCSNS Site and Alternative Sites 6-39
6-14 Nonradiological Impacts of Radioactive Waste Shipments from the VCSNS Site....................6-40
7-1 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Analysis 7-3
7-2 Comparison of Annual Carbon Dioxide Emission Rates....................7-30
7-3 Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Units 2 and 3 7-39
8-1 2022 Forecasted Demand....................8-17
8-2 Potential Impact the Proposed Project Would Have on SCE&G Baseload Capacity Resources and Fuel Diversity 8-19
8-3 2022 Forecasted Cumulative Supply....................8-24
8-4 Final Analysis of the Combined Power Supply and Demand Forecasts for SCE&G and Santee Cooper in 2022 8-26
9-1 Summary of Environmental Impacts of Coal-Fired Power Generation – 2214 MW....................9-14
9-2 Summary of Environmental Impacts of Natural-Gas-Fired Power Generation....................9-19
9-3 Summary of Environmental Impacts of a Combination of Power Sources....................9-27
9-4 Summary of the Environmental Impacts of New Nuclear, Coal-Fired, Natural-Gas-Fired, and a Combination of Alternatives 9-28
9-5 Comparison of Carbon Dioxide Emissions for Energy Alternatives 9-29

9-6 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the FA-1 Alternative Site Cumulative Analysis....................................9-45
9-7 Land-Use Impact Parameters for the FA-1 Site...9-51
9-8 Broad River Reduction in Flow and Assessed Impact Levels....................................9-53
9-9 Federally and State-Listed Species That May Occur on the FA-1 Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors.............................9-57
9-10 SCE&G Transmission-Line Information for the FA-1 Alternative Site 9-59
9-11 Santee Cooper Transmission-Line Information for the FA-1 Alternative Site................9-59
9-12 Aquatic Invasive Species Documented to Occur in the Vicinity of the FA-1 Alternative Site...9-65
9-13 Federally, Proposed Federally, and State-Listed Aquatic Species That May Occur on the FA-1 Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors 9-66
9-14 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cope Generating Station Alternative Site Cumulative Analysis 9-88
9-15 Land-Use Impact Parameters for the CGS Site...9-92
9-16 South Fork Edisto River Reduction in Flow and Assessed Impact Levels 9-94
9-17 Federally and State-Listed Species That May Occur on the CGS Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors.............................9-97
9-18 SCE&G Transmission-Line Information for the CGS Alternative Site 9-99
9-19 Santee Cooper Transmission-Line Information for the CGS Alternative Site................9-99
9-20 Federally, Proposed Federally, and State-Listed Aquatic Species That May Occur on the CGS Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors: 9-102
9-21 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Saluda Alternative Site Cumulative Analysis 9-124
9-22 Land-Use Impact Parameters for the Saluda Site 9-129
9-23 Federally and State-Listed Species That May Occur on the Saluda Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors...................9-135
9-24 SCE&G Transmission-Line Information for the Saluda Alternative Site 9-137
9-25 Santee Cooper Transmission-Line Information for the Saluda Alternative Site...........9-137
9-26 Federally, Proposed Federally, and State-Listed Aquatic Species That May Occur on the Saluda Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors 9-141

9-27 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Savannah River Alternative Site Cumulative Analysis 9-163

9-28 Land-Use Impact Parameters for the SR Alternative Site..9-167

9-29 Savannah River Reduction in Flow and Assessed Impact Levels 9-168

9-30 Savannah River Reduction in Flow and Combined Water-Use Impact.......................9-170

9-31 Federally and State-Listed Species That May Occur on the SR Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors............................9-172

9-32 SCE&G Transmission-Line Information for the SR Alternative Site 9-174

9-33 Santee Cooper Transmission-Line Information for the SR Alternative Site.................9-174

9-34 Federally, Proposed Federally, and State-Listed Aquatic Species That May Occur on the SR Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors 9-178

9-35 Comparison of Cumulative Impacts at the VCSNS Site and Alternative Sites 9-202

9-36 Comparison of Impacts on Waters of the United States for the Proposed and Four Alternative Sites...9-215

10-1 Unavoidable Adverse Environmental Impacts from Construction and Preconstruction Activities 10-5

10-2 Unavoidable Adverse Environmental Impacts from Operation 10-9

10-3 Monetary and Nonmonetary Benefits of the Proposed VCSNS Units 2 and 3 10-18

10-4 Internal and External Costs of Proposed VCSNS Units 2 and 3.................................10-21

Executive Summary

By letter dated March 27, 2008, the U.S. Nuclear Regulatory Commission received an application from South Carolina Electric and Gas , acting for itself and for Santee Cooper for combined construction permits and operating licenses for Virgil C. Summer Nuclear Station Units 2 and 3 to be located adjacent to the existing Unit 1 in Fairfield County, South Carolina. The NRC staff's review is based on Revisions 1 and 2 of the Environmental Report , received February 13, 2009 and July 2, 2010, respectively; responses to requests for additional information; and supplemental letters. This environmental impact statement also addresses public and agency comments received on the draft EIS published on April 15, 2010.

On March 2, 2010, SCE&G submitted a joint Federal/State Application for the Department of the Army Individual Permit to the U.S. Army Corps of Engineers . The USACE application number is SAC 2007-1852-SIR. The permit application was revised on December 16, 2010. A Public Notice advertising the revised application is being issued to coincide with the public availability of this EIS.

The proposed actions related to the VCSNS Units 2 and 3 application are NRC issuance of COLs for construction and operation of two new nuclear units at the VCSNS site, and USACE permit action on a DA Individual Permit application pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. The USACE is participating collaboratively on the review team. The reactors specified in the application are Westinghouse Electric Company, LLC Advanced Passive 1000 pressurized water reactors. The application references Revision 17 of the AP1000 certified design.

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

The purpose of SCE&G's requested NRC action is to obtain COLs to construct and operate two baseload nuclear power plants. These licenses are necessary but not sufficient for construction and operation of the units. A COL applicant must obtain and maintain the necessary permits from other Federal, State, and local agencies and permitting authorities. Therefore, the purpose of the NRC's environmental review of the SCE&G application is to determine if two new nuclear power plants of the proposed design can be constructed and operated at the VCSNS site without unacceptable adverse impacts on the human environment. The SCE&G permit application to the USACE is for work to prepare the site and facilities for a nuclear power-generation station at the existing VCSNS site.

The NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* on January 5, 2009, a Notice of Intent to prepare an EIS and conduct scoping. Two scoping meetings were held to obtain public input on the scope of the environmental review. The first meeting was held in Winnsboro, South Carolina, on January 27, 2009. The second meeting was held in Blair, South Carolina, on January 28, 2009. In addition, NRC held a public informational meeting for the local community on March 28, 2009. The NRC staff reviewed the comments received during the scoping process and contacted Federal, State, Tribal, regional, and local agencies to solicit comments.

To gather information and to become familiar with the sites and their environs, the NRC and its contractor, Pacific Northwest National Laboratory, visited the VCSNS site and four alternative sites in March 2009. During the site visits, the NRC staff and its contractor met with SCE&G staff, public officials, and the public. Included in this EIS are the results of the review team's analyses, which consider and weigh the environmental effects of the proposed actions; potential mitigation measures for reducing or avoiding adverse effects; the environmental impacts of alternatives to the proposed action; and the NRC staff's recommendation regarding the proposed action.

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

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

Potential mitigation measures were considered for each resource category and are discussed in the appropriate sections of the EIS.

In preparing this EIS, the NRC staff, its contractor staff, and USACE staff, referred to collectively as the review team, evaluated the applications, including the ER submitted by SCE&G; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NUREG-1555, *Environmental Standard Review Plan* and the Staff Memorandum *Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and*

Cultural/Historical Resources Analysis Issues in Environmental Impact Statements. In addition, the review team considered the public comments related to the environmental review received during the scoping process. Comments within the scope of the environmental review are included in Appendix D of this EIS.

The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs be issued as requested. This recommendation is based on the application, including the ER submitted by SCE&G; consultation with other Federal, State, Tribal, and local agencies; the staff's independent review; the staff's consideration of comments related to the environmental review that were received during the scoping process, the NRC staff's consideration of comments on the draft EIS; and the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The USACE will base its evaluation of the DA Individual Permit application on the requirements of USACE regulations, the Clean Water Act Section 404 Guidelines, and the USACE public interest review process. The USACE's permit decision will be made after issuance of the final EIS.

A 75-day comment period began on April 26, 2010, the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the filing of the draft EIS to allow members of the public and agencies to comment on the results of the environmental review. On May 25, 2010, the NRC and USACE staff conducted two public meetings near the VCSNS site to describe the results of the environmental review, provide members of the public with information to assist them in formulating comments on this EIS, respond to questions, and accept public comment. The public meeting also served as the USACE public hearing, which means a public proceeding conducted for the purpose of acquiring information or evidence that will be considered in evaluating a proposed DA permit action and that affords the public an opportunity to present their views, opinions, and information on such permit actions or Federal projects. After the comment period, the review team considered all the comments received during the comment period. These comments and review team responses are included in Appendix E of this final EIS.

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

Abbreviations/Acronyms

7Q10	lowest flow for 7 consecutive days expected to occur once per decade
AADT	annual average daily traffic
ac	acre
ACE	Ashepoo, Combahee, Edisto (river basin)
ac-ft	acre feet
ACHP	Advisory Council on Historic Preservation
A.D.	Anno Domini
ADAMS	Agencywide Documents Access and Management System
AEC	Atomic Energy Commission
AIS	(South Carolina) Aquatic Invasive Species (Task Force)
ALARA	as low as reasonably achievable
AP-1000	Advanced Passive 1000 pressurized water reactor
APE	area of potential effect
ARRA	American Recovery and Reinvestment Act of 2009
ASLB	Atomic Safety and Licensing Board
ASTM	American Society of Testing and Materials
AQCR	Air Quality Control Region
AQI	Air Quality Index
BA	biological assessment
BACT	Best Available Control Technology
BCRC	Brockington Cultural Resources Consulting
BEA	U.S. Bureau of Economic Analysis
BEIR VII	Biological Effects of Ionizing Radiation VII
BGEPA	Bald and Golden Eagle Protection Act
BLS	U.S. Bureau of Labor Statistics
BOD	biochemical oxygen demand
BMP	best management practice
BP	Before Present
Bq	becquerel(s)
BRWMA	Broad River Wildlife Management Area
Btu	British thermal unit
°C	degree(s) Celsius
C&D	construction and demolition debris
CAA	Clean Air Act
CBS	Carnagey Biological Services

CDC	U.S. Centers for Disease Control and Prevention
CDF	core damage frequency
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CFL	compact fluorescent light
CFR	Code of Federal Regulations
cfs	cubic foot/feet per second
CGS	Cope Generating Station
Ci	curie(s)
cm	centimeter(s)
CMC	criterion maximum concentration
CO	carbon monoxide
CO_2	carbon dioxide
COL	combined construction permit and operating license
COLA	combined license application
CORMIX	Cornell Mixing Zone Expert System
CPCN	Certificate of Environmental Compatibility and Public Convenience and Necessity
CR	County Road
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWIS	cooling-water intake structure
CWS	circulating-water system
CY	calendar year
d	day(s)
DA	Department of the Army
DAR	Daughters of the American Revolution
dB	decibel(s)
dBA	decibel(s) on the A-weighted scale
DBA	design basis accident
DCD	design control document
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
D/Q	deposition factor(s); annual normalized total surface concentration rate(s)
DSM	demand-side management
DTS	demineralised water treatment
EA	Environmental Assessment
EAB	exclusion area boundary
EDE	effective dose equivalent
EE/DSM	energy efficiency/demand-side management

EIA	Energy Information Administration
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
EPACT	Energy Policy Act
EPC	Engineer, Procure, Construct (contract)
EPRI	Electric Power Research Institute
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ER	Environmental Report
ESA	Endangered Species Act of 1973, as amended
ESP	Early Site Permit
ESRP	Environmental Standard Review Plan
° F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FA-1	Fairfield 1
FES	Final Environmental Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FP&S	Facilities Planning & Siting
FPC	Federal Power Commission
fps	foot (feet) per second
FPSF	Fairfield Pumped Storage Facility
FR	*Federal Register*
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft^2	square foot/feet
ft^3	cubic foot/feet
FWS	U.S. Fish and Wildlife Service
μg	microgram(s)
g	gram(s)
gal	gallon(s)
GC	gas centrifuge
GCRP	U.S. Global Change Research Program
GD	gaseous diffusion
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
GI-LLI	gastrointestinal lower large intestine

GIS	geographic information system
gpd	gallon per day
gpm	gallon per minute
HLW	high-level waste
hr	hour
HUC	Hydrologic Unit Code
Hz	hertz
I	Interstate
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined cycle
in	inch(es)
IRP	Integrated Resource Plan
IRWST	in-containment refueling water storage tank
ISFSI	independent spent-fuel storage installation
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
km/hr	kilometer(s) per hour
kV	kilovolt
kW	kilowatt
kW(e)	kilowatt electric
kWh	kilowatt-hour
L	liter(s)
lb/ac/mo	pound per acre per month
Ldn	day night average sound level
LEDPA	least environmentally damaging practicable alternative
lb	pound
LFG	landfill-based gas
LLC	Limited Liability Company
LLW	low-level waste
LOCA	loss-of-coolant accident
LOS	level of service
LPZ	low-population zone
LWA	Limited Work Authorization
LWD	large woody debris

LWR	light water reactor
μmhos/cm	micromhos per centimeter
μS/cm	microsievert(s) per centimeter
MACCS	Melcor Accident Consequence Code System
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m^3/s	cubic meter(s) per second
mA	milliampere(s)
mg	milligram(s)
MEI	maximally exposed individual
Mgd	million gallon(s) per day
mGy	milligray(s)
MHW	Mean High Water
mi	mile(s)
mi^2	square mile
MIT	Massachusetts Institute of Technology
mL	milliliter
mm	millimeter
MOU	Memorandum of Understanding
MOX	mixed oxides
mpg	mile(s) per gallon
mph	mile(s) per hour
mrad	millirad
mrem	millirem
msl or MSL	mean sea level
mSv	millisievert(s)
MT	metric ton(nes)
MTU	metric ton uranium
MW	megawatt(s)
MW(e)	megawatt(s) electric
MWh	megawatt-hour(s)
MW(t)	megawatt(s) thermal
MWd	megawatt-day
NA	not applicable
NAAQS	National Ambient Air Quality Standard
NAVD	Northern American Vertical Datum
NCBI	North Carolina Biotic Index
NCI	National Cancer Institute

NCRP	National Council on Radiation Protection and Measurements
NCW&SA	Newberry County Water & Sewer Authority
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NERP	National Environmental Research Park
NESC	National Electrical Safety Code
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSA	New South Associates
NSPS	new source performance standard
NSR	new source review
NTU	Nephelometric Turbidity Units
NUREG	U.S. Nuclear Regulatory Commission technical document
NWI	National Wetlands Inventory
O_3	ozone
ODCM	Offsite Dose Calculation Manual
OECD	Organization for Economic Cooperation and Development
OL	operating license
OSHA	Occupational Safety and Health Administration
OW	observation well
p.	page
PAM	primary amoebic meningoencephalitis
PARS	Publically Available Records System
PBA	powerblock area
pCi	picocurie(s)
pH	measure of acidity or basicity in solution
PIR	Public Interest Review
PIRF	Public Interest Review Factor
PK-12	preschool through 12th grade
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less

$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
pp.	pages
ppm	part(s) per million
PRA	probabilistic risk assessment
PSCSC	Public Service Commission of South Carolina
PSD	Prevention of Significant Deterioration (Permit)
PURPA	Public Utility Regulatory Policies Act
PV	photovoltaic
QL	quantification limit
rad	radiation absorbed dose
RAI	Request(s) for Additional Information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
RFP	Request for Proposal
RIMS II	Regional Input-Output Modeling System
ROI	region of interest
RRS	(SERC's) Reliability Review Subcommittee
Ryr	reactor year
s or sec	second(s)
SACTI	Seasonal/Annual Cooling Tower Impact (prediction code)
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
Santee Cooper	The State-owned electric and water utility, formally called South Carolina Public Service Authority
SC	South Carolina
SCBCB	South Carolina Budget and Control Board
SCDAH	South Carolina Department of Archives and History
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCDOT	South Carolina Department of Transportation
SCE&G	South Caroline Electric and Gas
SCFC	South Caroline Forestry Commission
SCIAA	South Caroline Institute of Archaeology and Anthropology
SCORS	South Caroline Office of Research and Statistics
SCR	selective catalytic reduction
SCS	Santee-Cooper System
SER	Safety Evaluation Report

SERC	Southeastern Electric Reliability Council
SHPO	State Historic Preservation Office (or Officer)
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SR	Savannah River (alternative site)
SRP	Savannah River Plant
SRS	Savannah River Site
SSC	structures, systems, or components
SU	Standard Unit(s)
Sv	sievert(s)
SWPPP	stormwater pollution prevention plan
SWS	service-water system
T	ton(s)
TBD	to be determined
T&E	threatened and endangered
TDES	Tennessee Department of Environment and Conservation
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Officer
TLD	thermoluminescent dosimeters
TRC	TRC Companies, Inc.
UC	University of Chicago
UF_6	uranium hexafluoride
UMTRI	Univiersity of Michigan Transportation Research Institute
UO_2	uranium dioxide
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFA	U.S. Fire Administration
USGS	U.S. Geological Survey
US	U.S. (State Highway)
VACAR	Virginia-Carolinas (subregion)
VCSNS	Virgil C. Summer Nuclear Station
VEGP	Vogtle Electric Generating Plant
VOC	violatile organic compound

Webb	R.S. Webb and Associates
Westinghouse	Westinghouse Electric Company, LLC
WHO	World Health Organization
WWTP	wastewater-treatment plant
WY	water year (October 1 through September 30)
χ/Q	atmospheric dispersion factor(s); annual average normalized air concentration value(s)
yd	yard(s)
yd^3	cubic yards
yr	year(s)
yr^{-1}	per year

1.0 Introduction

By letter dated March 27, 2008, the U.S. Nuclear Regulatory Commission (NRC) received an application from South Carolina Electric and Gas (SCE&G), acting for itself and for Santee Cooper (the State-owned electric and water utility, formally called the South Carolina Public Service Authority), for combined construction permits and operating licenses (COLs) for two new nuclear reactors at the Virgil C. Summer Nuclear Station (VCSNS) in Fairfield County, South Carolina (SCE&G 2008). The location of the proposed reactors is approximately 1 mi south of the existing VCSNS Unit 1 (SCE&G 2010a). The proposed VCSNS Units 2 and 3 would be jointly owned by SCE&G (55 percent) and Santee Cooper (45 percent), and operated by SCE&G (SCE&G 2010a). VCSNS Unit 1 is also jointly owned by SCE&G (66.7 percent) and Santee Cooper (33.3 percent), and operated by SCE&G (NRC 2004). With the exception of the transmission systems needed to route power from the proposed units, all of the construction and operation related to VCSNS Units 2 and 3 would be completely within the confines of the VCSNS site (SCE&G 2009a). On March 2, 2010, SCE&G submitted an application to the U.S. Army Corps of Engineers (USACE) for a Department of the Army (DA) individual permit to conduct construction activities that would result in alteration of waters of the United States, including wetlands. A revised permit application was received on December 16, 2010. A Public Notice describing the project and proposed revisions to include all transmission lines associated with the project, and as described in this environmental impact statement (EIS), is being issued to coincide with the availability of the EIS.

The proposed actions in these two applications are (1) NRC issuance of COLs for constructing and operating two new nuclear power reactors at the VCSNS site in Fairfield County, South Carolina, and (2) USACE issuance of permits pursuant to Section 404 of the Federal Water Pollution Control Act (33 USC 1344), as amended, by the Clean Water Act of 1977 (33 USC 1251, et seq.) (hereafter referred to as the Clean Water Act) and Section 10 of the Rivers and Harbors Appropriations Act of 1899 (33 USC 403). The USACE is participating in the preparation of this EIS as a cooperating agency. The COL and DA permit applications, as well as review processes for the NRC and the USACE, are described in Section 1.1.1.

1.1 Background

A COL is a Commission approval for constructing and operating one or more nuclear power facilities. NRC regulations related to COLs are found in Title 10 of the Code of Federal Regulations (CFR) Part 52, Subpart C.

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

According to 10 CFR 52.80(b), an application for a COL must contain an Environmental Report (ER). The ER provides input that the NRC staff evaluates in preparing the NRC's EIS. NRC regulations related to ERs and EISs are found in 10 CFR Part 51.

1.1.1 Applications and Reviews

The objective of SCE&G's requested NRC action is to give SCE&G the option of building and operating two nuclear power reactors within the service area of Santee Cooper and SCE&G in order to meet baseload generation needs by 2016 and 2019 (SCE&G 2010a). In addition to the COLs, SCE&G must obtain and maintain permits from other Federal, State, and local agencies and permitting authorities. The objective of SCE&G's requested USACE action is to obtain a DA permit to perform regulated dredge-and-fill activities that would affect wetlands and other waters of the United States and to erect overhead transmission lines across navigable waters. Collectively, the NRC staff (including its contractor staff at Pacific Northwest National Laboratory) and USACE staff who reviewed the ER and decided on impact levels are referred to as the "review team" throughout this EIS.

1.1.1.1 NRC COL Application Review

The objective of the NRC environmental review of the SCE&G application is to determine whether two nuclear reactors of the proposed design can be constructed and operated at the VCSNS site. SCE&G submitted Revision 1 of its ER on February 13, 2009 (SCE&G 2009b). Revision 2 of the ER was submitted on July 2, 2010 (SCE&G 2010a). The ER focuses on the environmental effects of constructing and operating two Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactors at the VCSNS site. The NRC standards for review of a COL application are outlined in 10 CFR 52.81. Detailed guidance for conducting the environmental portion of the review is found in guidance set forth in NUREG-1555, the Environmental Standard Review Plan (ESRP) (NRC 2000) and recent updates, hereinafter referred to as the ESRP, and the Staff Memorandum "Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements" (NRC 2010).

The SCE&G application references Revision 17 of the Westinghouse AP1000 reactor certified design (Westinghouse 2008) in its ER (SCE&G 2010a). Subpart B of 10 CFR Part 52 contains NRC regulations related to standard design certification. An application for a standard design certification undergoes an extensive review. Revision 15 of the AP1000 design is codified in 10 CFR Part 52, Appendix D. Where appropriate, this EIS incorporates results of the review of

Revision 15 and insights from the review of Revision 17. (Additional information about design certification is discussed in Section 3.2.1.)

In this EIS, the NRC staff evaluates the environmental effects of two Westinghouse AP1000 reactors at the VCSNS site. In addition to considering the environmental effects of the proposed action, the NRC considers alternatives to the proposed action, including the no-action alternative and the building and operation of new reactors at alternative sites. Also, the benefits of the proposed action (e.g., meeting an identified need for power) and measures and controls to limit adverse impacts are evaluated. The COL application includes several requests for exemptions from the AP1000 design certification under 10 CFR 52.93. The environmental impacts of the requested exemptions are considered in this EIS as part of the Federal action. The technical analysis for each design certification exemption is included in the NRC's Final Safety Evaluation Report (FSER), including a recommendation for approval or denial of each exemption.

After acceptance of the SCE&G application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* (FR) on January 5, 2009, a Notice of Intent to prepare an EIS and conduct scoping in compliance with requirements set forth in 10 CFR Part 51 (74 FR 323). Two scoping meetings were held to obtain public input on the scope of the environmental review. The first meeting was held in Winnsboro, South Carolina, on January 27, 2009. The second meeting was held in Blair, South Carolina, on January 28, 2009. The staff reviewed the comments received during the scoping process and responses were developed for each substantive comment. Comments and responses for comment categories that are within the scope of the NRC environmental review are included in Appendix D. A complete list of the scoping comments and responses is documented in the *V.C. Summer Combined License Scoping Summary Report* (NRC 2009a).

The NRC also held a public informational meeting for the local community on March 28, 2009, at McCrorey-Liston Elementary School in Blair, South Carolina. The March 28 meeting was an informal open house at which members of the public could engage NRC staff and ask questions about the NRC's environmental review process. A meeting summary is available electronically from Agencywide Documents Access and Management System (ADAMS) (NRC 2009b)

To gather information and to become familiar with the proposed and alternative sites and their environs, the review team visited the VCSNS site and four alternative sites in March 2009. During the VCSNS site visits, the NRC staff met with SCE&G 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 of this EIS. Other documents related to the VCSNS site and alternative sites were reviewed and are listed as references where appropriate.

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

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

This EIS presents the review team's analysis, which considers and weighs the environmental impacts of the proposed action at the VCSNS site, including the environmental impacts associated with constructing and operating reactors at the site, the impacts of constructing and operating reactors at alternative sites, the environmental impacts of alternatives to granting the COLs, and the mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's recommendation to the Commission regarding the issuance of the COLs for proposed VCSNS Units 2 and 3.

A 75-day comment period began on April 26, 2010, the date of publication of the U.S. Environmental Protection Agency (EPA) Notice of Availability of the draft EIS, to allow members of the public to comment on the results of the NRC staff's review (75 FR 21625). A public meeting was held on May 27, 2010, at White Hall AME Church in Jenkinsville, South Carolina. During this public meeting, the staff described the results of the NRC environmental review, provided members of the public with information to assist them in formulating comments on the draft EIS, responded to questions, and accepted comments. After the comment period, the review team considered all submitted comments. Comments within the scope of the environmental review have been addressed in the final EIS and are included in Appendix E. Changes made in response to public comments, updates to the material, and other substantive changes are identified by change bars in the margins of this final EIS.

1.1.1.2 USACE Permit Application Review

The USACE role as a cooperating agency in the preparation of this EIS is intended to provide the environmental information USACE needs to meets its NEPA obligation, complete its review, and draw conclusions regarding the least environmentally damaging practicable alternative (LEDPA), public good, and the Public Interest Review Factors (PIRFs) for its permitting decision. The USACE Record of Decision regarding the aforementioned permit application will reference those analyses and present any additional information required by USACE to support its permit decision.

In this EIS, the USACE evaluates certain construction and maintenance activities proposed in waters of the United States, including wetlands that would be affected by the proposed project. The USACE decision will reflect the national concern for both protection and use of important resources. The benefit that may reasonably be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments.

The decision whether to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity and its intended effect on the public interest. Evaluation of the probable impacts that the proposed activity may have on the public interest requires a careful weighing of all of the factors that become relevant in each particular case. A decision by the USACE to authorize this proposal, and if so, the conditions under which it will be allowed to occur, are therefore determined by the outcome of this general balancing process. All factors that may be relevant to the proposal must be considered, including the cumulative effects thereof. The USACE PIRFs are listed and described more fully in Appendix I.

For activities involving discharges regulated by Section 404 of the Clean Water Act, a permit will be denied if the discharge would not comply with the EPA's 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material found at 40 CFR Part 230 (hereafter the 404 (b)(1) Guidelines). Subject to the aforementioned guidelines and any other applicable guidelines and criteria (see 33 CFR 320.2 and 320.3), a permit will be granted unless the USACE district engineer determines that it would be contrary to the public interest. The following general criteria are considered in the evaluation of every application:

- the relative extent of the public and private need for the proposed structure or work
- where there are unresolved conflicts about resource use, the practicability of using practicable and reasonable alternative locations and methods to accomplish the objective of the proposed structure or work
- the extent and permanence of the beneficial and/or detrimental effects that the proposed structure or work is likely to have on the public and private uses to which the area is suited.

1.1.2 Preconstruction Activities

In a final rule dated October 9, 2007 (72 FR 57416), the Commission limited the definition of "construction" (10 CFR 50.10 and 51.4) to those activities that fall within its regulatory authority. Many of the activities required to construct a nuclear power plant are not within NRC's regulatory authority. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erecting support buildings and transmission lines, and other associated activities. These preconstruction activities may take place before the application for a COL is submitted, during the staff's review of a COL application, after a COL is granted, or in some cases, concurrently with NRC-regulated construction. Although preconstruction activities are outside the NRC's regulatory authority, many of them are within the regulatory authority of local, State, or other Federal agencies, including certain preconstruction activities that require permits from the USACE. Preconstruction activities for Units 2 and 3 are ongoing.

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

1.1.3 Cooperating Agencies

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

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

As described in the MOU, the NRC is the lead Federal agency, and the USACE is a cooperating agency in the development of the EIS. Under Federal law, each agency has jurisdiction related to portions of the proposed project. The goal of this cooperative agreement is the development of one EIS that serves the needs of both the NRC license decision process and the USACE permit decision process. While both agencies must comply with the requirements of NEPA, they also have mission requirements that must be met in addition to the NEPA requirements. The NRC makes license decisions under the Atomic Energy Act (42 USC 2011, et seq.), and the USACE makes permit decisions under the Rivers and Harbors Appropriations Act of 1899 and the Clean Water Act (33 USC 1251, et seq.). The USACE is cooperating with the NRC to ensure that the information presented in the NEPA documentation is adequate to fulfill the requirements of USACE regulations, the EPA's Clean Water Act Section 404(b)(1) Guidelines (40 CFR Part 230), which contain the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into waters of the United States, and the USACE public interest review process.

As a cooperating agency, the USACE is part of the NRC review team and is involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. The USACE refers to public meetings as hearings, but there is no adjudicatory process involved as there is for NRC hearings conducted by the Atomic Safety and Licensing Board. For the purposes of assessing environmental impacts under NEPA, the EIS uses the SMALL, MODERATE, or LARGE criteria discussed in Section 1.1.1.1 of this chapter; this approach has been vetted by the CEQ. However, for permit decisions under Section 404 of the Clean Water Act, the USACE can only permit the LEDPA and must address PIRFs. This EIS is intended to provide the information about the environmental impacts necessary to allow the USACE to address the public interest in the Record of Decision associated with the permit decision. However, some of the PIRFs not specifically related to environmental impact, such as mineral needs, are not addressed in this EIS.

The timing of the preparation of the EIS compared to the timing of the USACE permit review is such that the USACE will not have completed its assessment of the LEDPA criterion until it receives public feedback in the form of public comments on the draft EIS. The USACE will address whether the LEDPA criterion is met in the Record of Decision. The goal of the process is for the USACE to have all of the information necessary to make a permit decision when the final EIS is issued. However, it is possible that the USACE will still need some information from SCE&G to complete the permit documentation – information that SCE&G could not make available by the time of final EIS issuance. Also, any conditions required by the USACE, such as compensatory mitigation, will be addressed in the permit issued by the USACE. Mitigation is an important aspect of the review and balancing process on many DA permit applications. Consideration of mitigation will occur throughout the permit application-review process and includes avoiding, minimizing, rectifying, reducing, or compensating for resource losses. Losses will be avoided to the extent practicable. Compensation may occur onsite or at an offsite location.

1.1.4 Concurrent NRC Reviews

In reviews separate from the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These analyses are documented in a Safety Evaluation Report (SER). The SER presents the conclusions reached by the NRC regarding (1) whether there is reasonable assurance that two new reactors can be constructed and operated along with the existing unit at the VCSNS site without undue risk to the health and safety of the public; (2) whether the emergency preparedness program meets the applicable requirements in 10 CFR Part 50, 10 CFR Part 52, 10 CFR Part 73, and 10 CFR Part 100; and (3) whether site characteristics are such that adequate security plans and measures can be developed (10 CFR Part 50, 10 CFR Part 52, 10 CFR Part 73, and 10 CFR Part 100). The final SER for SCE&G's COL application is expected to be published as a NUREG document in the future. Revision 1 of the Final Safety Analysis Report (FSAR) for SCE&G's COL application was published on July 9, 2009; Revisions 2 and 3 of the FSAR were submitted to the NRC on January 28, 2010 and August 25, 2010, respectively (SCE&G 2009c, 2010b, c).

The draft EIS indicated that the COL application references the AP1000 plant design that has been certified by NRC (Title 10 of the Code of Federal Regulations [CFR] Part 52, Appendix D), as modified by the amendment to that design that Westinghouse has submitted to the NRC. At the time the draft EIS was published, Revision 17 of the *AP1000 Design Control Document* (Westinghouse 2008) was the Revision being considered in the design certification review, and the environmental review in the draft EIS accordingly accounted for the environmental impacts anticipated from use of the design in that Revision. Since publication of the draft EIS, Westinghouse has updated its design certification application with Revision 18 of the AP1000 DCD, and the SCE&G COL application has been updated to reference that Revision. The NRC staff has determined that none of the changes involved in the latest Revision has the potential to affect the environmental review documented in the EIS. For that reason, references to Revision 17 in this EIS have been left unchanged. If a subsequent Revision to the AP1000 DCD is submitted and referenced in the COL application, the staff will determine whether the change in Revision has the potential to affect the environmental review. Depending on the environmental significance of any such design change, the staff will supplement the EIS as appropriate.

1.2 The Proposed Federal Action

The proposed NRC Federal action is issuance, under the provisions of 10 CFR Part 52, of COLs for the proposed VCSNS site for two new Westinghouse AP1000 reactors. The proposed USACE Federal action is issuance of a permit pursuant to the Clean Water Act and Rivers and Harbors Appropriations Act of 1899 authorizing certain preconstruction activities that could potentially affect waters of the United States based on evaluation of the probable impacts, including cumulative impacts of the proposed construction activities on the public interest. The DA permit would allow the disturbance via permanent filling of approximately 0.66 ac of wetlands and 774 linear feet of streams regulated as waters of the United States, as well as the permanent conversion of 43.7 ac of forested wetlands to nonforested wetlands as a result of required transmission lines to connect the VCSNS to the electrical grid. This EIS provides the NRC and USACE analyses of the environmental impacts that could result from building and operating two new proposed units at the VCSNS site or at each of the four alternative sites. These impacts are analyzed by the NRC to determine whether the proposed site is suitable for the new units and whether any of the alternative sites are considered obviously superior to the proposed site.

1.3 The Purpose and Need for the Proposed Action

The purpose of and need for the proposed NRC and USACE actions are described below.

1.3.1 The NRC's Proposed Action

The purpose and need for the proposed NRC action (i.e., issuance of COLs) is to provide for additional baseload electric generating capacity by 2016 and 2019 within the service territories of SCE&G and Santee Cooper (SCE&G 2009d). SCE&G has stated this additional capacity is necessary "…to meet future generating needs for baseload power as such needs may be determined by state and owner decision makers" (SCE&G 2010a). The need for additional baseload power is discussed in Chapter 8 of this EIS.

Two COLs from the NRC are necessary for constructing and operating the proposed power plant. Preconstruction and certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COLs are granted. SCE&G must obtain and maintain permits or authorizations from other Federal, State, and local agencies and permitting authorities prior to undertaking certain activities. The ultimate decision whether to build a facility and the schedule for building are not within the purview of the NRC nor the USACE and would be determined by the license holder if the authorizations are granted.

1.3.2 The USACE Permit Action

The SCE&G permit application to the USACE is for work to prepare the site and facilities for a nuclear power-generation station at the existing VCSNS site. Defining the project objectives is critical to the evaluation of any project and to evaluating compliance with the Clean Water Act Section 404(b)(1) Guidelines. In addition to the NEPA-required purpose and need described above, the 404(b)(1) Guidelines and subsequent 404(q) guidance require that the USACE define the "basic project purpose" and the "overall project purpose" to verify appropriate consideration of alternatives.

The basic purpose is the most simple or irreducible objective of the project and is used to determine whether the applicant's project is "water dependent" (40 CFR 230.10(a)(3)). The water dependency test contained in the 404(b)(1) Guidelines creates a presumption that activities that do not require access to, proximity to, or siting within special aquatic sites to fulfill their basic project purpose are not water dependent. Therefore, the 404(b)(1) Guidelines state that practicable alternatives to non-water-dependent activities are presumed to exist, are less damaging, and are environmentally preferable to alternatives that involve discharges into special aquatic sites (e.g., wetlands and riffle and pool stream complexes) (40 CFR 230.10(a)(3)). The basic purpose of this project is to generate electricity for additional baseload capacity. Constructing facilities to create energy supplies is not a water-dependent activity, and in accordance with the 404(b)(1) Guidelines, practicable alternatives that do not involve discharges into special aquatic sites are presumed to exist unless clearly demonstrated otherwise (40 CFR 230.10(a)(3)).

In addition to defining the basic project purpose, the USACE must also define the overall project purpose. The overall project purpose establishes the scope of the alternatives analysis and is used for evaluating practicable alternatives under the 404(b)(1) Guidelines. In accordance with the 404(b)(1) Guidelines and guidance from USACE Headquarters, the overall project purpose must be specific enough to define the applicant's needs, but not so narrow and restrictive as to preclude a proper evaluation of alternatives. The USACE is responsible for controlling every aspect of the 404(b)(1) Guidelines analysis (HQUSACE 1989). In this regard, defining the overall project purpose for issuance of USACE permits is the sole responsibility of the USACE. While generally focusing on the SCE&G's statement, the USACE will in all cases exercise independent judgment in defining the purpose and need for the project from both SCE&G's and the public's perspectives (33 CFR Part 325; 53 FR 3120).

The overall purpose of the project is to construct a power-generating facility to provide for additional baseload electrical generating capacity to meet the growing demand in the State of South Carolina. The USACE concurs with the stated project purpose and long-term need to generate electricity to meet the growing demand in South Carolina.

1.4 Alternatives to the Proposed Action

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

In the no-action alternative, the proposed action would not go forward. The NRC could deny SCE&G's request for the COLs. If the request was denied, the construction and operation of two new nuclear generating units at the VCSNS site would not occur, nor would any benefits intended by the approved COLs be realized. The USACE could deny SCE&G's permit request. If the permit were denied, SCE&G's construction of the two new units would not go forward as proposed. Energy source alternatives include energy-replacement technologies such as oil- and gas-fired generation and wind power, focusing on alternatives that could generate baseload power. System design alternatives include heat-dissipation and circulating-water systems, intake and discharge structures, and water use and treatment systems. Finally, onsite alternatives evaluated by the USACE to reduce impacts on wetlands and shoreline resources are described.

In its ER, SCE&G defines a region of interest for use in identifying and evaluating potential sites for power generation (SCE&G 2010a). In this EIS the NRC staff evaluates the region of interest, the process by which alternative sites were selected, and the environmental impacts of construction and operation of new power reactors at those alternative sites using reconnaissance-level information. Using this process, SCE&G reviewed multiple sites and identified the suite of candidate sites for this project. The alternative sites included the Fairfield 1 site, a greenfield site owned by SCE&G on the Broad River in South Carolina; an existing fossil-fired site owned by SCE&G near Cope, South Carolina; a greenfield site owned by SCE&G in Saluda County, South Carolina; and the Savannah River Site in Aiken County, South Carolina (SCE&G 2010a). The objective of the comparison of environmental impacts is to determine whether any of the alternative sites is environmentally preferable and obviously superior to the proposed VCSNS site.

As part of the evaluation of permit applications subject to Section 404 of the Clean Water Act, the USACE is required by regulation to apply the criteria set forth in the 404(b)(1) Guidelines (33 USC 1344; 40 CFR Part 230). These guidelines establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404. Specifically, these guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem provided the alternative does not have other significant adverse consequences (40 CFR 230.10(a)). An area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed to fulfill the basic purpose of the proposed activity may be considered if it is otherwise a practicable alternative.

1.5 Compliance and Consultations

Before the construction and operation of the proposed new units, SCE&G is required to obtain certain Federal, State, and local environmental permits, as well as to meet applicable statutory and regulatory requirements. In its ER (SCE&G 2010a), SCE&G provided a list of environmental approvals and consultations associated with proposed VCSNS Units 2 and 3. Potential authorizations, permits, and certifications relevant to the proposed COLs are included in Appendix H of this EIS. The staff reviewed the list and 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 affect the acceptability of the VCSNS site for the construction and operation of the proposed two Westinghouse AP1000 reactors. A list of the key consultation correspondence is provided as Appendix F.

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 nuclear reactor units. Chapter 3 describes the power plant layout, structures, and activities related to building and operation that are used as the basis for evaluating the environmental impacts. Chapters 4 and 5 examine the environmental impacts of building (Chapter 4) and operating (Chapter 5) proposed VCSNS Units 2 and 3. Chapter 6 analyzes the environmental impacts of the uranium fuel cycle, transportation of radioactive materials, and decommissioning, while Chapter 7 examines the cumulative impacts of the proposed action as defined in 40 CFR 1508.7. Chapter 8 addresses the need for power. Chapter 9 discusses alternatives to the proposed action and analyzes energy sources, alternative sites and systems, and compares the proposed action with these alternatives. Chapter 10 summarizes the findings of the preceding chapters and provides a benefit-cost evaluation; it also presents the staff's recommendation with respect to the Commission's approval of the proposed site for COLs based on the NRC staff's evaluation of environmental impacts.

The appendices to this EIS provide the following additional information.

- Appendix A – Contributors to the Environmental Impact Statement
- Appendix B – Organizations Contacted
- Appendix C – Chronology of NRC and USACE Environmental Review Correspondence
- Appendix D – Scoping Comments and Responses
- Appendix E – Draft Environmental Impact Statement Comments and Responses
- Appendix F – Key Combined License Consultation Correspondence Regarding the Virgil C. Summer Nuclear Station Units 2 and 3 Combined License Application; and Biological Assessments
- Appendix G – Supporting Documentation for Radiological Dose Assessment
- Appendix H – Authorizations, Permits, and Certifications
- Appendix I – U.S. Army Corps of Engineers Public Interest Review Factors
- Appendix J – Carbon Dioxide Footprint Estimates for a 1000-MW(e) Reference Reactor

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."

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

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

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

33 CFR Part 325. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Part 325, "Processing of Department of the Army Permits."

40 CFR Part 230. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 230, "Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material."

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

53 FR 3120. February 3, 1988. "Environmental Quality; Procedures for Implementing the National Environmental Policy Act (NEPA)." *Federal Register*. Corps of Engineers, Department of the Army.

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74 FR 323. January 5, 2009. "South Carolina Electric and Gas Company Acting for Itself and as Agent for the South Carolina Public Service Company (Also Referred to as Santee Cooper) Virgil C. Summer Nuclear Station Units 2 and 3; Combined License Application; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*. U.S. Nuclear Regulatory Commission.

75 FR 21625. April 26, 2010. "Environmental Impacts Statements; Notice of Availability." *Federal Register*. U.S. Environmental Protection Agency.

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Clean Water Act. 33 USC 1251, et seq. (Also referred to as the Federal Water Pollution Control Act [FWPCA]).

Federal Water Pollution Control Act (FWPCA). 33 USC 1344, et seq. "Permits for Dredged or Fill Material."

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

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

South Carolina Electric and Gas (SCE&G). 2008. *V.C. Summer Nuclear Station Units 2 and 3 Project No. 743. Submittal of a Combined License Application for V.C. Summer Nuclear Station Units 2 and 3*. Revision 0, Jenkinsville, South Carolina. NND-08-0004. Accession No. ML081300460.

South Carolina Electric and Gas (SCE&G). 2009a. Letter from Ronald B. Clary (SCE&G, General Manager, New Nuclear Deployment) to U.S. Nuclear Regulatory Commission dated May 5, 2009 in response to letters from S.A. Byrne dated March 27 2008 and Ronald B. Clary dated February 13, 2009, "Subject: V.C. Summer Nuclear Station Units 2 and 3, Docket Numbers 52-027 and 52-028, Combined License Application – Environmental Report Audit Information Needs: ALT-1/NP-1, AQ-1, AQ-15, G-5, G-6, G-8, and NRHH-2." NND-09-0110. Accession No. ML091890158.

South Carolina Electric and Gas (SCE&G). 2009b. *V.C. Summer Nuclear Station Units 2 and 3 COL Application, Part 3, Applicant's Environmental Report – Combined License Stage*. Revision 1, Jenkinsville, South Carolina. Accession No. ML090510261.

South Carolina Electric and Gas (SCE&G). 2009c. *V.C. Summer Nuclear Station, Units 2 and 3 COL Application, Part 2, Final Safety Analysis Report*. Revision 1, Jenkinsville, South Carolina. Accession No. ML092170463.

South Carolina Electric and Gas (SCE&G). 2009d. Letter from Ronald B. Clary (SCE&G, General Manager, New Nuclear Deployment) to U.S. Nuclear Regulatory Commission dated May 11, 2009, "Subject: V.C. Summer Nuclear Station Units 2 and 3, Docket Numbers 52-027 and 52-028, Combined License Application – Environmental Report Audit Information Needs: ACC-11, ALT-3, AQ-5, AQ-6, GW-11, LU-3, and SW-12." NND-09-0126. Accession No. ML091350104.

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South Carolina Electric and Gas (SCE&G). 2010b. *V.C. Summer Nuclear Station, Units 2 and 3 COL Application, Part 2, Final Safety Analysis Report*. Revision 2, Jenkinsville, South Carolina. Accession No. ML100360598.

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

U.S. Nuclear Regulatory Commission (NRC). 2004. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 15, Regarding Virgil C. Summer Nuclear Station, Final Report*. NUREG-1437, Supplement 15, Washington, D.C. Accession No. ML040540718.

U.S. Nuclear Regulatory Commission (NRC). 2009a. *Environmental Impact Statement Scoping Process Summary Report, V. C. Summer Nuclear Station Units 2 and 3, Combined License Fairfield County, South Carolina.* Accession No. ML091960347.

U.S. Nuclear Regulatory Commission (NRC). 2009b. Memorandum from Patricia Vokoun (U.S. Nuclear Regulatory Commission, Project Manager, Office of New Reactors) to Ryan Whited (U.S. Nuclear Regulatory Commission, Chief, Office of New Reactors) dated May 5, 1009, "Subject: Summary of Public Meeting to Discuss Environmental Review Process for the Virgil C. Summer Nuclear Station Units 2 and 3 Combined License Application." Accession No ML091140076.

U.S. Nuclear Regulatory Commission (NRC). 2010. Staff Memorandum from Scott Flanders (DSER Division Director) to Brent Clayton (RENV Branch Chief) dated December 10, 2010, "Subject: Addressing Construction and Preconstruction Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues In Environmental Impact Statements." Accession No. ML100760503.

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

2.0 Affected Environment

The site proposed by South Carolina Electric and Gas (SCE&G) for combined construction permits and operating licenses (COLs) and a Department of the Army (DA) permit is located in Fairfield County, South Carolina, 26 mi northwest of the State capital, Columbia, South Carolina. The proposed Units 2 and 3 would be located approximately 1 mi to the south-southwest of existing Unit 1 on the Virgil C. Summer Nuclear Station (VCSNS) site. The location of proposed VCSNS Units 2 and 3 is described in Section 2.1, with the land use, water, ecology, socioeconomics, environmental justice, historic and cultural resources, geology, meteorology and air quality, and the nonradiological and radiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 examines related Federal projects and consultations, and references are presented in Section 2.13.

2.1 Site Location

SCE&G's proposed location for VCSNS Units 2 and 3 is shown in Figure 2-1. The centerline of proposed Units 2 and 3 would be located approximately 4700 ft south and 1800 ft west of the center of the existing Unit 1 containment building (SCE&G 2010a).

The VCSNS site is located in an unincorporated area of Fairfield County, South Carolina. The nearest population center to the VCSNS site that has more than 25,000 residents is Columbia, South Carolina, with a population of 124,818 in 2007 (SCBCB 2009e). Figure 2-2 shows the location of the VCSNS site in relationship to the counties, cities, and towns within a 50-mi radius of the site. The VCSNS site is generally bounded by the Monticello Reservoir to the north, with Interstate 26 (I-26) approximately 13 mi due west and I-77 approximately 18 mi due east. The Broad River is 1 mi west of the site (Figure 2-3). Access to the site from the south is via State Highway 215 (SC-215; Monticello Road) then west on County Road 311 (CR-311; Ollie Bradham Boulevard), which enters the site. Although the Broad River is considered navigable by the State of South Carolina, it is not considered so by the U.S. Army Corps of Engineers (USACE), and there is no barge access to the site (SCE&G 2009c), but local access points may be used to launch smaller barges and push vessels for cofferdam work as described in Section 4.3.2.1. Railroad access to the site is from a spur coming off the Norfolk Southern Railway transportation track from Columbia to Spartanburg (SCE&G 2010a). Jenkinsville, South Carolina, is the closest community and is located immediately east and south of the VCSNS site. The closest commercial or public general aviation airports located within the VCSNS region are the Fairfield County Airport 15 mi to the east, Newberry County Airport 18.6 mi to the west, Columbia Metropolitan Airport 27 mi to the south, and Columbia Owens Airport 27 mi south of the site (Maps of the World 2009). The VCSNS site occupies approximately 3600 ac of land and water (SCE&G 2010a).

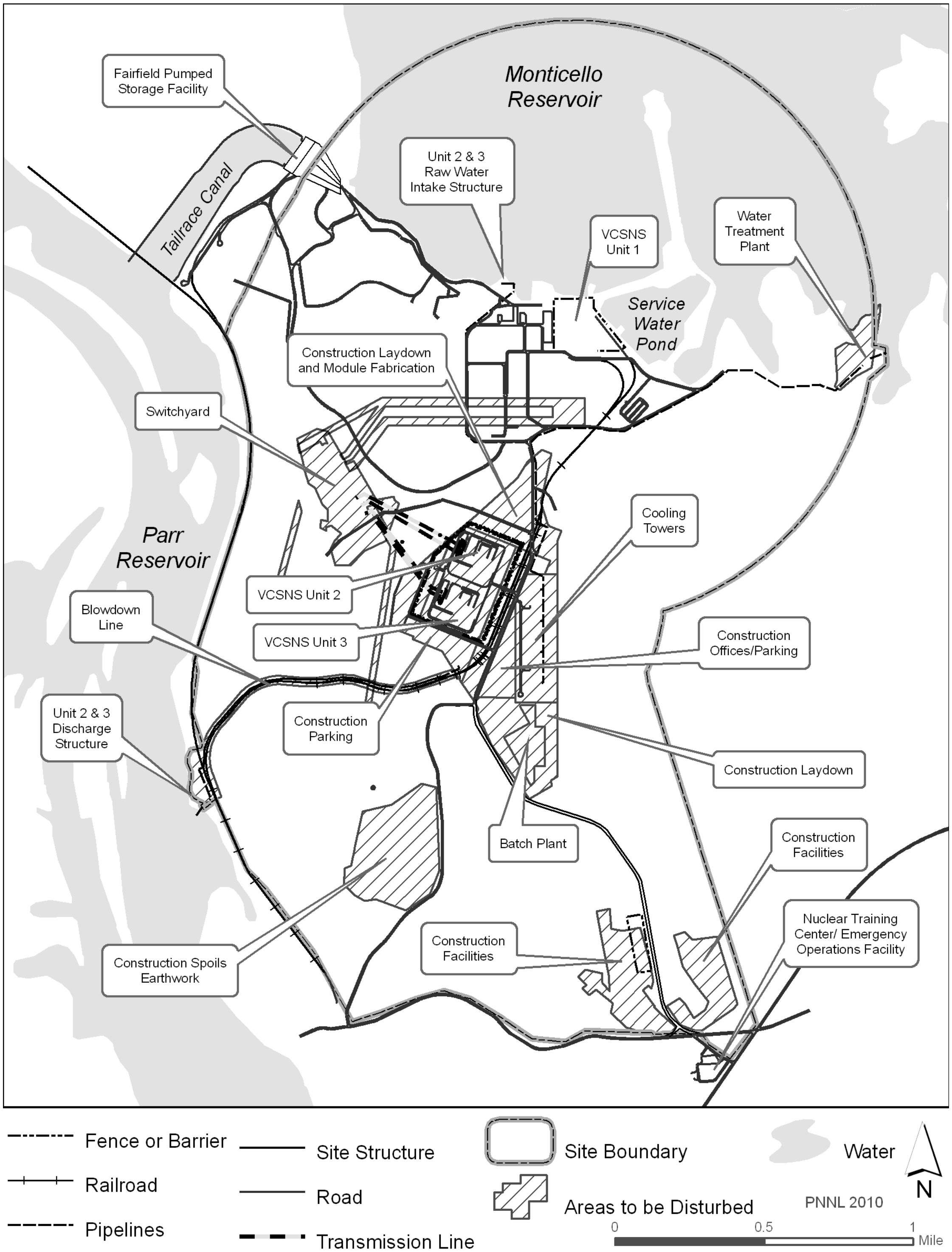

Figure 2-1. SCE&G's Proposed Location for VCSNS Units 2 and 3

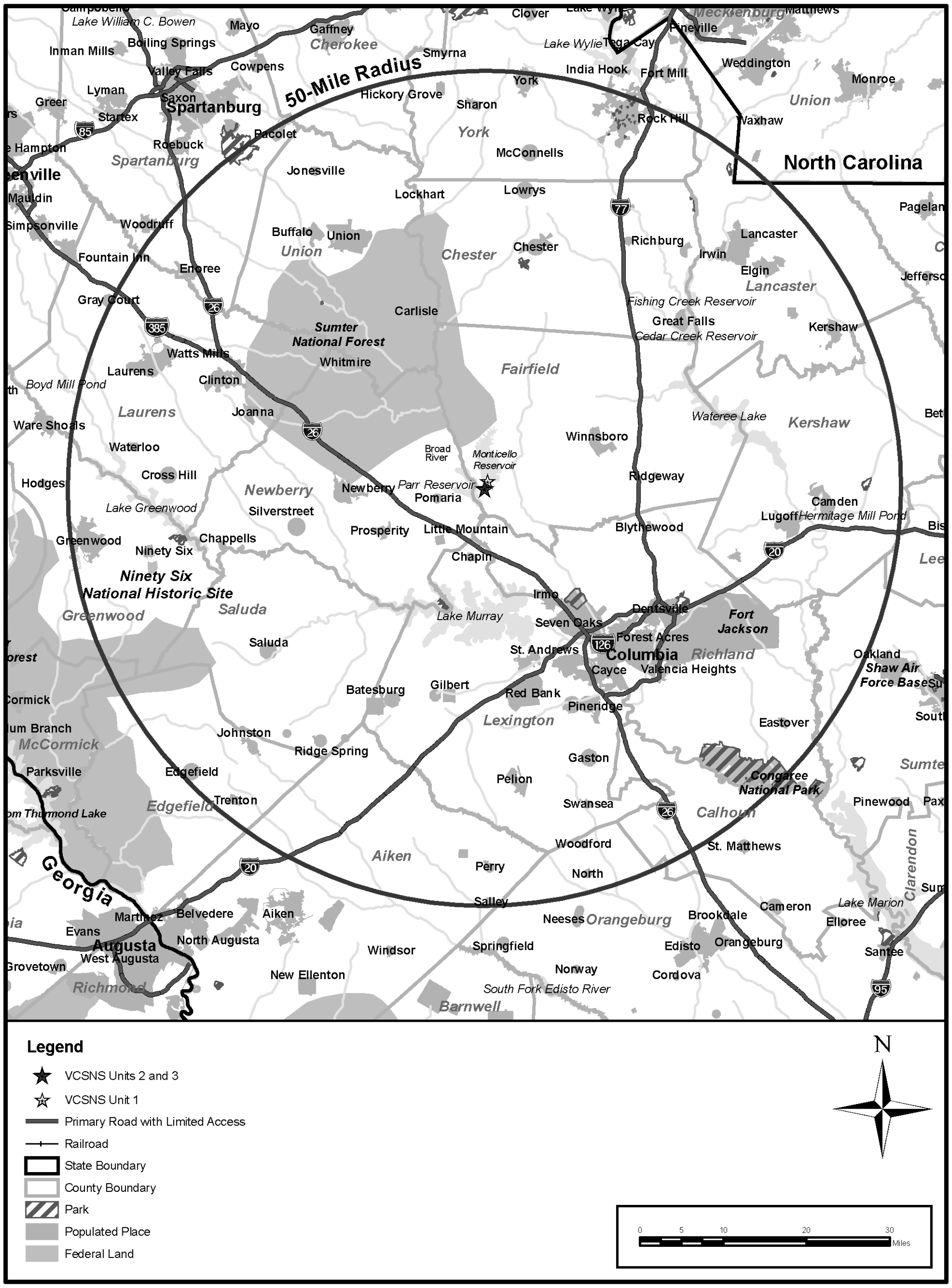

Figure 2-2. The Location of the VCSNS Site in Relationship to the Counties, Cities, and Towns Within a 50-mi Radius of the Site (SCE&G 2009a)

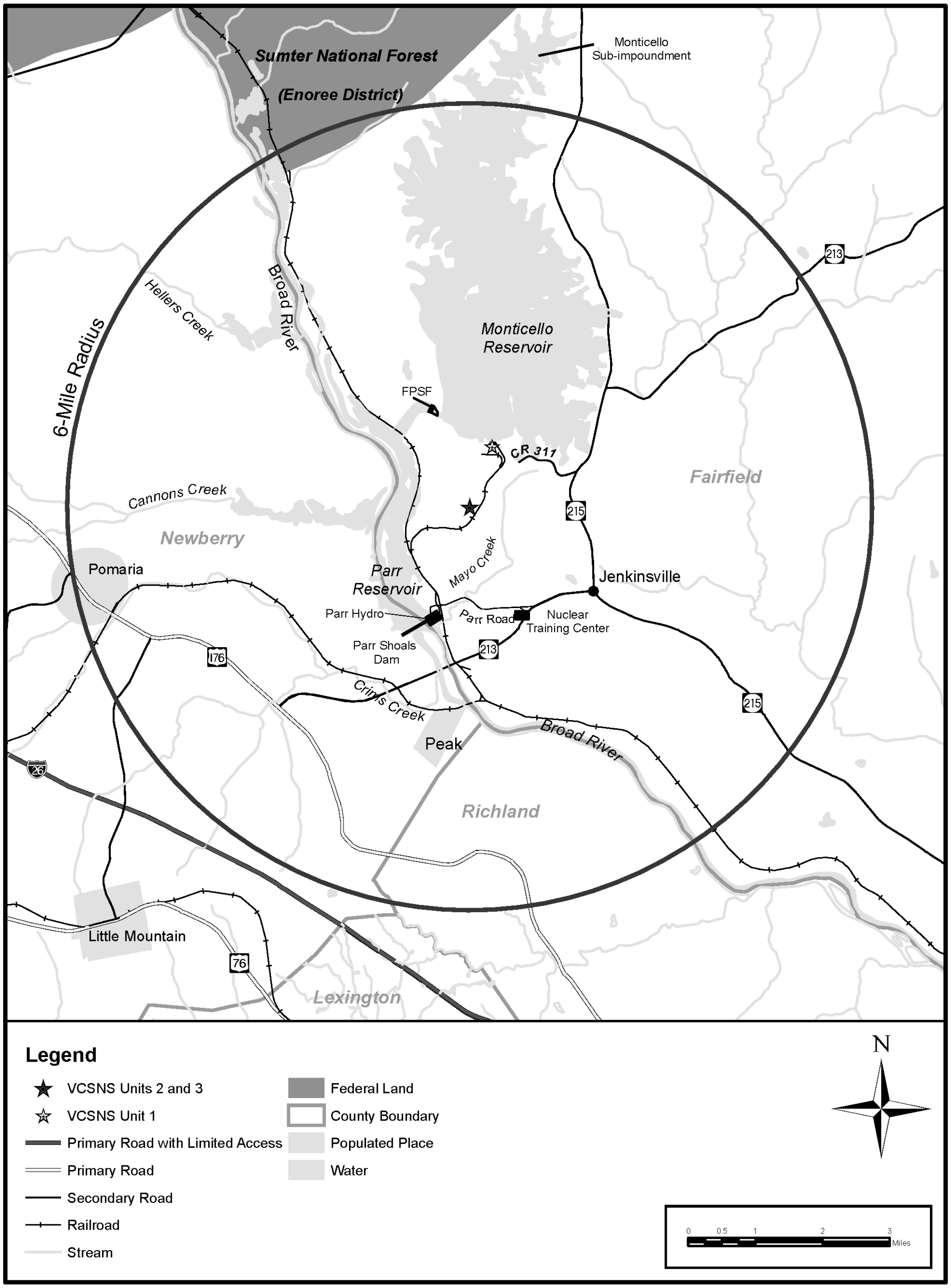

Figure 2-3. Map of the VCSNS Site and Vicinity Within the 6-mi Radius (SCE&G 2009a)

The Nuclear Training Facility, which would be used temporarily during development of the proposed new units, is located in the southern part of the site (SCE&G 2010a).

2.2 Land Use

This section discusses land-related issues for the VCSNS site. Section 2.2.1 describes the site and the vicinity within a 6-mi radius of the site. Section 2.2.2 discusses the existing and proposed transmission-line corridors and offsite areas. Section 2.2.3 discusses the region, defined as the area within 50 mi of the center point of the VCSNS Units 2 and 3 powerblock footprint.

2.2.1 VCSNS Site and Vicinity

The VCSNS site (see Figure 2-3) is located along the western edge of Fairfield County, South Carolina, on the southern shore of the Monticello Reservoir. It is in the immediate vicinity of four counties: Fairfield, Lexington, Newberry, and Richland, which together make up the Central Midlands region of the state.

The 3600-ac VCSNS site includes the following components: the existing Unit 1 plant site, part of Monticello Reservoir, part of the Fairfield Pumped Storage Facility, and the proposed locations for the Units 2 and 3 powerblocks, cooling towers, switchyard, discharge structures and blowdown lines, the proposed independent spent-fuel storage installation, and the proposed support facilities and laydown areas associated with the new units (see Figure 2-1). VCSNS Unit 1, which is licensed by the U.S. Nuclear Regulatory Commission (NRC), has a net electric generating capacity of 966 MW(e) (NRC 2004). Unit 1 began commercial operation on January 1, 1984 (DOE/EIA 2009). The one existing nuclear unit, auxiliary facilities such as the training center, and transmission-line corridors occupy approximately 492 ac of the VCSNS site, and another 784 ac extend into the Monticello Reservoir (SCE&G 2010a). Most of the remaining VCSNS site area is mixed forest, some of which is managed for timber production.

The VCSNS site is located in a sparsely populated, largely rural area, with forests and small farms composing the dominant land use. The site is primarily composed of low rolling hills with elevations ranging from 210 ft to 560 ft above mean sea level (msl). This Piedmont terrain varies from gently rolling to hilly and includes broad stream valleys. Jenkinsville and Peak are the closest settlements, although there are also homes built along the Unit 1 access road and the Monticello Reservoir shoreline. The Broad River flows in a northwest-to-southeast direction approximately 1 mi west of the site and serves as the boundary between Fairfield County (to the east) and Newberry County (to the west).

Columbia, South Carolina, the State capital, lies approximately 26 mi southeast of the VCSNS site. Within the 6-mi radius of the site are the towns of Jenkinsville (immediately east and south), Peak (1.6 mi from the closest point on the VCSNS property boundary and 3.1 mi from the centerpoint of the site), and Pomaria (4.5 mi to the closest point on the VCSNS property boundary and 5.5 mi from the site centerpoint). Small communities in the vicinity include

Dawkins (about 5 mi northwest of the site) and Monticello (about 5 mi northeast of the site). Winnsboro, the County Seat of Fairfield County lies, 15 mi east of the site.

VCSNS is co-located with a hydroelectric facility known as the Fairfield Pumped Storage Facility (FPSF). The general area has been used for energy production since 1914 when this reach of the Broad River was impounded for the Parr Hydroelectric Generating Station (also Parr Hydroelectric Plant or Parr Hydro), a small run-of-the-river hydroelectric plant, and Parr Reservoir was created. Later, a nearby coal-fired power plant operated for decades. Originally 1850 ac in area, the Parr Reservoir was enlarged to approximately 4400 ac in 1977 by raising the level of the Parr Shoals Dam 9 ft. This modification was necessary to support the development of the FPSF, which was built on Frees Creek, a small tributary of the Broad River. Monticello Reservoir was built in the Frees Creek valley to serve as the upper pool for the FPSF and the source of cooling water for VCSNS Unit 1. Parr Reservoir, which historically had been the source of water for Parr Hydro, assumed a dual function, providing water for both Parr Hydro and the FPSF (NRC 2004).

Current primary road access to the VCSNS site is via CR-311 (Ollie Bradham Boulevard), a two-lane paved road (see Figure 2-3). CR-311 intersects SC-215 approximately 1.5 mi east of Unit 1. SC-215 has a north-south orientation and is used by employees traveling from Richland and Fairfield Counties. Employees traveling from Richland and Lexington Counties may use U.S. Highway 176 (US-176) north to SC-213, which intersects SC-215 approximately 2 to 3 mi south of the VCSNS site. The site is also accessed by a railroad spur connected to the Norfolk Southern line. There is no direct access to the site via the Broad River. No natural gas lines or other fuel lines traverse the site.

The site is zoned as “industrial,” with electricity production and transmission among the permitted uses (Vismor 1997; Fairfield County 2005). Soil surveys covering the site and surrounding areas indicated that none of the site contains prime farmland as that term is defined by the U.S. Department of Agriculture Natural Resources Conservation Service at Title 7 of the Code of Federal Regulations (CFR) 657.5(a) (SCE&G, 2010a). There is no active farmland on the VCSNS site, but there are active farms in the vicinity. Most of the site is actively managed for forest products. No mineral deposits are actively mined on the site, but the vicinity has a significant blue granite quarrying industry (SCIway 2009).

Portions of the Sumter National Forest lay along the Broad River north of the VCSNS site. In addition, there are several boat launches and the 4400-ac Parr Hydro Wildlife Management Area in the vicinity of the Monticello Reservoir. Recreational uses in the vicinity include boating, fishing, hunting, hiking, and bicycling, and are generally associated with the Monticello Reservoir, Parr Hydro Wildlife Management Area, and Sumter National Forest. While SCE&G owns public recreation sites around Monticello Reservoir, the VCSNS site is not open to public recreation.

Land-use and land-cover statistics for the vicinity and region of the VCSNS site are listed in Table 2-1, and are based on U.S. Geological Survey (USGS 2001) geographic information system (GIS) data on land cover.

Table 2-1. Land Use and Land Cover in the Vicinity and Region of the VCSNS Site

	Site and Vicinity (6 mi)		Region (50 mi)	
Land Use/Land Cover	**Acres**	**Percent**	**Acres**	**Percentage**
Fresh water	10,827	13.95	159,273	3.21
Marsh/emergent wetland	23	0.03	2381	0.05
Pocosin	0	0.00	1472	0.03
Swamp	0	0.00	82,765	1.67
Bottomland/floodplain forest	3145	4.05	284,929	5.74
Wet soil	0	0.00	3200	0.06
Wet scrub/shrub thicket	697	0.90	55,828	1.12
Dry scrub/shrub thicket	3591	4.63	433,269	8.73
Sandy bare soil	0	0.00	2710	0.05
Open canopy/recently cleared forest	10,107	13.02	456,723	9.20
Rock outcrop	3	0.00	486	0.01
Aquatic vegetation	0	0.00	245	0.00
Closed canopy evergreen forest/woodland	20,054	25.83	929,537	18.72
Needle-leaved evergreen mixed forest/woodland	8301	10.69	572,401	11.53
Pine woodland	0	0.00	21,505	0.43
Dry deciduous forest/woodland	409	0.53	45,830	0.92
Mesic deciduous forest/woodland	12,240	15.77	769,774	15.50
Dry mixed forest/woodland	54	0.07	45,931	0.93
Mesic mixed forest/woodland	2399	3.09	88,327	1.78
Grassland/pasture	1171	1.51	124,336	2.50
Cultivated land	3562	4.59	603,971	12.16
Urban development	700	0.90	96,969	1.95
Urban residential	346	0.45	176,845	3.56
Wet evergreen	0	0.00	6284	0.13
Total	77,629	100.00	4,964,993	100.00

Source: USGS (2001)

2.2.2 Transmission-Line Corridors

The existing transmission system supporting VCSNS Unit 1 has ten 230-kV lines with one 115-kV line connecting the site to the transmission system. In addition, transmission-line corridors owned by Duke Energy pass to the northwest of the site but are not connected to Unit 1. The existing transmission systems owned by SCE&G and Santee Cooper (the State-owned electric and water utility, formally called the South Carolina Public Service Authority) in the vicinity of the VCSNS site are shown in Figure 2-4.

SCE&G and Santee Cooper had defined macrocorridors for the proposed transmission lines prior to the draft environmental impact statement (EIS) but had not yet defined specific rights-of-way within those macrocorridors. Both have now defined specific rights-of-way for each proposed transmission line. To avoid possible confusion, this final EIS uses the following terms in distinct contexts when discussing transmission lines:

- "Route" refers to the general course of a transmission line over a landscape.
- "Right-of-way" refers to a two-dimensional polygon defined by the legal boundaries of property ownership or an easement for a transmission line.
- "Corridor" refers to a two-dimensional polygon defined by the limits of routine vegetation management for a transmission line.

Right-of-way refers to the entire area under the control or ownership of the utility and corridor refers to the specific and potentially smaller area that will be maintained as appropriate for the transmission lines within it. Thus, right-of-way and corridor might be the same along some sections, but when the two differ, right-of-way will be the more inclusive area. "Macrocorridor" refers to the broader polygons for transmission-line development mentioned in the draft EIS.

The addition of Units 2 and 3 to the VCSNS site would require six new 230-kV lines (three for Unit 2, three for Unit 3) (SCE&G 2010a). Routes have been sited for the expected new transmission-line corridors and are illustrated in Figure 2-5.

The planned routes of the new transmission lines are described as follows (SCE&G 2010a):

- VCSNS-Killian – This SCE&G line would be routed from the VCSNS site to the vicinity of Winnsboro and then generally follow the I-77 corridor to connect to the existing Killian substation near Killian, South Carolina, running 37 mi southeast of the plant and northeast of Columbia. Even though 31 mi of the new line would be built entirely within existing SCE&G right-of-way, portions of the right-of-way would have to be cleared of forest vegetation in order to establish a corridor for the new line. All but the final 6 mi of this line would be routed within existing SCE&G corridors. The 6 mi would be built in new right-of-way not adjacent to any existing transmission-line right-of-way (SCE&G 2010b). However, portions of the new right-of-way would be located immediately adjacent to existing roads or other utilities.

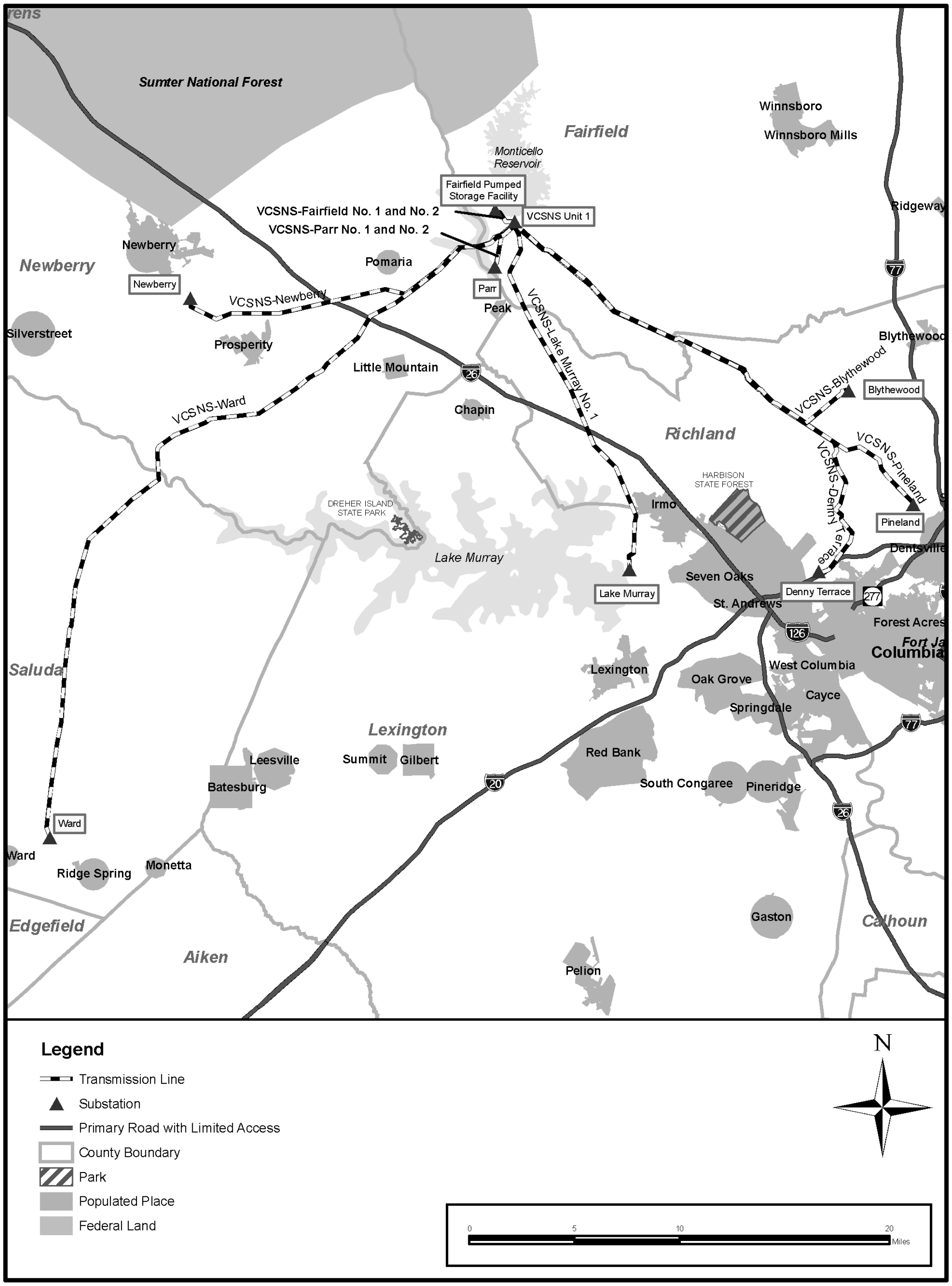

Figure 2-4. Existing VCSNS Unit 1 Transmission Lines (SCE&G 2009a)

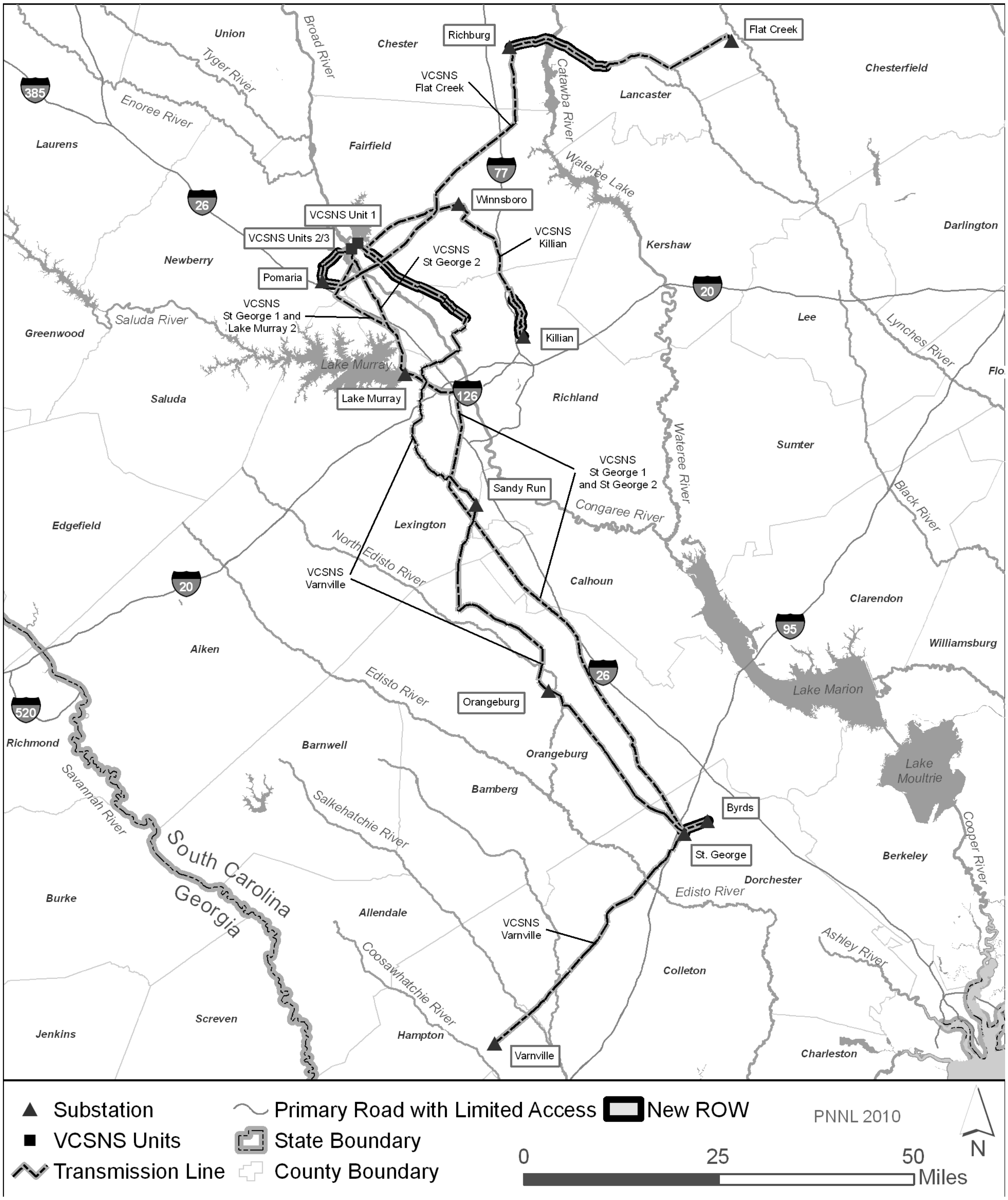

Figure 2-5. VCSNS Units 2 and 3 Expected New Transmission-Line Routes (based on MACTEC 2009 and Pike 2010)

- VCSNS-Flat Creek – This Santee Cooper line would connect to the existing Winnsboro substation near Winnsboro, then to the existing Richburg switching station near Great Falls, South Carolina, and finally to the existing Flat Creek substation east of Lancaster, South Carolina, running about 72 mi in length (SCE&G 2010b). About 17 mi of new corridor running immediately adjacent to the existing corridor would be required (MACTEC 2009).
- VCSNS-St. George No. 1 and No. 2 – These SCE&G lines originate at the proposed VCSNS Units 2 and 3 switchyard and run generally south to a proposed new substation near St. George, South Carolina. The St. George No. 1 line would share the existing Parr Hydro-Chapin and Saluda Hydro-Newberry corridors with the new SCE&G Lake Murray No. 2 line to the Lake Murray substation near the eastern shore of Lake Murray. The St. George No. 2 line would run parallel with the existing Lake Murray No. 1 line from the VCSNS Units 2 and 3 switchyard to the Lake Murray substation. The St. George No. 1 and No. 2 lines would intersect near the Killian substation and run in a common corridor through existing rights-of-way to a proposed substation near St. George, South Carolina (Pike 2010). These transmission lines would be built entirely within existing transmission-line rights-of-way (SCE&G 2010b).
- VCSNS-Lake Murray No. 2 – This SCE&G line would connect to the existing Lake Murray switchyard for the McMeekin and Saluda Hydro stations near the eastern boundary of Lake Murray. About 22 mi of new line would be built within the existing Parr Hydro-Chapin and Saluda Hydro-Newberry corridors, and would be co-located with the proposed St. George No. 2 line (SCE&G 2010b). Even though the new line would be built entirely within existing SCE&G right-of-way, portions of the right-of-way would have to be cleared of forest vegetation in order to establish a corridor for the new line.
- VCSNS-Varnville – This 167-mi Santee Cooper line would connect to the existing Pomaria substation, then to Sandy Run substation near Sandy Run, then to the Orangeburg substation in Orangeburg, then to the proposed Byrds substation near St. George, and then to the existing Varnville substation near Varnville, South Carolina, in Hampton County (SCE&G 2010b). About 22 mi of new corridor running immediately adjacent to the existing corridor and about 0.5 mi of entirely new corridor would be required (MACTEC 2009).

Table 2-2 and Table 2-3 characterize the representative land uses in the potentially affected transmission-line corridors for SCE&G's and Santee Cooper's corridors, respectively. These values are based on independent siting studies performed on behalf of each utility (Pike 2010; MACTEC 2009). Table 2-4 summarizes the classification of prime farmland in the affected transmission-line corridors. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses, or under defined conditions would be available for these uses (7 CFR Part 657). In addition to Federally designated as prime farmland, farmland of statewide importance has been designated by individual State and County agricultural boards as being especially important to food crop production regionally (7 CFR Part 657). None of the designated farmland resources found in the proposed transmission-line corridors is currently cultivated, nor would cultivation be precluded in the future (Pike 2010).

Apart from the proposed transmission facilities, no other offsite areas would experience land-use impacts from the proposed action.

Table 2-2. Land Use and Land Cover in Affected SCE&G Transmission-Line Corridors

	VCSNS-Killian		VCSNS-Lake Murray No. 2/ St. George No. 1		VCSNS-St. George No. 2		VCSNS-St. George No. 1 and No. 2	
Land Use/Land Cover	**Acres**	**Pct.**	**Acres**	**Pct.**	**Acres**	**Pct.**	**Acres**	**Pct.**
Fresh water	0.59	0.16	6.43	2.29	2.11	0.89	14.84	1.25
Marsh/emergent wetland	0.00	0.00	0.00	0.00	0.00	0.00	15.31	1.29
Pocosin	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Swamp	0.05	0.01	0.00	0.00	0.00	0.00	13.78	1.16
Bottomland/floodplain forest	11.77	3.22	9.23	3.29	6.22	2.61	58.28	4.91
Wet scrub/shrub thicket	1.24	0.34	4.65	1.66	0.67	0.28	56.47	4.76
Dry scrub/shrub thicket	22.98	6.30	23.71	8.44	16.23	6.82	175.32	14.78
Sandy bare soil	5.81	1.59	0.00	0.00	0.00	0.00	0.00	0.00
Open canopy/recently cleared forest	84.08	23.04	45.44	16.17	37.99	15.96	104.78	8.83
Closed canopy evergreen forest/woodland	40.27	11.03	21.90	7.79	27.83	11.69	21.84	1.84
Needle-leaved evergreen mixed forest/woodland	35.90	9.84	48.48	17.25	39.90	16.76	39.18	3.30
Pine woodland	0.00	0.00	0.00	0.00	0.00	0.00	7.32	0.62
Dry deciduous forest/woodland	9.89	2.71	2.92	1.04	1.26	0.53	8.19	0.69
Mesic deciduous forest/woodland	46.78	12.82	41.01	14.59	44.61	18.74	49.79	4.20
Dry mixed forest/woodland	0.32	0.09	0.45	0.16	2.68	1.12	18.65	1.57
Mesic mixed forest/woodland	1.93	0.53	22.12	7.87	18.78	7.89	44.08	3.72
Grassland/pasture	11.38	3.12	18.02	6.41	13.78	5.79	40.22	3.39
Cultivated land	27.76	7.60	11.85	4.22	7.19	3.02	300.36	25.33
Urban development	48.46	13.28	7.23	2.57	6.22	2.61	55.36	4.67
Urban residential	15.78	4.32	17.55	6.24	12.54	5.27	159.67	13.46
Wet evergreen	0.00	0.00	0.00	0.00	0.00	0.00	2.55	0.21
Total acreage	365.0	100.00	281.0	100.00	238.0	100.00	1,186.0	100.00
Route length (mi)	37.0		22.0		18.0		76.0	
Average corridor width (ft)	81		105		109		129	

Table 2-3. Land Use in Affected Santee Cooper Transmission-Line Corridors

Land Use/Land Cover	VCSNS-Flat Creek Acres	VCSNS-Flat Creek Percent	VCSNS-Varnville Acres	VCSNS-Varnville Percent
Fresh water	13.70	1.25	15.31	0.60
Marine water	0.00	0.00	0.00	0.00
Marsh/emergent wetland	0.14	0.01	50.91	2.01
Pocosin	0.00	0.00	2.67	0.11
Swamp	0.00	0.00	62.93	2.48
Bottomland/floodplain forest	36.25	3.32	189.71	7.47
Wet soil	0.81	0.07	0.00	0.00
Wet scrub/shrub thicket	8.27	0.76	140.84	5.55
Dry scrub/shrub thicket	58.01	5.31	298.62	11.76
Sandy bare soil	2.42	0.22	0.00	0.00
Open canopy/recently cleared forest	286.40	26.19	422.03	16.63
Rock outcrop	5.25	0.48	0.00	0.00
Closed canopy evergreen forest/woodland	226.62	20.72	173.64	6.84
Needle-leaved evergreen mixed forest/woodland	99.98	9.14	186.97	7.37
Pine woodland	3.76	0.34	2.76	0.11
Dry deciduous forest/woodland	3.44	0.31	26.93	1.06
Mesic deciduous forest/woodland	171.91	15.72	148.04	5.83
Dry mixed forest/woodland	0.00	0.00	35.47	1.40
Mesic mixed forest/woodland	5.69	0.52	65.29	2.57
Grassland/pasture	60.73	5.55	89.95	3.54
Cultivated land	81.38	7.44	413.28	16.28
Urban development	17.72	1.62	44.33	1.75
Urban residential	11.05	1.01	146.24	5.76
Wet evergreen	0.00	0.00	22.60	0.89
Total acreage	1094	100.00	2539	100.00
Route length (mi)	72		167	
Average corridor width (ft)	125		125	

Source: USGS 2001; MACTEC 2008, 2009; SCE&G 2010c; review team analysis of GIS-based routing data supplied by the applicant. Totals affected by rounding.

Table 2-4. Special Farmland Designations in Proposed Transmission-Line Corridors

Farmland Classification	VCSNS-Killian	VCSNS-Lake Murray No. 2 and St. George No. 1	VCSNS-St. George No. 2	VCSNS-St. George No. 1 and No. 2	VCSNS-Flat Creek	VCSNS-Varnville	Total
Prime farmland (ac)	94	70	34	350	221	645	1414
Farmland of statewide importance (ac)	38	119	99	268	171	760	1455
Other conditional prime farmland (ac)	10	17	11	88	64	258	448

Source: MACTEC 2009; Pike 2010. Totals affected by rounding.

2.2.3 The Region

The region surrounding the VCSNS site is shown in Figure 2-2. The region consists of the area within the 50-mi radius of the VCSNS site. It includes several heavily populated counties, but much of the region surrounding the VCSNS has a low population density. Columbia, the State capital of South Carolina, Newberry, the County Seat of Newberry County, and Winnsboro, the County Seat of Fairfield County, are shown in Figure 2-2.

All or portions of 22 counties are within 50 mi of the VCSNS site, 21 of which are in South Carolina. The largest cities in the region include Columbia (population 124,818 in 2007) 26 mi to the southeast, Newberry (population 10,893 in 2007) 14 mi to the west, Lexington (population 14,995 in 2007) 15 mi south, and Winnsboro (population 3564 in 2007) 14 mi east of the site (SCBCB 2009e). The major interstate highways running near the site are I-20, I-26, and I-77.

The closest commercial or public general aviation airports located within the VCSNS region are the Fairfield County Airport 15 mi to the east, Newberry County Airport 18.6 mi to the west, Columbia Metropolitan Airport 27 mi to the south, and Columbia Owens Airport 27 mi south of the site.

Table 2-1 characterizes the existing land uses in the affected region. The State of South Carolina mandates that cities and counties have comprehensive land-use plans to govern regional growth and associated commercial and residential development. As a result, zoning ordinances are in effect in all of the affected counties to ensure that new development is managed and conforms to the intent of the comprehensive plans.

2.3 Water

This section describes the hydrologic processes and waterbodies in and around the VCSNS site, the existing water use, and the quality of water in the proposed Units 2 and 3 environment. Building activities would make use of or affect local groundwater, surface water, and public water supplies. During proposed Units 2 and 3 operations, makeup water for cooling and other plant uses would be drawn from the Monticello Reservoir. Units 2 and 3 liquid effluents, except for water-treatment plant return flow, would discharge to the Parr Reservoir. The water-treatment plant return flow would discharge to Monticello Reservoir. The VCSNS site and these hydrologic features are shown in Figure 2-6.

Descriptions of the building impacts, operating impacts, cumulative impacts, and alternative sites and alternative plant systems are provided in sections of Chapters 4, 5, 7, and 9, respectively. Sections of these chapters that relate to hydrology draw from information presented in this chapter and the VCSNS Environmental Report (ER) (SCE&G 2010a).

Elevations in this EIS are reported based on either the National Geodetic Vertical Datum of 1929 (NGVD29) or the National American Vertical Datum of 1988 (NAVD88). In the vicinity of the VCSNS site, the NGVD29 is 0.696 ft lower than the NAVD88. For example, VCSNS Units 2 and 3 have a design plant grade of 400 ft NAVD88 and 400.696 ft NGVD29.

2.3.1 Hydrology

This section describes the site-specific and regional hydrologic features that would affect, or be altered by, construction, preconstruction, and operation of proposed VCSNS Units 2 and 3. The hydrologic conditions at the proposed location for Units 2 and 3 are described in Section 2.3 of the VCSNS ER (SCG&E 2010a) and in Section 2.4 of the Final Safety Analysis Report (FSAR) (SCE&G 2010b).

2.3.1.1 Surface-Water Hydrology

Figure 2-7 and Figure 2-8 show the location of the VCSNS site with respect to the Broad River and its watershed. The VCSNS site is located approximately 150 mi from the Atlantic Ocean. The only major river near VCSNS is the Broad River, which is approximately 1 mi west of the proposed location of VCSNS Units 2 and 3. The river reach near the VCSNS site is approximately 2000 ft wide and has a maximum depth of about 15 ft. The Broad River is impounded by Parr Shoals Dam (Figure 2-3), which is located about 2 mi downstream of the proposed locations of the two new units. Above the Parr Shoals Dam, the Broad River watershed area is approximately 4550 mi^2 (SCG&E 2010a).

The Broad River originates in North Carolina at Lake Lure in the Blue Ridge Mountains. The Broad River drainage is mostly composed of forest and agricultural lands. The Broad and the Saluda rivers combine to form the Congaree River near Columbia, South Carolina, about 28 mi southeast of the site (SCG&E 2010a). The Congaree River combines with the Wateree River to form the Santee River, which discharges to the Atlantic Ocean.

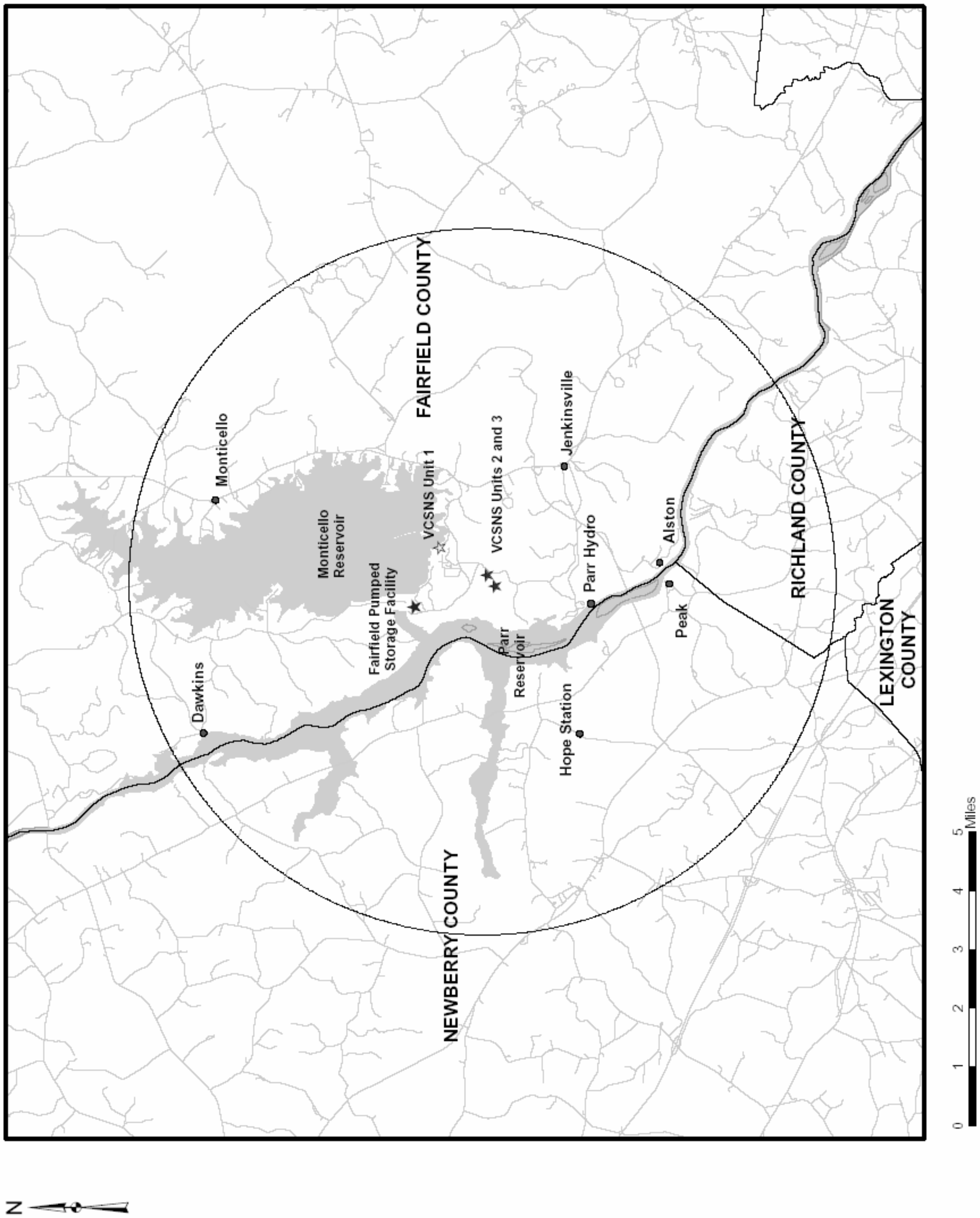

Figure 2-6. Major Hydrologic Features Within the 6-mi Radius of VCSNS Units 2 and 3 (SCG&E 2009a)

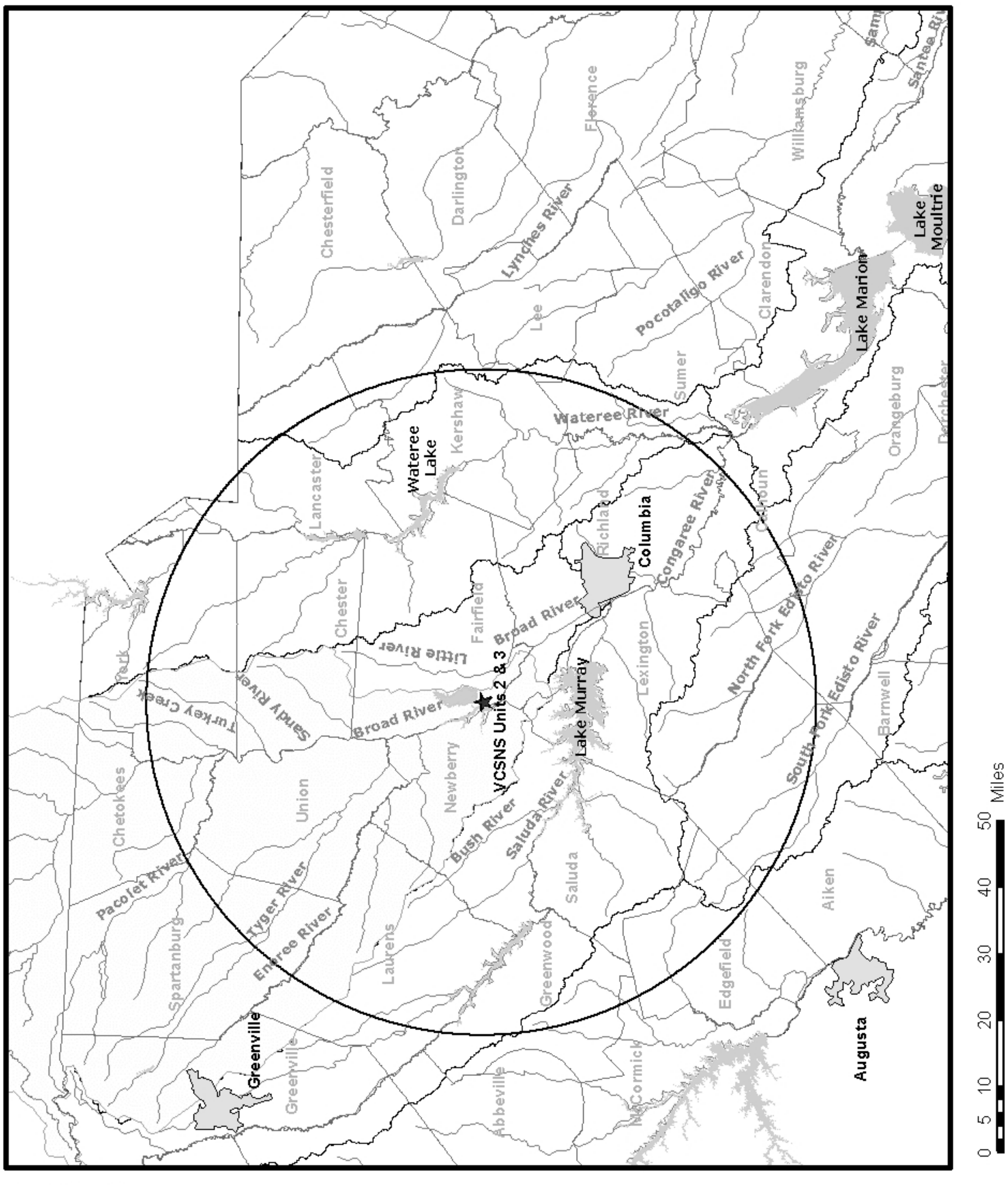

Figure 2-7. Major Hydrologic Features Within the 50-mi Radius of VCSNS Units 2 and 3 (SCG&E 2009a)

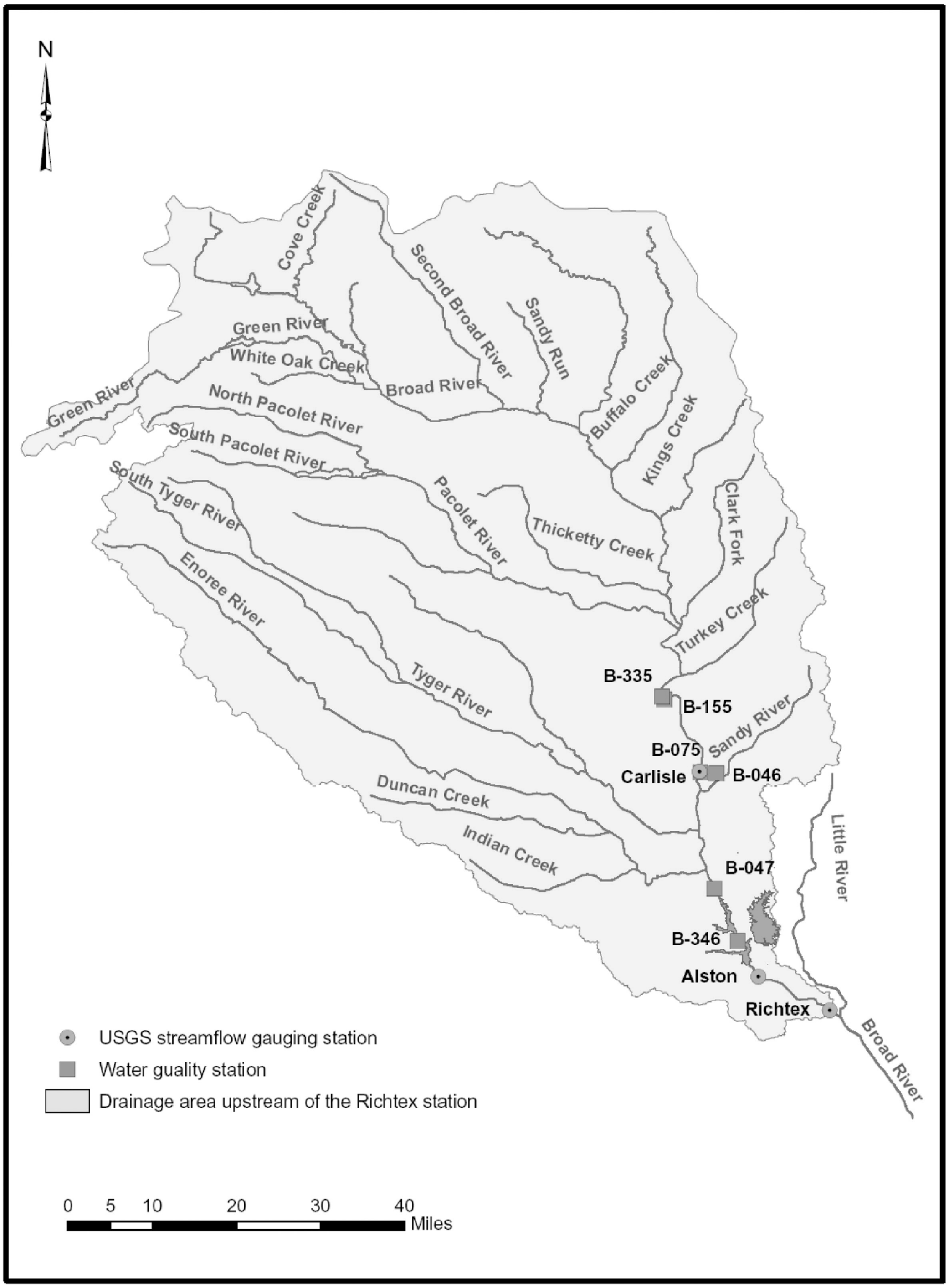

Figure 2-8. Broad River Basin Upstream of the VCSNS Site, Showing the Nearest Stream-Flow Gauging Stations (SCG&E 2009a)

During the operation of proposed VCSNS Units 2 and 3, makeup water for the circulating-water system would be obtained from the Monticello Reservoir whose storage is controlled by operation of the FPSF and from withdrawals and exchanges with the Broad River/Parr Reservoir. The intake structure for Units 2 and 3 would be located on the southern shore of Monticello Reservoir. Characteristics of Parr Reservoir and Monticello Reservoir are listed in Table 2-5. Monticello Reservoir was created by four dams (referred to as Dams A, B, C, and D as noted in Table 2-5) on Frees Creek at the southern end of the reservoir (SCE&G 2010a).

Table 2-5. Summary of Reservoir Characteristics

Characteristic	Parr Reservoir	Monticello Reservoir
Created by	Parr Shoals Dam	Dams A, B, C, and D
Surface area	4400 ac	6800 ac (including a 300-ac subimpoundment for recreational use) (SCE&G 2010a)
Usable storage at crest elevation	29,000 ac-ft	45,000 ac-ft
Drainage area	4550 mi^2	17.4 mi^2
Evaporation	50 ac-ft/day (25 cfs)	65 ac-ft/day (33 cfs), plus 44 ac-ft/day (22 cfs) from condenser water

The existing VCSNS Unit 1 withdraws water from and discharges it to Monticello Reservoir. Proposed VCSNS Units 2 and 3 would withdraw water from Monticello Reservoir and discharge it to Parr Reservoir. The discharges to Parr Reservoir would include Units 2 and 3 cooling-water system blowdown, liquid discharges from the radwaste building, industrial wastewater, and sanitary effluent. A small discharge from the proposed water-treatment plant would be made into Monticello Reservoir (SCE&G 2010a).

The two nearest active U.S. Geological Survey (USGS) gauging stations are at Alston (monitored from October 1896 to 1907, then 1980 to present) downstream of the VCSNS site on the Broad River and at Carlisle (monitored from October 1938 to present) upstream of the VCSNS site. A third nearby gauging station (Richtex), located downstream from the Alston station, was monitored beginning in October of 1925 but monitoring was discontinued in 1983. The locations of these stations are shown in Figure 2-8. SCE&G summarized flow characteristics for the Broad River at these three gauging stations (SCE&G 2010a) (see Table 2-6). The summary data reported for Alston and Carlisle in the VCSNS ER are consistent with those in *Water Resources Data, South Carolina, Water Year 2005: Water-Data Report SC-05-1* published by the USGS in 2006 (Cooney et al. 2006). There is seasonality in Broad River flows. The review team determined that about 64 percent of the annual Broad River flow (at Alston, South Carolina) occurs during the 6 months (December to May) while 36 percent occurs during the remaining months. The review team based these calculations on data presented by the Cooney et al (2006).

Table 2-6. Broad River Flow Characteristics at Three Gauges Near the VCSNS Site. All values in the table are reported in cubic feet per second.

Flow Characteristic	Carlisle	Alston	Richtex
Mean annual daily flow	3880	6302	6155
Highest annual mean flow	5977	11,750	NA
Lowest annual mean flow	1255	2153	NA
Annual 7-day minimum	220	200	NA
Maximum mean daily flow	114,000	130,000	NA
Instantaneous maximum flow	123,000	140,000	228,000

Source: SCE&G 2010a.
NA = not applicable.

The reported Broad River flow characteristics are comparable to those independently calculated by the review team. The values are based on all data that were available as of June 22, 2009, and are presented in Table 2-7. The USGS data sets only reflect daily averages, so the maximum instantaneous flows are not included in the following table. Maximum and minimum values from the data set were determined from the processed daily values; the minimum 7-day average was similarly determined.

Table 2-7. Broad River Flow Characteristics Calculated by the Review Team (cfs)

Flow Characteristic	Carlisle	Alston	Richtex
Mean daily	3767	5950	6228
Highest monthly mean	6088	12,541	14,209
Highest daily mean	114,000	130,000	211,000
Lowest daily mean	44	48	149
Minimum 7-day within calendar year	206	200	593

The VCSNS ER reports that the annual precipitation in the region is about 45 in. and runoff is reported to be approximately 18 in. These averages are consistent with those reported by the South Carolina State Climatology Office (SCSCO 2009). The long-term annual runoff amounts for the Broad River as reported by the USGS for Carlisle and Alston are 18.89 in. and 17.78 in., respectively.

Historical flooding is described in ER Section 2.3.1.1.2. Of the two flood seasons – January to April and July to December – the latter, associated with the hurricane season, has yielded the larger floods. The ER references peak flow and water levels at the USGS gauging stations (SCE&G 2010a). Corresponding flow values for the Broad River at Parr Shoals Dam were estimated using measured flows at nearby stations and scaling them by the ratios of watershed areas from gauged sites (Richtex and Alston).

Historical low flows are reported for USGS gauging stations located at Alston and Richtex. SCE&G reported lowest daily means at Richtex and Alston of 149 and 48 cfs, respectively. The latter value was reported to have been reduced due to active withdrawal by the FPSF at the time of the measurement; the next lowest daily reported discharge at Alston is 156 cfs, which is 44 cfs below the annual 7-day minimum reported by the USGS. The review team independently verified that 156 cfs was the second lowest value in the Alston data set and that 149 cfs is the minimum value in the Richtex data set.

SCE&G estimated a 100-year minimum flow at Richtex of 125 cfs. The review team confirmed this determination.

The 7-day low flow estimated at Parr Shoals Dam is 190 cfs using the synthetic record produced by SCE&G (as previously described). The 100-year daily mean low-flow estimate was 125 cfs; this estimate was based on annual low daily mean flows. When this analysis was repeated using annual minimum 7-day low flows, the 100-year low flow was estimated to be 430 cfs. The USGS reported a 7Q10 low flow (lowest flow for 7 consecutive days expected to occur once per decade) for Alston of 853 cfs (SCE&G 2010a).

The flow of water between Parr Reservoir and Monticello Reservoir is controlled by the FPSF. The Parr Reservoir pool elevation can vary by as much as 10 ft/day based on FPSF operations; the average daily fluctuation is about 4 ft. Daily fluctuation in Monticello Reservoir due to FPSF operations can cause pool elevation to range from 420.5 to 425 ft NGVD29.

Bathymetric surveys were made in 2006 in both Parr and Monticello reservoirs to map areas in the vicinity of the VCSNS Units 2 and 3 discharge outlet and intake structures, respectively. These surveys indicate that Monticello Reservoir rapidly deepens in front of the proposed location of the intake structure (deepens by 25 ft within 125 ft of the shore) (SCE&G 2010a, Figure 2.3-10). The surveys also indicate that the proposed discharge diffuser would extend into a relatively deep channel (as much as 20 ft below reservoir water elevation) along the eastern shore of Parr Reservoir (SCE&G 2010a).

2.3.1.2 Groundwater Hydrology

Section 2.8 of this chapter briefly describes the geologic setting of the VCSNS site. VCSNS FSAR Section 2.5 (SCE&G 2010d) provides a detailed description of the geology and geologic history of the site and surrounding area. As described in Section 2.8, the VCSNS site is located in the Piedmont physiographic province (see Figure 2-9) and has crystalline bedrock (predominantly igneous granitic rocks with some metamorphic rocks) mantled by saprolite and residual soils. Based on regional descriptions and site characterization in this area (as described below), two groundwater zones were identified: an uppermost saprolite/shallow bedrock zone (which contains the water table) and a bedrock zone in fractured crystalline rocks (see Figure 2-10).

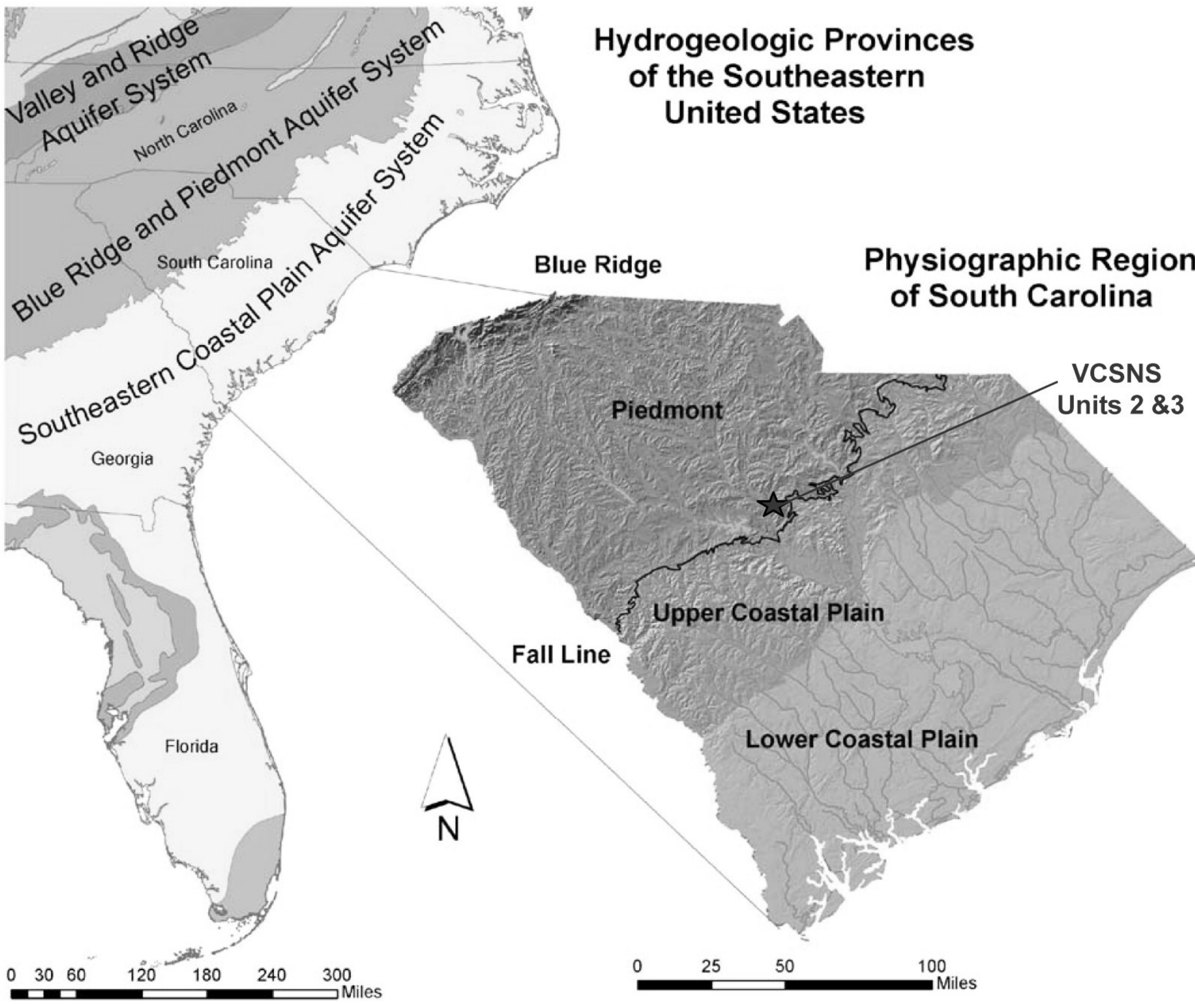

Figure 2-9. Physiographic Provinces of South Carolina and Hydrogeologic Provinces of the Southeastern United States Showing the VCSNS Site Location (SCE&G 2009a)

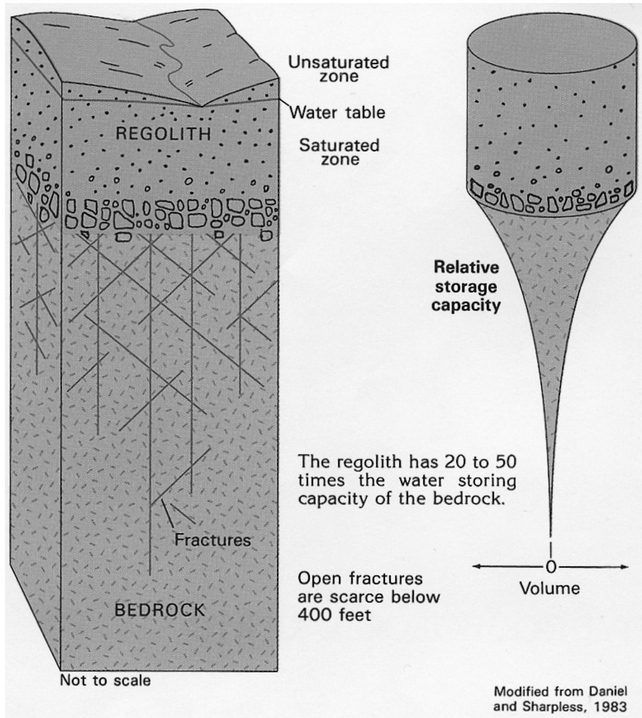

Figure 90. *The regolith, or layer of weathered rock material, soil, and alluvium overlies fractured crystalline bedrock. The majority of the water is stored in the more porous regolith and percolates downward into the interconnected fractures. Therefore, wells can obtain some of this stored water even though they are cased entirely through the regolith.*

Figure 2-10. Diagram of Regolith and Fractured Bedrock Groundwater Zones in the Piedmont Physiographic Province of the Southeastern United States (USGS 1990)

Regional Groundwater Description

The USGS Groundwater Atlas (USGS 1990) provides a regional description (Alabama, Florida, Georgia, and South Carolina) of the aquifers within the Piedmont physiographic province, which underlies the VCSNS site. The USGS Groundwater Atlas also provides a generalized conceptual model of groundwater flow in the Piedmont physiographic province (see Figure 2-11 [from Figure 92 of USGS 1990]). The atlas describes the aquifers in the Piedmont physiographic province as generally unconfined with the water table forming a "subdued replica of surface topography." Groundwater recharges on the hilltops and slopes (everywhere except the lower parts of valleys) and "discharges as springs, seeps, baseflow to streams, and as seepage to lakes" (USGS 1990).

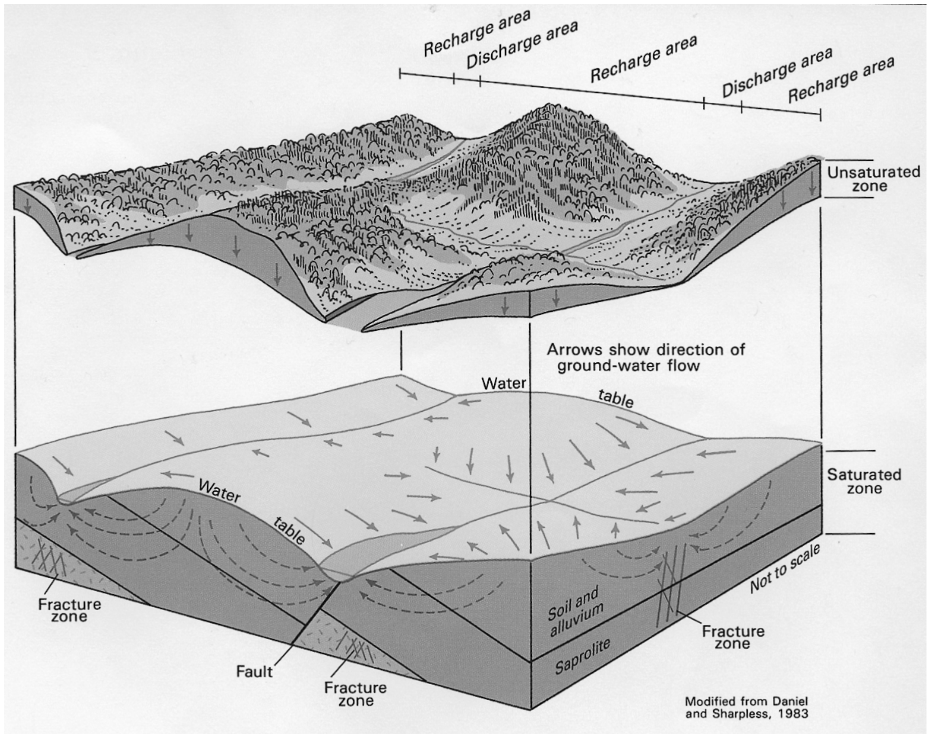

Figure 92. *Ground water percolates downward through the unsaturated zone (shown lifted up) to the water table, then moves laterally to discharge points. In the bedrock, the water is channeled through fractures.*

Figure 2-11. Conceptual Model of Groundwater Flow in the Piedmont Physiographic Province of the Southeastern United States (USGS 1990)

According to the atlas, the crystalline bedrock has "few primary pore spaces, and the porosity and permeability of the unweathered and unfractured bedrock are extremely low" (USGS 1990). The atlas explains that groundwater from this region is obtained from the regolith (which includes the residual soils and saprolite) and fractures in the bedrock (see Figure 2-11). Well yields in the Piedmont physiographic province of the southeastern United States are described as follows (USGS 1990):

> Although some wells completed in the Piedmont and Blue Ridge aquifers yield almost 500 gallons per minute, the average reported well yield is much less and generally is in the range of about 15 to 20 gallons per minute. Yields of large-diameter wells drilled for public water supply average about 30 gallons per minute. Part of the variation in yield depends upon the type of rock in which the well is completed.

The USGS Groundwater Atlas summarizes well yield data from different rock types for one site located in the Piedmont physiographic province (Greenwood County, South Carolina) (USGS 1990) that range from 0 to 150 gpm; however, the reported median well yields are less than 30 gpm. The USGS Groundwater Atlas describes well yields from the regolith as being related to the thickness and topography (USGS 1990) with larger volumes (50 gpm or more) occurring in valleys with regolith thicknesses greater than 50 ft and only "small volumes of water" for wells on slopes and hills where the regolith is generally thin. In the South Carolina Department of Health and Environmental Control (SCDHEC) 2006 South Carolina Annual Water Use Summary, Butler et al. (2007) state that for the Piedmont physiographic province "groundwater occurs in the fractures of the bedrock and overlying soil and saprolite" and "[t]he saprolite grades downward through a highly permeable transition zone to unaltered parent bedrock. Groundwater conditions of the bedrock are dependent on the number of fractures and degree of interconnection of the fracture systems." Comparing well yields in the physiographic provinces of South Carolina (see Figure 2-9), the report also states that, "[i]n general, wells in the Blue Ridge and Piedmont regions yield little water when compared to wells drilled in the Coastal Plain owing to the inherently low porosity and permeability of the crystalline rock present in the upstate."

The South Carolina Department of Natural Resources (SCDNR) South Carolina Water Plan (Badr et al. 2004) describes the aquifers in the Piedmont physiographic province as follows: "[t]he storage capacity of fractures and saprolite is very small compared to that of the Coastal Plain aquifers." In addition, Badr et al. (2004) state that wells in the fractured bedrock of the Piedmont physiographic province "typically yield only between 5 and 15 gpm."

According to the U.S. Environmental Protection Agency (EPA) website (EPA 2009a), no sole-source aquifers are designated in the area.

Onsite Groundwater Description

The hydrogeology of the VCSNS site as described by SCE&G in its ER (SCE&G 2010a) is consistent with the regional descriptions of the aquifers listed above. Detailed hydrogeologic characterization was conducted at the site as part of the Unit 1 characterization and construction and extensive preapplication subsurface characterization for proposed VCSNS Units 2 and 3 (SCE&G 2010a,).

As part of the groundwater characterization of the proposed VCSNS Units 2 and 3 site, 31 monitoring wells were installed with 22 completed in the saprolite/shallow bedrock zone (see Figure 2.3-26 in the SCE&G ER [2010a]) and 9 monitoring wells completed in the deep bedrock zone (see Figure 2.3-27 in the SCE&G ER [2010a]). This network contains five adjacent monitoring well pairs for saprolite/shallow bedrock zone and deep bedrock zone monitoring. Table 2.4-216 of the VCSNS FSAR (SCE&G 2010b) provides the observation well details.

Groundwater levels were collected monthly for 13 months from this monitoring well network (from June 2006 to June 2007;see Table 2.3-20 of the ER [SCE&G 2010a]). SCE&G provided trend plots for the water levels measured in these wells (see Figures 2.3-28 and 2.3-29 of the ER [SCE&G 2010a]) and prepared four quarterly piezometric surface maps (June 2006, September 2006, December 2007, and March 2007) for the saprolite/shallow bedrock zone and the deep bedrock zone in the FSAR (SCE&G 2010b, Figures 2.4-237 to 2.4-244). Piezometric surface maps were also prepared for the last monthly water-level measurements in June 2007 and are shown in Figures 2.3-30 and 2.3-31 of SCE&G's ER (SCE&G 2010a). The piezometric surface maps are consistent with the regional conceptual model of groundwater in the Piedmont physiographic province from the USGS Groundwater Atlas (USGS 1990), described above, where the water table reflects a subdued version of the surface topography.

In general, the trend plots showed that the water levels were relatively constant during the monitoring period except for three wells that showed large increases. These increases were interpreted as being caused by slow recovery due to low permeability. One of these three observation wells (OWs), OW-624, was screened in the saprolite/shallow bedrock zone and two wells, OW-233 and OW-627a, were screened in the deep bedrock zone. One shallow monitoring well in the network, OW-312, which was screened higher than the water table measured in other wells in its vicinity, was dry over the entire period.

Based on the piezometric surface maps developed from the 2006-2007 water-level monitoring data at the site and using the most recent measurements to account for well recovery (Shown in Figures 2.3-30 and 2.3-31 of SCE&G's ER [SCE&G 2010a]), it appears that the groundwater in the saprolite/shallow bedrock zone flows from the "ridgetops toward the drainage swales, with the piezometric surface approximately parallel to the topography" (SCE&G 2010b). The drainage swales include the two unnamed creeks to the northwest and southwest of the location for proposed VCSNS Units 2 and 3 and Mayo Creek to the east.

The vertical gradients from the five shallow and deep well pairs installed at the site for the June 2006 to June 2007 monthly water-level measurements are depicted in VCSNS ER Figure 2.3-32 (SCE&G 2010a). The largest calculated vertical gradients were for wells OW-621a/b and OW-627a/b, which are the farthest away from the ridgetops at the proposed locations of VCSNS Units 2 and 3 and indicated a downward vertical flow direction; however based on the water-level data collected, one well may not have fully recovered from installation during this water-level monitoring period (deep bedrock well OW-627a).

Aquifer Material Properties

Field hydraulic testing consisted of slug testing in 29 of the 31 observations wells installed around the site in both the saprolite/shallow bedrock zone and deep bedrock zone. Packer tests were conducted on four selected deep bedrock zone boreholes (SCE&G 2010a). American Society for Testing and Materials procedures were followed when conducting the slug tests and packer tests (ASTM D4044 and D4630, respectively [SCE&G ER 2010a]). Slug tests were not conducted on 2 of the 31 observation wells because one well was dry and the other well was screened in fill and residual soil. The results of 8 of the 29 slug tests were identified as being invalid or unreliable (SCE&G 2010a). Hydraulic conductivity results, along with calculated minimum, maximum, and geometric mean values, from the analysis of the slug tests are reported in VCSNS ER Table 2.3-21 (SCE&G 2010a) and also described in the FSAR (SCE&G 2010d). d For the slug tests, the maximum hydraulic conductivity result reported for each well was selected based on the highest value of either the falling head test or rising head test analysis. Overall the hydraulic conductivities measured for the saprolite/shallow bedrock zone were higher than the deep bedrock zone based on these tests. A general trend of decreasing hydraulic conductivity with increasing depth was seen from the slug test and packer test data for the deep bedrock zone (see Figure 2.4-246 of the VCSNS FSAR [SCE&G 2010b]).

Grain size, moisture content, specific gravity, and total porosity measured for residual soil and saprolite samples from the VCSNS site are listed in Table 2.3-23 of the VCSNS ER (SCE&G 2010a). Porosity measurements for the fractured deep bedrock were estimated using mean values from a study conducted in the Piedmont physiographic province (SCE&G 2009p, 2010a).

Groundwater Pathways

VCSNS Units 2 and 3 would be situated on a hilltop near a groundwater divide, as indicated on the piezometric surface maps (SCE&G 2010a, Figures 2.3-30 and 2.3-31). Based on the piezometric surface maps, groundwater flows off the hill toward the drainage swales of the unnamed creeks to the northwest and southwest of the proposed units and toward Mayo Creek on the east. Mayo Creek enters the Broad River downstream of the Parr Shoals Dam. Groundwater velocities are estimated from hydraulic gradients, hydraulic conductivity values based on hydraulic tests, and effective porosity estimates for the two groundwater zones. SCE&G provided conservative estimates for groundwater velocities and travel times along the primary and alternate groundwater pathways identified in Section 2.4.13 of the VCSNS FSAR (SCE&G 2010d). The staff's description and evaluation of groundwater pathways and travel times will be documented in the Safety Evaluation Report (SER).

2.3.2 Water Use

This section describes the current water use in the vicinity of proposed VCSNS Units 2 and 3. Permitting the use of water resources is regulated by the SCDHEC as part of its Water Quality Protection Program (SCDHEC 2009a). If the groundwater withdrawals are inside a Capacity Use Area, such use falls under the SCDHEC Groundwater Use and Reporting Program (SCDHEC 2005). The VCSNS site is not in a capacity use area. Laws applicable to the use of groundwater near the VCSNS site include the Groundwater Use and Reporting Act (SC Code Ann. 49-5 2009). Applicable laws regarding the use of surface water include the South Carolina Surface Water Withdrawal and Reporting Act (SC Code Ann. 49-4 2009).

2.3.2.1 Surface-Water Use

Total (surface and ground) water use within South Carolina is reported by SCDHEC (SCDHEC 2009a). These annual summaries include the previous years' total water use. This use includes both consumptive and nonconsumptive water use. The totals are listed in Table 2-8 below. Additional details are included in ER Table 2.3-27 and ER Table 2.3-38 (SCE&G 2010a). The data indicate a significant fluctuation in water usage on an annual basis and the dominance of surface-water usage.

Table 2-8. Annual Water Use Within South Carolina

Year	Total (trillion gallons)	Surface (trillion gallons)
2001	11.8	11.7
2002	14.3	14.2
2003	22.9	22.8
2004	18.8	18.7
2005	20.4	20.4
2006	16.4	16.3

Source: SCDHEC 2009a

Local surface-water users include hydroelectric and thermal power industries and public water suppliers. Several hydroelectric projects use surface water, but not consumptively. Local surface-water sources are used by Fairfield, Newberry, and Richland Counties (Table 2-9). The total reported water use for these three counties in 2004 was 3.9 trillion gallons (SCE&G 2010a). Fairfield County represents 83 percent of this use, the majority of which was hydroelectric power generation (SCDHEC 2009a). Local users of surface water in Fairfield County include the town of Winnsboro and VCSNS Unit 1. At a distance of approximately 28 mi along the Broad River from the VCSNS site, the City of Columbia is the closest downstream large user of surface water.

Table 2-9. Local and Downstream Surface-Water Users Reported by SCE&G for 2004

Users	County	Surface-Water Source
Town of Winnsboro	Fairfield	Sand Creek and 192-Acre Lake
VCSNS Unit 1	Fairfield	Broad River transfers to Monticello Reservoir
City of Columbia	Richland	Broad River and Lake Murray
City of Newberry	Newberry	Saluda River
Town of Whitmire	Newberry	Duncan Creek and Enoree River
Parr Shoals Dam	Fairfield	Broad River

Source: SCE&G 2010a

The Federal Energy Regulatory Commission (FERC) establishes a minimum flow through Parr Shoals Dam. Modification of the FERC license would be necessary to establish use requirements at Parr and Monticello reservoirs for VCSNS Units 2 and 3 needs.

2.3.2.2 Groundwater Use

The SCDHEC 2006 South Carolina Water Use Report (Butler et al. 2007) states “Counties in the Piedmont and Blue Ridge physiographic provinces depend primarily on the abundant regional rainfall that recharges lakes, reservoirs and major river systems.” Correspondingly, these bodies of surface water serve as the main source of water for public supply, industry, agriculture, and power production in the Piedmont Region.

The SCDHEC reports water use annually by county and category (aquaculture, golf course, industrial, irrigation, mining, water supply, and other) (Butler et al. 2007). Water use for these categories is reported separately for groundwater and surface water. Table 2.3-26 of the VCSNS ER (SCE&G 2010a) summarizes groundwater use for counties within a 50-mi radius of the VCSNS site in 2004 (based on the SCDHEC water-use data) and shows that public water supplies are the largest users of groundwater reported for this region. The groundwater use in Fairfield County, reported for 2006 was 71.9 million gallons, which is about 10 percent of the reported value for water supply from surface water (722 million gallons) for this county (Butler et al. 2007). Of the groundwater water-use categories in this report, only the “water supply” category had values reported for groundwater use in Fairfield County in 2006.

Public water-supply wells within 6 mi of VCSNS Units 2 and 3 are listed in FSAR Table 2.4-215 (SCE&G 2010b) based on the SCDHEC database and EPA Safe Drinking Water Information System database for population served (see SCE&G 2009d). The table lists 14 active public water-supply wells in the area screened in the Piedmont physiographic province bedrock aquifer with design yields, where known, ranging from 5 to 29 gpm.

The ER states that “[g]roundwater within 2 miles of the site is primarily used for domestic purposes” (SCE&G 2010a). The closest groundwater well to the site is at a private residence approximately 1 mi east of the site (SCE&G 2010a). Information about pumping rates for private wells is not available (SCE&G 2009d), but well yields are generally limited in this area by the relatively low productivity of the aquifers in the Piedmont physiographic province, as discussed in Section 2.3.1.2 of this chapter. The ER states that “the nearest large groups of wells are located approximately 1.5 miles east of the site along SC 215 and in Jenkinsville approximately 2.5 miles southeast of the site” which serve “private residences and stores” (SCE&G 2010a). The ER also lists the Jenkinsville Water Company that has nine wells, three wells within 2 mi of the site.

Process and domestic water for VCSNS Unit 1 is supplied by Monticello Reservoir (SCE&G 2010a). Groundwater is pumped from two wells at a total rate of approximately 26 gpm to reduce below-grade seepage in buildings in the protected area around Unit 1 (SCE&G 2010a). Seepage in this area is due to the close proximity of the Monticello Reservoir (SCE&G 2010a).

2.3.3 Water Quality

The following sections describe the quality of surface-water and groundwater resources in the vicinity of the VCSNS site.

2.3.3.1 Surface-Water Quality

The bodies of surface water where water quality could be affected by VCSNS Units 2 and 3 are the Parr Reservoir/Broad River, Monticello Reservoir, and Mayo Creek. Smaller unnamed creeks on the site could also be affected by stormwater runoff. All blowdown from the VCSNS Units 2 and 3 cooling towers, liquid discharges from the radwaste building, industrial wastewater, and sanitary effluent would discharge to Parr Reservoir. A new water-treatment plant would return a small amount of water to Monticello Reservoir. Mayo Creek and other unnamed creeks could temporarily receive discharge from the dewatering system during the VCSNS Units 2 and 3 construction period. Some surface-water runoff from the proposed Units 2 and 3 site would also drain to Mayo Creek and other unnamed creeks to the south and west (SCG&E 2010a).

Water quality in the Broad River, Parr Reservoir, and Monticello Reservoir has been periodically evaluated by SCDHEC, SCDNR, and SCE&G. SCE&G has conducted monthly water-quality monitoring in Monticello Reservoir since 1995 (SCE&G 2010a). The SCDHEC measures turbidity, dissolved oxygen, biochemical oxygen demand, alkalinity, nitrogen, phosphorous, fecal coliform, organic carbon, and metals in the Parr Reservoir/Broad River as well as at two stations in Monticello Reservoir (Figure 2-12). As described earlier in Section 2.3.1, the Parr Reservoir is a run-of-the-river impoundment of the Broad River adjacent to the VCSNS site. Water is exchanged between Monticello and Parr reservoirs by the FPSF. Because of this exchange of water the long-term water quality will be similar between the reservoirs. The range of water-quality constituent concentrations measured in Monticello and Parr reservoirs in 2004 and 2005 and in Monticello Reservoir in 2006 are shown in Table 2-10, Table 2-11, and Table 2-12. Monitoring data for the Monticello Reservoir demonstrate that these waters are low in common ions, hardness, dissolved solids, and conductivity. Analysis of these sampling data sets does not reveal any atypical values for waterbodies located in the Piedmont region (SCE&G 2010a).

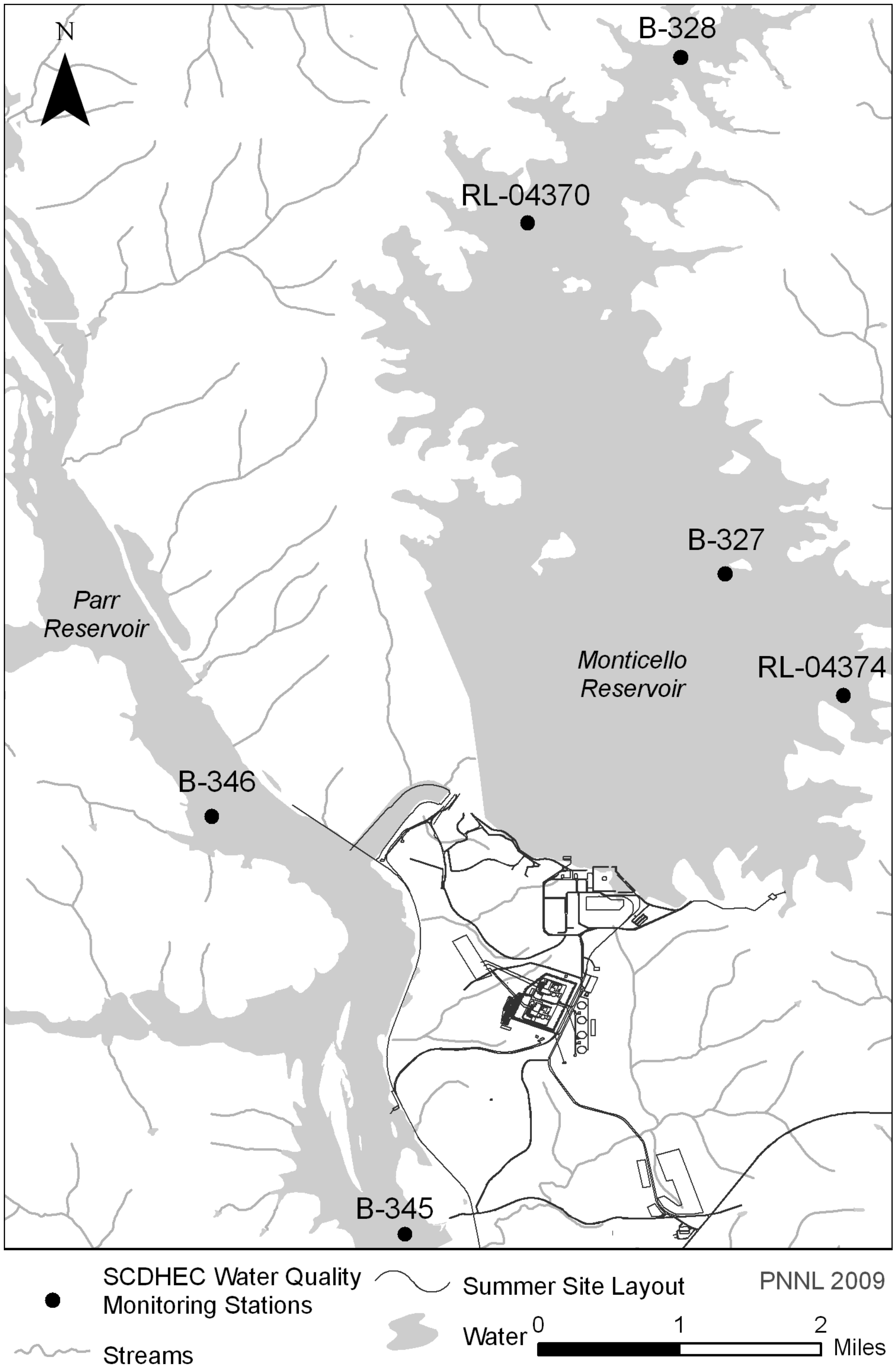

Figure 2-12. The SCDHEC Water-Quality Sampling Locations near the VCSNS Site

Table 2-10. Surface-Water-Quality Data for 2004

Analyzed Parameters	Monticello Reservoir		Parr Reservoir	
	Sample Location B-327	Sample Location B-328	Sample Location B-345	Sample Location B-346
Temperature (°C)/(°F)	9.3°–31.6°C	8.9°–31.2°C	8.0°–29.2° C	7.0°–28° C
	48.7°–88.9°F	48°–88.2°F	46.4°–84.6°F	44.6°–82.4°F
Turbidity (NTU)	3.0–12.0	1.3–4.9	4.6–46	6.4–95
Dissolved oxygen (mg/L)	6.38–12.72	6.99–13.25	4.95–11.50	Less than QL–11.90
BOD (mg/L)	Less than QL–2.0	All less than QL	All less than QL	All less than QL
pH	7.11–8.68	7.41–8.11	6.95–7.66	7.12–7.68
Alkalinity, carbonate as $CaCO_3$ (mg/L)	17–25	23–24	16–26	14–25
Total Nitrogen (NH_3) (mg/L)	Less than QL–0.50	Less than QL–0.20	Less than QL–0.20	Less than QL–0.50
Total N (Kjeldahl) (mg/L)	0.22–0.60	0.38–0.74	0.23–0.48	0.14–0.61
Total N (nitrite/nitrate) (mg/L)	0.11–0.46	Less than QL–0.062	0.25–0.51	0.28–0.58
Total phosphorous (mg/L)	Less than QL–0.039	Less than QL–0.021	Less than QL–0.052	0.030–0.13
Total fecal coliform (# cells/100 mL)	Less than QL–7	Less than QL–32	2 – 140	Less than QL–240
Total organic carbon (mg/L)	2.4–3.2	4.7–5.2	2.2–2.9	2.0–3.3
Cadmium, total (µg/L)	All less than QL	All less than QL	All less than QL	All less than QL
Chromium, total (µg/L)	All less than QL	All less than QL	All less than QL	All less than QL
Copper, total (µg/L)	All less than QL	All less than QL	All less than QL	All less than QL
Iron, total (µg/L)	130–600	42–160	220–880	450–1100
Lead, total (µg/L)	All less than QL	All less than QL	Less than QL	All less than QL
Manganese, total (µg/L)	Less than QL–18	Less than QL–44	20–40	33–50
Mercury, total (µg/L)	All less than QL	Less than QL–19	All less than QL	All less than QL
Nickel, total (µg/L)	All less than QL	All less than QL	All less than QL	All less than QL
Zinc, total (µg/L)	Less than QL–21	All less than QL	Less than QL–48	All less than QL

Sources: EPA 2006a; SCE&G 2010a
Note: Sample depths 0.3 m
NTU = Nephelometric Turbidity Units; BOD = biochemical oxygen demand; QL = quantification limit; < = less than

Table 2-11. Surface-Water-Quality Data for 2005

Analyzed Parameter	Monticello Reservoir Sample Location B-327 Result	Parr Reservoir Sample Location B-345 Result
Temperature (°C)/(°F)	11.4°–32°C	10.6°C–29.3°C
	52.5°F–89.6°F	51.1°F–84.7°F
Turbidity (NTU)	2.5–12	6.5–47
Dissolved oxygen (mg/L)	5.15–10.92	4.32–10.52
BOD (mg/L)	All less than QL	All less than QL
pH (SU)	6.9–8.5	6.7–7.88
Total nitrogen (NH_3) (mg/L)	<QL–0.2	<QL–0.25
Total N (Kjeldahl) (mg/L)	0.21–0.53	0.24–0.56
Total N (nitrite/nitrate) (mg/L)	0.14–0.59	0.27– 0.62
Total phosphorous (mg/L)	<QL–0.038	0.027–0.083
Hardness, Ca & Mg-total (mg/L)	14	15
Alkalinity, carbonate as $CaCO_3$, total (mg/L)	17–24	17–24
Cadmium, total (µg/L)	All less than QL	All less than QL
Total Organic Carbon (mg/L)	<QL–3.2	3.0–3.9
Chromium, total (µg/L)	All less than QL	<L–25
Copper, total (µg/L)	All less than QL	All less than QL
Iron, total (µg/L)	150–350	330–1800
Lead, total (µg/L)	All less than QL	All less than QL
Nickel, total (µg/L)	All less than QL	All less than QL
Zinc, total (µg/L)	<QL–10	All less than QL
Total fecal coliform (# cells/100 mL)	<QL–100	2–480
Enterococcus group bacteria, total (# cells/100 mL)	<QL–12	<QL–310

Sources: EPA 2006a; SCE&G 2010a
NTU = Nephelometric Turbidity Units; BOD = biochemical oxygen demand; SU = standard units; QL = quantification limit; < = less than

Table 2-12. Monticello Reservoir Water-Quality Data for 2006

Analyzed Parameter	Result	Analyzed Parameter	Result
Antimony (µg/L)	<QL	Nickel (µg/L)	<QL
Arsenic (µg/L)	<QL	Potassium (µg/L)	2206
Barium (µg/L)	17.7	Selenium (µg/L)	<QL
Beryllium (µg/L)	<QL	Silver (µg/L)	<QL
Cadmium (µg/L)	<QL	Sodium (µg/L)	10,280
Calcium (µg/L)	3425	Thallium (µg/L)	<QL
Chromium (µg/L)	<QL	Zinc (µg/L)	<QL
Copper (µg/L)	<QL	Silica (µg/L)	8025
Iron (µg/L)	101	Sulfate (mg/L)	4.3
Lead (µg/L)	<QL	Total Dissolved Solids (mg/L)	63
Magnesium (µg/L)	1856	Total Hardness (Calcium) (mg/L)	16.2
Manganese (µg/L)	<QL	Total Suspended Solids (mg/L)	3
Mercury (liquid) (µg/L)	<QL	Turbidity (nephelometric turbidity units)	2.3
Ammonia-N (mg/L)	0.21	Platinum-Cobalt (SU)	15
Chlorophyll a (mg/L)	0.00690	Total Organic Carbon (mg/L)	1.7
Ortho-phosphorous (mg/L)	0.034	Strontium (mg/L)	0.038
Phosphorous (mg/L)	0.021	Chemical Oxygen Demand (mg/L)	<QL
BOD 5-Day (mg/L)	<QL	Cyanide (mg/L)	<QL
Fecal Coliform-MF (# cells/100 mL)	<QL		

Source: SCE&G 2010a
Water sample also analyzed for volatile organics (Method 624), semi-volatile organics (Method 625), and for pesticides/polychlorinated biphenyls (Method 608). All parameter results were below laboratory quantitative limits levels.
< = less than; QL = quantification limit; SU = standard units; BOD = biochemical oxygen demand

The SCDHEC regularly assesses water quality in the Broad River, Parr Reservoir, and Monticello Reservoir and compares results to State water-quality standards (SCDHEC 2008a, b). The standards are used to assemble a Clean Water Act Section 303(d) list of impaired waters based on metal concentrations, pH, dissolved oxygen levels, organic elements, fecal coliform and organism tissue evaluations, and the presence of biota. The variability of pH in the Monticello Reservoir was such that it was listed as impaired (aquatic life use would not be supported) (SCDHEC 2008b). Stations B-046 on the Broad River near Carlisle and B-345 in Parr Reservoir were considered impaired due to elevated copper level and/or potential degradation of the aquatic life uses standards established by the Clean Water Act and SCDHEC. Parr Reservoir station B-346 was included in the list as impaired because of elevated total phosphorus concentrations (SCDHEC 2008b).

Monthly water-temperature profiles in Monticello Reservoir have been measured by SCE&G since 1991 (SCE&G 2010a). Measurement locations were selected to characterize the circulation and thermal aspects of the reservoir near the VCSNS Unit 1 intake, discharge canal, and a control site. Other water-quality parameters were also monitored (pH, conductivity, dissolved oxygen). Monticello Reservoir temperature data are presented in detail in Section 2.3 of the ER (SCE&G 2010a). Most of the reservoir, represented by a station near the Unit 1 intake and a station away from Unit 1 or FPSF influence, can be briefly characterized as varying from about 50°F in winter months up to 85°F at the surface in summer. Through spring and midsummer, temperatures at the 50-ft depth were up to 12°F cooler than the surface; other times of the year, little variation with depth was observed (SCE&G 2010a).

Broad River water-temperature data are available from the USGS stations in the area (Richtex, Alston, and Carlisle) (see Figure 2-8). Analysis of these data sets suggests that the water temperatures in Parr Reservoir varied seasonally from 38.3°F to 86°F. To independently characterize the water temperatures in Parr Reservoir, the daily water temperature record at Carlisle gauging station was examined. This is the closest station to Parr Reservoir with a recent and long observational record (1983-2009). For each year of data, the daily records were averaged over a 3-month rolling period. Then monthly statistics (mean, minimum, and maximum) were computed over all years for each rolling 3-month period. The lowest 3-month average for February to March was 43°F and the highest for summer (July-August) was 84°F.

Sediment transport within the Broad River has not been measured. Changes in land-use patterns since the 1800s have affected the soil erosion in the watershed (Kovacik and Winberry 1987; NCDWQ 1998). Parr Reservoir bed sediment grain-size analysis was reported in the ER, Section 2.3.1.1.6 (SCE&G 2010a). The reservoir bed material is primarily clay, clay-silt, sand, sand-silt; some gravel was also noted. This characterization is consistent with that of the USGS (USGS 2003). No bedload sediment transport measurements are available for the Broad River. Measurements of Broad River total suspended solids are reported by SCDHEC once every 2 years. The water-quality sampling stations closest to VCSNS Units 2 and 3 are B-047 (12 mi upstream of Parr Shoals Dam) and B-046 (21 mi upstream of Parr Shoals Dam), as shown in Figure 2-8 (SCE&G 2010a).

Temperature, pH, dissolved oxygen, and conductivity in Mayo Creek, measured during macroinvertebrate surveys conducted in 2008 and 2009, are provided in Table 2-13 (CBS 2009b). These data were consistent with earlier measurements made by SCE&G at three locations in July 2006 and November 2006 (Tetra Tech NUS, Inc. 2007). Water-quality measurements were within the State standards for Class FW (freshwaters) (SCDHEC 2008a), and indicated that Mayo Creek water quality was similar to other groundwater-fed streams in the area (SCE&G 2010a).

Table 2-13. Mayo Creek Water-Quality Data for 2008 and 2009

Date	Station	Temperature (°C) [°F]	pH	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/L)
July 2008	1	22.6 [72.7]	7.2	122	6.5
July 2008	2	21.3 [70.3]	7.0	123	7.2
July 2008	3	20.9 [69.6]	7.0	126	6.8
October 2008	1	17.1 [62.8]	7.4	101	12.3
October 2008	2	15.1 [59.2]	7.3	96	10.8
October 2008	3	14.9 [58.8]	7.3	106	8.9
January 2009	1	8.9 [48.0]	7.3	89	11.5
January 2009	2	9.6 [49.3]	7.6	87	9.9
January 2009	3	9.4 [48.9]	7.5	88	11.7
April 2009	1	13.6 [56.5]	7.1	82	9.2
April 2009	2	13.7 [56.7]	7.2	110	9.5
April 2009	3	15.2 [59.4]	7.3	111	9.5

Source: CBS 2009b (except review team provided temperature converted to °F)

2.3.3.2 Groundwater Quality

Baseline nonradiological groundwater quality was established around the proposed VCSNS Units 2 and 3 location by monitoring that consisted of one round of sampling from nine wells in late August/early September 2006 for a subset of analyses (SCE&G 2010a) and more detailed water-quality analyses from eight wells during the second half of 2007. The 2007 water-quality monitoring consisted of one sampling round for four wells, two sampling rounds for three wells, and three sampling rounds for one well (SCE&G 2010a, ER Table 2.3-36). The detailed water-quality monitoring results from 2007 were compared to SCDHEC drinking-water standards (SCE&G 2010a, ER Table 2.3-36). The State drinking water maximum contaminant level values are published in *R.61-58, State Primary Drinking Water Regulation* (SCDHEC 2009d). Based on this comparison, the groundwater exceeded the SCDHEC State drinking-water standards in at least one well during a sampling round for the following analyses: sulfates, total dissolved solids, turbidity, total coliform, cadmium, iron, lead, platinum-cobalt, and pH.

Low levels of tritium were detected in two wells located near the proposed VCSNS Unit 3 location during the 2007 monitoring (SCE&G 2010a). The potential source of this tritium was the permitted disposal of condensate polisher resin in the area in 1994. The results from soil samples collected and analyzed from this area in 2006 indicated that radiological concentrations were below the Low Limits of Detection specified in the Offsite Dose Calculation Manual as described by SCE&G (2009e). Details about the sampling and results are contained in SCE&G 2009e.

2.3.4 Water Monitoring

Surface-water and groundwater monitoring are described in the following sections.

2.3.4.1 Surface-Water Monitoring

Broad River flows are monitored continuously at several USGS gauging stations near the VCSNS site (Figure 2-8). Flow information is mostly available for calculation of long-term daily average flows. The station name, number, location, and period of record for the three Broad River gauging stations closest to VCSNS are summarized in Table 2-14. The USGS also records or has recorded Broad River water temperature at these three stations during periods listed in Table 2-14.

Table 2-14. USGS Flow and Temperature Monitoring on the Broad River

Station	Number	Location	Flow Monitoring Period(s)	Temperature Monitoring Period(s)
Carlisle	02156500	21 mi upstream of Parr Shoals Dam	October 1938 to present	1965 to 1965; 1968-1975
Alston	02161000	1.2 mi downstream from Parr Shoals Dam	October 1896 to December 1907, October 1980 to present	November 1971 to July 1972
Richtex	02161500	14 mi downstream from Parr Shoals Dam	October 1925 to September 1983	October 1959 to September 1960; July 1972 to July 1974

Source: SCE&G 2010a

Water quality in the Broad River, Parr Reservoir, and Monticello Reservoir continues to be periodically monitored by SCE&G and SCDHEC. SCE&G's water-monitoring program for VCSNS Unit 1 at Monticello Reservoir has been ongoing since 1995; SCE&G measures temperature, dissolved oxygen, pH, and specific conductance monthly at three reservoir locations (SCE&G 2010a, Section 2.3.1.1.5). Monitoring locations are (1) near the circulating-water intake for VCSNS Unit 1, (2) near the VCSNS Unit 1 thermal discharge, and (3) in the northern part of Monticello Reservoir outside of the influence of the FPSF and VCSNS Unit 1. SCE&G recorded temperature continuously near the VCSNS Unit 1 circulating-water intake during the summer months from 1992 to 1994. SCDHEC monitors water quality statewide, cycling through each watershed at least every 5 years (SCDHEC 2008c). SCDHEC monitors the following suite of water-quality parameters at the stations in the vicinity of VCSNS shown in Figure 2-8 and Figure 2-12:

- temperature, turbidity, dissolved oxygen, biochemical oxygen demand
- pH and alkalinity

- total nitrogen, total phosphorus, total fecal coliform, total organic carbon
- metals, including cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, and zinc.

As described in Section 2.3.3, SCE&G conducted preapplication water-quality monitoring of Mayo Creek in 2006, 2008, and 2009 (TetraTech NUS, Inc. 2007; SCE&G 2010a; CBS 2009b).

2.3.4.2 Groundwater Monitoring

The results of preconstruction preapplication groundwater monitoring for VCSNS Units 2 and 3 were described previously in Section 2.3.1.2 for hydrologic monitoring (i.e., water levels) and EIS Section 2.3.3.2 for groundwater-quality monitoring. Hydrologic groundwater monitoring reported in the ER (see ER Table 2.3-20 [SCE&G 2010a]) consisted of monthly measurements of water levels from June 2006 through June 2007 from 31 wells around VCSNS Units 2 and 3. Monitoring of groundwater quality around VCSNS Units 2 and 3 consisted of one round of sampling of nine wells in late August/early September 2006 for a subset of analyses (see ER Table 2.3-35, SCE&G 2010a). More detailed water-quality analyses were conducted on water collected from eight wells during the second half of 2007, with one sampling round for four wells, two sampling rounds for three wells, and three sampling rounds for one well (see Table 2.3-36 of the ER [SCE&G 2010a]).

EIS Section 4.2.4 describes the hydrologic and water-quality groundwater monitoring proposed during facility preconstruction/construction and EIS Section 5.2.4 describes the hydrologic and water-quality groundwater monitoring proposed during operations. Radiological monitoring of groundwater is discussed in EIS Sections 2.11 and 5.9.

2.4 Ecology

This section describes the terrestrial and aquatic ecology of the site and vicinity, which includes the biological communities and habitats that might be affected by the building, operation, or maintenance of proposed VCSNS Units 2 and 3. Sections 2.4.1 and 2.4.2 provide general descriptions of terrestrial and aquatic environments on and in the vicinity of the VCSNS site as well as the additional area associated with the proposed six new 230-kV transmission lines.

Detailed descriptions are provided where needed to support the analysis of potential ecological impacts from the building, operation, or maintenance of new nuclear power-generation facilities and the associated power-transmission systems. These descriptions also support the evaluation of mitigation activities identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts. Descriptions of terrestrial and aquatic monitoring programs are also included.

2.4.1 Terrestrial and Wetlands Ecology

The VCSNS site is surrounded by a mosaic of forests and farmland, typical of the Piedmont physiographic province. This province begins in the southernmost portion of New York State and stretches in a southwestward direction to approximately mid-Alabama (Godfrey 1980). The Piedmont region has been heavily farmed and cultivated, thereby altering the pre-settlement landscape considerably (Kirkman et al. 2007). This section identifies terrestrial ecological resources and describes species composition and other structural and functional attributes of biotic communities that might be affected by the construction, operation, and maintenance of proposed VCSNS Units 2 and 3 and the proposed transmission-line system. It also identifies important terrestrial resources, as defined by the NRC (NRC 2000) that might be affected by the proposed action.

2.4.1.1 Terrestrial Resources – Site and Vicinity

The terrestrial communities found on the VCSNS site and vicinity are characteristic of the Southern Outer Piedmont ecoregion (Griffith et al. 2002). The surrounding landscape comprises gently rolling hills and valleys dissected by an abundance of streams. Vegetation communities common in the Southern Outer Piedmont ecoregion include mixed oak forest and oak-hickory-pine forest. Common tree canopy species consist of white oak (*Quercus alba*), southern red oak (*Quercus falcata*), black oak (*Q. velutina*), mockernut (*Carya alba*) and pignut hickories (*C. glabra*), some loblolly pine (*Pinus taeda*), and shortleaf pine (*Pinus echinata*). Sites that have a moderate amount of moisture (mesic sites) such as riparian areas contain American beech (*Fagus grandifolia*), northern red oak (*Q. rubra*), tulip poplar (*Liriodendron tulipifera*), and red maple (*Acer rubrum*) (Griffith et al. 2002). The dominant cover in the vicinity of VCSNS is mixed forest (SCE&G 2010a).

The VCSNS site comprises approximately 3600 ac, which includes approximately 784 ac of open water in the Monticello Reservoir (SCE&G 2010a). The Parr Reservoir lies just west of the site (SCE&G 2010a). The proposed project site for VCSNS Units 2 and 3 is within the current nuclear facility boundary just south of existing VCSNS Unit 1, in an area that was cleared and used for storage, spoils disposal, and laydown areas during the construction of Unit 1 (SCE&G 2010a). The VCSNS site is primarily a human-altered system that has changed dramatically since the development of VCSNS Unit 1 and the damming of the Broad River and Frees Creek, which created Parr and Monticello reservoirs, respectively. Historical photographs illustrate the change on this site since 1938 (see Figure 2-13). Also, see Section 2.2.1 for the current land-use categories and acreage on the VCSNS site.

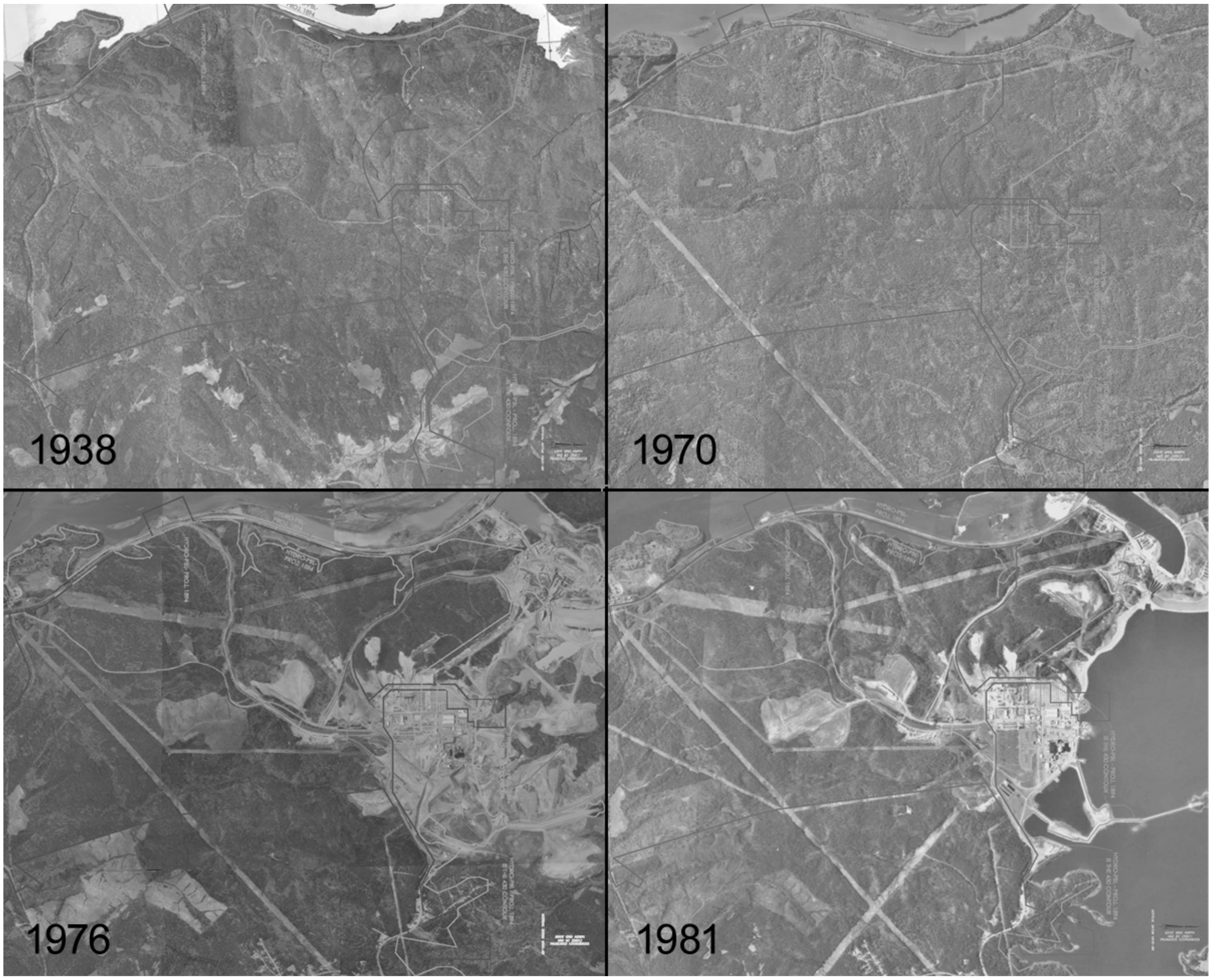

Figure 2-13. Historical Photos Showing How the VCSNS Site Has Changed Since 1938 (SCE&G 2009v)

Existing Terrestrial Cover Types

Forests on the VCSNS site are managed by SCANA Services' Forestry Operations group, but timber harvests are not common (NRC 2003). A variety of cover types are present including planted pine forest, naturally vegetated pine forest, mixed pine-hardwood forest, and hardwood forest. Pine forests are primarily second-growth stands of loblolly pine either natural or planted; older forests are characterized by the presence of hardwoods such as white oak. Hardwood-dominant stands occur mainly along streams and side slopes (Figure 2-14) (SCE&G 2010a).

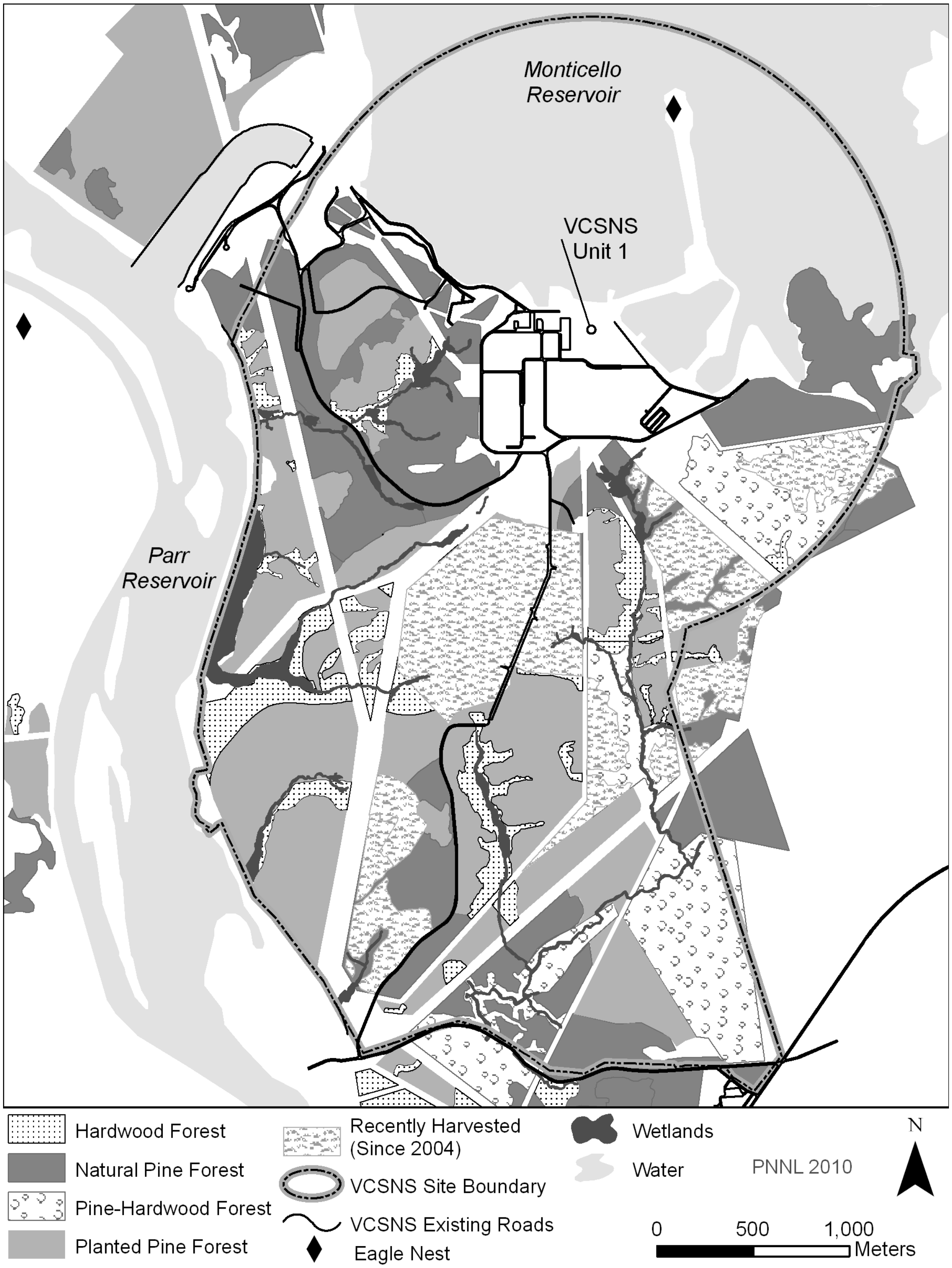

Figure 2-14. Map of the Cover Types on the VCSNS Site

Pine Forest

Natural and planted pine forests on the VCSNS site (including those most recently harvested since 2004) consist mostly of naturally vegetated and cultivated loblolly pine. These forests are early successional, even-aged stands that produce a closed canopy with little to no understory of either woody or herbaceous cover (FPC 1974). Much of the pine forest consists of planted pines, which are generally poor wildlife habitat, lacking in both food and cover needed by native wildlife (SCDNR 2005a).

Mixed Pine-Hardwood Forest

Mixed pine-hardwood forests occur primarily in the eastern portion of the VCSNS site and consist of loblolly pine and longleaf pine (*Pinus palustris)*, with a variety of other species including tulip poplar, red maple, winged elm (*Ulmus alata*), persimmon (*Diospyros virginiana*), eastern redcedar (*Juniperus virginiana*), black gum (*Nyssa sylvatica*), American beech, American holly (*Ilex opaca*), black cherry (*Prunus serotina*), and sweetgum (*Liquidambar styraciflua*) (SCE&G 2002a; Nelson 2006).

Hardwood Forest

Hardwood forests make up a small portion of the forested communities on the VCSNS site and are predominately located along stream bottoms and surrounding ravines (NRC 2004). Typical canopy species present include white oak, southern red oak, black gum, and some American beech (Nelson 2007). Flowering dogwood (*Cornus florida*) is a dominant understory species and herbaceous species such as Hepatica (*Hepatica americana*), golden alexander (*Zizia trifoliata*), sanicle (*Sanicula marilandica*), Christmas fern (*Polystichum acrostichoides*), and little nut-rush (*Scleria oligantha*) are common along small streams (SCE&G 2002a).

Wetlands

Wetlands present on the VCSNS site are typical of those found in the South Carolina Piedmont and include both palustrine (marshes, bogs, fens, etc.) and lacustrine (on the shores of lakes and/or reservoirs) wetlands. Most of the wetlands are forested and are associated with small streams, seeps, and beaver ponds (SCE&G 2010a). Typical species that would be found on these types of sites include those mentioned above in the mixed pine-hardwood and hardwood cover types as well as tulip poplar, sweetgum, white ash (*Fraxinus americana*), black cherry, sedge (*Carex* spp.), and red maple. There is also limited freshwater marsh habitat in shallow backwaters along Parr Reservoir that contains emergent wetland species, such as cattail (*Typha latifolia*), bulrushes (*Scirpus* spp.), rushes *(Juncus* spp.), sedges (*Carex* spp.), smartweed (*Polygonum hydropiperoides*), pickerelweed (*Pontederia cordata*), lizard's tail (*Saururus cernuus*), water primrose (*Ludwigia* spp.), and water pennywort (*Hydrocotyle* spp.) (SCE&G 2010a).

Wildlife

Terrestrial wildlife species found on the VCSNS site are typical of those found in the Southern Outer Piedmont ecoregion of South Carolina. A variety of species inhabit the forested, wetland, and open water habitats present, including amphibians, reptiles, birds, and mammals. Recent biological surveys of the site have been conducted in support of VCSNS Unit 1 license renewal (SCE&G 2002a) and more recently to provide information regarding potential occurrences of threatened and/or endangered species on the VCSNS site (Tetra Tech NUS, Inc. 2008, 2009a; Nelson 2006, 2007). Informal observations of wildlife and vegetation were made during the surveys. Ecological monitoring data collected in the early 1970s to mid-1980s were also reviewed to provide additional information regarding the wildlife likely to be observed on the VCSNS site and vicinity.

Mammals

Mammals that occur on the VCSNS site include those typically found in the Piedmont such as the white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), muskrat (*Ondatra zibethica*), bobcat (*Lynx rufus*), beaver (*Castor canadensis*), opossum (*Didelphis virginiana*), hispid cotton rat (*Sigmodon hispidus*), eastern mole (*Scalopus aquaticus*), house mouse (*Mus musculus*), white-footed mouse (*Peromyscus leucopus*), gray fox (*Urocyon cinereoargenteus*), and the eastern spotted skunk (*Spilogale putorius*) (SCDNR 2005b). Small-mammal trapping was conducted in the early 1970s before construction of VCSNS Unit 1 and then again in 2008 and 2009 with Sherman™ live traps (Tetra Tech NUS, Inc. 2008).

Amphibians and Reptiles

Several species of reptiles and amphibians are known to occur on the VCSNS site, including black racer snake (*Coluber constrictor*), ringneck snake (*Diadophis punctatus*), and rat snake (*Elaphe obsolete*); lizards such as the Carolina anole (*Anolis carolinensis*), and fence lizard (*Sceloporus undulates*); and various skinks and toads (FPC 1974; SCE&G 2010a). The Piedmont of South Carolina is not as rich in herpetofauna as the other parts of the state (SCDNR 2005a).

Birds

Birds that occur on the VCSNS site include those typically found in the Piedmont. Various species of dabbling ducks such as mallard (*Anas platyrhynchos*), black duck (*Anas rubripes*), and green-winged teal (*Anas crecca*) use the freshwater marsh habitat in Parr Reservoir, and Monticello Reservoir supports a resident population of Canada geese (*Branta canadensis leucopareia*). Bald eagles (*Haliaeetus leucocephalus)* nest near the site and are observed frequently, and a variety of wading birds, songbirds, birds of prey, and other migratory and nonmigratory birds occur on the VCSNS site. Table 2-15 lists avian species observed and recorded on the VCSNS site during other previously described ecological surveys conducted in 2002, 2006, 2007, and 2008. The taxa in bold are species the State of South Carolina have determined to be Priority Species (SCDNR 2005b).

Table 2-15. Avian Species Observed on the VCSNS Site

Wading Birds, Shorebirds, and Other Water Birds	**Passerines and Other Birds (continued)**
Blue-winged teal (*Anas discors*)	Mourning dove (*Zenaida macroura*)
Mallard (*Anas platyrhynchos*)	Blue jay (*Cyanocitta cristata*)
Black duck (*Anas rubripes*)	Yellow-rumped warbler (*Dendroica coronata*)
Great egret (*Ardea alba*)	**Prairie warbler (*Dendroica discolor*)**
Great blue heron (*Ardea herodias*)	Pine warbler (*Dendroica pinus*)
Canada goose (*Branta canadensis*)	Pileated woodpecker (*Dryocopus pileatus*)
Green heron (*Butorides virescens*)	**Dark-eyed junco (*Junco hyemalis*)**
Killdeer (*Charadrius vociferus*)	**Loggerhead shrike (*Lanius ludovicianus*)**
Little blue heron (*Egretta caerulea*)	Belted kingfisher (*Megaceryle alcyon*)
Herring gull (*Larus argentatus*)	Red-bellied woodpecker (*Melanerpes carolinus*)
Double-crested cormorant (*Phalacrocorax auritus*)	Wild turkey (*Meleagris gallopavo*)
Birds of Prey and Soaring Birds	Song sparrow (*Melospiza melodia*)
Cooper's hawk (*Accipiter cooperii*)	Northern mockingbird (*Mimus polyglottos*)
Red-tailed hawk (*Buteo jamaicensis*)	Great crested flycatcher (*Myiarchus crinitus*)
Red-shouldered hawk (*Buteo lineatus*)	Tufted titmouse (*Parus bicolor*)
Turkey vulture (*Cathartes aura*)	Carolina chickadee (*Parus carolinensis*)
Black vulture (*Coragyps atratus*)	Indigo bunting (*Passerina cyanea*)
Bald eagle (*Haliaeetus leucocephalus*)	Downy woodpecker (*Picoides pubescens*)
Passerines and Other Birds	Rufous-sided towhee (*Pipilo erythrophthalmus*)
Red-winged blackbird (*Agelaius phoeniceus*)	Summer tanager (*Piranga rubra*)
Ruby-throated hummingbird (*Archilochus colubris*)	**Golden-crowned kinglet (*Regulus satrapa*)**
Great horned owl (*Bubo virginiana*)	Eastern phoebe (*Sayornis phoebe*)
Northern cardinal (*Cardinalis cardinalis*)	Eastern bluebird (*Siala sialis*)
Pine siskin (*Carduelis pinus*)	**Brown-headed nuthatch (*Sitta pusilla*)**
Northern bobwhite (*Colinus virginianus*)	Yellow-bellied sapsucker (*Sphyrapicus varius*)
Yellow-billed cuckoo (*Coccyzus americanus*)	Northern rough-winged swallow (*Stelgidopteryx serripennis*)
Northern flicker (*Colaptes auratus*)	Barred owl (*Strix varia*)
Eastern wood pewee (*Contopus virens*)	Carolina wren (*Thryothorus ludovicianus*)
American crow (*Corvus brachyrhynchos*)	American robin (*Turdus migratorius*)
White-throated sparrow (*Zonotrichia albicollis*)	Brown thrasher (*Toxostoma rufum*)
Red-eyed vireo (*Vireo olivaceus*)	White-eyed vireo (*Vireo griseus*)

Sources: SCDNR 2005a; SCE&G 2010a.
NOTE: Taxa in bold represent South Carolina Priority Species (SCDNR 2005b).

2.4.1.2 Terrestrial Resources – Transmission Lines

This section describes terrestrial resources known to occur on or in the vicinity of the existing transmission-line corridors and in proposed new transmission-line corridors required to integrate the electrical power generated at proposed VCSNS Units 2 and 3 into the electrical grid system. As described in Section 2.2.2, a total of six new offsite 230-kV transmission lines would be needed to distribute the power generated by the proposed Units 2 and 3 at the VCSNS site. This would require upgrading existing transmission lines within existing corridors and clearing for new corridors. Santee Cooper would maintain two of the lines, which total 239 mi, and SCE&G would maintain the other four in three corridors for a total of 153 corridor mi (one double-circuit line and two single-circuit lines). The proposed transmission-line corridors pass through forested and agricultural lands typical of central South Carolina. Most of the lines would be situated in two ecoregions, the Southern Outer Piedmont and Sandhills. Two of the proposed transmission lines would extend slightly into the Coastal Plain ecoregion (See Figure 2-5 for proposed transmission line route). Land use along the proposed SCE&G and Santee Cooper transmission-line corridors is summarized in Table 2-2 and Table 2-3.

The proposed corridors for the VCSNS-Lake Murray line (SCE&G), the VCSNS-Flat Creek line (Santee Cooper), and VCSNS-Killian line are located entirely within the Southern Outer Piedmont ecoregion. Each line would be routed within existing corridors to the extent possible with the exception of approximately 17 mi of new corridor, adjacent to exisiting corridor, required for the Flat Creek line, and approximately 6 mi of new corridor, not adjacent to existing corridor, needed for the VCSNS-Killian line (FP&S 2008; MACTEC 2008, 2009; Pike 2010). Because these three proposed transmission lines would lie entirely within the Southern Outer Piedmont ecoregion, the habitat types are the same as those described for the VCSNS site in Section 2.4.1.1.

The proposed VCSNS-Varnville (167 mi) and VCSNS-St. George No. 1 and No. 2 (98 mi) transmission lines cross several counties and ecoregions. Both begin in the Southern Outer Piedmont and cross the Sandhills into the Coastal Plain ecoregion. Brief descriptions of the habitat types for both ecoregions are provided below (Griffith et al. 2002). The VCSNS-Varnville line (Santee Cooper) would be routed within existing transmission-line corridors except for approximately 22 mi of new corridor adjacent to existing corridor and 0.5 mi of new corridor not adjacent to existing corridor. The VCSNS-St. George No. 1 and 2 lines (SCE&G) would be routed entirely within existing corridors (MACTEC 2009; Pike 2010).

The Sandhills ecoregion is the inland portion of the Coastal Plain that forms a discontinuous belt of varying widths of deep sands across the middle of the state (SCDNR 2005a). The sandy soils create a xeric environment that supports distinctive vegetation dominated by longleaf pines and American turkey oaks (*Quercus laevis*). High-frequency, low-intensity fires in the past created and supported fire-adapted longleaf pine-wiregrass communities, characterized by longleaf pine and loblolly pine with a midstory of oaks, mostly turkey oak along with blackjack oak (*Q. marilandica*), upland willow oak (*Q. incana*), and post oak (*Q. stellata*). However, fire suppression in the last several decades has allowed succession to proceed to oak-hickory forests similar to those of the Piedmont. Logging activities and fire suppression created large tracts of even-aged pine plantations and forests that do not provide high-quality wildlife habitat (SCDNR 2005a). Vegetation community types in the Sandhills ecoregion include grassland and early successional habitats, Sandhills pine woodland, seepage slopes, ponds and depressions, blackwater stream systems, and river bottoms. Common wildlife species found in the Sandhills ecoregion are white-tailed deer, eastern cottontail, gray squirrel, opossum, and raccoon. A variety of bird species also inhabit the region and include wild turkey (*Meleagris gallopavo*), northern mockingbird (*Mimus polyglottos*), and several species of warblers. A high diversity of reptiles and amphibians reside in the various habitats present in this region (SCDNR 2005a; Griffith et al. 2002).

The Coastal Plain, the largest ecoregion in South Carolina, consists of two different landscapes. The inner portion bordering the Sandhills is largely agricultural, with small patches and hardwood remnant forests along creeks. The flatwoods make up the outer portion, which is primarily pine-dominant forest. Large floodplains cross both portions and a majority of them are forested. The most dominant vegetation habitat types are grassland and early successional habitats, pine forest, and river bottoms (SCDNR 2005a). The southern floodplain forests include bottomland hardwood forest consisting of bottomland oaks, red maple, sweetgum, green ash (*Fraxinus pennsylvanica*), bitternut hickory (*Carya cordiformis*), and cypress-gum swamps dominated by water tupelo (*Nyssa aquatica*), swamp tupelo (*Nyssa biflora*), bald cypress (*Taxodium distichum*), and pond cypress (*Taxodium ascendens*) (Griffith et al. 2002). Although understory vegetation in the cypress-gum swamp community is sparse, a variety of wildlife species − from amphibians to mammals – use this habitat. Common wildlife species found in this region include many game species – white-tailed deer, eastern cottontail, gray squirrel, opossum, raccoon, wild turkey, northern bobwhite (*Colinus virginianus*), mourning dove (*Zenaida macroura*), red fox (*Vulpes vulpes*), gray fox, wood duck (*Aix sponsa*), mink (*Mustela vision*), otter (*Lontra canadensis*), and beaver (SCE&G 2010a; SCDNR 2005b).

2.4.1.3 Important Terrestrial Species and Habitats

The NRC has defined important species as any species that are rare, ecologically sensitive, play an ecological role, or are relied on by a valuable species, and/or have economic or recreational value (NUREG-1555 [NRC 2000]). The U.S. Fish and Wildlife Service (FWS) identifies threatened or endangered species in 50 CFR 17.11 and 50 CFR 17.12. Important species also include rare species proposed for listing as threatened or endangered, published in the *Federal Register* (FR) as candidates for listing, or listed as threatened, endangered, or species of concern by the state in which they occur. Biological indicator species that respond to and indicate environmental change are also classed as important species.

No areas designated by FWS as critical habitat exist at the VCSNS site (NRC 2004). SCE&G conducted surveys for threatened and endangered species at the VCSNS site and found none (SCE&G 2002a; Nelson 2006, 2007). The locations of ecological surveys conducted on the VCSNS site are shown in Figure 2-15.

Threatened, endangered, and other special-status species that may occur in the vicinity of the VCSNS site are listed in Table 2-16. This table is composed of listed species with recorded occurrences in Fairfield, Lexington, Newberry, and Richland Counties in South Carolina (FWS 2010; SCDNR 2010a).

The review team's biological assessment of the Federally listed threatened and endangered terrestrial plant and animal species that potentially could occur at or near the VCSNS site is provided in Appendix F. The review team has prepared a supplement to the biological assessment to address comments from the FWS. The supplement is included in Appendix F. Life-history attributes of species pertinent to the review of SCE&G's application, as well information about the occurrence of these species in the project area, are summarized below.

Threatened and Endangered Species Occurring Within and in the Vicinity of the VCSNS Site (within 6 mi of the site)

Fauna

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Rafinesque's big-eared bat is State-listed as endangered and is found in forested areas, primarily in pine or mixed pine-hardwood stands. This species roosts in a variety of places including hollow trees, under bark, in abandoned buildings, and under bridges. The species has been recorded in Aiken and Richland Counties, but there are no recorded occurrences at the VCSNS site (NRC 2004).

Bald eagle (*Haliaeetus leucocephalus*). The bald eagle was the only Federally listed species found on the VCSNS site during the surveys conducted in 2002, 2006, 2008, and 2009 (SCE&G 2002a; Nelson 2006; Tetra Tech NUS, Inc. 2008, 2009a). The bald eagle was delisted in 2007 but remains protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Adult and juvenile bald eagles are commonly observed on the VCSNS site, and they nest and forage along Monticello and Parr reservoirs. The closest nest is located on the north end of the jetty in the Monticello Reservoir, approximately 1.7 mi north of proposed VCSNS Units 2 and 3, and another one is located on the west side of the Parr Reservoir approximately 1.8 mi northwest of the proposed new reactor units as shown in Figure 2-14 (SCE&G 2010a).

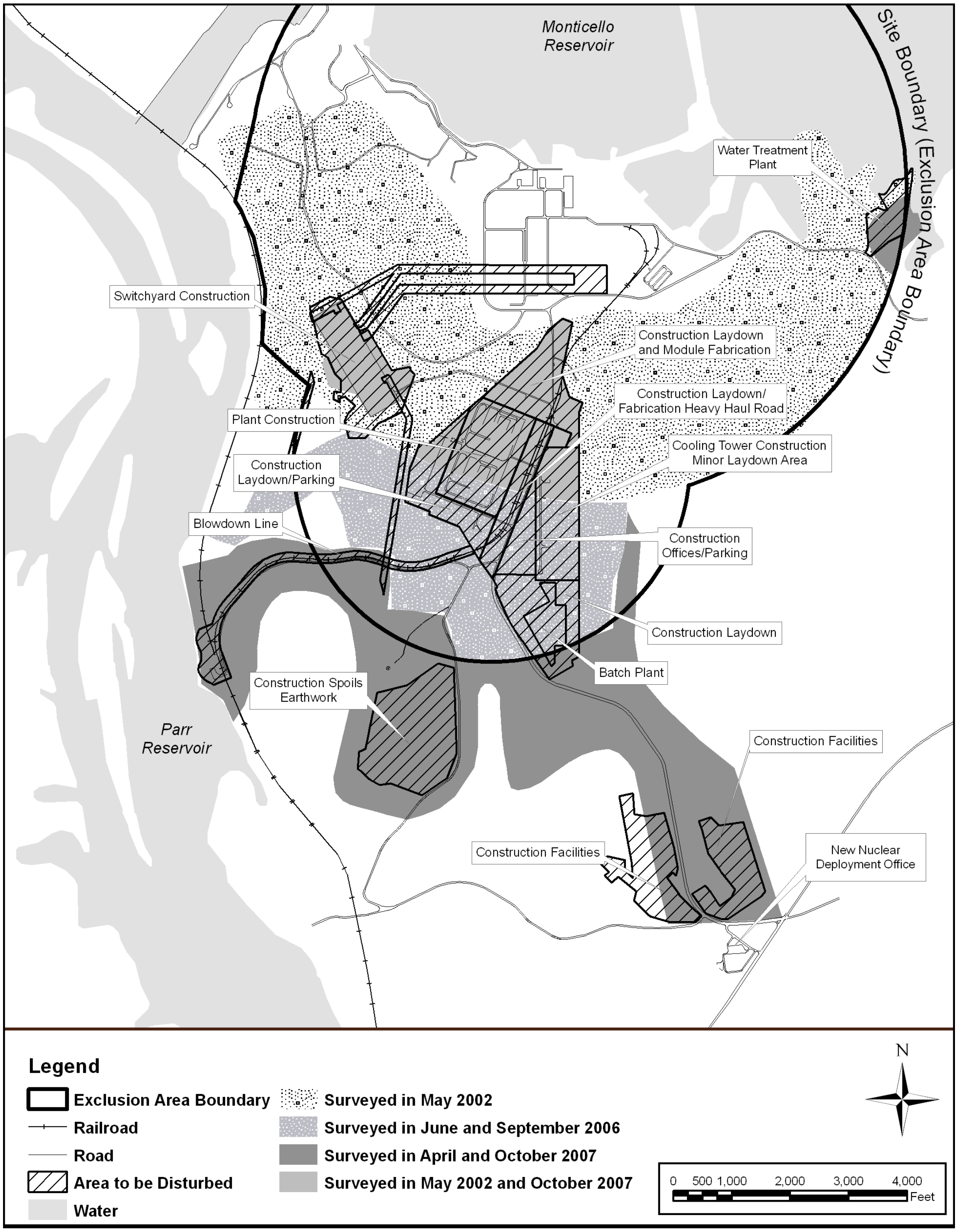

Figure 2-15. Threatened and Endangered Species Survey Locations at the VCSNS Site (based on SCE&G 2010g)

Table 2-16. Federally and State-Listed Terrestrial Species Occurring Within and in the Vicinity of the VCSNS Site (within 6 mi of the site)

Scientific Name	Common Name	Federal/State Status	County
Mammals			
Corynorhinus rafinesquii	Rafinesque's big-eared bat	SE	Richland
Birds			
Haliaeetus leucocephalus	Bald eagle	BGEPA, SE, ST	Fairfield, Lexington, Newberry, Richland
Picoides borealis	Red-cockaded woodpecker	FE/SE	Richland
Mycteria americana	Wood stork	FE/SE	Lexington, Newberry, Richland
Amphibians			
Hyla andersonii	Pine Barrens treefrog	ST	Richland
Plants			
Echinacea laevigata	Smooth coneflower	FE	Lexington, Richland
Lysimachia asperulifolia	Rough-leaved loosestrife	FE	Richland
Oxypolis canbyi	Canby's dropwort	FE	Richland

Sources: SCDNR 2010a; FWS 2010
BGEPA = Bald and Golden Eagle Protection Act; FE = Federally listed as endangered; SE = State listed as endangered; ST = State listed as threatened

Wood stork (*Mycteria americana*). The wood stork is Federally and State-listed as endangered and is known to occur in Lexington and Richland Counties (FWS 2010). A variety of wetlands are used by this species for nesting, feeding, and roosting, and in South Carolina, colony sites are surrounded by extensive palustrine forested wetlands. Wood storks are known to nest in the upper branches of black gum or cypress trees that are located in standing water (swamps). Shallow, open water is required for successful foraging (FWS 1986; Murphy 2006).

Red-cockaded woodpecker (*Picoides borealis*). The red-cockaded woodpecker is listed as Federally and State endangered and is known to occur in Lexington and Richland Counties (FWS 2010). Populations of this species are distributed across the southeastern United States and managed by distinct recovery units. Red-cockaded woodpeckers are dependent on open, mature pine forests and savannahs for prime foraging and nesting habitat. The large, old pines are needed because the birds excavate cavities in the living trees completely within the heartwood to roost and nest in. The cavity trees must be in homogeneous stands of pine with little to no midstory present. Red-cockaded woodpeckers require 75 to 200 ac of foraging habitat (large mature pines) with a well-developed herbaceous layer that includes native bunchgrasses and forbs. There is no suitable habitat for this species on the VCSNS site (NRC 2004).

Pine barrens treefrog (*Hyla andersonii*). The pine barrens treefrog is State-listed as threatened and is known to occur in Richland County (SCDNR 2010a). This species inhabits trees in swamps adjacent to sandhill habitats (NRC 2004). There is no recorded occurrence of this species on or near the VCSNS site (FPC 1974) and none of the species was encountered during any of the surveys in 2002, 2006, or 2007 (see Figure 2-15) (SCE&G 2002a; Nelson 2006, 2007).

Flora

Smooth coneflower (*Echinacea laevigata*). Smooth coneflower is Federally-listed as endangered and is known to occur in Richland County and may possibly occur in Lexington County (SCDNR 2010a; FWS 2010). This species is found in meadows and open woodlands on basic or near neutral soils, often with eastern redcedar. Questions remain concerning the biology and natural distribution of this species in South Carolina (Nelson 2006). It is rare throughout its range and has sustained significant habitat loss, at least in part due to fire-suppression activities (Porcher and Rayner 2001). Smooth coneflower was not observed in the study area during surveys and the likelihood of it being present on the VCSNS site is marginal due to the lack of appropriate soils (Nelson 2007).

Rough-leaved loosestrife (*Lysimachia asperulifolia*). The rough-leaved loosestrife is Federally-listed as endangered and is known to occur in Richland County (FWS 2010; SCDNR 2010a). This perennial herb occurs in ecotones between longleaf pine uplands and pond pine pocosins (upland swamps) in moist, sandy, or peaty soils with low vegetation. Rough-leaved loosestrife has also been found to occur in disturbed areas such as roadside depressions, powerline rights-of-way, firebreaks, and trails (NatureServe 2009a). There is no recorded occurrence of this species at or near the VCSNS site (NRC 2004) and none of this species is encountered during surveys conducted in 2006 and 2007 (Nelson 2006, 2007).

Canby's dropwort (*Oxypolis canbyi*). Canby's dropwort is Federally-listed as endangered and is known to occur in Richland County (FWS 2010). This perennial herb grows in wet meadows, wet pine savannahs, shallow pineland ponds, and cypress-pine swamps (NRC 2004). There are no recorded occurrences of this species at or adjacent to the VCSNS site (NRC 2004; Nelson 2006, 2007).

Important Species

Other important species, as defined in NUREG-1555 (NRC 2000) that occur on the VCSNS site are game species and Federal and/or State-listed species of concern. The game species present on the VCSNS site include white-tailed deer, eastern cottontail, northern bobwhite, mourning dove, wild turkey, and various species of waterfowl. Hunting is allowed and occurs in the Broad River Wildlife Management Area (BRWMA) that is adjacent to the VCSNS site and is managed by the SCDNR (SCE&G 2010a; SCDNR 2007). Several species listed as species of concern by the State of South Carolina are known to occur in Fairfield County and they include 12 plant species and 1 mammal, but none of the species was found on the VCSNS site during surveys (SCDNR 2006a; Nelson 2007).

Important Habitats

Important habitats include those designated as critical habitats by FWS as well as sanctuaries, refuges, and/or preserves that have been set aside and protected by State and/or Federal agencies or organizations. Critical habitats are those that are designated to support Federally listed threatened or endangered species. There are no areas on or near the VCSNS site that are designated as critical habitat by the FWS (SCE&G 2010a).

Wetlands on the VCSNS site are typically associated with small streams in steep ravines. Some wetlands on the site were created by beaver activity and could provide habitat for migratory birds and other avian communities throughout the year (Edwards and Otis 1999). There is also freshwater marsh habitat along the shores of reservoirs that contains emergent plants, such as pickerelweed, smartweed, and lizard’s tail, which provide food and/or cover for a variety of wildlife including waterfowl, migratory birds, white-tailed deer, and reptiles and amphibians (SCE&G 2010a, Table 2.4-4). Interior wetlands, reservoirs, and riverine systems present on the VCSNS site provide migration and wintering habitat for waterfowl and some shorebirds (SCDNR 2005a). SCE&G stated that all streamside management zones on the VCSNS site are protected and managed according to the South Carolina Forestry Commission best management practices (BMPs) (SCFC 1994).

There are two waterfowl management areas on and in the vicinity of the VCSNS site: the Monticello Reservoir Waterfowl Management Area and the Parr Reservoir Waterfowl Management Area, and both could be considered wildlife refuges (SCE&G 2010a). SCE&G refers to the area as Parr Reservoir Waterfowl Management Area and the SCDNR refers to the same area as the BRWMA. The BRWMA was established in the late 1970s to mitigate for activities associated with the construction of VCSNS Unit 1 and it is managed by SCDNR. This area is used by a wide variety of species such as ring-necked duck (*Aythya collaris*), wood duck, mallard, and green-winged teal. The BRWMA is also widely used for recreational activities such as hunting, bird watching, fishing, and boating. There is public access most of the year; however, due to the small size of the area, the BRWMA is closed to the public during winter months to avoid disturbing migrating waterfowl. Various other wildlife species use the BRWMA and are present throughout the year, such as wading birds and mammals (including deer, bobcat, fox, coyote, raccoon, and others). Birds of prey such as the bald eagle can also be found foraging in the BRWMA and nesting nearby (SCDNR 2007).

Important Species – Transmission Lines

Federally and State-listed terrestrial species classified as threatened and endangered and known to occur in the counties crossed by the proposed transmission lines (Calhoun, Chester, Colleton, Dorchester, Hampton, Fairfield, Lancaster, Lexington, Newberry, Orangeburg, and Richland) are listed in Table 2-17. The list was obtained from FWS county lists for the State of South Carolina and the SCDNR Heritage Trust database (FWS 2010; SCDNR 2010a).

Field surveys for threatened and endangered Federally and State-listed species were conducted during May, June, July, and August of 2002 along existing transmission-line corridors associated with VCSNS Unit 1 (SCE&G 2002b). A large portion of the new lines required for VCSNS Units 2 and 3 would be routed in the existing corridors, but approximately 45 mi of new corridor (including both adjacent to and not adjacent to existing right-of-way) would also be required (SCE&G 2010a; MACTEC 2010). SCE&G and Santee Cooper conducted reconnaissance-level studies in 2010 for each of the proposed new transmission-line corridors to identify areas likely to support habitat for Federally listed threatened and endangered plant and animal species. They conferred with the FWS and SCDNR and acquired the most current GIS data to determine where the targeted Federally listed threatened and endangered species surveys should be conducted (Palmetto 2010; MACTEC 2010). State-listed species were not addressed in the 2010 field surveys. SCE&G and Santee Cooper overlaid their proposed transmission-line corridor routes onto the SCDNR and FWS occurrence maps to identify potential areas where protected species might occur. On-the-ground surveys were then conducted by SCE&G and Santee Cooper in September, October, and November 2010 in the specific areas identified with the highest potential for threatened and endangered species to occur (Palmetto 2010; MACTEC 2010). No critical habitat was identified and no targeted species were observed (Palmetto 2010; MACTEC 2010; SCDNR 2010b).

Fauna

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Rafinesque's big-eared bat is State-listed as endangered and is found in forested areas, primarily in pine or mixed pine-hardwood stands. This species roosts in a variety of places including hollow trees, under bark, in abandoned buildings, and under bridges. The species has been recorded in Colleton, Dorchester, Orangeburg, and Richland Counties (SCDNR 2010a). Surveys for State-listed species were not conducted along the proposed transmission-line corridors, but there were no known occurrences of this species within or within 1 mi of any of the proposed corridors (SCDNR 2010b).

Table 2-17. Federally and State-Listed Terrestrial Species in Counties Crossed by the Proposed Transmission-Line Corridors

Scientific Name	Common Name	Legal Status	County
Mammals			
Corynorhinus rafinesquii	Rafineque's big-eared bat	SE	Colleton, Dorchester, Orangeburg, Richland
Birds			
Elanoides forficatus	American swallow-tailed kite	SE	Dorchester
Haliaeetus leucocephalus	Bald eagle	BGEPA/ SE	Calhoun, Chester, Colleton, Dorchester, Fairfield, Lancaster, Lexington, Newberry, Orangeburg, Richland
Mycteria americana	Wood stork	FE/SE	Calhoun, Colleton, Dorchester, Hampton, Lexington, Newberry, Richland
Picoides borealis	Red-cockaded woodpecker	FE/SE	Calhoun, Chester, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland
Sterna antillarum	Least tern	ST	Colleton, Dorchester
Reptiles			
Gopherus polyphemus	Gopher tortoise	SE	Colleton, Dorchester, Hampton
Clemmys guttata	Spotted turtle	ST	Colleton, Dorchester, Hampton
Amphibians			
Ambystoma cingulatum	Flatwoods salamander	FT/SE	Colleton, Orangeburg
Hyla andersonii	Pine barrens treefrog	ST	Richland
Pseudobranchus striatus	Dwarf siren	ST	Hampton, Orangeburg
Rana capito	Gopher frog	SE	Dorchester, Hampton, Orangeburg
Vascular Plants			
Amphianthus pusillus	Pool sprite	FT/ST	Lancaster
Echinacea laevigata	Smooth coneflower	FE/SE	Lancaster, Lexington, Richland
Helianthus schweinitzii	Schweinitz's sunflower	FE/SE	Lancaster, Lexington
Isoetes melanospora	Black-spored quillwort	FE/SE	Lancaster
Lindera melissifolia	Pondberry	FE/SE	Colleton, Dorchester
Lysimachia asperulifolia	Rough-leaved loosestrife	FE/SE	Richland
Oxypolis canbyi	Canby's dropwort	FE/SE	Colleton, Dorchester, Hampton, Orangeburg, Richland
Schwalbea americana	American chaffseed	FE	Colleton

Sources: SCDNR 2010a; FWS 2010
BGEPA = Bald and Golden Eagle Protection Act; FE = Federally listed as endangered;
FT = Federally listed as threatened; SE = State listed as endangered; ST = State listed as threatened

Bald eagle (*Haliaeetus leucocephalus*). The bald eagle was delisted in 2007 but remains protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. There are no known occurrences of bald eagle nests within 0.5 mi of the proposed SCE&G corridors identified by the FWS data layer, nor were any nests observed during on-the-ground surveys conducted along proposed corridors located within 2 mi of rivers or large bodies of water (Palmetto 2010). The closest nest to a Santee Cooper proposed corridor is approximately 1 mi from the VCSNS-Varnville line in the Broad River drainage in Newberry County (MACTEC 2010).

Wood stork (*Mycteria americana*). The wood stork is Federally and State-listed as endangered and is known to occur in Richland County (FWS 2010). A variety of wetlands are used by this species for nesting, feeding, and roosting, and in South Carolina, colony sites are surrounded by extensive palustrine forested wetlands. Wood storks are known to nest in the upper branches of black gum or cypress trees that are located in standing water (swamps). Shallow, open water is required for successful foraging (FWS 1986; Murphy 2006). There are no known occurrences of wood stork rookeries in the proposed transmission-line routes and none were observed during field surveys, but there is sufficient foraging habitat present throughout the project area and it is likely wood storks could inhabit those areas (Palmetto 2010; MACTEC 2010; SCDNR 2010b).

Red-cockaded woodpecker (*Picoides borealis*). The red-cockaded woodpecker is listed as Federally and State endangered and is known to occur in Lexington and Richland Counties (FWS 2010). Populations of this species are distributed across the southeastern United States and managed by distinct recovery units. Red-cockaded woodpeckers are dependent on open, mature pine forests and savannahs for prime foraging and nesting habitat. The large, old pines are needed because the birds excavate cavities in the living trees completely within the heartwood to roost and nest in. The cavity trees must be in homogeneous stands of pine with little to no midstory present. Red-cockaded woodpeckers require 75 to 200 ac of foraging habitat (large mature pines) with a well-developed herbaceous layer that includes native bunchgrasses and forbs.

When reviewed in 2010, the SCDNR elemental occurrence database indicated that red-cockaded woodpeckers occur in Dorchester and Orangeburg Counties (SCDNR 2010b). There is one recorded occurrence within 0.5 mi of the proposed St. George 1 – St. George 2 transmission line corridor; however, SCDNR stated that it is an extirpated population (SCDNR 2011). There are two other recorded occurrences of the red-cockaded woodpecker approximately 1 mi away from the proposed transmission line corridors; however, none were observed during targeted field surveys conducted by SCE&G and Santee Cooper in 2010 (Palmetto 2010; MACTEC 2010; SCDNR 2010b). SCE&G and Santee Cooper identified fifteen locations on the proposed transmission line rights-of-way as potentially providing habitat for the red-cockaded woodpecker. Only one site, located on the proposed new right-of-way for the

VCSNS-Flat Creek line, was found in the field to actually contain suitable foraging habitat (MACTEC 2010).

American swallow-tailed kite (*Elanoides forficatus*). The American swallow-tailed kite is State listed as endangered in Dorchester County (SCDNR 2010a). It is found in floodplain forests and other large tracts of forested wetlands and mixed pine habitats of the outer coastal plain (SCDNR 2006b). Surveys for State-listed species were not conducted along the proposed transmission-line corridors, but there were no known occurrences of this species within 1 mi of any of the proposed corridors (SCDNR 2010b).

Flatwoods salamander (*Ambystoma cingulatum*). The flatwoods salamander is Federally listed as threatened and State-listed as endangered and is known to occur in Colleton and Orangeburg Counties (FWS 2010; SCDNR 2010a). Populations of this species are distributed throughout the lower Southeastern Coastal Plain from southern South Carolina through southern Georgia to northern Florida and southwestern Alabama (Palis 1997). Flatwoods salamander habitat includes generally open-canopied pine savannas and flatwoods of the southeastern coastal plain with cypress swamps present for breeding (Palis 1997). Four sites were identified to have potential habitat for the flatwoods salamander, but field observation determined that none of them contained suitable habitat (Palmetto 2010).

Pine barrens treefrog (*Hyla andersonii*). The pine barrens treefrog is State-listed as threatened and is known to occur in Richland County (SCDNR 2010a). This species inhabits trees in swamps adjacent to sandhill habitats (NRC 2004). Surveys for State-listed species were not conducted along the proposed transmission-line corridors, but there were no known occurrences of this species within 1 mi of any of the proposed corridors (SCDNR 2010b).

Gopher frog (*Rana capito*). The gopher frog, a stocky frog approximately 6 to 9 cm long with a loud call, is State-listed as endangered and occurs in Dorchester, Hampton, and Orangeburg Counties (SCDNR 2010a). The primary habitat for this species is native xeric upland habitats that include longleaf pine, turkey oak sandhill, xeric to mesic longleaf pine flatwoods, sandpine scrub, xeric oak hammocks, and varying successional stages of these habitats (NatureServe 2009b). Gopher frogs are generally associated with areas where gopher tortoises occur (NatureServe 2009b). Surveys for State-listed species were not conducted along the proposed transmission-line corridors, but there are no known occurrences of this species within 1 mi of any of the proposed corridors (SCDNR 2010b).

Dwarf siren (*Pseudobranchus striatus*). The dwarf siren is a slender, eel-like salamander with no hind limbs that it State-listed as threatened and occurs in Dorchester and Hampton Counties (SCDNR 2010a; NatureServe 2009b). This species is most often associated with cypress or gum ponds as well as other shallow, acidic wetlands of the flatwoods, usually found in thick vegetation or in bottom mud and debris (NatureServe 2009b; Amphibiaweb 2011). Surveys for State-listed species were not conducted along the proposed transmission-line corridors, but there are no known occurrences of this species within 1 mi of any of the proposed corridors (SCDNR 2010b).

Gopher tortoise (*Gopherus polyphemus*). The gopher tortoise is State-listed as endangered in Colleton, Dorchester, and Hampton Counties (SCDNR 2010a). This species is a large terrestrial turtle with a domed carapace. It commonly occupies a variety of well-drained sandy habitats, including sandhill, sand pine scrub, xeric hammock, pine flatwoods, dry prairie, coastal grasslands and dunes and mixed hardwood-pine communities (NatureServe 2009b). The gopher tortoise prefers open habitats that support a variety of herbaceous ground cover for foraging (NatureServe 2009b). Surveys for State-listed species were not conducted along the proposed transmission-line corridors, but there are no known occurrences of this species within 1 mi of any of the proposed corridors (SCDNR 2010b).

Spotted turtle (*Clemmys guttata*). The spotted turtle is State-listed as threatened in Colleton, Dorchester, and Hampton Counties (SCDNR 2010a). It inhabits a variety of wetland types including small ponds, small streams, swamps, flooded forests, and other shallow waterbodies (SCDNR 2006b). Surveys for State-listed species were not conducted along the proposed transmission-line corridors, but there were no known occurrences of this species within or within 1 mi of any of the proposed corridors (SCDNR 2010b).

Flora

Smooth coneflower (*Echinacea laevigata*). Smooth coneflower is Federally and State-listed as endangered and is known to occur in Richland and Lancaster Counties, and may possibly occur in Lexington County (SCDNR 2006a; FWS 2010; SCDNR 2010a,b). This species is found in meadows and open woodlands on basic or near neutral soils, often with eastern redcedar. Questions remain concerning the biology and natural distribution of this species in South Carolina (Nelson 2006). It is rare throughout its range and has sustained significant habitat loss, at least in part due to fire-suppression activities (Porcher and Rayner 2001).

A total of 13 locations were identified (10 in the proposed SCE&G transmission-line corridors and 3 in the proposed Santee Cooper corridors) to have habitat characteristics to support smooth coneflower, but no individuals were found in field surveys (Palmetto 2010; MACTEC 2010). In several instances, although a location was identified as having high potential for the species to occur, on-the-ground surveys determined suitable habitat did not exist (MACTEC 2010).

Rough-leaved loosestrife (*Lysimachia asperulifolia*). The rough-leaved loosestrife is Federally and State-listed as endangered and is known to occur in Richland County (FWS 2010; SCDNR 2010a). This species was not identified by SCDNR to have elemental occurrence data within 1 mi of any of the proposed transmission-line corridors (SCDNR 2010b). This perennial herb occurs in ecotones between longleaf pine uplands and pond pine pocosins (upland swamps) in moist, sandy, or peaty soils with low vegetation. Rough-leaved loosestrife has also been found to occur in disturbed areas such as roadside depressions, powerline rights-of-way, firebreaks, and trails (NatureServe 2009a). A total of 29 locations were identified by SCE&G and Santee Cooper as having high potential for occurrence of rough-leaved loosestrife, but field assessments determined that suitable habitat did not exist at any of those locations (Palmetto 2010; MACTEC 2010).

Canby's dropwort (*Oxypolis canbyi*). Canby's dropwort is Federally and State-listed as endangered and is known to occur in Richland County (FWS 2010). This perennial herb grows in wet meadows, wet pine savannahs, shallow pineland ponds, and cypress-pine swamps (NRC 2004). Twenty wetland depressions along the VCSNS-St. George No. 1 and No. 2 corridor were identified and field-checked in November of 2010 and only one of them contained suitable habitat (Palmetto 2010). The wetland depression was surveyed for the presence of Canby's dropwort, but none was found (Palmetto 2010). The closest known population of this species to the proposed Santee Cooper transmission-line corridor occurs approximately 1.5 mi from an existing corridor in Orangeburg County (MACTEC 2010). Nine locations were surveyed for the presence of Canby's dropwort and none were found.

Pool sprite (*Amphianthus pusillus*). Pool sprite, also known as little amphianthus, is listed as threatened and is known to occur in Lancaster County, which would be crossed by the proposed transmission-line corridors (FWS 2010; SCDNR 2010a). There was one recorded occurence within 1 mi of a proposed transmission-line corridor in Lancaster County identified by SCDNR (SCDNR 2010b). This aquatic plant occurs in small (usually less than 1-m^2) shallow pools on the crests and flattened slopes of granite outcrops and requires ideal moisture and light conditions for successful seed germination (FWS 2008b). Pool sprite is endemic to open flat granite rocks, with enough surface area to allow the development of shallow pools that fill with water during spring rainy periods when the seeds germinate, followed by rapid growth, flowering, and fruit setting (NRC 2003). The entire life span of this delicate plant is only 3 to 4 weeks (FWS 2008b). Aerial photography identified granite outcrops in Lancaster County along the proposed new right-of-way that were subsequently field-verified and found not to contain suitable habitat (MACTEC 2010).

Schweinitz's sunflower (*Helianthus schweinitzii*). Schweinitz's sunflower is listed as endangered and is known to occur in Lancaster County, which would be crossed by the proposed VCSNS-Flat Creek line corridor (FWS 2010; MACTEC 2010). There are no recorded occurrences within 1 mi of any of the proposed transmission-line corridors (SCDNR 2010b). It is a shade-intolerant perennial herb that produces solitary stems up to 2 m tall and bears yellow flower heads in late summer and early autumn. This species requires full to partial sun and prefers Piedmont longleaf pine forest clearings and edges. Adapted to high-frequency, low-intensity fires, this species occurs mostly in transmission-line corridors and along roadsides because fire-suppression activities throughout its range have depleted suitable natural habitat (NatureServe 2009b).

Five locations were identified as having high potential for Schweinitz's sunflower and were subsequently ground surveyed (MACTEC 2010). No Schweinitz's sunflowers or suitable habitat were found at any locations (Palmetto 2010). In addition, field teams conducted limited visual reconnaissance of this species in areas of moderate potential along proposed existing and new rights-of-way, but no individuals or suitable habitat were found (MACTEC 2010).

Black-spored quillwort (*Isoetes melanospora*). The black-spored quillwort is Federally and State-listed as endangered and is known to occur in Lancaster County at Forty-Acre Rock (FWS 2010; NatureServe 2009a). There was one recorded occurrence within 1 mi of a proposed transmission-line corridor in Lancaster County (SCDNR 2010b). This granite outcrop species is an inconspicuous plant, generally under 8 cm tall. Like the pool sprite, another granite outcrop species, the black-spored quillwort is restricted to shallow, flat-bottomed depressions on granitic outcrops, where water collects after rain. These depressions are less than 1 cm deep and usually contain soil at least 2 cm deep (NatureServe 2009a). The depressions, sometimes called vernal pools, solution pits, or weather pits, are formed naturally by erosion over millions of years. Plants rarely occur in shallow pools formed by quarrying activities (FWS 2008b). Aerial photography identified granite outcrops in Lancaster County along the proposed new right-of-way that were subsequently field-verified to not contain suitable habitat for black-spored quillwort (MACTEC 2010).

Pondberry (*Lindera melissifolia*). Pondberry is Federally and State-listed as endangered and is known to occur in Colleton and Dorchester Counties (FWS 2010). There are no recorded occurrences within 1 mi of any of the proposed transmission-line corridors (SCDNR 2010b). This deciduous aromatic shrub ranges from 0.5 to 2 m tall and usually grows in clumps in a variety of seasonal wetland habitats throughout the region (NatureServe 2009a). Its flowering period is from late February to mid-March; its fruiting period is from August to early October. Searches for this species can be performed throughout the entire growing season, because masses of yellowish flowers are produced prior to leafing out, making the thicket-forming shrubs conspicuous, and leaves are diagnostic when combined with growth habit and/or fruit (USDA 2010). Habitat alteration and loss are the most considerable threat to this species (NatureServe 2009a). Six locations were identified to have high potential for pondberry and were subsequently ground surveyed (MACTEC 2010). Neither individuals nor suitable habitat were found at any of the locations (MACTEC 2010).

American chaffseed (*Schwalbea americana*). American chaffseed is Federally and State-listed as endangered and is known to occur in Colleton County (FWS 2010; SCDNR 2010a). There are no recorded occurrences within 1 mi of any of the proposed transmission-line corridors (SCDNR 2010b). This species is a monotypic perennial in the figwort family and is found in open pine flatwoods and savannas in moist to dry acidic sandy loam soils to sandy peat loams

(FWS 1995). Flowering occurs between April and June, but the dark brown stems are distinctive and easy to identify after flowering (FWS 1995). Four locations of potentially suitable habitat were identified in the Santee Cooper proposed transmission-line corridors. Neither individuals nor suitable habitat were found during ground surveys (MACTEC 2010).

Important Habitats – Transmission Lines

Wetlands

Palustrine, lacustrine, and riverine freshwater wetlands occur within and around all of the proposed six new transmission-line corridors and are typical of those found in the various physiographic regions of South Carolina. Palustrine wetlands make up approximately 70 percent of the total wetland area in the State of South Carolina (Dahl 1999). Palustrine wetlands include areas commonly referred to as wet pine flatwoods, pocosins, Carolina bays, beaver ponds, bottomland hardwood forests, swamps (muck peat), and freshwater marshes. Although they may be seasonally dry and may lack surface connections to stream systems, Carolina bays provide breeding habitat for numerous amphibians, including the flatwoods salamander (*Ambystoma cingulatum*), tiger salamander (*Ambystoma tigrinum*), and gopher frog (*Lithobates capito*) (SCDNR 2005a). Seeps and shrub bogs that occur in xeric longleaf pine habitat in the Sandhills ecoregion are home to the pine barrens treefrog (SCDNR 2005a). Lacustrine wetlands include the shallows of permanently flooded lakes and reservoirs and intermittent lakes. Riverine wetlands are limited to shallow freshwater river and stream channels or, in the case of deep rivers, to shallow areas along the shore. Palustrine forested wetlands are the most common wetland type that occurs in South Carolina and in the proposed transmission-line corridors (FP&S 2008; MACTEC 2008; Dahl 1999).

For the draft EIS, SCE&G and Santee Cooper estimated the extent of wetlands and other waters of the United States in its proposed transmission-line corridors by consulting available U.S. Department of Agriculture (USDA) county soil surveys, FWS National Wetlands Inventory (NWI) maps, and USGS topographic maps (FP&S 2008; MACTEC 2008). Subsequent to the draft EIS, both utilities completed wetland delineations on the proposed transmission-line corridors; and received a Preliminary Jurisdictional Determination from the USACE (USACE 2010).

2.4.1.4 Terrestrial Ecology Monitoring

Many ecological studies were conducted on or near the VCSNS site before and since the construction of Unit 1, including a baseline biotic survey for the Broad River Study Area by Dames and Moore (1974), the final EIS for the Parr Hydroelectric Project by the Federal Power Commission in 1974 (FPC 1974), an environmental monitoring report for the VCSNS Unit 1 site prepared by Dames and Moore for SCDHEC and NRC (Dames and Moore 1985). As recently as 2002, a threatened and endangered species survey of the Unit 1 site and transmission-line corridors in support of license renewal (SCE&G 2002b). Targeted studies were conducted in 2006 and 2007 to survey for threatened and endangered species and small mammal trapping was conducted in 2008 and 2009 on the VCSNS site (Nelson 2006, 2007; Tetra Tech NUS, Inc. 2008, 2009a). Other than the reconnaisance and field studies conducted to support this EIS as described above, no terrestrial ecology monitoring has been performed for the proposed transmission-line corridors.

2.4.2 Aquatic Ecology

The major aquatic environments within the vicinity of proposed VCSNS Units 2 and 3 include the Broad River, Monticello and Parr reservoirs, and Mayo Creek (Figure 2-3). Mayo Creek is the largest stream within the site vicinity and it receives drainage from several small seasonal tributary channels. The Monticello and Parr reservoirs are the largest waterbodies near the site. The proposed VCSNS Units 2 and 3 would withdraw water from Monticello Reservoir and discharge it to Parr Reservoir.

2.4.2.1 Aquatic Resources – Site and Vicinity

Aquatic resources on or in the vicinity of the VCSNS site include the river, reservoirs, and creek mentioned previously. There are no aquatic sanctuaries or preserves that could be affected by the proposed action, and no habitats are present that could be defined as critical habitat for an aquatic species.

Broad River

The Broad River basin encompasses approximately 2400 mi^2 and 27 watersheds within the State of South Carolina and includes almost 2800 mi of streams and more than 14,500 ac of lakes. The basin falls within the boundaries of seven counties in the state: Cherokee, Spartanburg, York, Union, Chester, Fairfield, and Richland (SCDHEC 2007). Within the State of South Carolina, the Broad River basin is entirely within the Piedmont ecoregion. The Piedmont is characterized by gently rolling to hilly terrain, with relatively confined stream valleys, and elevations ranging from 375 to 1000 ft above msl. Major tributaries of the Broad River basin include the Tyger and Enoree rivers, which intersect the Broad River from the west (SCE&G 2010a). Of the 1.5 million ac associated with the basin, more than 60 percent are forested, with approximately 24 percent used for agriculture, and less than 10 percent classified as urban development (SCDHEC 2007). As shown in Figure 2-3, the Broad River flows south along the Sumter National Forest and flows to the west of the VCSNS site. A run-of-the-river impoundment along the Broad River near the vicinity of the VCSNS forms the Parr Reservoir.

The Broad River basin is a sub-basin within the larger Santee-Cooper River basin (Basin), the second largest basin in the eastern United States. Land-use practices, the construction of dams, and the deterioration of water quality led to the decline of diadromous fish in the Basin. Recent improvements to water quality and fish passage have prompted additional habitat improvements as outlined in the Santee-Cooper Basin Diadromous Fish Passage Restoration Plan (Plan) (FWS 2001). This multi-agency Plan focuses on restoring habitat connectivity for diadromous fish that were historically present within the Basin. Target species include American eel (*Anguilla rostrata*), American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis),* hickory shad (*Alosa mediocris*), Atlantic sturgeon (*Acipenserosyrinchus oxyrinchus*), and shortnose sturgeon (*Acipenser brevirostrum*). Objectives of the Plan include (1) increasing upstream passage for target fish species, (2) increasing downstream passage for target fish species, (3) restoring and maintaining adequate instream flows for fish migrations, (4) restoring and maintaining water-quality conditions, and (5) conserving, preserving, and restoring important habitats that support life-history strategies for migratory fish populations (FWS 2001).

Within the Basin, the Plan identified the Broad River sub-basin as a high priority for restoration due to the amount of potential habitat available as well as the quality of existing habitat. There is currently no evidence that the diadromous fish species targeted in the Plan reside within the vicinity of the VCSNS site; however, there are documented historical accounts of American shad and American eel within the Broad River in the vicinity of Fairfield and Newberry Counties as well as within waters upstream of the VCSNS site (FWS 2001). Historical accounts of sturgeon and blueback herring within the Basin lack sufficient information to link with specific geographic regions; however, there is evidence these fish migrated within the Broad River sub-basin (FWS 2001).

In response to the Plan, hydroelectric utilities and State and Federal entities have enacted the Santee River Basin Accord (Accord). The Accord outlines a systematic plan for enhancing and restoring passage at specific dams within the Basin. Several dams along the Broad River are slated for fish passage restoration if biological criteria are met for selected diadromous fish species at downstream monitored locations (SRBA 2008). The Plan and the Accord outline specific target species; however, it is thought that other nontarget migratory species such as striped bass (*Morone saxatilis*) and robust redhorse (*Moxostoma robustum*) will also benefit from restoration of fish passage at Broad River impoundments (FWS 2001; Self and Bettinger 2006, respectively).

Parr Reservoir

As described by SCE&G (2010a), the Parr Reservoir was created in 1914 by installing a 2000-ft-long dam across the Broad River at Parr Shoals (Figure 2-3). The purpose of the dam was to provide a pool for the original Parr Hydroelectric Plant. Before 1977, the surface area of the reservoir was 1850 ac. In 1977, the reservoir level was raised 9 ft, which increased the surface area to approximately 4400 ac, to accommodate the operation of the (SCE&G 2010a). Parr Reservoir is approximately 7 mi long and has an average water depth of 15 ft (SCE&G 2010a). Because of the operation of the FPSF, hydrologic patterns in the Parr Reservoir are variable. Generally, water from the Monticello Reservoir is released through the FPSF into Parr Reservoir throughout the day and early evening to provide hydroelectric power at the FPSF, resulting in a net southward flow in Parr Reservoir. During the night, when electrical demand is lower, water from Parr Reservoir is pumped upward into the Monticello Reservoir (SCE&G 2010a).

As described by SCE&G (2010a), the flow conditions and 4-day retention time of water in Parr Reservoir generally promote high dissolved oxygen levels and turbid conditions. As noted in Section 2.3, there are two SCDHEC water-quality monitoring stations in Parr Reservoir (Figure 2-12). The upstream station (B-346) is above the intake/discharge canal for the FPSF. The downstream station (B-345) is in the forebay near the Parr Shoals Dam. Fecal coliform concentrations at these stations were deemed low enough to support recreational (e.g., swimming) uses (SCDHEC 2007). According to SCDHEC (2007) water-monitoring results, water conditions were not optimal to support aquatic life at the two stations on Parr Reservoir. The total phosphorus concentrations at the upstream monitoring station above the intake/discharge canal for the FPSF were found to exceed the standards for supporting use by aquatic life. At the downstream station, elevated copper concentrations were deemed to exceed the aquatic life criterion, and therefore were not optimal to support aquatic life at this location (SCDHEC 2007). There are no fish consumption advisories in Parr Reservoir (SCDHEC 2009b).

Following commencement of operation at the VCSNS Unit 1, aquatic monitoring efforts in Parr Reservoir included an evaluation of the fish community composition by means of gillnetting and boat electroshocking. During 1983 and 1984, 27 species were sampled from Parr Reservoir (Dames and Moore 1985). Eight species of centrarchids accounted for 44 percent of the entire catch and two species of clupeids (gizzard shad [*Dorosoma cepedianum*] and threadfin shad [*D. petenense*]) accounted for 43 percent of the catch. The remaining catch included taxa that each contributed less than 10 percent of the total catch: ictalurids (6.5 percent), catostomids (3.3 percent), moronids (0.9 percent), cyprinids (0.9 percent), percids (0.7 percent), lepisosteids (0.2 percent), and esocids (0.02 percent) (Dames and Moore 1985).

During 2001 and 2002, SCDNR conducted an inventory of fishes in the Broad River. Using boat and backpack electroshocking methods, a total of 44 fish species were sampled throughout 27 km of the Broad River at stations both upstream and downstream of Parr Reservoir (Bettinger et al. 2003). The most dominant species sampled throughout the study included redbreast sunfish (*Lepomis auritus),* bluegill (*L. macrochirus*), and notchlip redhorse (*Moxostoma collapsum*). These three fish species made up 50 percent of the total catch. Other commonly encountered taxa in the Broad River included gizzard shad, whitefin shiner (*Cyprinella nivea)*, sandbar shiner (*Notropis scepticus)*, and brassy jumprock (*Moxostoma* cf. *lachneri*). A quantitative evaluation of the data set derived from electroshocking efforts indicated that the presence of impoundments along the Broad River did not result in fragmentation of the community composition of fishes; however Bettinger et al. (2003) suggest "…a different community composition might exist in the absence of dams." The Bettinger et al. (2003) study did not include a sampling site within the vicinity of the VCSNS site. However two sites between the Parr and Neal Shoals dams were included in the study (Figure 2-16); site 2 was located upstream of the confluence of the Enoree River, 22 km above Parr Shoals Dam and site 3 was located upstream of the Tyger River confluence. Taxa comprising more than 10 percent of the total combined catch at the sampling sites nearest the VCSNS site (i.e., sites 2 and 3) included gizzard shad, whitefin shiner, greenfin shiner (*Cyprinella chloristia*), spottail shiner (*Notropis hudsonius)*, sandbar shiner, notchlip redhorse, snail bullhead (*Ameiurus brunneus*), white perch (*Morone americana)*, margined madtom (*Noturus insignis*), redbreast sunfish, bluegill, redear sunfish (*L. microlophus)*, and Piedmont darter (*Percina crassa)* (Bettinger et al. 2003).

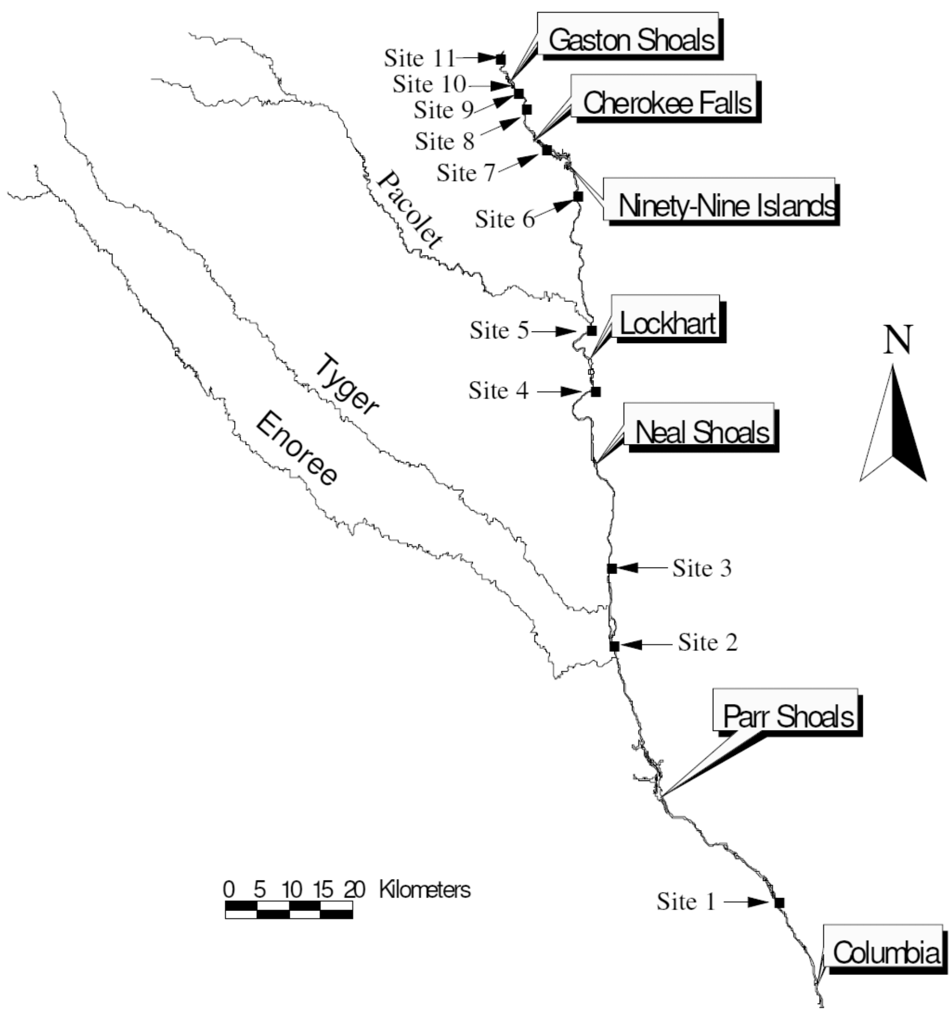

Figure 2-16. Broad River Basin and Impoundments (after Bettinger et al. 2003)

Between 2006 and 2009, SCE&G conducted intermittent inventories of fish community composition near the vicinity of the VCSNS site. The sampling efforts used a combination of boat electrofishing, gillnets, and hoop nets and documented 28 species of fish in Parr Reservoir (Table 2-18; Normandeau 2007, 2008, 2009a; Quattlebaum 2008a). Similar to the species composition determined during the 1983-1984 study year, the Normandeau (2007, 2008, 2009a) and Quattlebaum (2008a) sampling efforts found that clupeids and centrarchids comprised the largest percentages of catch in Parr Reservoir; 31 and 24 percent, respectively. Ictalurids (five species) accounted for 18 percent of the total abundance during the 2006-2009 effort, which represents an increase from the 1983-1984 Dames and Moore (1985) results. Gizzard shad, representing over 18 percent of the total catch, was the most abundant species sampled during the 2006-2009 Parr Reservoir sampling effort. Other predominant species included bluegill (15 percent of the total catch), threadfin shad (12 percent of the total catch), channel catfish (*Ictalurus punctatus*; 12 percent of the total catch), and white perch (11 percent of the total catch) (data derived from Normandeau 2007, 2008, 2009a; Quattlebaum 2008a).

SCDNR (2005b) designated priority conservation species throughout the state. Designations were focused on species that are rare or at risk of imperilment and also included consideration for species that may be at risk in locations outside the state boundaries. The SCDNR (2005b) assessment identified 56 freshwater fishes, 6 diadromous fishes, 26 freshwater mussels, and 4 freshwater snails. Species were ranked according to conservation priority, which included three categories: highest, high, and moderate. Of the 28 fish species collected during the 2006-2009 Parr Reservoir sampling effort (Normandeau 2007, 2008, 2009a; Quattlebaum 2008a), 6 are included in the SCDNR priority conservation species list. Designation of these six species ranges from moderate to highest priority (Table 2-18).

To examine the benthic community in Parr Reservoir, SCE&G collected benthic invertebrates near the proposed location of the discharge structure for Units 2 and 3 (approximately 1 km upstream of Parr Shoals Dam) and at an upstream control station approximately 9 km upstream of Parr Shoals Dam. Benthic samples were analyzed by Carnagey Biological Services (CBS). Seasonal (e.g., quarterly) monitoring occurred for one year between 2008 and 2009 (CBS 2008a, c; CBS 2009c, d). Results were evaluated using a combination of bioassessment metrics and analyzed using statistical comparison techniques. The bioassessment metrics included taxa richness, various biotic indices (e.g., Ephemeroptera, Plecoptera, and Trichoptera [EPT] index, North Carolina Biotic Index [NCBI]), and comparisons of functional groups and abundances described by Plafkin et al. (1989) in *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish.* The survey efforts yielded at least 22 different taxa from 8 orders (CBS 2008a, c; CBS 2009c, d). A temporally complete evaluation indicated that overall bioassessment metrics were not significantly different through time. These results indicate few differences in benthic community and water-quality conditions between the reference station and the proposed discharge location (CBS 2009d).

Table 2-18. Fish Species Sampled from 2006-2009 Survey Efforts in Mayo Creek and Parr and Monticello Reservoirs

Family	Common Name	Scientific Name	Relative Abundance (percent)[a]			Species Status[b]
			Mayo Creek	Parr Reservoir	Monticello Reservoir	
Catostomidae	Brassy jumprock	*Moxostoma* cf. *lachneri*	4.43	0.590	0.00	--
	Highfin carpsucker	*Carpiodes velifer*	0.00	0.147	0.00	Highest Priority
	Northern hogsucker	*Hypentelium nigricans*	0.6	0.00	0.194	--
	Notchlip redhorse	*Moxostoma collapsum*	0.00	2.06	0.824	Moderate Priority
	Quillback	*Carpiodes cyprinus*	0.00	0.811	0.048	High Priority
	Robust redhorse	*Moxostoma robustum*	0.00	0.147	0.00	Highest Priority
	Shorthead redhorse	*Moxostoma macrolepidotum*	0.00	5.16	1.45	--
Centrarchidae	Black crappie	*Pomoxis nigromaculatus*	0.00	0.147	2.28	--
	Bluegill	*Lepomis macrochirus*	0.795	15.0	29.2	--
	Largemouth bass	*Micropterus salmoides*	0.227	6.78	5.67	--
	Pumpkinseed	*Lepomis gibbosus*	0.00	1.11	1.36	--
	Redbreast	*Lepomis auritus*	15.4	0.074	0.582	--
	Redear sunfish	*Lepomis microlophus*	0.3	1.03	0.630	--
	Smallmouth bass	*Micropterus dolomieu*	0.00	0.295	0.194	--
	Warmouth	*Lepomis gulosus*	0.00	0.00	0.291	--
Clupeidae	Gizzard shad	*Dorosoma cepedianum*	0.00	18.4	25.3	--
	Threadfin shad	*Dorosoma petenense*	0.00	12.1	0.00	--
Cyprinidae	Bluehead chub	*Nocomis leptocephalus*	29.6	0.00	0.00	--
	Creek chub	*Semotilus atromaculatus*	7.83	0.00	0.00	--
	Eastern silvery minnow	*Hybognathus regius*	0.00	0.516	0.388	--
	Golden shiner	*Notemigonus crysoleucas*	0.00	0.590	0.00	--
	Greenfin shiner	*Cyprinella chloristia*	0.681	0.00	0.00	Moderate Priority
	Sandbar shiner	*Notropis scepticus*	10.8	0.147	0.00	--
	Spottail shiner	*Notropis hudsonius*	0.00	3.76	1.02	--
	Whitefin shiner	*Cyprinella nivea*	0.00	0.221	1.60	--
	Yellowfin shiner	*Notropis lutipinnis*	26.4	0.00	0.00	--
Ictaluridae	Blue catfish	*Ictalurus furcatus*	0.00	5.38	12.6	--

Table 2-18. (contd)

Family	Common Name	Scientific Name	Relative Abundance (percent)[a]			Species Status[b]
			Mayo Creek	Parr Reservoir	Monticello Reservoir	
	Channel catfish	*Ictalurus punctatus*	0.00	11.6	3.73	--
	Flat bullhead	*Ameiurus platycephalus*	0.114	0.00	0.485	Moderate Priority
	Margined madtom	*Noturus insignis*	0.114	0.00	0.00	--
	Snail bullhead	*Ameiurus brunneus*	0.00	0.074	0.048	Moderate Priority
	White catfish	*Ameiurus catus*	0.00	0.884	1.60	Moderate Priority
Lepisosteidae	Longnose gar	*Lepisosteus osseus*	0.00	0.295	0.00	--
Moronidae	White bass	*Morone chrysops*	0.00	0.00	0.097	--
	White perch	*Morone americana*	0.00	11.2	9.94	--
Percidae	Piedmont darter	*Percina crassa*	0.114	0.00	0.00	High Priority
	Seagreen darter	*Etheostoma thalassinum*	1.02	0.00	0.00	High Priority
	Tessellated darter	*Etheostoma olmstedi*	2.38	0.00	0.00	--
	Yellow perch	*Perca flavescens*	0.00	1.33	0.485	--
Poeciliidae	Eastern mosquitofish	*Gambusia holbrooki*	0.00	0.147	0.00	--

Sources: Data were derived from Normandeau (2007, 2008, 2009a), Tetra Tech NUS, Inc. (2007, 2009b), and Quattlebaum (2008a, b).

(a) Relative abundance was calculated as the total number of individuals (within a taxon) caught divided by the total number of individuals (among all taxa) within a particular waterbody. Note: survey approaches often included more than one sample method.

(b) The species status is a priority conservation rank designated by the South Carolina Department of Natural Resources (SCDNR 2005b).

-- = No conservation status assigned

Aquatic vegetation provides structural and functional ecosystem services to aquatic communities. Structurally, aquatic vegetation stabilizes sediments, can reduce flow velocities, and provides habitat for aquatic biota. Functionally, aquatic vegetation facilitates nutrient cycling in aquatic communities through growth and addition of biomass to the system, which can contribute to the base of the aquatic food web. SCE&G implemented an investigation of the aquatic vegetation community of Parr Reservoir during October 2008 by qualitatively assessing the occurrence of vegetation along 11 transects throughout the reservoir. Eleven plant species were identified during the survey. Two invasive species, alligatorweed (*Alternanthera philoxeroides*) and water primrose were observed at all locations (Quattlebaum 2008c). Other species noted by Quattlebaum (2008c) included smooth beggartick (*Bidens laevis*), bulrush, coon's tail (*Ceratophyllum demersum*), lizard's tail, marsh pennywort (*Hydrocotyle umbellata*), pickerelweed, smartweed (*Polygonum persicaria)*, cattail, and rushes.

Monticello Reservoir

The Monticello Reservoir was formed in 1977 by damming Frees Creek, a small tributary of the Broad River that flowed into Parr Reservoir approximately 1 mi upstream from the Parr Shoals Dam (SCE&G 2010a; NRC 2004). Monticello Reservoir is hydraulically connected to the Parr Reservoir via the FPSF, and it serves both as an upper pool for the FPSF and as a cooling pond for VCSNS Unit 1 (NRC 2004) (Figure 2-1). To the northeast, the reservoir contains a subimpoundment which is a 300-ac area owned by SCE&G and co-managed by SCE&G and SCDNR (SCE&G 2010a, SCDNR 2002). The subimpoundment fishery is managed differently from the main reservoir in that SCDNR regulates lower allowable fishery catch limits and limits boat operations to electric motors (SCDNR 2002). The Monticello Reservoir, excluding the subimpoundment, is approximately 6 mi long with a total surface area of 6500 ac. The average water depth is 59 ft and the maximum depth is approximately 126 ft (SCE&G 2010a).

Between 2000 and 2004, the SCDHEC evaluated the water quality in the Broad River basin to assess the overall health and condition of aquatic areas throughout the basin. There are four SCDHEC stations in Monticello Reservoir as shown in Figure 2-12). Stations B-328 and B-327 were sampled monthly. At station B-328, located in the Monticello subimpoundment, water-quality parameters (e.g., dissolved oxygen, pH, toxins, turbidity, nutrients) met the compliance criteria and standards for supporting aquatic life and recreational uses. Throughout the 5-year monitoring period, this station yielded indications of improving conditions via a reduction in 5-day biochemical oxygen demand, turbidity, fecal coliform, and total nitrogen and phosphorus concentrations (SCDHEC 2007). Approximately 3.5 mi southwest of the subimpoundment station, water conditions were suboptimal to support aquatic life due to an exceedance of pH criteria at station B-327. Recreational use was not restricted at this mid-lake location (SCDHEC 2007). Two randomly selected stations on Monticello Reservoir were monitored monthly for 1 year during 2004. The first station (RL-04370) was approximately 1.5 mi southwest of the subimpoundment station, and the second station (RL-04374) was approximately 1 mi southeast of the mid-lake station. Station RL-04370 yielded benzoic acid, cadmium, DDD and DDE (metabolites of DDT) in the sediment sample. Station RL-04374 yielded benzoic acid, cadmium, nickel, chromium, copper, zinc, bis(n-octyl) phthalate, DDT, and DDE in the sediment sample. Despite the occurrence of these chemical constituents, recreational use was not restricted and water conditions were optimal for aquatic life near both stations (SCDHEC 2007). Based on analysis of fish tissue, there are no consumption advisories on Monticello Reservoir (SCDHEC 2007).

Following commencement of operation at the VCSNS Unit 1, aquatic monitoring efforts in Monticello Reservoir included an evaluation of the fish community composition by means of gillnetting and boat electroshocking. During 1983 and 1984, 32 taxa representing 8 families were sampled from Monticello Reservoir (Dames and Moore 1985). Ten species of centrarchids made up 55 percent of the entire catch and two species of clupeids (gizzard shad and threadfin shad) made up 28 percent of the catch. Dames and Moore (1985), reported the remaining catch in Monticello Reservoir to include ictalurids (7 percent), catostomids (5 percent), percids (3 percent), cyprinids (2 percent), moronids (<1 percent), and lepisostids (<1 percent).

Cove rotenone studies conducted by SCDNR in 1987, 1988, 1995, and 1996 collected 29 species of fish in Monticello Reservoir (Christie and Stroud 1996, 1997). Between 1988 and 1995, the community composition of fish in the Monticello Reservoir remained stable. The predominant species were gizzard shad, channel catfish, white bass (*Morone chrysops*), and bluegill. In 1996, a shift in community structure was noted by a decrease in the standing stocks of white bass and a dramatic increase in the standing stocks of blue catfish (*Ictalurus furcatus*) (Christie and Stroud 1997).

Seasonal creel surveys were conducted by SCDNR from 1997 to 1999. Fish targeted by anglers include ictalurids (blue catfish, channel catfish), centrarchids (bluegill, black crappie [*Pomoxis nigromaculatus*], largemouth bass (*Micropterus salmoides*), cyprinids (carp [*Cyprinus carpio*]), and moronids (white bass, white perch). In Monticello Reservoir, ictalurids were targeted 46 percent of the time. Bluegill and largemouth bass were also popular fish targeted by anglers (Christie and Stroud 1999). While fishing efforts in Monticello Reservoir were found to be lower compared with other reservoirs, an increasing trend in fishing effort within Monticello Reservoir was noted (Christie and Stroud 1999).

Between 2006 and 2009, SCE&G initiated inventories of fish community composition near the vicinity of the VCSNS site. The sampling effort used a combination of boat electrofishing, gillnets, and hoop nets and documented 24 fish species in Monticello Reservoir, excluding the subimpoundment (Table 2-18; Normandeau 2007, 2008, 2009a). Similar to the trends noted by Dames and Moore (1985), centrarchids (comprising seven species) contributed the largest proportion (40 percent) of the total catch and clupeids (e.g., gizzard shad) were secondary in abundance (25 percent) during the 2006-2009 sampling effort. As noted in the fish community trends in Parr Reservoir, the abundance of ictalurids in Monticello Reservoir appears to have increased (18 percent of the total 2006-2009 catch) since the early 1980s (Normandeau 2007, 2008, 2009a). The most predominant species captured in the Monticello Reservoir between 2006 and 2009 included bluegill (29 percent of the total catch), gizzard shad (25 percent), blue catfish (13 percent), and white perch (10 percent).

To examine the benthic community in Monticello Reservoir, SCE&G collected macroinvertebrate samples at three stations in the reservoir. The reference station was located approximately 3 mi northwest of the VCSNS site. Two additional stations were located at the south end of the reservoir near the proposed Units 2 and 3 water-treatment intake and raw-water intake structures, respectively (CBS 2009d). Samples were analyzed by CBS. Seasonal (e.g., quarterly) monitoring occurred from July 2008 to April 2009 (CBS 2008a, c; CBS 2009c, d). Results were evaluated using a combination of bioassessment metrics and analyzed using statistical comparison techniques. The survey efforts yielded at least 15 different taxa from 11 orders (CBS 2008a, c; CBS 2009c, d). The general trends in benthic community structure at the control station and the two water-intake stations do not indicate disparate conditions (CBS 2008a, c; CBS 2009c, d).

SCE&G conducted an investigation of the aquatic vegetation community of Monticello Reservoir on November 6, 2008 at six locations, including the proposed raw-water and water-treatment intakes. Biologists used a viewing tube to facilitate observations in shallow-water locations and used a rake for sampling in deep water areas. No aquatic plants were observed in the shallow water at the six sampling locations. Only stoneworts (*Nitella* spp.), branched multicellular algae, were collected from a deeper-water area offshore of the public boat landing on the eastern shore of Monticello Reservoir (SCE&G 2010a).

Onsite Streams

There are 49,288 linear feet of streams within the VCSNS site boundary. Most of the onsite streams are seasonal (see Table 2-19, Figure 4-2). Mayo Creek is the primary perennial stream located on the VCSNS site. Tetra Tech NUS, Inc. (2007) describes Mayo Creek as a typical Piedmont stream characterized by flowing through a mixed hardwood forest, almost completely shaded by tree canopy. The creek originates 0.5 mi southeast of VCSNS Unit 1, and flows approximately 3.6 mi southwest before draining into the Broad River, downstream of the Parr Shoals Dam (Figure 2-3). The Mayo Creek drainage area is approximately 6 mi^2 and encompasses mixed hardwood forests that may mitigate surface-water temperatures during warm summer months (Tetra Tech NUS, Inc. 2007; SCE&G 2010a). In addition to Mayo Creek, there are intermittent and seasonal stream channels within the VCSNS site vicinity. Fish have been noted in residual pools associated with intermittent tributary channels, but there may be insufficient water to maintain connectivity between habitats to perpetuate aquatic biota (Tetra Tech NUS, Inc. 2007).

Aquatic biota rely on the overall quality of water within a particular habitat for survival and sustainability. The results of water-quality parameters measured in conjunction with four seasonal sampling events that occurred between July 2006 and July 2009 indicate that all sampling stations in Mayo Creek met the SCDHEC quality standards for temperature and dissolved oxygen in freshwater habitats (Tetra Tech NUS, Inc. 2007, 2009b; Quattlebaum 2008b; CBS 2008b, 2009a, b). The SCDHEC freshwater classification standards, which are approved by the EPA (in accordance with Section 303(c) of the Clean Water Act and 40 CFR Part 131), indicate the suitability of a waterbody for various purposes including the sustainability of aquatic biota (SCDHEC 2004). One metric, pH, did not meet the SCDHEC freshwater standards at one or more stations during the 2009 winter and spring sampling events which may have been due to a faulty water quality meter (Tetra Tech NUS, Inc. 2009b). During the 2006 summer and fall aquatic surveys, pH values met the criterion, but were detected at the minimum threshold value for the freshwater standard (Tetra Tech NUS, Inc. 2007; SCDHEC 2004). Increased acidity has been linked to environmental and biological conditions (organic content and phytoplankton production) within specific geographic regions (SCDHEC 2009c), but changes in increased acidity can impose adverse impacts on the growth and survival of critical early life stages of aquatic organisms (Fuiman 2002; Houde 2002).

Table 2-19. VCSNS Onsite Stream Characteristics

Stream Name	Linear Feet	Average Width (ft)	Average Depth (ft)	Substrate	Tributary Stream Order	Flow Regime
C	3656	20	0.83	sand, gravel	--	--
F	6850	12	<1	silt, sand	First	seasonal
G	1778	15	4	silt	Second	seasonal
H	1426	15	4	silt	Second	seasonal
K	9517	25	6	silt, sand	Third	seasonal
L	2342	12	4	sand	Second	seasonal
M	9364	15	--	--	--	perennial
N	5454	12	0.25-3	silt, sand, gravel	First	seasonal
P	2044	10	0.25-3	silt, sand, gravel	First	seasonal
T	6857	10	0.25-3	silt, sand, gravel	First	seasonal

Data Source: USACE 2009
-- Information not available

Fish surveys were conducted in Mayo Creek throughout the lower, middle, and upper stream segments and within a tributary channel of the creek. Methods for fish sampling included minnow traps (unbaited and left to fish overnight) and backpack electrofishing (single-pass sampling transects ranging from 166 to 205 ft in length) (Tetra Tech NUS, Inc. 2007, 2009b; Quattlebaum 2008b). A total of 16 taxa were sampled during the 2006-2009 fish survey efforts (Table 2-18). While there were similarities in the type of taxa encountered throughout the various stream reaches, species abundances were not distributed similarly within Mayo Creek.

The most predominant species encountered during the Mayo Creek sampling efforts included the yellowfin shiner (*Notropis lutipinnis*), bluehead chub (*Nocomis leptocephalus*), sandbar shiner, and redbreast sunfish.

Benthic macroinvertebrates were sampled seasonally from three stations in Mayo Creek between July 2008 and April 2009. The intent of the sampling was to evaluate the community of macroinvertebrates and assess stream condition (CBS 2008b, d; CBS 2009a, b). The first station was the most upstream station sampled on Mayo Creek and located approximately 1 mi upstream of Parr Road. The second station was approximately 0.12 mi upstream of Parr Road on Mayo Creek, and the third station was located 164 ft downstream of Parr Road (CBS 2009b). Results were evaluated using a combination of 12 bioassessment metrics and analyzed using statistical comparison techniques. The bioassessment metrics included taxa richness, various biotic indices (e.g., EPT index, NCBI, community loss index, etc.), and comparisons of functional groups and abundances described by Plafkin et al. (1989) in *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish*.

Based on the qualitative assessment of the composition of benthic macroinvertebrates in Mayo Creek, CBS concluded that the community was under duress, which may have been explained by drought conditions observed during the July 2008 sampling event (CBS 2008b). The October 2008 sampling event resulted in similar conclusions with regard to a community of benthic macroinvertebrates that demonstrated signs of stress. CBS (2008d) noted drought conditions persisted throughout much of the summer, which may partially explain the results, although no data were provided to support this supposition. According to the SCDHEC bioclassification rating system (e.g., the mean of the NCBI and EPT indices), conditions at the most upstream station improved slightly following the January 2009 sampling to achieve a score of "good" yet the remaining two downstream stations only achieved ratings of "good/fair," indicating partial impairment (CBS 2009a). The April 2009 results indicated that conditions within Mayo Creek improved as all stations yielded "good" bioclassification scores. Throughout the study period, water quality (pH, conductivity, and dissolved oxygen) was measured in conjunction with macroinvertebrate collections. Despite a range of benthic community conditions (e.g., stressed, impaired, good), water-quality metrics were within the SCDHEC freshwater quality standards (CBS 2009b). During the survey efforts at least 43 taxa were encountered, representing 14 orders (CBS 2008b, d; CBS 2009a, b). Mayfly (*Caenis* sp.) and caddisfly (*Cheumatopsyche* sp.) were the most predominant.

2.4.2.2 Aquatic Resources – Transmission Lines

The delivery of power associated with VCSNS Units 2 and 3 would require upgrading existing transmission-line corridors and substations, and clearing new transmission-line corridors, and construction of a new substation. Two entities, SCE&G and Santee Cooper, are responsible for identifying the proposed locations associated with new and upgraded transmission lines. In total, six new offsite 230-kV lines are proposed for the transmission of electricity associated with proposed VCSNS Units 2 and 3 (Figure 2-5) (SCE&G 2010b; Pike 2010; MACTEC 2009). Systematic field surveys for aquatic organisms are not included as part of the transmission-line site-selection process. In the absence of empirical data, reconnaissance-level information pertaining to species designated as endangered, threatened, or species of concern and critical habitat associated with the counties in which the transmission lines would occur was derived from FWS (2010, 2011) and SCDNR (2010a) and is provided in Table 2-20. In addition, map-based evaluative summaries, which cross reference the co-locations of transmission-line corridors and Federally protected species, were used for analyses (Palmetto 2010; MACTEC 2010).

Santee Cooper Transmission Lines

The following descriptions of the proposed actions associated with the Santee Cooper transmission lines were derived from the MACTEC (2008, 2009) transmission-line siting studies. Santee Cooper proposed the addition of 239 mi of transmission lines with 83 percent of the new transmission lines occurring within existing transmission-line corridors (Figure 2-5). The VCSNS-Flat Creek line, would extend 72 mi northeast from the VCSNS site to the existing Flat Creek substation, and would require approximately 17 mi of new corridor running adjacent to existing corridor. The VCSNS-Flat Creek line is located within the Piedmont ecoregion of the state and crosses an estimated 55 perennial streams and 13 watersheds within the Broad, Catawba, and Pee Dee river basins. The VCSNS-Varnville line would extend 167 mi south from the VCSNS site to the existing Varnville substation, and would require approximately 22 mi of new corridor running adjacent to existing corridor, and approximately 0.5 mi of new corridor not adjacent to existing corridor. The VCSNS-Varnville line is located within the Piedmont and Coastal Plain ecoregions of the state and crosses an estimated 85 perennial streams within 23 watersheds and falls within the Salkehatchie, Edisto, Saluda, and Broad river basins.

The largest water crossings associated with the VCSNS-Flat Creek line occur within an existing corridor at an unnamed impoundment near Winnsboro (1200 ft wide) and adjacent to an existing corridor at the Fishing Creek Reservoir (1300 ft wide). The Fishing Creek Reservoir crossing would require a new, 85-ft-wide corridor that would be placed adjacent and parallel to the north of an existing corridor (MACTEC 2009). The VCSNS-Varnville line crosses the Saluda River (240 ft wide) and the Broad River at two discrete locations (475 ft and 500 ft wide). The installation of transmission lines across waterbodies would be done in accordance with SCDHEC consultation and permitting. Four of the 18 navigable water crossings associated with the Santee Cooper transmission lines would include new transmission-line corridors spanning the following waterbodies: Fishing Creek Reservoir, Parr Reservoir, Little River, and Cedar Creek (MACTEC 2009).

SCE&G Transmission Lines

SCE&G has outlined a plan to install approximately 6 mi of new transmission-line corridor as well as upgrade 147 mi of existing corridors. The only line proposed to include new transmission-line corridors is the VCSNS-Killian line, which totals 37 mi in length. The transmission-line route would primarily reside within existing transmission-line corridors. From the VCSNS site, the VCSNS-Killian line would extend northeast toward Winnsboro then follow a southeasterly direction to Blythewood. The final 6 mi of the VCSNS-Killian line, which represents approximately 16 percent of the total length, would occupy a new transmission-line corridor and would extend southeasterly from Blythewood to Killian (Pike 2010). Drainages associated within the VCSNS-Killian line would be primarily within the Piedmont ecoregion and include various streams within the Lower Broad River, Wateree River, and Congaree River watersheds (FP&S 2008; Pike 2010).

Table 2-20. Aquatic Species Designated as Threatened, Endangered, Proposed for Federal Listing, or Species of Concern and Critical Habitat in Counties Crossed by Transmission-Line Corridors

Scientific Name	Common Name	Status	County
Reptiles			
Caretta caretta	Loggerhead sea turtle	FT/ST	Colleton
Chelonia mydas	Green sea turtle	FE	Colleton
Dermochelys coriacea	Leatherback sea turtle	FE	Colleton
Lepidochelys kempii	Kemp’s ridley sea turtle	FE	Colleton
Fish			
Acipenser brevirostrum	Shortnose sturgeon	FE/SE	Calhoun, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland
Acipenser osyrinchus oxyrinchus	Atlantic sturgeon	PFE	Calhoun, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland
Etheostoma collis	Carolina darter	SE ST	Fairfield Richland
Fundulus diaphanus	Banded killifish	SC	Richland
Notropis chiliticus	Redlip shiner	SC	Richland
Rhinichthys atratulus	Blacknose dace	SC	Richland
Semotilus lumbee	Sandhills chub	SC	Lancaster
Mollusks			
Alasmidonta varicosa	Brook floater	SC	Lancaster
Anodonta couperiana	Barrel floater	SC	Hampton
Elliptio congaraea	Carolina slabshell	SC	Orangeburg
Elliptio lanceolata	Yellow lance	SC	Newberry, Lancaster
Lasmigona decorata	Carolina heelsplitter	FE/SE	Chester, Fairfield, Lancaster, Lexington,

Table 2-20. (contd)

Scientific Name	Common Name	Status	County
			Richland, Newberry
Pyganodon cataracta	Eastern floater	SC	Hampton, Lancaster, Orangeburg
Strophitus undulatus	Squawfoot	SC	Lancaster, Richland
Toxolasma pullus	Savannah lilliput	SC	Orangeburg
Utterbackia imbecillis	Paper pondshell	SC	Hampton, Orangeburg
Villosa constricta	Notched rainbow	SC	Lancaster
Villosa delumbis	Eastern creekshell	SC	Chester, Colleton, Hampton, Fairfield, Lancaster, Orangeburg, Richland
Elimia catenaria	Gravel elimia	SC	Richland
Crustacean			
Distocambarus youngineri	Saluda crayfish	SC	Newberry
Aquatic Vegetation			
Myriophyllum laxum	Piedmont water-milfoil	SC	Orangeburg, Richland, Lexington
Potamogeton confervoides	Algae-like pondweed	SC	Richland
Potamogeton foliosus	Leafy pondweed	SC	Orangeburg
Critical Habitat			
Lasmigona decorata	Flat Creek	CH	Lancaster

Sources: Pike 2010; MACTEC 2009; FWS 2010, 2011; SCDNR 2010; 67 FR 44502
FE = Federally Endangered, SE = State Endangered, FT = Federally Threatened, PFE = Proposed Federally Endangered, CH = Critical Habitat

The remaining SCE&G transmission-line routes would be placed within existing corridors. The VCSNS-St. George No. 1 and No. 2 corridors would be routed within the Piedmont and Coastal Plain ecoregions. and would encompass the drainage areas of the following systems: Lower Broad, Congaree, North Fork Edisto and the Edisto rivers. The remaining two SCE&G transmission lines,the VCSNS-Lake Murray No. 2 and St. George No. 1 transmission-line and VCSNS-St. George No. 2 transmission-line, would be routed within the Piedmont ecoregion that includes the lower Broad and Saluda drainages (Pike 2010).

In addition to the four transmission lines described above, SCE&G would add three onsite lines to connect the VCSNS Units 2 and 3 switchyard to the existing Unit 1 switchyard (Pike 2010). These connector lines would cross streams located to the northeast and south of the Units 2 and 3 switchyard (e.g., Streams C, F-2, F-4, and two unnamed streams; Figure 4-2).

2.4.2.3 Important Aquatic Species

The NRC has defined important species as any species that are rare, ecologically sensitive, play an ecological role, are relied on by a rare or valuable species, and/or have commercial or recreational value (NUREG-1555 [NRC 2000]). The FWS identifies threatened or endangered species in 50 CFR 17.11 and 50 CFR 17.12. Important species also include rare species proposed for listing as threatened or endangered; published in the *Federal Register* as candidates for listing; or listed as threatened, endangered, or species of concern by the state in which they occur. Biological indicator species that respond to and indicate environmental change are also classed as important species. The following section includes recreationally important species, invasive species, important species, and protected species that have been documented at the VCSNS site, or are thought to occur in the vicinity of the site or in the counties proposed for transmission-line siting. The Comprehensive Wildlife Conservation Strategy developed by the SCDNR identifies conservation priority species (SCDNR 2005b), some of which are known to occur at the VCSNS site. Numerous aquatic taxa are State species of concern within the site and vicinity, including the counties proposed for the siting of transmission lines. The species specific to the proposed transmission-line corridors are listed in Table 2-20. No commercially important aquatic species are known to occur in the vicinity of the VCSNS site. No Federally or proposed Federally listed threatened or endangered aquatic species are known to occur at the VCSNS site, but there are listed species present within counties that are proposed for transmission-line siting. Transmission-line routes for the VCSNS site cross waterbodies in the following counties: Calhoun, Chester, Colleton, Dorchester, Fairfield, Hampton, Lancaster, Lexington, Newberry, Orangeburg, Richland.

Recreationally Important Species

The identification of species deemed to be recreationally important was derived from published creel surveys (Christie and Stroud 1998, 1999) and game fish outlined in the SCDNR freshwater fishing rules and regulations document (SCDNR 2009). Table 2-21 is a compilation of recreationally sought-after fish that are known to occur in the Parr and Monticello reservoirs.

In South Carolina, largemouth bass are among the most sought-after sportsfish (Bulak and Crane 2009). While largemouth bass occur within waters near the VCSNS site and accounted for 15 to 19 percent of the fishing effort in Monticello Reservoir during the late 1990s, SCDNR creel surveys indicate that the fishing effort in Monticello Reservoir was primarily directed at channel catfish and blue catfish (Christie and Stroud 1998, 1999). Qualitative data pertaining to fishing effort do not exist for Parr Reservoir, but efforts purportedly target catfish species in this reservoir as well (Hayes 1999).

Invasive Species

While some circumstances may result in economical or ecological benefits from non-native species, biological invasions by non-native species are primarily associated with adverse impacts (OTA 1993; Strayer et al. 2006; Vitousek et al. 1996). The decline of native taxa, especially species at risk of imperilment, has been linked to the introduction of non-native species throughout the United States (Wilcove et al. 1998). There are many mechanisms by

Table 2-21. Summary of Recreational Fish Species Known to Occur in Parr or Monticello Reservoirs

Family	Common Name	Scientific Name	Percent Abundance[a]	State Distribution	Habitat	Thermal Tolerance	Size	Diet	Notes
Centrarchidae	Largemouth Bass[b]	*Micropterus salmoides*	Parr: 6.8 Monticello: 5.7	Found in waters throughout the state	Streams, lakes, reservoirs, ponds. Warm, clear, backwaters. Tolerant of turbidity, and warm-water temps for short periods	Can tolerate warm water temp (36°C) for short periods Spawning: 16-24°C	120-650 mm; adults	Plankton, insects, small fish, crayfish, amphibians and mammals	Native to SC; though information on native distribution within the state is conflicting
	Smallmouth Bass[c]	*Micropterus dolomieu*	Parr: 0.3; Monticello: 0.2	Occurs in the Broad, upper Saluda, and Savannah river tributaries	Lakes, reservoirs, streams Prefers cold, clear water	Spawning: 16-24°C	200-686 mm; adults	Microcrustaceans, aquatic insects, fish larvae, other fish, crayfish	Non-native species Males guard nest
	Black Crappie[b]	*Pomoxis nigromaculatus*	Parr: 0.1; Monticello: 2.3	Found in waters throughout the state	Backwater areas in rivers, reservoirs, and ponds. Associates with vegetation, LWD, and cool, clear waters	Range: 4-33°C Spawning: 15-20°C	130-490 mm; adults	Microcrustaceans, insects, larval fish, small fish including gizzard and threadfin shad	Native to SC. Highly fecund. Pelagic larvae.
	Bluegill[b]	*Lepomis macrochirus*	Parr: 15; Monticello: 29	Found in waters throughout the state	Rivers, streams, lakes, ponds, reservoirs; pools, low-velocity waters, aquatic vegetation	Range: 5-35°C. Critical thermal max: 37-41°C Spawning: 19-25°C	178-410 mm; adults	Insects, microcrustaceans, crayfish, mollusks, and small fish	Native to SC, but widely stocked throughout the state. Commonly referred to as bream. Tolerant of many environmental conditions.
	Redbreast Sunfish[b]	*Lepomis auritus*	Parr: 0.1; Monticello: 0.6	Found in waters throughout the state	Streams, rivers, reservoirs; low velocity water; deep pools and backwaters; LWD and undercut banks	Spawning: 16-31°C	60-240 mm; adults	Insects, crayfish, mollusks, arthropods, some fish	Native to SC.

Table 2-21. (contd)

Family	Common Name	Scientific Name	Percent Abundance[a]	State Distribution	Habitat	Thermal Tolerance	Size	Diet	Notes
Centrarchidae	Redear Sunfish[b]	*Lepomis microlophus*	Parr: Monticello: 0.6	Found in waters throughout the state	Streams, rivers, lakes, reservoirs, ponds, swamps Associated with vegetation and backwaters	Spawning: 16-24°C	134-381 mm; adults	Invertebrates, zooplankton, aquatic insects, gastropods, and mollusks	In SC, native south of Savannah River; introduced in other drainages. Molariform pharyngeal teeth
	Pumpkinseed[b]	*Lepomis gibbosus*	Parr: 1.1; Monticello: 1.4	Found in waters throughout the state	Backwaters of streams, rivers, ponds, and reservoirs Associated with vegetation	Range: 5-33°C Spawning: 16-27°C	78-381 mm; adults	Microcrustaceans, aquatic insects, gastropods, clams, some fish and aquatic vegetation	Native to SC. Molariform pharyngeal teeth
Ictaluridae	Blue Catfish[b]	*Ictalurus furcatus*	Parr: 5.4; Monticello: 13	Found in most major drainages	Rivers and reservoirs Deep, swift, turbid water	Spawning: 21-24°C	508-1650 mm; adults	Fish, crayfish, aquatic insects, vegetation, mollusks, crayfish, fish including threadfin and gizzard shad	Non-native to SC
	Channel Catfish[b]	*Ictalurus punctatus*	Parr: 12; Monticello: 3.7	Found in most major drainages; often stocked in ponds	Small-to-large rivers, tributaries, reservoirs, ponds; deep pools with structure/cover; tolerates warm and turbid water	Spawning: 21-30°C	267-1270 mm; adults	Fish, crayfish, mollusks, aquatic insects, and aquatic vegetation	Unclear if this species is native to SC
Percidae	Yellow perch[b]	*Perca flavescens*	Parr: 1.3; Monticello: 0.5	Found in most major drainages	Rivers, streams, lakes, reservoirs. Can tolerate a range of temperatures; cool to warm	Spawning: 2-19°C	152-400 mm; adults	Insects, microcrustaceans, crayfish, fish	In SC, native range occurs south to the Santee River basin Introduced elsewhere

Table 2-21. (contd)

Family	Common Name	Scientific Name	Percent Abundance[a]	State Distribution	Habitat	Thermal Tolerance	Size	Diet	Notes
Moronidae	White Bass[b]	*Morone chrysops*	Parr: 0.0; Monticello: 0.1	Occurs in river basins within the Piedmont and Coastal Plains	Mainstream rivers and deep areas within reservoirs; low velocity water, aquatic vegetation and other structure	Spawning: 15-17°C	275-450 mm; adults	Zooplankton, aquatic insects, crayfish, fish	Non-native to SC
	White perch[b]	*Morone americana*	Parr: 11; Monticello: 10	Found in most major drainages	Initially associated with estuarine and brackish waters, but has established in freshwater environments	Spawning: 10-16°C	100-350 mm; adults	Microcrustaceans, shrimp, crab, crayfish, worms, fish	Info on native range in SC is conflicting Some reports indicate its native range extends south as far as the Pee Dee

Percent abundance was determined based on total number of individuals sampled during the 2006-2009 (Normandeau 2007, 2008, 2009a, and Quattlebaum 2008a) aquatic surveys of Parr and Monticello reservoirs.
Sources: Rohde et al. 2009; Marcy et al. 2005; Jenkins and Burkhead 1994
Sources: Rohde et al. 2009; Jenkins and Burkhead 1994
LWD = large woody debris, SC = South Carolina

which non-native species affect native taxa. At the species level, the presence of invasive species can affect the growth and behavioral patterns of native species, and lead to increased competition. At the ecosystem level, large-scale effects of invasive species can induce changes in abundance and community structure and alteration of structural and functional integrity of habitats (Parker et al. 1999; Vitousek et al. 1996). Detriment from non-native species also includes economic impacts. Non-native vegetation can clog waterways by altering hydrologic flow and increasing sedimentation (OTA 1993). Invasive mollusks, including Asian clams (*Corbicula fluminea*), zebra mussels (*Dreissena polymorpha*), and quagga mussels (*D. bugensis*), clog water systems associated with power-generation facilities and at a national level can cost $1 billion/year to manage (OTA 1993; Pimentel et al. 2005).

The South Carolina Aquatic Invasive Species (AIS) Task Force, represented by Federal, State, and nongovernmental entities, has developed a management strategy aimed at minimizing adverse impacts imposed by aquatic invasive species. The AIS Task Force has identified AIS as species that are nonindigenous to South Carolina and may be capable of asserting adverse impacts on aquatic ecosystems or presenting economic constraints. Of the list of invasive species considered to be a management concern within South Carolina, two plant species, two fish species, and one mollusk species are known to occur in the vicinity of the VCSNS site (Table 2-22).

Table 2-22. Aquatic Invasive Species Documented to Occur in the Vicinity of the VCSNS Site

Common Name	Scientific Name	Type	Invasive Attributes	Occurrence at the VCSNS Site
Alligatorweed	*Alternanthera philoxeroides*	Freshwater plant	Aggressive, rapid colonizing plant, affects flow and uptake of water	Parr Reservoir
Water primrose	*Ludwigia uruguayensis*	Freshwater plant	Rhizomatous, chokes shorelines, affects water use and access, decreases flow, clogs water-intake structures	Parr Reservoir
Blue catfish	*Ictalurus furcatus*	Freshwater fish	Can tolerate a range of environmental conditions, piscivorous, competes for prey resources with native catfish	Parr Reservoir, Monticello Reservoir
White perch	*Morone americana*	Freshwater fish	Competes with recreationally important fish such as white bass and crappie	Parr Reservoir, Monticello Reservoir
Asian clam	*Corbicula fluminea*	Freshwater clam	Competes with native mollusks for food and space, alters substrate conditions; high densities clog water-intake structures	Parr Reservoir

Sources: SCDNR 2008; SCE&G 2010a
Survey efforts included multiple sample methodologies and spanned multiple spatial and temporal scales

Ecologically Important Species

Species that occupy a role critical to the function of the local ecosystem are also considered important, in addition to species that may serve as biological indicators of environmental change.

Bluehead Chub (*Nocomis leptocephalus*)

The bluehead chub is an ecologically important species because of its role as an ecosystem engineer in freshwater habitats. The male bluehead chub facilitates spawning activities by constructing a nest from stream gravel. The nest structures are used by other species such as blackbanded darter (*Percina nigrofasciata*), yellowfin shiner, and rosyface chub (*Hybopsis rubrifrons*). The attribute of manipulating substrate, which provides structure beneficial to other fish, has resulted in the designation of bluehead chub as a keystone species (Rohde et al. 2009; Marcy et al. 2005). Wallin (1992) documented a symbiotic spawning relationship between bluehead chub and yellowfin shiner and suggested that yellowfin shiner cannot spawn in the absence of their symbiotic counterpart.

The bluehead chub is commonly found in the Piedmont ecoregion of South Carolina (Rohde et al. 2009). It was the most abundant species encountered during surveys in Mayo Creek (Tetra Tech NUS, Inc. 2007, 2009b). The diet of bluehead chub consists of aquatic and terrestrial insects as well as crustaceans, clams, and algae (Rohde et al. 2009).

Eastern Creekshell (*Villosa delumbis*)

The eastern creekshell maintains a global status rating of secure; however, the State-level status of this freshwater mussel is undetermined within South Carolina (NatureServe 2009b). It has been identified as a species of moderate conservation priority (SCDNR 2005b) and is listed as a species of concern within Fairfield County (SCDNR 2010a). This species occurs in streams and rivers in benthic conditions ranging from mud to coarse substrates and is often associated with tree roots near the edges of aquatic habitats. The eastern creekshell is thought to be sensitive to alterations of aquatic habitats (e.g., modifications, sedimentation, water quality), but empirical evidence to support these suppositions is lacking (SCDNR 2006b). It is unknown whether this species occurs at the VCSNS site.

Eastern Floater (*Pyganodon cataracta*)

At the global and national scales, the eastern floater, a freshwater mussel, has been designated as secure, yet the overall status of this species within the State of South Carolina is undetermined (NatureServe 2009b). In Fairfield County, the eastern floater is listed as a South Carolina species of concern (SCDNR 2005b). Eastern floaters commonly occur throughout drainages of the Atlantic Ocean. They are reportedly tolerant of a range of environmental conditions and are found within a variety of aquatic environments, including lakes, streams, and large rivers (NatureServe 2009b). The eastern floater is characterized by an easily penetrable thin shell, making it a preferred prey resource by other aquatic biota (PDCNR 2007). One individual of this species was collected near the proposed raw-water intake in April 2009 (CBS 2009c, d).

Yellow Lance (*Elliptio lanceolata*)

This freshwater mussel is designated as being globally imperiled to vulnerable (NatureServe 2009b) and is a species of concern in Newberry County, South Carolina (SCDNR 2005b). Precise population assessments are difficult to achieve due to questions regarding the taxonomic classification of *Elliptio* sp. As such, there are few detailed accounts of life-history information pertaining to the yellow lance. It occurs in association with sandy sediments and appears to be intolerant of fine sediments and chemical pollutants (NatureServe 2009b). It is unknown whether this species occurs at the VCSNS site.

Broad River Spiny Crayfish (*Cambarus spicatus*)

The Broad River spiny crayfish is relegated to a narrow distribution within the States of North and South Carolina. Little is known about the life-history characteristics of this crayfish (NatureServe 2009b; SCDNR 2006b). This species has been classified as vulnerable at both global and national scales. In South Carolina, the Broad River spiny crayfish is considered vulnerable and has been designated as a species with the highest ranked conservation priority (SCDNR 2006b; SCDNR 2005b). Fairfield County is one of three counties in which the Broad River spiny crayfish has been documented. Habitat associations include areas characterized by sand deposits, log jams, and debris (SCDNR 2006b). No spiny crayfish were collected during sampling efforts and it is unknown whether this species occurs at the VCSNS site (Tetra Tech NUS, Inc. 2007, 2009b).

Crayfish (*Distocambarus youngineri*)

Distocambarus youngineri, also commonly known as the Saluda crayfish (FWS 2008a) and the Newberry burrowing crayfish (Taylor et al. 2007), is a species of crayfish that is listed as critically imperiled at global, national, and State levels due to its very limited distribution (NatureServe 2009b). This species has been encountered in few locations in South Carolina; all occurrences have been limited to Newberry County and only one occurrence has been documented within the Broad River (SCDNR 2006b). The crayfish is designated as a South Carolina species with the highest conservation priority (SCDNR 2005b). It burrows in moist sediments and leaf litter and is associated with headwater or seasonal streams characterized by a mixed-hardwood overstory (SCDNR 2006b). No Saluda crayfish were collected during sampling efforts and it is unknown whether this species occurs at the VCSNS site (Tetra Tech NUS, Inc. 2007, 2009b).

Flat Bullhead (*Ameiurus platycephalus*)

While populations of this species are thought to be stable in South Carolina, the flat bullhead has become threatened by land-use practices and species interactions with non-native freshwater catfish (ictalurids) in other southern regions and is listed as a moderate conservation priority by SCDNR (Bettinger 2006b). The flat bullhead is distributed in all drainages of South Carolina, but is more commonly associated with the upper Catawba, Broad, and Savannah rivers (Rohde et al. 2009; Marcy et al. 2005). The largest populations of flat bullhead in South Carolina are thought to reside within the Broad River (Bettinger 2006b), yet these fish made up less than 1 percent of the overall catch during electrofishing efforts within the Broad River (Bettinger et al. 2003) and 0 to 7 percent of the catch among several Broad River tributary streams (Bettinger et al. 2006). Flat bullhead have been encountered in Mayo Creek (0.1 percent of the total abundance) (Tetra Tech NUS, Inc. 2007, 2009b) and Monticello Reservoir (0.5 percent of the total abundance), but none was captured during recent Parr Reservoir sampling efforts (Normandeau 2007, 2008, 2009a; Quattlebaum 2008a). Juvenile fishes are associated with small, clear streams, while adults tend to reside in the slow-moving, soft-bottom habitats of rivers. Flat bullhead are omnivorous; food items include aquatic insects, small fish, mollusks, bryozoans, and vegetation (Rohde et al. 2009; Marcy et al. 2005).

Greenfin Shiner (*Cyprinella chloristia*)

The greenfin shiner is a South Carolina species of moderate conservation priority (SCDNR 2005b). Its distribution is relegated to the Piedmont ecoregion within the Santee and Pee Dee drainages; it is endemic to the Carolinas (Rohde et al. 2009; Bettinger 2006a). Greenfin shiners were encountered during sampling efforts in Mayo Creek (2006-2009) where their abundance represented approximately 1 percent of the total catch (Tetra Tech NUS, Inc. 2007, 2009b). Current populations appear to be stable in South Carolina, but the ability of this species to perpetuate within a fairly limited geographic region is unknown (Bettinger 2006a). Greenfin shiners are typically found in large creeks, medium-sized rivers, and sometimes in reservoirs. They tend to be associated with pools, slow-moving, cool, clear waters, and substrates that range from sand to rocks. They are crevice spawners, and as such, require coarse substratum for egg deposition (Rohde et al. 2009; Bettinger 2006a). Prey items include terrestrial insects, benthic insect larvae (chironomid, caddisfly, stonefly, and beetle larvae), and dragonfly nymphs (Rohde et al. 2009).

Notchlip Redhorse (*Moxostoma collapsum*)

The notchlip redhorse was formerly described as a race of the silver redhorse (*Moxostoma anisurum*), but is currently recognized as a distinct species (Marcy et al. 2005; Jenkins and Burkhead 1994). Because of this former taxonomic classification, existing knowledge pertaining to life-history attributes of the notchlip redhorse likely encompasses attributes of the silver redhorse. Categorized as a South Carolina species of moderate conservation priority, the notchlip redhorse is documented to occur within the Broad, Pee Dee, Santee, and Savannah rivers (Sessions et al. 2006; Rohde et al. 2009). The notchlip redhorse has been captured in aquatic surveys in the Parr and Monticello reservoirs. Data from these surveys indicate that the notchlip redhorse comprised 2 and 0.8 percent of the total catch in the Parr and Monticello reservoirs, respectively (Normandeau 2008, 2009a; Quattlebaum 2008a). Population declines of the notchlip redhorse have been noted in several rivers in North Carolina; and the status of this species is being reviewed in South Carolina, where this species is thought to be affected by land-use activities that increase siltation in waterways (Sessions et al. 2006). Aquatic habitat for the notchlip redhorse includes large rivers and tributary channels (Sessions et al. 2006; Rohde et al. 2009). Adults and juveniles are associated with pool habitats, but adults are found in pools with greater depths and larger flows, while juveniles reside in pools found in backwaters. The notchlip redhorse is found in benthic conditions that range from silt to rocky (Rohde et al. 2009).

Snail Bullhead (*Ameiurus brunneus*)

Snail bullheads are found throughout the State of South Carolina and are common in the Santee and Savannah river watersheds (Rohde et al. 2009). Snail bullheads are thought to maintain stable populations in South Carolina; however, this species is experiencing declines in many drainages throughout its range. Furthermore, non-native flathead catfish (*Pylodictis olivaris)* and blue catfish pose a threat to the sustainability of snail bullhead populations. For these reasons, the snail bullhead is a species of moderate conservation priority in South Carolina (Bettinger 2006b). During 2006-2009 aquatic surveys at the VCSNS site, one snail bullhead was captured in each of the two reservoirs (Parr and Monticello) (Normandeau 2007, 2008, 2009a; Quattlebaum 2008a). Dames and Moore (1985) also captured this species in Parr (1978, 1982-1984) and Monticello reservoirs (1979-1984). The Broad River is said to maintain some of the largest populations of snail bullhead (Bettinger 2006b). Snail bullheads occupy moderate-sized rivers and can tolerate warm water temperatures. These fish are associated with runs and riffle habitat and rock substratum (Jenkins and Burkhead 1994; Rohde et al. 2009). Snail bullheads are omnivores. Their diet includes insect larvae, snails, fish, algae, and aquatic vegetation (Rohde et al. 2009).

White Catfish (*Ameiurus catus*)

The white catfish is considered stable throughout much of its range, including South Carolina. However, the link between introductions of non-native species (flathead and blue catfish) and localized population declines of white catfish has resulted in this fish being designated as a species of moderate conservation priority in South Carolina (Sessions et al. 2006). The white catfish is distributed throughout all watersheds of South Carolina (Rohde et al. 2009; Sessions et al. 2006). In the Parr Reservoir and Monticello reservoirs, this species accounted for 0.9 percent and 1.6 percent of the respective catches during the 2006-2009 surveys at the VCSNS site (Normandeau 2007, 2008, 2009a; Quattlebaum 2008a).

White catfish reside in rivers of medium-to-large size and are associated with low-velocity, turbid waters. Their occupation of small streams is reportedly rare; however, white catfish can occur in reservoirs, warm-water ponds, and brackish waters (Jenkins and Burkhead 1994; Rohde et al. 2009). Benthic habitat associations include substrates of small grain-size fractions; i.e., sand or silt. White catfish prey on a diversity of items, including gizzard and threadfin shad, herring, bream, other catfishes, mayfly nymphs, and vegetation (Rohde et al. 2009). The diet of juvenile white catfish consists primarily aquatic insects. Adults are omnivorous and their diet includes aquatic invertebrates, fish, and vegetation (Jenkins and Burkhead 1994).

Highfin Carpsucker (*Carpiodes velifer*)

The populations of highfin carpsuckers in the upper Santee River basin are thought to be stable, but because populations of this species in other river systems are imperiled, conservation of this species in South Carolina is thought to be integral to the preservation of highfin carpsuckers at larger spatial scales. Distribution of the highfin carpsucker is limited to the Broad, Congaree, Santee, and Savannah rivers (Self and Bettinger 2006; Rohde et al. 2009). There are historical accounts of this species in the Pee Dee River, but current knowledge suggests that the highfin carpsucker may have been extirpated from this drainage. Due to the limited distribution of the highfin carpsucker in South Carolina, this species has been deemed a State species of highest conservation priority (Self and Bettinger 2006). The highfin carpsucker was encountered during the 2006-2008 aquatic surveys in Parr Reservoir (0.1 percent of the total catch); however, none was collected from Monticello Reservoir. Survey efforts during the late 1970s to early 1980s noted the presence of this species in both reservoirs (Dames and Moore 1985).

The highfin carpsucker resides in river habitats characterized by clean water and moderate current velocities. Substrate conditions range from sand to gravel (Marcy et al. 2005; Rohde et al. 2009). Compared to other carpsucker species, the highfin appears less tolerant of siltation (Pflieger 1997). Food items are derived from the benthos and include algae, insect larvae, and mollusks (Rohde et al. 2009).

Piedmont Darter (*Percina crassa*)

The Piedmont darter is a South Carolina species of high conservation priority (SCDNR 2005b). Information pertaining to this species is sparse (Rohde et al. 2009). While it is often encountered during aquatic inventories, knowledge pertaining to the overall abundance of Piedmont darters in streams is limited. In addition, its conservation status stems from the limited global distribution, which reportedly identifies South Carolina as making up one-third of the spatial extent of Piedmont darter habitat (Hayes and Bettinger 2006a). In South Carolina, Piedmont darters have been documented to occur between the Blue Ridge, Piedmont, and Inner Coastal Plain ecoregions (Rohde et al. 2009). They are associated with riffle habitats where stream temperatures vary from cool to warm. Known prey items include caddisfly and dipteran larvae, as well as stonefly and mayfly nymphs. During the 2006-2009 aquatic surveys only one Piedmont darter was captured and this occurred in Mayo Creek (Tetra Tech NUS, Inc. 2007, 2009b; Quattlebaum 2008b).

Quillback (*Carpiodes cyprinus*)

Populations of quillback are thought to be stable throughout its geographic range. In South Carolina, quillback are distributed across South Carolina within the Coastal Plain and Piedmont ecoregions (Rohde et al. 2009). The upper Santee and Savannah watersheds purportedly sustain ample populations. However, the quillback has been designated as a State species of high conservation priority because taxonomic data indicate that the quillback found along the Atlantic slope may be distinct from those found in other regions (Lamprecht and Bettinger 2006). Jenkins and Burkhead (1994) suggest that while the quillback is a widely distributed species, its abundance is difficult to assess because this fish is rarely encountered during aquatic survey efforts due in part to its association with large deep pools, which are difficult to adequately sample. Few quillback were captured during 2006-2008 sampling efforts in Parr and Monticello reservoirs, where they accounted for 0.8 and 0.1 percent of the total catches, respectively (Normandeau 2007, 2008, 2009a; Quattlebaum 2008a). Quillback were also encountered during 1978-1984 survey efforts in Parr and Monticello reservoirs (Dames and Moore 1985). Quillback can occupy a range of aquatic habitats from rivers to reservoirs and lakes. They are typically found in association with low river velocities and a range of substrate types (Jenkins and Burkhead 1994; Pflieger 1997). Quillback migrate into smaller, tributary streams to spawn (Rohde et al. 2009). Their diet includes algae, detritus, insects, and mollusks (Jenkins and Burkhead 1994; Pflieger 1997).

Robust Redhorse (*Moxostoma robustum*)

The robust redhorse is a large riverine catostomid (sucker) whose taxonomy was in dispute until 1991 when it was collected from the Oconee River, Georgia. Originally thought to have inhabited the Atlantic slope drainages from the Pee Dee River in North Carolina to the Altamaha River in Georgia, remnant populations of the robust redhorse are known to exist in the Oconee and Ocmulgee rivers in Georgia, the Savannah River of Georgia and South Carolina, and the Pee Dee River of North and South Carolina (Nichols 2003). Once the rediscovery of this lost species was confirmed, efforts to document the existing robust redhorse indicated the need for conservation efforts. During 1995, in lieu of designating a Federal listing of this species through the Endangered Species Act, a Memorandum of Understanding between State and Federal agencies as well as industrial partners was instituted in the form of the Robust Redhorse Conservation Committee. While this species is listed as endangered in Georgia, the robust redhorse does not maintain a legal status for protection in the Carolinas; it is listed as a South Carolina species of highest conservation priority (Self and Bettinger 2006). The Robust Redhorse Conservation Committee has implemented efforts to reintroduce this native species to river basins such as the Broad River by stocking rivers with robust redhorse fingerlings (Self and

Bettinger 2006; Rohde et al. 2009). In 2008, SCDNR caught two robust redhorse while electrofishing for smallmouth bass (*Micropterus dolomieu*) in Monticello Reservoir (NRC 2009a). Aquatic surveys in the vicinity of the VCSNS site resulted in the capture of two robust redhorse in the Parr Reservoir, representing 0.1 percent of the total catch (Quattlebaum 2008a; Normandeau 2008).

Robust redhorse have been found in mainstream river habitats that include riffles, runs, and pools. These fish have been noted to associate with deep water pools and in-stream habitat structures such as woody debris. Prey items include mollusks, which the species crushes with pharyngeal teeth that resemble molars (Self and Bettinger 2006; Rohde et al. 2009). Spawning reportedly occurs in areas with coarse substrate (Rohde et al. 2009).

Seagreen Darter (*Etheostoma thalassinum*)

In South Carolina, the seagreen darter is found in tributaries of the Santee River and is commonly encountered within the upper Santee drainage (Rohde et al. 2009). Populations of the seagreen darter are considered stable in South Carolina, but it has been listed as a State species of high conservation priority because half of the global distribution of this darter purportedly occurs within the state. Furthermore, the overall distribution of this species is constrained to a small geographic region (Hayes and Bettinger 2006a).

The seagreen darter is associated with large creeks and small rivers. Habitat use includes riffles characterized by moderate to swift currents (Hayes and Bettinger 2006a; Rohde et al. 2009). This species can tolerate a range of thermal and turbid conditions (Rohde et al. 2009). The seagreen darter was encountered during the 2006-2009 Mayo Creek aquatic surveys where it accounted for 1 percent of the total catch (Tetra Tech NUS, Inc. 2007).

Diadromous Fish

The Santee-Cooper Basin Diadromous Fish Passage Restoration Plan (FWS 2001) focuses on restoring habitat connectivity for diadromous fish that were historically present within the Basin. Target species include American eel (*Anguilla rostrata*), American shad, blueback herring, hickory shad, Atlantic sturgeon, and shortnose sturgeon. The Columbia Dam fishway was completed in 2006, allowing fish to access an additional 24 mi of habitat on the Broad River. It was designed to facilitate the passage of American shad and blueback herring (Kleinschmidt 2007). Both sturgeon species are described in the following section on Federally and State-listed species.

American eel (*Anguilla rostrata*). The American eel prefers soft mud or sand substrates and is widespread throughout the mid-Atlantic in estuaries, rivers, creeks, lakes, and ponds. American eel were not present in Monticello Reservoir, Parr Reservoir, or Mayo Creek during recent sampling surverys (Normandeau 2007, 2008, 2009a; Quattlebaum 2008a; Tetra Tech NUS, Inc.

2007, 2009b). Historical records indicate that American eels were present in the Santee basin, which includes the Broad River, above the fall line and into North Carolina (FWS 2001). This catadromous species spawns in the Sargasso Sea and migrates to fresh inland waters as juveniles and young adults. Females continue migration upstream to freshwater habitats that are highly oxygenated and provide sufficient food resources. Males tend to stay in brackish, estuarine waters. Migration for reproductively active adults begins in the fall, and spawning occurs in mid-winter.

American shad (*Alosa sapidissima*), blueback herring (*A. aestivalis*), and hickory shad (*A. mediocris*). The anadromous American shad, blueback herring, and hickory shad spend most of their adult life in the open ocean, returning to natal freshwater streams for spawning activities. The spawning season begins in March and ends in May, and the young migrate downriver to estuary habitat following hatching where they wait for water temperatures to begin to decrease before moving offshore (Rohde et al. 2009). All three species were not detected in recent sampling events in Monticello Reservoir, Parr Reservoir, or Mayo Creek (Normandeau 2007, 2008, 2009a; Quattlebaum 2008a; Tetra Tech NUS, Inc. 2007, 2009b). All three species are important for recreational or commercial fisheries, and all life stages represent important food sources for other predatory fish and wildlife. The once huge populations of shad and herring in South Carolina rivers started to decline in the mid-nineteenth century due to dam construction, pollution, and overfishing (FWS 2001).

Critical Habitats

No areas designated by FWS as critical habitat exist at the VCSNS site (NRC 2004). However, critical habitat for the Carolina heelsplitter (*Lasmigona decorata*) is present in Flat Creek, proposed for a transmission-line crossing in Lancaster County. This is discussed in the following section.

Federally and State-Listed Species

Eight Federally or State-listed threatened or endangered aquatic species are currently listed for counties relevant to the VCSNS Units 2 and 3 and associated transmission-line corridors in South Carolina.

Carolina Darter (*Etheostoma collis*)

The Carolina darter is listed as a State endangered species in Fairfield County and a State threatened species in Richland County (SCDNR 2010a) and is also classified as a species of high conservation priority in South Carolina (SCDNR 2005b). While there are reported accounts pertaining to the distribution of the Carolina darter within the Piedmont ecoregion, the overall abundance of this species is unknown (Hayes and Bettinger 2006b). Bettinger et al. (2006) suggest that the Carolina darter does not exist within the Broad River drainage, yet Rohde et al.

(2009) refer to accounts of this species in the upper and lower Broad River. This disparate information may be confounded by the taxonomic status of the Saluda darter (*E. saludae*) because debate continues regarding the separation of the two fish at the subspecies level or at the species level (NatureServe 2009b; Rohde et al. 2009; Jenkins and Burkhead 1994).

The Carolina darter was not documented during the SCDNR 2000-2004 Broad River drainage aquatic surveys, but the Saluda darter was captured at several stream stations during the study (Bettinger et al. 2003, 2006). Neither of these darters was encountered during the 2006-2009 aquatic surveys within the vicinity of the VCSNS site (Tetra Tech NUS, Inc. 2007, 2009b; Quattlebaum 2008a, 2008b; Normandeau 2007, 2008, 2009a), nor was either captured during the 1978-1984 survey efforts within Parr and Monticello reservoirs (Dames and Moore 1985).

The Carolina darter resides in small streams within the Piedmont ecoregion characterized by slow current velocities. Habitat associations include in-stream structure, such as large woody debris and a range of substrate conditions: mud, sand, and rock. The diet of the Carolina darter includes chironomid larvae, ostracods, copepods, and amphipods (Rhode et al. 2009).

Carolina Heelsplitter (*Lasmigona decorata*)

The Carolina heelsplitter is the sole freshwater mussel within South Carolina that maintains a designation as a Federally endangered species, and it is designated as a State species of highest conservation priority. The six known populations of the Carolina heelsplitter within the state are defined by geographic location: (1) Savannah River tributaries in Edgefield and McCormick Counties; (2) Cuffeytown Creek in Greenwood and McCormick Counties; (3) Lynches River and Flat Creek in Chesterfield, Kershaw, and Lancaster Counties; (4) Gills Creek in Lancaster County; (5) Fishing Creek in Chester County; and (6) Bull Run Creek in Chester County (SCDNR 2006b; 67 FR 44502). In addition to the counties containing critical habitat, FWS (2011) lists Chester, Fairfield, Lancaster, Lexington, Newberry, and Richland Counties as having potential habitat for the Carolina heelsplitter. However, there are no verified species occurrences within Fairfield, Lexington, and Newberry Counties.

Historic distribution of this species in South Carolina included the Pee Dee and Savannah drainages and possibly the Saluda drainage. Historic associations included freshwater habitats ranging from small-to-large streams and rivers. The Carolina heelsplitter has been noted to occur in association with substrate ranging from fine to coarse grain size fractions. Occurrences of the Carolina heelsplitter have been correlated in stream habitat complexity characterized as shaded, stable stream banks, and the presence of undercut banks, root wads, and large woody debris.

Designated critical habitat includes 103.2 km of streams and rivers in South Carolina that occur in conjunction with the known populations. The lateral boundaries of the critical habitats for the Carolina heelsplitter are denoted by the ordinary high-water mark along channel edges (67 FR 44502). Designated critical habitats for the Carolina heelsplitter do not occur in the vicinity of the VCSNS site, and the species has never been found in the Parr and Monticello reservoirs or in onsite creeks and streams.

The routing of Santee Cooper transmission-line corridors for VCSNS Units 2 and 3 is proposed to occur within two South Carolina counties that contain critical habitat for the Carolina heelsplitter: Chester and Lancaster Counties. The VCSNS-Flat Creek line will require a new corridor crossing across Fishing Creek Reservoir in Lancaster County near drainages known to support the Carolina heelsplitter. However, the known Gills Creek population is upstream from the location of the proposed new corridor; approximately 15 mi north and 12 mi northeast (MACTEC 2010). The existing VCSNS-Flat Creek corridor crosses a portion of Flat Creek in Lancaster County that is listed by FWS as critical habitat and supports the Lynches River / Flat Creek population of Carolina heelsplitter (Figure 2-17). The Carolina heelsplitter is also known to occur within 1 mi of the existing VCSNS-Varnville and VCSNS-Flat Creek transmission-line corridors at several locations in Richland and Lancaster Counties (SCDNR 2010b).

A portion of the SCE&G VCSNS-Killian line occurs within Fairfield County near watersheds that are potential Carolina heelsplitter habitat; however, Pike (2010) reported no occurrences of the heelsplitter associated with this transmission-line corridor. GIS-based analysis confirms no spatial overlap in known locations of this species and SCE&G transmission lines (SCDNR 2010b).

Further discussion of life-history attributes and potential for impacts on the Carolina heelsplitter is presented in Appendix F in a biological assessment and supplement prepared for FWS.

<u>Shortnose Sturgeon (*Acipenser brevirostrum*)</u>

The shortnose sturgeon was initially listed as a Federally endangered species in 1967 and is designated as a species of highest conservation priority by SCDNR (McCord 2006; NMFS 2009). This amphidromous species uses freshwater, estuarine, and marine habitats to complete its life cycle (Rohde et al. 2009; McCord 2006; NMFS 2009). In South Carolina, populations of shortnose sturgeon exist in the Ashepoo, Combahee, and Edisto rivers (flowing to St. Helena Sound), the Pee Dee, Waccamaw, and Black rivers (flowing to Winyah Bay), and the Savannah, Cooper, and Santee rivers. There is also a small landlocked population of shortnose sturgeon in the Santee-Cooper Lake system (Collins et al. 2003).

In freshwater habitats, shortnose sturgeon are associated with soft bottom substrates in deep water. Spawning occurs in freshwaters characterized by low-to-moderate velocities and over substrates that include clay, sand, gravel, and woody debris (Rohde et al. 2009; McCord 2006). Eggs are adhesive and survival is reportedly dependent on water with little turbidity (McCord 2006).

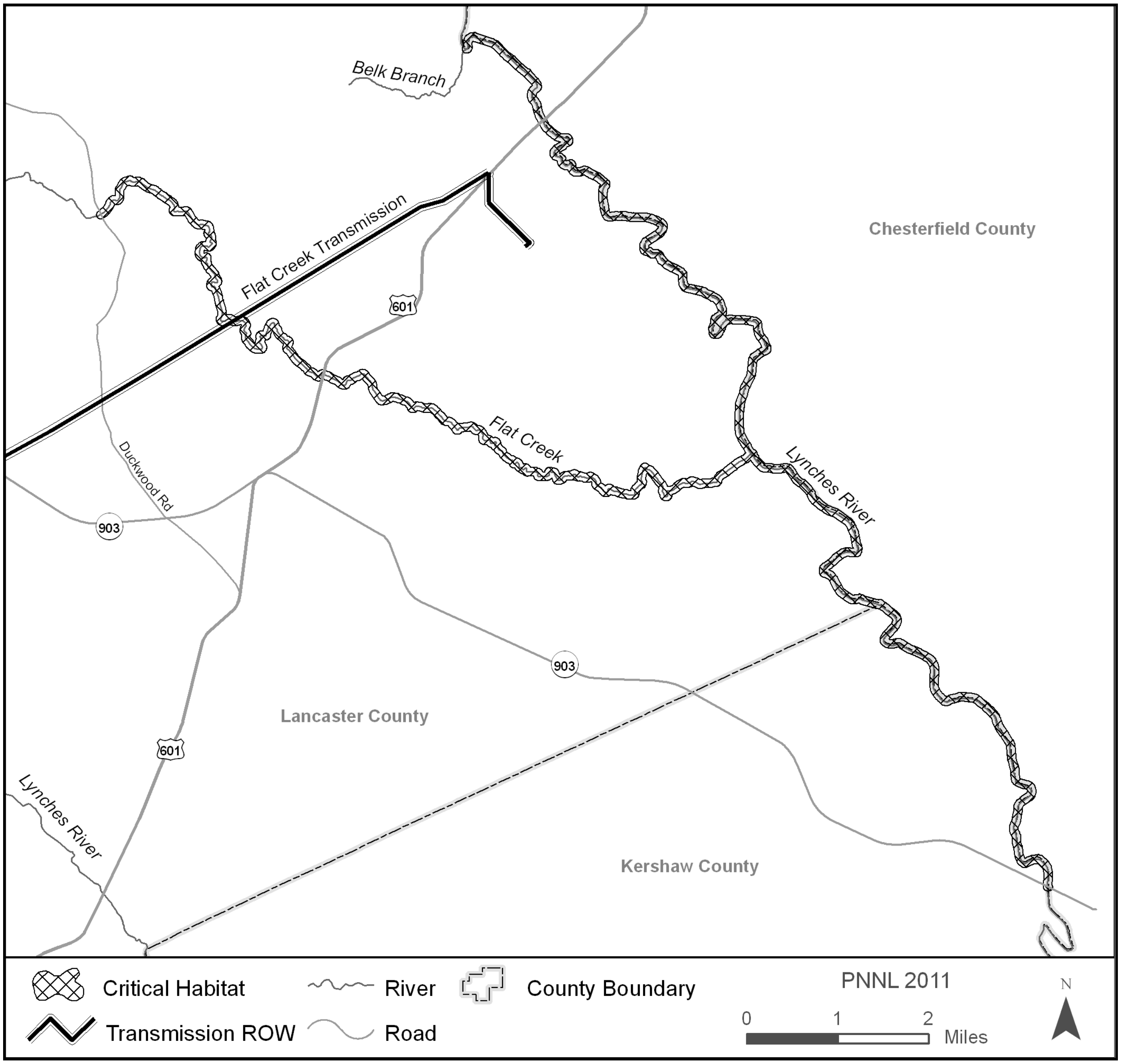

Figure 2-17. Existing Portion of Santee Cooper VCSNS-Flat Creek Line Crossing of Carolina Heelsplitter Critical Habitat (MACTEC 2010; 67 FR 44502)

The shortnose sturgeon has not been reported to occur in the vicinity of the VCSNS site, but the routing of transmission-line corridors for VCSNS Units 2 and 3 is proposed to occur within seven South Carolina counties that are associated with the occurrence of shortnose sturgeon: Calhoun, Colleton, Dorchester, Hampton, Lexington, Orangeburg, and Richland Counties. Shortnose sturgeon are not reported to occur in river systems that would be crossed by new corridor associated with VCSNS Units 2 and 3 transmission lines (Palmetto 2010; MACTEC 2010). Further discussion of life-history attributes and the potential for impacts is presented in Appendix F in a biological assessment and supplement prepared for the National Marine Fisheries Service (NMFS).

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

The Atlantic sturgeon is not currently listed either Federally or by the State of South Carolina. However, on October 6, 2010, the NMFS published in the *Federal Register* (75 FR 61904) a proposed rule for listing the Carolina and South Atlantic distinct population segments of the Atlantic sturgeon as endangered under the Endangered Species Act. In light of this proposed listing, the review team is now considering the Atlantic sturgeon in its analysis.

According to the Atlantic Sturgeon Status Review Team (ASSRT 2007), it is likely that Atlantic sturgeon once occurred in many riverine and estuarine ecosystems within South Carolina. While Atlantic sturgeon have been noted to occur in many South Carolina coastal rivers during the past several decades, specific information detailing population records for each of these rivers is not readily available. There appears to be little quantitative evidence linking the occurrence of Atlantic sturgeon in specific streams and rivers to spawning populations in South Carolina. South Carolina Rivers with recent documented occurrences of Atlantic sturgeon include Waccamaw, Pee Dee, Santee, Cooper, Edisto, Combahee, Coosawatchie, and Savannah Rivers (ASSRT 2007). Because these river systems are also habitat for shortnose sturgeon, counties for potential occurrence of Atlantic sturgeon will be considered the same as for the shortnose sturgeon. Carcasses of three adult Atlantic sturgeon were found above the Wilson and Pinopolis dams in Lake Moultrie during the 1990s. However, while a fish lift at the St. Stephen Hydroelectric Project operates to pass fish during the spring, there have been no observations of an adult Atlantic sturgeon passing this facility. It is assumed that the fall zone on the Santee-Cooper River system was the uppermost limit to spawning of Atlantic sturgeon prior to development of the Santee-Cooper Hydroelectric Project (ASSRT 2007).

Characteristics of the early life-history attributes of Atlantic sturgeon such as age at seaward migration and residence time in freshwater habitats varies within natal streams as well as across geographic regions (Jenkins and Burkhead 1994). Juveniles migrate from spawning areas toward saline habitats where individuals spend months to years rearing in estuarine environments. In marine environments, Atlantic sturgeon make extensive migrations from their natal estuary presumably to productive foraging grounds (ASSRT 2007). Spawning is believed to occur in flowing water between the salt wedge and the fall line of large rivers. Like the shortnose sturgeon, spawning adults generally migrate upriver during the spring (February to March) in southern rivers. A fall-spawning migration also may occur in some southern rivers (ASSRT 2007).

The Atlantic sturgeon have not been reported to occur in the vicinity of the VCSNS site, but may occur in waterbodies spanned by the existing VCSNS-Varnville transmission-line corridors. Atlantic sturgeon are not reported to occur in river systems that will be crossed by new corridor associated with VCSNS Units 2 and 3 transmission lines (Palmetto 2010; MACTEC 2010).

Further discussion of life-history attributes and the potential for impacts is presented in Appendix F as a supplement to the biological assessment prepared for the NMFS.

Sea Turtles

Four Federally listed species of sea turtles exist in South Carolina and are associated with one county, Colleton, which is proposed to include transmission-line corridors for VCSNS Units 2 and 3 (Figure 2-5). The loggerhead (*Caretta caretta*)sea turtle is listed as threatened whereas the green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles are listed as endangered (see Table 2-20) (FWS 2010). The loggerhead sea turtle is also listed as a State threatened species for Colleton County (SCDNR 2010a). All sea turtles have certain life-history similarities in that females swim ashore to sandy beaches and deposit eggs in nesting pits that are covered to allow incubation. Juveniles hatch, struggle out of the sandy nest, and make their way to their respective ocean habitats (Carr et al. 1982). Colleton County has a sandy shoreline on the Atlantic coast that includes habitat where it is possible for sea turtle nesting to occur. The portion of the VCSNS-Varnville transmission-line corridor within Colleton County would run within existing transmission-line corridors that are adjacent to and west of I-95, which is over 25 mi west from the coastline and is not proposed to cross any marine habitats (MACTEC 2009). Therefore, although the four species of sea turtles occur in Colleton County, no activities associated with VCSNS Units 2 and 3 would affect these species, and they are not discussed further.

2.4.2.4 Aquatic Monitoring

The aquatic ecology near the vicinity of the VCSNS site has been described through various monitoring programs since the 1970s (e.g., Dames and Moore 1985; Christie and Stroud 1998, 1999; Hayes 1999). Recent monitoring efforts were implemented to document the condition of aquatic ecology in Mayo Creek and Monticello and Parr reservoirs as part of the preparation of the SCE&G COL application (e.g., Normandeau 2007, 2008, 2009a, b; Quattlebaum 2008a, b; Tetra Tech NUS, Inc. 2007, 2009b; CBS 2008a, b, c, d; CBS 2009a, b, c, d). These recent (2006-2009) efforts summarized fish community composition, benthic resources, and submerged aquatic vegetation at select locations near the vicinity of the VCSNS.

2.5 Socioeconomics

This section describes the socioeconomic baseline of the proposed VCCNS project site. It also describes the characteristics of the region surrounding the VCSNS site, including population demographics and density, and uses the data to form the basis for assessing the potential social and economic impacts from the construction and operation of the proposed VCSNS Units 2 and 3. Unless otherwise specified, the information presented in this section is based on the VCSNS ER (SCE&G 2010a), and has been confirmed by the review team.

Socioeconomic impacts may occur in the region surrounding the proposed site. This discussion emphasizes the socioeconomic characteristics of Fairfield, Newberry, Lexington, and Richland Counties, although it considers the entire region within the 50-mi radius of the site.[(a)] The scope of the review of site-specific community characteristics is guided by the magnitude and nature of the expected impacts of construction, maintenance, and operation of the proposed project. The four counties identified above constitute the economic impact area where the review team expects all noticeable economic impacts such as employment, income effects, and tax impacts would occur.

The population data for the region are based on the 2000 U.S. Census or more recent estimates and population projections from the South Carolina Budget and Control Board (SCBCB) as noted. In addition, the review team analyzed the economic, employment, and population trends for the region using additional U.S. Census data sets and population projections from the SCBCB.

The region is a 50-mi circle centered on the proposed powerblock and covers all or a portion of 21 counties in South Carolina, including Aiken, Calhoun, Cherokee, Chester, Edgefield, Fairfield, Greenwood, Kershaw, Lancaster, Laurens, Lee, Lexington, McCormick, Newberry, Orangeburg, Richland, Saluda, Spartanburg, Sumter, Union, and York. The region also covers a portion of Union County, North Carolina. Figure 2-2 shows a map of the region.

2.5.1 Demographics

For the purposes of this analysis, the review team 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 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.

(a) For the purposes of this EIS, the relevant region is limited to the area necessary to include social and economic base data for (1) the county in which the proposed facility would be located and (2) the specific portions of surrounding counties and urbanized areas (generally, up to 50 mi from the VCSNS site) from which the construction/operations workforce would be principally drawn, or that would receive stresses to community services by a change in the residence of construction/operations workers.

2.5.1.1 Resident Population

In its ER (SCE&G 2010a), SCE&G reports that, based on the 2000 U.S. Census, 111 people live within 2 mi of the center of the VCSNS Units 2 and 3 powerblock, about 289 within 3 mi, 12,209 within 10 mi, 151,925 within 20 mi, and 1,028,075 within 50 mi. The population density for the 50-mi region surrounding the VCSNS site is approximately 131 persons/mi^2. Table 2-23 presents population trends and projections for the region and various subset areas.

The population growth rates shown in Table 2-23 were calculated for each county based on county projections obtained from the SCBCB. The SCBCB presents annual population projections by county for the 2010-2035 period using standard population cohort-component methods.

Data in Table 2-23 indicate that the region has been growing and is projected to continue to grow at a slightly faster rate than the State of South Carolina as a whole for the foreseeable future. The majority of the population distribution is to the east and south of the VCSNS site. Significant population centers are shown in Table 2-24. The distribution of the 2000 resident population in the 50-mi region by age is shown in Table 2-25.

The combined resident population of the four counties closest to the VCSNS site could be characterized as being predominately Caucasian (62.8 percent compared to 68.4 percent Caucasian in the State of South Carolina), although Fairfield County had a higher percentage of African American residents than the region as a whole (57.7 percent compared to 34.2 percent state-wide) (SCBCB 2009a). Median family income in the Columbia Metropolitan Statistical Area (including Richland, Fairfield, Lexington, Calhoun, and Saluda Counties) in 2009 was $62,100, compared to the State median family income of $55,000 (HUD 2009). Newberry County's 2009 median family income was $50,500 and is reported separately because the county is not part of a metropolitan area.

2.5.1.2 Transient Population

Transients include people who work in or visit large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels, or work at recreational areas or special events where there may be seasonal and workday variations in population. The VCSNS 50-mi region includes a number of facilities, venues, and recreational areas that attract transient populations in substantial numbers.

Outdoor recreation opportunities in the VCSNS 50-mi region include a number of parks and water-based and forest-based recreational opportunities. Several large lake-based recreation areas in the four closest counties to the site are accessible to relatively large numbers of annual visitors. These parks provide locations for a range of activities, including fishing, camping, biking, horse-riding, picnicking, and hiking. Table 2-26 summarizes the overnight capacity and recent visitation trends for these resources.

Table 2-23. Historical and Projected Populations for Counties in the VCSNS Region

County	1970[a]	1980[a]	1990[a]	2000[a]	2007[b]	2010[c]	2020[c]	2030[c]	2040[d]	2050[d]	2060[d]
Fairfield	19,999	20,700	22,295	23,454	23,333	23,760	25,190	26,610	28,058	29,584	31,193
Lexington	89,012	140,353	167,611	216,014	243,270	255,100	294,510	333,180	373,865	419,518	470,746
Newberry	29,273	31,242	33,172	36,108	37,633	38,390	40,900	43,400	45,942	48,633	51,482
Richland	233,868	269,735	285,720	320,677	357,734	366,550	395,920	425,960	457,424	491,212	527,496
Economic Impact Area	372,152	462,030	508,798	596,253	661,970	683,800	756,520	829,150	905,289	988,947	1,080,917
Annual Average Growth Rate		2.4%	1.0%	1.7%	1.1%	0.3%	1.1%	1.0%	0.9%	0.9%	0.9%
Aiken	91,023	105,625	120,940	142,552	152,307	158,120	177,510	196,500	216,243	237,970	261,880
Calhoun	10,780	12,206	12,753	15,185	14,777	15,210	16,660	17,980	19,272	20,657	22,142
Cherokee	36,791	40,983	44,506	52,537	54,015	55,800	61,760	67,350	72,976	79,072	85,678
Chester	29,811	30,148	32,170	34,068	32,531	33,020	34,620	36,000	37,280	38,605	39,978
Edgefield	15,692	17,528	18,375	24,595	25,435	26,560	30,270	33,520	36,692	40,164	43,964
Greenwood	49,686	57,847	59,567	66,271	68,259	69,770	74,840	79,750	84,770	90,106	95,778
Kershaw	34,727	39,015	43,599	52,647	58,168	60,370	67,700	74,810	82,135	90,177	99,006
Lancaster	43,328	53,361	54,516	61,351	73,393	74,800	79,480	83,940	88,402	93,101	98,050
Laurens	49,713	52,214	58,092	69,567	69,582	72,040	80,220	87,660	95,073	103,113	111,833
Lee	18,323	18,929	18,437	20,119	19,988	20,270	21,180	22,060	22,937	23,849	24,797
McCormick	7955	7797	8868	9958	10,098	10,450	11,590	12,720	13,880	15,146	16,527
Orangeburg	69,789	82,276	84,803	91,582	89,952	91,450	96,400	100,700	104,784	109,033	113,455
Saluda	14,528	16,150	16,357	19,181	18,748	19,150	20,470	21,570	22,580	23,637	24,744
Spartanburg	173,724	201,861	226,800	253,791	275,534	283,530	310,220	336,810	364,459	394,377	426,751
Sumter	79,425	88,243	102,637	104,646	103,943	106,180	113,630	121,160	128,954	137,250	146,080
Union	29,230	30,751	30,337	29,881	27,770	27,640	27,190	26,570	25,861	25,171	24,499
York	85,216	106,720	131,497	164,614	208,827	218,990	252,860	287,970	326,022	369,102	417,875
Union, NC[e]	54,714	70,380	84,211	123,677	181,652	210,069	304,688	399,306	493,924	588,542	683,160
50-mi Region	1,266,607	1,494,064	1,657,263	1,932,475	2,146,949	2,237,219	2,537,808	2,835,526	3,141,533	3,468,019	3,817,114
Annual Average Growth Rate	NA	1.8%	1.1%	1.7%	1.2%	1.4%	1.3%	1.2%	1.1%	1.0%	1.0%
South Carolina	2,590,516	3,121,820	3,486,703	4,012,012	4,407,709	4,549,150	5,020,400	5,488,460	5,975,731	6,506,262	7,083,894
Annual Average Growth Rate	NA	2.1%	1.2%	1.5%	1.1%	1.1%	1.0%	0.9%	0.9%	0.9%	0.9%
North Carolina[e]	5,084,411	5,880,095	6,632,448	8,049,313	9,041,821	9,572,644	11,272,964	12,935,056	14,597,148	16,259,240	17,921,332
Annual Average Growth Rate	NA	1.6%	1.3%	2.1%	1.4%	2.0%	1.8%	1.5%	1.3%	1.1%	1.0%

(a) SCBCB 2009b
(b) SCBCB 2009c
(c) SCBCB 2009d
(d) Extension of the SCBCB 2025-2035 trend
(e) North Carolina data from the following sources: USCB 1995; USCB 2009a; NCOSBM (2009a, b, c);

Table 2-24. Selected 2007 Population Centers in the VCSNS Region

City	Population
Columbia	124,818
Lexington	14,995
West Columbia	13,907
Cayce	12,556
Irmo	11,542
Newberry	10,893
Chester	6040
Winnsboro	3564
Blythewood	1299

Source: SCBCB 2009e

Table 2-25. 2000 Age Distribution Near the VCSNS Site

	Fairfield		Lexington		Newberry		Richland		South Carolina	
Age Group	Number	Percent of Population	Number	Percent of Population	Number	Percent of Population	Number	Percent of Population	Number	Percent of Population
Under 18	6128	26.1	56,313	26.1	8701	24.1	77,609	24.2	1,009,641	25.2
18 to 24	2019	8.6	17,874	8.3	3551	9.8	44,135	13.8	407,851	10.2
25 to 44	6520	27.8	68,334	31.6	9977	27.6	101,459	31.6	1,185,955	29.6
45 to 64	5693	24.3	51,504	23.8	8556	23.7	65,999	20.6	923,232	23.0
65 and over	3094	13.2	21,989	10.2	5323	14.7	31,475	9.8	485,333	12.1
Totals	24,545		216,014		36,108		320,677		4,012,012	

Source: SCE&G 2010a

Table 2-26. High-Capacity Recreation Areas in the Region

Recreation Site	Camp Sites[(a)]	2004-5 Campers[(b)]	2004-5 All Visitors[(b)]	2006-7 Campers[(c)]	2006-7 All Visitors[(c)]
Chester State Park	31	6411	29,166	6324	36,675
Dreher Island State Recreation Area	112	30,577	206,948	38,410	154,749
Lake Greenwood State Recreation Area	145	51,125	139,152	53,840	151,233
Lake Wateree State Recreation Area	72	32,435	133,008	32,011	156,580
Sesquicentennial State Park	89	9641	105,672	18,795	105,648

(a) SCBCB 2007
(b) SCBCB 2009f
(c) SCBCB 2009g

The Sumter National Forest is located north of the VCSNS site and offers a wide range of recreational activities, including camping, fishing, hiking, and hunting. The region features many other developed recreation sites, including parks, wildlife management areas, historic sites, forests, and recreation areas, but the sites listed in Table 2-26 represent most of the capacity among all recreation sites in the region.

The Fort Jackson military base is within the 50-mi analytical region, located about 30 mi east of the VCSNS site. Fort Jackson employs 4000 civilians and is the largest and most active Initial Entry Training Center in the Army, training 19,000 new soldiers each year.

The largest capacity and greatest number of hotels and motels in the area are concentrated primarily in the larger cities, and hence, are at some distance from the VCSNS site. However, there are several motels in the vicinity of the site. The greater Columbia area has more than 10,334 hotel rooms spread over 110 separate properties (SCBCB 2008).

2.5.1.3 Migrant Labor

The U.S. Census Bureau (USCB) defines a migrant laborer as someone who is working seasonally or temporarily and moves one or more times from one place to another for seasonal or temporary employment. During VCSNS scheduled refueling outages, there is an influx of construction-related migrant laborers to the area who are hired by VCSNS to carry out fuel-reloading activities, equipment maintenance, and other projects associated with the outage. VCSNS employs an average of about 655 contract employees during refueling outages, which occur every 18 months (NRC 2004), and approximately 90 percent of those employees come from outside the 50-mi region.

Migrant farm workers are defined as workers whose employment requires travel that prevents them from returning to their permanent place of residence the same day. Migrant farm workers tend to work short-duration, labor-intensive jobs, such as harvesting fruits and vegetables. The 2007 Census of Agriculture indicates that the reported migrant farm worker population in the region is approximately 200 (USDA 2007a). The number is approximate because of differences between the county- and State-level reporting requirements (USDA 2007b).

2.5.2 Community Characteristics

The VCSNS site is located in a rural area of western Fairfield County. The site itself is on the Monticello Reservoir, which is surrounded by wetlands and pine forest, with sparse residential development. The site is near metropolitan Columbia, the Richland County Seat and capital of South Carolina. However, Fairfield County is much more rural than Richland County; and is governed from the County Seat of Winnsboro.

An unincorporated residential area surrounds the VCSNS site, although it remains sparsely populated. The land surrounding the site is also zoned for low-density residential development.

To the west, I-26 passes the site, although the site itself is only accessible by State and county roads, or by a railroad spur. Besides Columbia, the VCSNS site is not near other large population centers.

The characteristics of the populations of the four most local counties vary widely around the State averages for minority proportion and the proportion living below the poverty level. Fairfield County, the host county for the new nuclear units, has nearly double the minority proportion of the state as a whole and a proportion of individuals living in poverty that is 22 percent higher than the State average. The other three counties all have poverty proportions that are lower than the State average and closer to the national average. Lexington County, composed mostly of suburbs of Columbia, is more than 80 percent Caucasian, which differs significantly from the rest of the area. The four-county local area is described in terms of racial characteristics and income level in Table 2-27.

Further discussion of the demographic composition of the local area can be found under Environmental Justice (see Section 2.6). 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.

Table 2-27. Minority and Low-Income Populations

Location	Percentage Minority	Percentage Below Poverty
United States	30.9	13.3
South Carolina	32.7	15.6
Fairfield	60.4	20.0
Lexington	18.5	11.8
Newberry	37.6	13.4
Richland	50.6	13.5

Source: Adapted from USCB 2005-2007 American Community Survey (USCB 2009b, c, d, e, f)

2.5.2.1 Economy

As the economic hub of the Central Midlands, the City of Columbia is the center of government and industry for a wide area in central South Carolina. Relatively recently, the I-26 corridor has seen significant commercial and residential development in the areas of West Columbia and Irmo. The University of South Carolina and several regional medical facilities have attracted a well-educated workforce to this area. Fort Jackson, a large military installation in Columbia, is supported by nearly 4000 civilian employees.

The principal economic centers within the region are found in Columbia (Richland and Lexington Counties), Newberry (Newberry County), Clinton (Laurens County) and Union (Union County). However, the economy of the Central Midlands is dominated by Columbia.

The construction of Unit 1 provides context for what the potential impacts of constructing the new units would be. The NRC was completing its Final Environmental Statement (FES) for the Operating License (OL) for VCSNS Unit 1 just as final construction of that unit was winding down over the 1979-1981 period. As such, the Unit 1 OL FES provides a glimpse of the observed socioeconomic impacts from that construction project. The review team noted that at that time the construction contractor commissioned a workforce survey to ascertain information such as the residence pattern of the construction workers. Of the approximately 2400 workers surveyed, 1913, or about 80 percent came from within the VCSNS region, and 927, or nearly 50 percent came from either Lexington or Richland Counties (NRC 1981). The review team also observed that more than 70 percent of the workers came from the Central Midlands area, with the remainder coming from outside the region.

The VCSNS site currently employs approximately 635 full-time operations employees (SCE&G 2009e), with an average of 740 additional contract workers over two recent maintenance outages (SCE&G 2010a). About 95 percent of the current operating workforce resides in Fairfield, Lexington, Newberry, and Richland Counties (see Table 2-28). Therefore, this four-county area is considered to be the economic impact area when discussing employment, income, and output impacts from construction and operations. The review team used the distribution of VCSNS employees as the basis for several demographic assumptions in its economic impact assessment, which is discussed in Chapters 4 and 5 of this EIS.

Table 2-28. VCSNS Unit 1 Operations Employment by County and State

County or Summary Level	2006 Employment	Percent
Fairfield County	58	9.1
Lexington County	219	34.5
Newberry County	115	18.1
Richland County	209	32.9
Economic impact area	601	94.6
Other counties	34	5.4
VCSNS Operations Employment	635	100.0

Source: After SCE&G 2009e

Table 2-29 shows the unemployment rates for all counties in the 50-mi region for the 2005-2009 period. Between 2005 and 2008, the four-county economic impact area remained relatively stable. However, unemployment in Fairfield County has risen significantly in the last year as a result of economic conditions similar to those seen elsewhere in the country associated with the current economic downturn. The four-county economic impact area's unemployment rate has recently risen to about the national unemployment rate. As the current recession has deepened, the Central Midlands and Columbia, specifically, have not been able to avoid impacts of the national economic downturn. The increase in unemployment is largely tied to construction and manufacturing-based industries.

Table 2-29. Employment Trends in the Region

County or Summary Level	Labor Force					Unemployment Rate				
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
Aiken	69,850	70,462	70,579	70,640	69,590	5.9	6.3	5.3	5.9	9.7
Calhoun	6567	6585	6466	6478	6,070	7.3	7.0	6.2	7.7	12.6
Cherokee	22,920	23,234	23,609	23,198	21,782	7.9	7.5	6.7	9.3	16.4
Chester	14,425	14,550	13,826	13,383	12,697	9.2	10.0	10.8	12.3	20.5
Edgefield	10,358	10,229	10,282	10,291	10,066	7.2	7.6	6.2	6.8	10.7
Fairfield[(a)]	10,424	10,401	10,176	10,195	9,722	7.8	8.8	8.4	10.8	13.4
Greenwood	29,562	29,259	28,913	28,014	27,597	9.1	7.8	6.8	7.9	12.9
Kershaw	27,075	27,769	28,053	28,103	27,018	6.6	6.2	5.3	6.6	11.0
Lancaster	27,219	27,884	27,009	26,016	25,409	8.4	8.8	9.5	11.8	17.9
Laurens	30,956	31,203	30,948	31,270	28,946	6.7	6.8	7.1	7.4	12.0
Lee	7511	7601	7489	7331	7,340	9.5	9.4	8.1	9.6	14.9
Lexington[(a)]	121,271	124,747	126,165	126,391	122,588	4.9	4.6	4.1	4.9	8.4
McCormick	3152	3216	3159	3057	2,904	11.2	10.8	9.8	11.1	16.8
Newberry[(a)]	16,425	16,831	17,060	17,207	16,412	7.0	6.3	5.5	7.2	11.8
Orangeburg	36,630	36,590	37,160	36,633	35,703	9.6	9.0	8.0	10.5	15.9
Richland[(a)]	160,746	165,869	170,132	170,437	164,652	6.0	5.7	5.2	6.1	9.6
Saluda	8648	8791	8634	8650	8,158	6.6	6.1	5.2	5.9	9.9
Spartanburg	121,762	124,974	126,527	128,179	119,763	7.5	6.5	5.6	6.9	12.4
Sumter County	42,470	42,218	41,479	39,420	39,164	8.5	7.7	7.0	8.6	13.0
Union County	11,293	10,985	10,637	10,455	9,907	10.8	10.7	8.9	11.1	19.9
York County	89,815	94,695	99,019	99,076	96,185	6.7	6.2	5.3	7.2	14.2
Region	869,079	888,093	897,322	894,424	861,673	6.9	6.5	5.9	7.1	12.0
Economic impact area	308,866	317,848	323,533	324,230	313,374	5.7	5.4	4.9	5.9	9.4
South Carolina	1,927,674	1,976,649	2,006,179	2,004,244	1,915,794	6.7	6.3	5.6	6.9	11.7

Source: BLS 2009c, 2010.
(a) Part of the four-county economic impact area

Table 2-30 shows the occupational characteristics of residents of Fairfield, Lexington, Newberry, and Richland Counties. Richland County is the center of retail and health care industries in the Central Midlands. In addition, because Columbia, the capital of South Carolina, is in Richland County, government and government enterprises play a large role in the local economy. Lexington County has become a suburb of Columbia. State government employment accounts

for 16.7 percent of nonfarm employment in Richland County. Nearly 30 percent of employment in Newberry County is in manufacturing industries. Table 2-31 illustrates the occupational makeup of construction employment in the Columbia metropolitan area. The metropolitan area appears to support healthy levels of the construction trades, which could be expected to be needed for the development of the VCSNS units.

Table 2-32 shows median family income information covering the four-county economic impact area based on the 2000 census and 2009 Housing and Urban Development estimates. In general, family incomes in the four-county economic impact area grew faster than the South Carolina pace but lagged behind the rest of the country. Family incomes in Newberry County appear to be noticeably below the State and national averages in 2009, while family incomes across the Columbia metropolitan area appear to be about equal to the national average. The Columbia metropolitan area family median income is about 13 percent higher than the statewide average.

2.5.2.2 Taxes

The VCSNS site is located in Fairfield County. SCE&G would pay all of its property taxes to Fairfield County. Table 2-33 illustrates recent trends in property tax payments SCE&G has made, attributable to the current VCSNS facility and SCE&G lands. These revenues currently represent about 37 percent of the Fairfield County property tax collections. This share has declined slightly over time because of Unit 1 depreciation and Fairfield County's tax base has grown modestly over the last 10 years – most significantly in the last 3 to 4 years. Property tax revenues are distributed primarily into education, human services, and capital and debt, with the rest being distributed among several other categories (sheriff, community services, and general administration). Santee Cooper also contributes a minor amount of fee-in-lieu-of-taxes to Fairfield County, but this amount represents only a negligible source of revenue. Of note, SCE&G is the single largest property tax payer in Fairfield County.

SCE&G also pays sales and use taxes on the in-state purchases of goods and services made in support of VCSNS Unit 1 operations; however, for Unit 1 operations, these revenues are not significant revenue sources for the State. Additional sales taxes would be raised by the additional purchases and consumption from new workers associated with VCSNS Units 2 and 3 (SCE&G 2010a). Tax impacts from construction and operations are discussed in Sections 4.4.3.2 and 5.4.3.2 of this EIS.

Table 2-30. 2007 Employment by Industry in the Economic Impact Area

Industry	Fairfield	Lexington	Newberry	Richland
Total employment	8735	140,579	18,046	273,583
Wage and salary employment	6779	105,478	15,302	244,897
Proprietors employment	1956	35,101	2744	28,686
Farm proprietors employment	209	962	621	398
Nonfarm proprietors employment	1747	34,139	2123	28,288
Farm employment	229	1213	812	451
Nonfarm employment	8506	139,366	17,234	273,132
Private employment	6788	120,756	14,563	207,517
Forestry, fishing, related activities, and other	D	316	400	D
Mining	D	193	D	D
Utilities	D	560	D	2246
Construction	519	13,408	1,258	12,163
Manufacturing	865	12,176	5,004	11,560
Wholesale trade	604	7328	389	9467
Retail trade	827	17,242	1775	26,263
Transportation and warehousing	D	6670	D	2870
Information	D	1166	70	D
Finance and insurance	95	5265	298	19,970
Real estate and rental and leasing	342	9707	326	10,973
Professional, scientific, and technical services	D	6198	D	16,167
Management of companies and enterprises	D	711	D	3290
Administrative and waste services	434	8435	906	19,787
Educational services	D	1302	398	4,795
Health care and social assistance	D	9569	1225	27,148
Arts, entertainment, and recreation	91	2291	189	3389
Accommodation and food services	294	9730	732	18,330
Other services, except public administration	575	8489	892	D
Government and government enterprises	1718	18,610	2671	65,615
Federal, civilian	46	587	112	8547
Military	98	1019	158	11,354
State and local	1574	17,004	2401	45,714
State government	241	1766	245	32,075
Local government	1333	15,238	2156	13,639

Source: BEA 2009
D = Data not disclosed

Table 2-31. 2006-2009 Construction Industry Occupational Employment in the Columbia Metropolitan Area

Occupation Title	2006	2007	2008	2009
Construction and extraction occupations	15,780	18,170	16,880	14,360
First-line supervisors/managers of construction trades and extraction workers	1850	2120	2140	1920
Brickmasons and blockmasons	490	450	310	280
Carpenters	1810	2450	2180	1590
Tile and marble setters	120	D	D	D
Cement Masons and concrete finishers	410	280	340	300
Construction laborers	1650	1860	1740	2070
Paving, surfacing, and tamping equipment operators	180	370	370	260
Operating engineers and other construction equipment operators	1140	1120	1130	800
Drywall and ceiling tile installers	520	710	670	450
Electricians	1470	1830	1670	1190
Glaziers	100	D	D	D
Insulation workers, mechanical	D	130	260	230
Painters, construction and maintenance	620	700	600	550
Pipelayers	220	210	270	140
Plumbers, pipefitters, and steamfitters	1230	1790	1490	1060
Reinforcing iron and rebar workers	60	60	D	D
Roofers	260	290	300	240
Sheet metal workers	320	320	340	480
Structural iron and steel workers	110	40	40	70
Helpers – brickmasons, blockmasons, stonemasons, and tile and marble setters	370	250	150	50
Helpers – carpenters	510	470	400	310
Helpers – electricians	550	560	540	440
Helpers – painters, paperhangers, plasterers, and stucco masons	D	D	110	D
Helpers – pipelayers, plumbers, pipefitters, and steamfitters	490	490	420	320
Helpers, construction trades, all other	170	280	180	120
Construction and building inspectors	300	280	160	170
Hazardous materials removal workers	160	100	130	170
Septic tank servicers and sewer pipe cleaners	80	70	D	D
Helpers – extraction workers	50	D	D	D

Sources: BLS 2008, 2009a, b
D = Data not revealed by the Bureau of Labor Statistics (BLS) for disclosure reasons

Table 2-32. Annual Median Family Income (Current Dollars) by County for the Four-County Economic Impact Area

County	2000 Median Family Income	2009 Median Family Income	2000 to 2009 Percent Change	2009 Index Versus SC	2009 Index Versus US
Fairfield	49,269	62,100	26.0	1.129	0.970
Lexington	49,269	62,100	26.0	1.129	0.970
Newberry	40,582	50,500	24.4	0.918	0.789
Richland	49,269	62,100	26.0	1.129	0.970
South Carolina	44,227	55,000	24.4	1.000	0.859
United States	50,046	64,000	27.9	1.164	1.000

Source: HUD 2009

Table 2-33. 2003-2008 Property Tax Revenue Trends Related to VCSNS Unit 1 (dollars)

Year	VCSNS-Related Property Taxes Paid to Fairfield County	Other SCE&G-Related Property Taxes Paid to Fairfield County	Total SCE&G-Related Tax Revenue Accrued to Fairfield County	Fairfield County Total Property Tax Revenue (all sources)	VCSNS Percent of Fairfield County Property Tax Revenue
1999	12,529,680	4,952,021	17,481,701	27,772,061	45.1
2000	12,272,620	4,984,243	17,256,863	29,604,792	41.5
2001	12,273,100	4,898,955	17,172,055	28,801,287	37.6
2002	12,199,280	4,912,241	17,111,521	32,624,790	37.4
2003	12,903,760	5,157,484	18,061,244	32,225,887	40.0
2004	12,711,245	5,173,217	17,884,462	32,381,035	39.3
2005	13,564,310	5,565,492	19,129,802	32,527,833	41.7
2006	14,209,970	5,065,878	19,275,848	37,733,947	37.7
2007	14,295,100	5,730,027	20,025,127	37,988,361	37.6
2008	14,280,560	5,714,524	19,995,084	38,649,841	36.9

Sources: SCE&G 2009m; SCORS 2009

2.5.2.3 Transportation

The VCSNS 50-mi region has a well-developed transportation network of Federal, State, and county highways, a primary freight railroad service, a primary commercial airport, and 11 smaller public airports that provide ready access to the population centers of the region.

The major interstate highways near the VCSNS site include I-26, which links the regional population center of Columbia to the VCSNS site and neighboring counties; I-77, which links Columbia to Charlotte, North Carolina; and I-20, which links Columbia to Atlanta, Georgia. Fairfield County is linked to Columbia via US-321 to Winnsboro, while SC-215 connects Jenkinsville with Columbia and provides primary access to the VCSNS site.

Primary road access to the VCSNS site from the greater Columbia area to the southeast uses I-20 to US-176, which connects to SC-213. SC-213 connects to SC-215 in Jenkinsville, and SC-215 runs north to the current site access road. The roads providing primary access from I-20 to the site are two-lane highways. There are no alternate routes that would provide the majority of the workforce with efficient access to the site. Hence, the local highways (SC-213 and SC-215) currently exhibit heavy traffic volumes during shift change time periods at existing VCSNS Unit 1. Table 2-34 provides current traffic volume data for routes in the vicinity of the VCSNS site compared to the rated capacity of those roadways in terms of “level of service” (LOS). LOS is a generally accepted transportation metric estimated on a scale from A to F, where A is the best and F is the worst in terms of traffic volume and related road wear. SC-213 and SC-215 are two-lane rural roadways managed to maintain LOS “C” conditions (SCDOT 2009c).

Table 2-34. 2008 Annual Average Daily Traffic (AADT) for Selected Routes in the Vicinity of the VCSNS Site

Route	Route Location	2008 AADT	LOS “C” Capacity
SC-213	Newberry County Line to SC-215	2400	8600
SC-213	US-176 to Fairfield County Line	1700	8600
SC-215	Richland County Line to SC-213	1600	10,800
SC-34	Newberry County Line to SC-215	1600	16,800
SC-34	SC-215 to US-321	2300	16,800
SC-34	I-26 to Fairfield County Line	2200	16,800
US-176	Newberry County Line to I-26	5900	16,800

Sources: SCDOT 2009a, b

The review team assessed whether projects funded under the American Recovery and Reinvestment Act of 2009 might affect transportation routes in the vicinity of the site. Although many projects are planned within South Carolina, none is in the vicinity of the VCSNS site. The review team did not identify any transportation planning documents that address the routes listed in Table 2-34.

The only airport in the region with scheduled commercial air service is the Columbia Metropolitan Airport. Eleven other public general aviation airports are in the region. These include Lexington County, Columbia Owens (Richland County), Newberry County, Trenton Younce Field (Edgefield County), Saluda County, Greenwood County, Laurens County, Aiken Municipal (Aiken County), Chester Catawba Regional (Chester County), Woodward Field (Kershaw County), and Fairfield County airports. Over the last 10 years, the Columbia Metropolitan Airport has averaged about 58,000 commercial flight operations per year (SC Aeronautics 2009).

Railroad service in the vicinity is provided by two freight rail carriers, CSX Transportation and Norfolk Southern Railway (SCE&G 2010a). Passenger railroad service from Amtrak is only available from Columbia. The Norfolk Southern Railway serves the northern half of the state with lines connecting Columbia to the Greenville/Spartanburg area and to Charlotte (SCE&G 2010a). VCSNS has a railroad spur that connects to the Norfolk Southern line on the east side of the Broad River that runs through Columbia and Spartanburg (NRC 2004).

A high-speed railroad corridor is being planned along a northeast corridor that would link Columbia, South Carolina and Raleigh, North Carolina. A second corridor would connect Atlanta, Georgia, to Greenville/Spartanburg, South Carolina, and then link to Charlotte and Greensboro, North Carolina (SCE&G 2010a). As currently envisioned, the Raleigh line would run through central Fairfield County.

2.5.2.4 Aesthetics and Recreation

The VCSNS site is on a plateau south of Monticello Reservoir and is surrounded by forests. When observed from on land, the site is largely concealed by the surrounding forest. From Monticello Reservoir the view toward the proposed VCSNS Units 2 and 3 would be somewhat obscured by the existing Unit 1. The site has already been altered with the construction of the original Unit 1, and the proposed expansion would add four new cooling towers and associated plumes. The multiple high-voltage transmission lines associated with the VCSNS site and the Unit 1 containment building are the dominant man-made visual features in the surrounding landscape.

Fairfield County offers a wide array of outdoor activities around Monticello Reservoir and the surrounding woodlands including hiking, camping, fishing, boating, horseback riding, and hunting. The region includes many opportunities for outdoor activities, in addition to those found at Monticello Reservoir. Other major lakes within the region include Lake Wateree, Lake Murray, and Lake Greenwood. Outdoor activities in the region include backpacking, climbing, camping, hunting, hiking, boating, fishing, and swimming, among others. There are a number of public historic sites and the Congaree Swamp National Monument preserves the largest remnant of old-growth floodplain forest remaining in North America (NPS 2009).

Within the immediate vicinity of the VCSNS site, hunting, fishing, and pleasure boating are among the most popular recreational activities. Fairfield County operates a recreation site on the shore of Monticello Reservoir, in the town of Jenkinsville. SCE&G provides recreation sites and boat launch facilities around the reservoir, which are managed by SCDNR. The nearby Sumter National Forest offers opportunities for many forms of outdoor recreation, including hunting, fishing, camping, and hiking, among others.

2.5.2.5 Housing

Within the region of the VCSNS site are a number of communities ranging from the urban center of greater Columbia to the smaller cities and towns of Newberry, Winnsboro, Batesburg, Camden, Clinton, Lancaster, and smaller towns and rural areas such as Jenkinsville, Peak, Ridgeway, and Chester. The communities in Fairfield, Lexington, Newberry, and Richland Counties, where the majority of in-migrating labor is expected to live, are connected by an extensive highway, county road, and railroad system that support the area surrounding the VCSNS site. Many of the residential areas in the immediate vicinity of the VCSNS site are outside the jurisdictional boundaries of cities and towns. Rental property is available in the larger communities such as Newberry, Chapin, Irmo, and West Columbia. There also are several hotels/motels in the four-county area.

The greater Columbia metropolitan area has grown significantly since the 2000 U.S. Census. The USCB (2009g) estimates showed a total of 10,913 housing units in Fairfield County in 2008. Assuming that the vacancy rate remains relatively constant, 1692 of the units would be vacant and available when construction begins. Over the 2000-2008 period, the housing stock in the four-county area grew by 18.3 percent, with the addition of more than 33,300 new units (USCB 2009g). Housing stock growth in Richland County has significantly outpaced that of the other three counties in the four county area – 20.9 percent for Richland County compared to 11.8 percent elsewhere since 2000.

Recent residential development principally has been focused in the adjacent communities of Irmo, West Columbia, and Lexington, to support population growth in the Columbia metropolitan area as a whole. While three new housing developments are planned or awaiting construction in the Jenkinsville area bordering the Monticello Reservoir, the land surrounding the VCSNS site remains sparsely populated. Table 2-35 provides a snapshot of the real estate market in the counties closest to the VCSNS site.

Table 2-35. 2000 Census Housing Characteristics in the Four-County Area

Characteristic	Fairfield	Lexington	Newberry	Richland	Four-Counties	South Carolina
Total Housing Units	10,383	90,978	16,805	129,793	247,959	1,753,670
Total Occupied Units	8774	83,240	14,026	120,101	226,141	1,533,854
Owner-Occupied	6794	64,265	10,776	73,757	155,592	1,107,617
Renter-Occupied	1980	18,975	3250	46,344	70,549	426,237
Total Vacant Units	1609	7738	2779	9692	21,818	219,816
Percent Total Vacant Units	15.5	8.5	16.5	7.5	8.8	12.5
Median Value (single-family owner occupied)	$69,900	$106,300	$78,000	$98,700	$98,880	$94,900
Percent Change 1990 to 2000 in Commuter	18.9	34.7	16.3	18.5	23.8	24.3
Mean Travel Time to Work, Minutes	28.3	26	25.3	21.7	NA	24.3

Source: SCE&G 2010a
NA = Not applicable

2.5.2.6 Public Services

The political jurisdictions providing public services in the region include State, county, and municipal agencies and school districts. The review team expects that the public service impacts from the proposed action would be largely proportional to where the workers would reside. Therefore, the four-county area would likely bound the extent of such impacts, and the review team would not expect any significant public service impacts beyond the four-county area. The ensuing discussion of baseline conditions is confined to just the four-county area. As part of its evaluation, the review team visited the region to meet with local officials regarding the potentially affected public services and to validate SCE&G's assertions in its ER.

Water Supply and Waste Treatment

In the Central Midlands region, public water systems draw from surface water (i.e., rivers, lakes, and streams) or groundwater. The fall line, a line marking the transition between the Piedmont and the Coastal Plain physiographic ecoregions, approximately follows I-20 and splits the Central Midlands. VCSNS site is in the Piedmont, north of the fall line. Two of the four counties (Fairfield and Newberry) of interest lie entirely in the Piedmont. Approximately one-third of Lexington and Richland Counties lies in the Piedmont, with the remainder in the Coastal Plain.

The Piedmont is characterized by a limited groundwater supply due to the dense, crystalline rock substrate. Most of the large municipal systems in the Central Midlands north of the fall line obtain water from the Broad or Saluda rivers or one of their impoundments. However, some smaller municipalities have wells that can adequately meet water demands.

Currently, public water-supply facilities have excess capacity. According to local planning officials, water supply in the region is not a concern. Communities are adequately served by the current water supplies and planners estimate that the counties will continue to have adequate supply through current planning periods (SCE&G 2010a). Table 2-36 and Table 2-37 describe water suppliers in the four-county area, their current capacities, and their average daily production.

Wastewater treatment in the region is provided by local jurisdictions. Municipalities determine treatment methods based on needs and available technologies, within budget constraints. Currently, the municipalities in the four counties are able to meet projected wastewater-treatment needs (SCE&G 2010a). Table 2-38 provides public wastewater capacities and average daily production. Rural areas of each county use septic systems.

Police, Fire, and Medical Services

The Fairfield County Emergency Management Office is the lead agency responsible for emergency management planning in Fairfield County. It coordinates planning with both the Governor's Division of Emergency Management and SCE&G when responding to emergencies. Table 2-39 and Table 2-40 provide police and fire information for the four-county area, respectively. Emergency management officials consider current police and fire protection to be adequate at this time (SCE&G 2010a).

Scoping comments indicated that crime in the vicinity of the VCSNS site is a concern, and the review team's visits to the area confirmed that during Unit 1 construction, the presence of a large number of construction workers in the area contributed to noticeable increases in crime, such as assaults and drug- and alcohol-related misdemeanors. The review team compiled baseline crime statistics for the region from 2006 State-reported data (SCLED 2009). Table 2-41 lists the most recent detailed county-level arrest data reported in the State. Of note, the rate of violent crime in Lexington and Richland Counties was noticeably lower than the more rural local counties and the State in the 2007 report. The overall arrest rate in Fairfield County is about equal to the State arrest rate.

Table 2-36. Public Groundwater Supply Resources[a]

Groundwater System Name	System Number	Treatment Capacity (Mgd)	Reported Annual Average Withdrawal (Mgd)	Population Served
Fairfield County				
Jenkinsville Water District (9 wells and purchased from Midcounty)	2020001	NA	0.15	1969
Midcounty Water District #1 (4 wells[a] and purchased from Winnsboro)	2020002	NA	0.083	1487
Town of Ridgeway (1 well and purchased from Winnsboro)	2010002	NA	0.056	950
Lexington County				
Gaston Rural Water District (7 wells)	3220002	NA	0.46	6756
Gilbert Summit (7 wells and purchased from Lexington Co. Joint)	3220001	NA	0.41	4518
Newberry County				
Town of Prosperity (3 wells)	3610005	NA	0.058	1347

Source: After SCE&G 2010a
(a) Includes community water systems of 3 million gallons per month or greater; smaller systems are not required to report groundwater withdrawal.
NA = not applicable

Table 2-37. Public Surface-Water Supply Resources by County[a]

Surface-Water System Name	Treatment Capacity (Mgd)	Reported Annual Average Withdrawal (Mgd)	Population Served	Excess Capacity (Mgd)
Fairfield County				
Town of Winnsboro (Sand Creek and 192-ac Lake)	3.1	1.54	8303	1.56
Lexington County				
Town of Batesburg-Leesville (Lightwood Knot Creek, Duncan Creek)	2.4	1.1	7652	1.3
City of Cayce (Congaree Creek and purchased from Lexington Co. Joint, Lexington, and Columbia)[a]	6.0	3.1	15,250	2.9
City of West Columbia (Saluda River and Lake Murray and purchased from Cayce)	20	9.8	29,763	10.2
Lexington Co. Joint Municipal Water System (Lake Murray and purchased from West Columbia)	4.3	2.3	12,264	2.0
Town of Lexington (purchased from West Columbia and Lexington Co. Joint)	4.5	1.8	7659	2.7
Newberry County				
City of Newberry (Saluda River)	8.1	5.1	10,145	3.0
Town of Whitmire (Enoree River, Duncan Creek)	1.0	0.64	2755	0.36
Richland County				
Fort Jackson (US Army) (purchased from Columbia)	6.6	2.2	32,841	4.4
City of Columbia [(Lake Murray and Columbia Canal [Broad River])	126	65	223,660	61

Source: SCE&G 2010a
(a) Includes community water systems of 3 million gallons per month or greater.

Table 2-38. Public Wastewater-Treatment Systems by County[(a)]

System Name	Maximum Treatment Capacity (Mgd)	Average Daily Wastewater Processed (Mgd)	Estimated Excess Wastewater-Treatment Capacity (Mgd)[(b)]
Fairfield County			
Winnsboro/Jackson Creek Plant	1.5	Not Provided	Unknown
Lexington County			
Cayce Wastewater Treatment Facility (WWTF)	9.5	5.5 to 6.0	3.5 to 4.0
Town of Chapin	5.0 (proposed)	0.58	4.4 (proposed)
Batesburg-Leesville WWTF	2.5	1.3 to 1.5	1.0 to 1.2
Lexington-Coventry Woods Wastewater Treatment Plant	1.95	1.0	0.95
Newberry County			
City of Newberry/Bush River Wastewater Treatment Plant	3.22	2.5	0.7
Town of Whitmire	1.0	0.5 to 0.6	0.4 to 0.5
Richland County			
Columbia Metro Wastewater Treatment Plant	60	35	25
East Richland County Public Service District/Gills Creek	16.0	Not Provided	Unknown
Richland County/Broad River WWTF	6.0	1.2	4.8

Source: SCE&G 2010a
(a) Includes major facilities with a capacity of 1 million gpd or more
(b) Estimate assumes entire maximum treatment capacity is available to treat wastewater flow that is above average.

Table 2-39. Law Enforcement Personnel in 2005 by County

Political Jurisdiction	Total Law Enforcement Employees	Total Police Officers[(a)]	Total Civilians[(b)]
Fairfield County			
Fairfield County	47	45	2
Winnsboro	27	26	1
Ridgeway	2	2	0
Total	76	73	3
Lexington County			
Lexington County	376	214	162
Cayce	74	61	13
West Columbia	56	45	11
Lexington	38	33	5
Batesburg-Leesville	25	20	5
Irmo	21	19	2
Springdale	9	8	1
Swansea	7	7	0
Chapin	6	6	0
Pelion	3	3	0
Total	615	416	199
Newberry County			
Newberry County	94	46	48
Newberry	29	25	4
Prosperity	4	4	0
Total	127	75	52
Richland County			
Richland County	490	453	37
Columbia	339	301	38
Eastover	4	4	0
Total	833	758	75
Total All Counties	1651	**1322**	**329**

Sources: FBI 2006a, b

(a) Individuals who ordinarily carry a badge and a firearm and have full arrest powers.

(b) Personnel such as clerks, radio dispatchers, stenographers, jailers, and mechanics.

Table 2-40. Fire Protection Personnel by County[(a)]

Fire Department Name	Number of Stations	Active Firefighters (Career)	Active Firefighters (Volunteer)	Active Firefighters (Paid per Call)	Non Firefighting (Civilian)	Non Firefighting (Volunteer)	Total Personnel
Fairfield County							
Winnsboro Public Safety	1	22	0	9	2	0	33
Fairfield Community Volunteer Fire Department	2	0	25	0	0	0	25
Dutchman Creek Volunteer Fire Department	1	0	16	0	0	2	18
Jenkinsville Volunteer Fire Department	1	0	9	0	0	6	15
Greenbrier-Bethel Volunteer Fire Department	2	0	9	0	0	2	11
Lexington County							
Lexington County Fire Service	24	134	380	0	0	0	514
Voridian Fire & Rescue	1	14	0	70	5	0	89
Cayce Fire Department	1	48	2	0	12	2	64
Batesburg-Leesville Fire Department Station 25	2	3	38	0	0	0	41
Irmo Fire District	2	31	0	6	0	0	37
Pine Grove Fire Station	1	6	0	25	0	1	32
Oak Grove Fire Station	1	9	8	8	0	0	25
West Columbia Fire Department	1	24	0	0	0	0	24
South Congaree Fire Station	1	8	8	3	0	0	19
Gaston Fire Station	1	4	12	0	0	2	18
Sandy Run - Calhoun Volunteer Fire Department	1	0	16	0	0	0	16
Columbia Metropolitan Airport Fire/Rescue	1	15	0	0	0	0	15
Newberry County							
Consolidated Volunteer Fire Department	2	0	42	0	0	10	52
Fairview Volunteer Fire Department	2	0	27	0	1	15	43
City of Newberry Fire Department	1	19	18	0	1	1	39

Table 2-40. (contd)

Fire Department Name	Number of Stations	Active Firefighters (Career)	Active Firefighters (Volunteer)	Active Firefighters (Paid per Call)	Non Firefighting (Civilian)	Non Firefighting (Volunteer)	Total Firefighters
Newberry City Fire Department	2	19	18	0	1	1	39
Prosperity Fire Department	2	0	35	0	0	0	35
Silverstreet Volunteer Fire Department	1	0	28	0	0	0	28
Whitmire Fire Department	1	0	25	0	0	0	25
Chappells Volunteer Fire Department Station #10	1	0	18	0	0	6	24
Pomaria Fire Department	1	0	19	0	0	0	19
Richland County							
Columbia Fire Department	31	385	107	0	23	5	520
McEntire Air National Guard Fire Department	1	52	0	0	0	0	52
Total All Counties	**89**	**793**	**860**	121	**45**	**53**	**1872**

Source: USFA 2008

(a) Data are from the U.S. Fire Administration (USFA) National Fire Department Census. Responses are voluntary and the USFA estimates that, as of 2008, approximately 85 percent of the nation's fire departments have responded.

Table 2-41. 2007 Arrests per 1000 for Fairfield, Lexington, Newberry, and Richland Counties

Offense Category	Fairfield	Lexington	Newberry	Richland	South Carolina
Alcohol-related	9.09	6.27	15.20	6.43	8.08
Drug-related	9.04	6.82	12.49	8.66	8.56
Family offenses	0.09	0.09	0.13	0.04	0.37
Fraud and related	1.11	1.99	7.55	7.10	4.92
Juvenile-related	0.13	0.56	0.11	0.53	0.54
Nuisance-related	8.40	3.50	11.48	3.88	5.62
Personal (abductions, intimidation, extortion)	0.39	0.17	0.48	0.20	0.53
Property destruction	3.90	1.11	4.46	1.86	2.43
Thefts	4.80	2.96	6.62	4.58	5.87
Vice (sex, gambling, weapons offenses)	0.56	0.33	0.85	1.38	0.94
Violent (murder, rape, assault)	8.40	4.51	8.56	5.31	7.40
All other (traffic, etc.)	5.23	3.19	67.44	2.46	6.68
Total arrests per 1000	45.90	28.30	67.92	39.97	45.27
2006 Population	23,333	243,270	37,633	357,734	4,407,709

Source: SCLED 2009

Table 2-42 presents hospital use and medical practitioner data by county. Hospitals in Richland County include five general hospitals (with one under construction) and one military hospital. More than 8000 people are employed in the medical industry in Richland County. Fairfield, Lexington, and Newberry Counties each have one general hospital and Lexington County is adding a second smaller hospital (SCE&G 2010a).

Table 2-42. Hospital Data for Fairfield, Lexington, Newberry, and Richland Counties

County	2000 Population	Hospital Beds	Hospital Beds per 1000 Population	Physicians	Physicians per 1000 Population
Fairfield	23,454	50	2.1	19	0.81
Lexington	216,014	376	1.7	337	1.6
Newberry	36,108	103	2.9	52	1.4
Richland	320,677	1533	4.8	1330	4.2
Total	596,253	2062	3.5	1738	2.9

Source: SCE&G 2010a

All four counties have health departments that are available to residents regardless of their ability to pay. Services offered include child and adolescent health programs, women's health programs, immunizations, laboratory services, teen pregnancy prevention programs, scoliosis screening, parasite screening, diabetes screening, health education and counseling, homemaker services for the elderly, prenatal services, and sexually transmitted disease prevention and education (SCE&G 2010a).

Social services in the four-county area are provided by State and local governmental and nongovernmental organizations. The United Way helps support many organizations in the four counties. The primary State-level organization that provides social services is the South Carolina Department of Social Services, which oversees numerous programs and services, similar to other such departments in other states (SCE&G 2010a).

2.5.2.7 Education

Fairfield and Newberry Counties each have a single-county school district. However, there are five districts in Lexington County and two districts in Richland County.

Table 2-43 lists the total 2008 student enrollment, the proportion of students participating in free and reduced lunch programs, the number of schools in each district, and each district's student-to-teacher ratio for the four county area. Of note, the Fairfield School District shows considerably higher eligibility for free and reduced school lunch programs than the other districts in the four-county area. Within the Fairfield district, the closest school to the VCSNS site is McCrorey Liston Elementary. Table 2-44 presents the school-by-school free and reduced meal program eligibility in Fairfield County.

All of the school districts that are likely to feel some impact from an influx of students associated with the development of the VCSNS site have been growing in recent years and making accommodations to manage that growth. Each district has a facilities plan that provides a roadmap for addressing enrollment increases. Currently, all of the districts have been addressing increased enrollments either through new revenue generation or the increased tax base that is attributable to population growth and property development (SCE&G 2010a).

Table 2-43. School Characteristics in the Four-County Area

Public School District	2008 Enrollment	Free and Reduced Lunch Participation Percent	Number of Schools	Student/ Teacher Ratio
Fairfield	3719	83.8	8	11.3
Lexington 01	20,421	30.6	23	13.7
Lexington 02	9378	55.6	16	13.4
Lexington 03	2092	61.8	4	13.6
Lexington 04	3567	68.2	5	14.7
Lexington 05*	16,929	25.1	19	13.5
Newberry	6146	63.6	11	13.1
Richland 01	24,600	62.2	49	12.4
Richland 02	24,008	39.2	27	13.7
Totals	110,860	46.2	162	13.3

Source: SCDOE 2009
Note: Lexington District 5 includes portions of Richland County.

Table 2-44. Fairfield County Public School Free and Reduced Meal Eligibility

Public School	2008 Enrollment	Percent of Students Eligible for Free and Reduced Lunch
Fairfield Central High School	980	73.47
Fairfield Intermediate	572	82.17
Fairfield Middle School	510	86.47
Fairfield Primary	539	92.95
Geiger Elementary	391	86.96
Gordon Odyssey Academy	156	89.74
Kelly Miller Elementary	305	92.79
McCrorey Liston Elementary	266	83.46
District Total	3719	83.81

Source: After SCDOE 2009

Table 2-45 lists the colleges and universities found in the region. The local community colleges are partnering with the VCSNS site-development team to develop training curricula that would produce qualified local technicians and construction workers for the jobs at the VCSNS site.

Table 2-45. Colleges and Universities in the VCSNS Region

Institution	City	County	Highest Degree Offered
Public Senior Institutions			
University of South Carolina	Columbia	Richland County	Doctoral Degrees
Lander University	Greenwood	Greenwood County	Master's Degrees
Winthrop University	Rock Hill	York County	Master's Degrees
Other Public Institutions			
University of South Carolina – Lancaster	Lancaster	Lancaster County	Associates Degrees
University of South Carolina – Union	Union	Union County	Associates Degrees
Public Technical Colleges			
Midlands Technical College	Columbia	Richland County	Associates Degrees
York Technical College	Rock Hill	York County	Associates Degrees
Private Senior Institutions			
Allen University	Columbia	Richland County	Baccalaureate Degrees
Benedict College	Columbia	Richland County	Baccalaureate Degrees
Columbia International University	Columbia	Richland County	Doctoral Degrees
Columbia College	Columbia	Richland County	Master's Degrees
Lutheran Theological Seminary	Columbia	Richland County	Doctoral Degrees
Newberry College	Newberry	Newberry County	Baccalaureate Degrees
Presbyterian College	Clinton	Laurens County	Baccalaureate Degrees

Source: SCE&G 2010a

2.6 Environmental Justice

Environmental justice refers to a Federal policy established by Executive Order 12898 (59 FR 7629) under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.[a] The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although it is not subject to the Executive Order, the Commission[b] 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).

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

(b) The Commission is the body of up to five NRC commissioners that formulates policies, develops regulations governing nuclear reactor and nuclear material safety, issues orders to licensees, and adjudicates legal matters.

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 determined. 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 American Indian settlements.

The racial population is expressed in terms of the percentage of people that are minorities in an area, and, in this discussion, the sum of the racial minority populations is referred to as the aggregate racial minority population. Persons of Hispanic/Latino origin are considered an ethnic minority and may be of any race. The review team did not include Hispanics in its aggregate race estimate because the Federal government considers race and Hispanic origin to be two separate and distinct concepts (USCB 2001). Table 2-46 shows the overall representation of the populations of interest in the VCSNS 50-mi region and the State of South Carolina as a whole.

Table 2-46. Regional Minority and Low-Income Populations by Census Blocks Meeting Environmental Justice Criteria

Category	Number of Blocks (out of 864 Total)	Percent of Total
African American	211	24.4
Aggregate minority	241	27.9
Hispanic	12	1.4
American Indian or Alaskan native	1	0.1
Asian	1	0.1
Native Hawaiian or Other Pacific Islander	0	0.0
Persons reporting some other race	0	0.0
Multiracial	0	0.0
Low-income population	54	6.3

Source: Review team U.S. Census data analysis.

2.6.1 Methodology

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

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

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

The identification of census block groups that meet the above two-step criterion is not sufficient for the review team to conclude that a disproportionately high and adverse impact exists. Likewise, the lack of census block groups meeting the above criteria cannot be construed as evidence of no disproportionate and adverse impacts. To reach an environmental justice conclusion, starting with the identified populations of interest, the review team must investigate all populations in greater detail to determine if there are potentially significant environmental effects that may have disproportionately high and adverse impacts on minority or low-income populations. To determine whether such effects may be present, the review team considers the following:

- Health Considerations
  1. Are the radiological or other health effects significant or above generally accepted norms?
  2. Is the risk or rate of hazard significant and appreciably in excess of the general population?
  3. Do the radiological or other health effects occur in groups affected by cumulative or multiple adverse exposures from environmental hazards?
- Environmental Considerations
  4. Is there an impact on the natural or physical environment that significantly and adversely affects a particular group?
  5. Are there any significant adverse impacts on a group that appreciably exceed or [are] likely to appreciably exceed those on the general population?
  6. Do the environment effects occur in groups affected by cumulative or multiple adverse exposure from environmental hazard? (NRC 2007b)

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

The review team estimated that in the 2000 U.S. Census, 864 census block groups were wholly or partially within the 50-mi region. Using the individual comparison criteria (comparing the block group to the state in which it is located), GIS analysis found 211 block groups that have African American populations of interest, 12 with Hispanic ethnicity, 1 with American Indian or Alaskan Native populations, 1 with Asian populations, and none with multiracial populations of interest. There are 241 block groups in the region with aggregate minority populations that were 20 percent or greater than the State average, all of which also have a minority population of 50 percent or greater. There were no blocks with minority populations of Hawaiian or other Pacific Islander, or multi-racial groups exceeding either the 20-percent or 50-percent criterion. Fifty-four blocks were identified as having low-income households that are 20 percent or greater than the State or County average, 16 of which have 50 percent or more low-income households.

Figure 2-18 and Figure 2-19 illustrate the findings of the analysis of the 2000 U.S. Census data. None of the identified low-income census block groups with populations of interest are located within the 6-mi vicinity of the VCSNS site. However, the review team identified three African American census block groups within the site vicinity. Upon further investigation, local officials within and near Jenkinsville revealed that not only was the local population comprised almost exclusively of African Americans, but it also included a high proportion of low-income populations (NRC 2010). The review team also noted that the Fairfield County School District exhibits a proportion of free and reduced lunch participation that is significantly greater than the other districts (see Section 2.5.2.7) in the general area. Based on the information in the VCSNS ER, public input, and the review team's outreach and analysis, the review team determined that because there are minority and low-income communities within the vicinity of the site, impacts on these communities must be considered in greater detail, as discussed in Section 2.6.2. The result of the review team's analyses can be found in Sections 4.5 and 5.5 of this EIS.

Transmission-line corridor impacts on potentially affected populations are discussed in the context of cumulative impacts in Section 7.4. The routes of the planned corridors have been presented in Section 2.2.2. Generally, the transmission-line siting process attempts to minimize effects on all residential development, and impacts are considered by the review team in the full context of building and operating the new units.

Figure 2-18. Aggregate Minority Populations in Block Groups That Meet the Environmental Justice Selection Criteria

Figure 2-19. Low-Income Populations in Block Groups That Meet the Environmental Justice Selection Criteria

2.6.2 Scoping and Outreach

The review team interviewed local, State, and county officials, business leaders, and key members of minority communities within the economic impact area to assess the potential for disproportionately high and adverse socioeconomic effects that may be experienced by minority and low-income communities during construction and operation of the proposed new VCSNS units (NRC 2010). The NRC staff issued an advanced notice of public meetings for EIS scoping purposes in accordance with the NRC's guidance (see Appendix D). The review team also contacted local Tribal governments to determine historic or cultural uses in the region (see Section 2.7.4). It was through this scoping and outreach process that the review team determined that the populations within the vicinity of the VCSNS site included a percentage of low-income families not captured by the two-step assessment of census block groups. The review team was also made aware of anecdotal information about local subsistence fishing by the members of the town of Jenkinsville and communities of Dawkins and Blair (NRC 2010).

2.6.3 Subsistence and Communities with Unique Characteristics

For each of the identified low-income and minority populations, it is necessary to determine if any of the populations appears to have a unique characteristic at the population level that would cause an impact to disproportionately affect them. Examples of unique characteristics might include lack of vehicles, sensitivity to noise, location within the site vicinity, or subsistence activities, but such unique characteristics need to be demonstrably present in the population and relevant to the potential environmental impacts of the plant. If the impacts from the proposed action would appear to affect an identified minority or low-income population more than the general population because of one of these or other unique characteristics, then a determination would be made about whether the impact is disproportionate when compared to the general population. Through its review of the applicant's ER, its own outreach and research (NRC 2010), and through scoping meeting comments, the review team identified potentially unique community characteristics for further consideration: location along access roads that may become congested, subsistence fishing and hunting in the lands near the VCSNS site, and a common practice of home vegetable gardening to supplement diets. The review team assesses these unique characteristics and practices of this population in Sections 4.5 and 5.5 of this EIS.

2.6.4 Migrant Populations

The USCB defines a migrant worker as an individual employed in the agricultural industry in a seasonal or temporary nature and who is required to be absent overnight from his/her permanent place of residence. From an environmental justice perspective, there is a potential for outdoor workers to be disproportionately affected by emissions in the environment. Although Richland County and immediately adjacent counties are urban population centers, there are a number of farms within the region. Based on agricultural census data, these farms do not hire an especially large number of migrant workers, and none is located within the 6-mi vicinity of the VCSNS site (see Section 2.5.1.3).

2.6.5 Environmental Justice Summary

The review team found low-income, African American, and aggregated minority populations that exceed the percentage criteria established for environmental justice analyses within the 50-mi region. Several of these minority census block groups are clustered in the vicinity of the VCSNS site and further investigation by the review team revealed that these block groups displayed a high concentration of low-income populations not evident at the census block group level. Therefore, the review team performed additional analyses before making a final environmental justice determination. The results of the analyses can be found in Sections 4.5 and 5.5.

2.7 Historic and Cultural Resources

In accordance with 36 CFR 800.8(c), the staff has elected to use the National Environmental Policy Act (NEPA) process to comply with the obligations found under Section 106 of the National Historic Preservation Act, as amended (NHPA). The NRC has determined that the physical and visual Area of Potential Effect (APE) for the COL review is the area at the VCSNS Units 2 and 3 site and the immediate environs that may be affected by land-disturbing activities associated with construction and operation of the new VCSNS Units 2 and 3. The USACE also considers the transmission-line rights-of-way to be within the APE for its permit review. In addition to NUREG-1555 (NRC 2000), NRC Staff Memorandum (NRC 2010b) provides guidance to staff on cultural and historic resource analysis in its environmental reviews.

USACE regulations at 33 CFR Part 325, Appendix C, describe the USACE obligation to comply with the regulations of the NHPA (36 CFR Part 800). In addition to any specific conditions regarding known cultural resources coordinated with the Tribal Historic Preservation Officer (THPO) or South Carolina State Historic Preservation Office (SHPO), every USACE DA permit includes a general condition that advises and requires the permittee to immediately notify USACE if any previously unknown resources are encountered during activities that would constitute preconstruction and construction.

This section discusses the historic and cultural background in the VCSNS 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 building and operation are found in Sections 4.6 and 5.6, respectively.

2.7.1 Cultural Background

This section provides an overview and summary of the cultural history of the VCSNS site and region based on documentation provided in the Supplemental EIS for renewal of the VCSNS Unit 1 Operating License (NRC 2004, Section 2.2.9), Revision 1 of the ER (SCE&G 2009a), and the first cultural resources survey report completed by SCE&G's cultural resources contractor, New South Associates (NSA 2007a) submitted by SCE&G (2009b). The area in and around the VCSNS site has a rich cultural history and a substantial record of significant cultural resources associated with the prehistoric and historic periods. This part of southern South Carolina has a cultural sequence that extends back to about 12,000 years Before Present (BP).

Prehistoric occupation of the area is generally grouped into four periods: Paleo-Indian (12,000 to 10,000 BP), Archaic (10,000 to 3000 BP), Woodland (3000 BP to 800 BP) and Mississippian (A.D. 1100–1640) (NSA 2007a). Settlement during the early prehistoric period is characterized by mobile groups exploiting big game and the presence of the Clovis projectile point. Subsistence on multiple resources including smaller game and plants as well as more sedentary settlement patterns particularly along rivers, characterize the Archaic period. Reliance on shellfish and the development of pottery occurred during the late Archaic period. Ceramic typology, use, and function evolved and diversified during the Woodland period with an increase in sedentary settlement patterns and a reliance on agriculture in the Mississippian period. Two significant Mississippian period archaeological sites are located in the vicinity of the VCSNS site; the Blair Mound and the McCollum Mound (NSA 2007a).

The contact period is the transitional period between the prehistoric and historic periods when Euro-American settlers and explorers first visited the area in the mid-16th century (NSA 2007a; NRC 2004). Several groups of American Indians lived in South Carolina during this time, many of which became extinct or merged with other groups due to non-American Indian encroachment by Spanish, French, and British explorers and settlers by the mid-1700s. The largest groups were the Catawba and the Cherokee who likely used the Broad River region for resource gathering (SCE&G 2009a). Several Tribal groups and descendants of earlier groups are present today in South Carolina (descendants of the Cherokee, the Catawba, Pee Dee, Chicora, Edisto, Santee, and Chicora-Waccamaw Tribes) (NRC 2004). In 1838, the Cherokee were forced to leave the eastern United States and resettle in Oklahoma (NRC 2004). Today, the Catawba are the only Federally recognized Tribe that resides in the State of South Carolina, but there are several other Federally and non-Federally recognized groups that have an interest in South Carolina and are officially recognized by the State of South Carolina (SCE&G 2009a).

The historic period overlaps with the contact period and begins with the arrival of Euro-American settlers. The European colonization of South Carolina began in the early 1600s. South Carolina was established in 1670 with the founding of Charleston (NSA 2007a) and was divided into South and North Carolina in 1710 (NRC 2004). Permanent European settlement did not occur in the Fairfield County area until the early 1740s with settlement occurring along the Broad River. During the American Revolution, many settlers in the area were divided between the British and Patriot sides, which resulted in several skirmishes. With the culmination of the war during the nearby Battle of Cowpens, the British eventually withdrew from Charleston in 1782 (NSA 2007a; SCE&G 2009a).

Cotton production and plantations were established in the area in the 1800s and increased during the 1850s. An increase in slave populations accompanied the increase in cotton plantations in the area (SCE&G 2009a; NSA 2007a). During the late 19th century, the Civil War and Reconstruction period resulted in major economic social adjustments in the area. Cotton production ceased in the 1930s as a result of hard economic times, the boll weevil, and depletion of the area's topsoil (NRC 2004; NSA 2007a; SCE&G 2009a). Camp Pearson, a Civilian Conservation Corps camp was established in 1933 as a soil erosion camp at Parr, which is located just south and west of the VCSNS site (NSA 2007a; SCE&G 2009a).

2.7.2 Historic and Cultural Resources at the Site

This section describes cultural resources that may be affected by building and operating the proposed VCSNS Units 2 and 3. The direct effects APE, which takes into account physical impacts on known resources resulting from constructing and operating VCSNS Units 2 and 3, has been defined by SCE&G (2009c) as "the area where ground disturbing activities could potentially occur and was selected to encompass SCE&G property lines, all of the water-intake locations, the northern boundary of the switchyard, rework along Parr Road, the northern edge of Fairfield Hydro Road and the Norfolk Southern Railroad" (SCE&G 2009f) (see Figure 2-20). The APE is based on property boundaries and not on areas to be affected by building activities (SCE&G 2009h). A visual effects APE was not defined because the proposed project activities would be located in rolling terrain that is forested and not visible from major roads or nearby public property (SCE&G 2009a, c, g).

Transmission lines leaving the site would be visible in places (SCE&G 2009g). The South Carolina SHPO has concurred with the APE definitions identified by each of the individual surveys completed for the COL activities that are summarized and referenced below.

Previous cultural resources investigations occurred in the vicinity of and within the VCSNS site APE indicating that the region was used during prehistoric times, particularly during the Middle Archaic period and Mississippian period (Teague 1979; SCDHPT 1984). Six prehistoric sites were recorded in these areas by the South Carolina Institute of Archeology and Anthropology (SCIAA) in 1972, and reported by Teague in 1979, as part of an archaeological survey

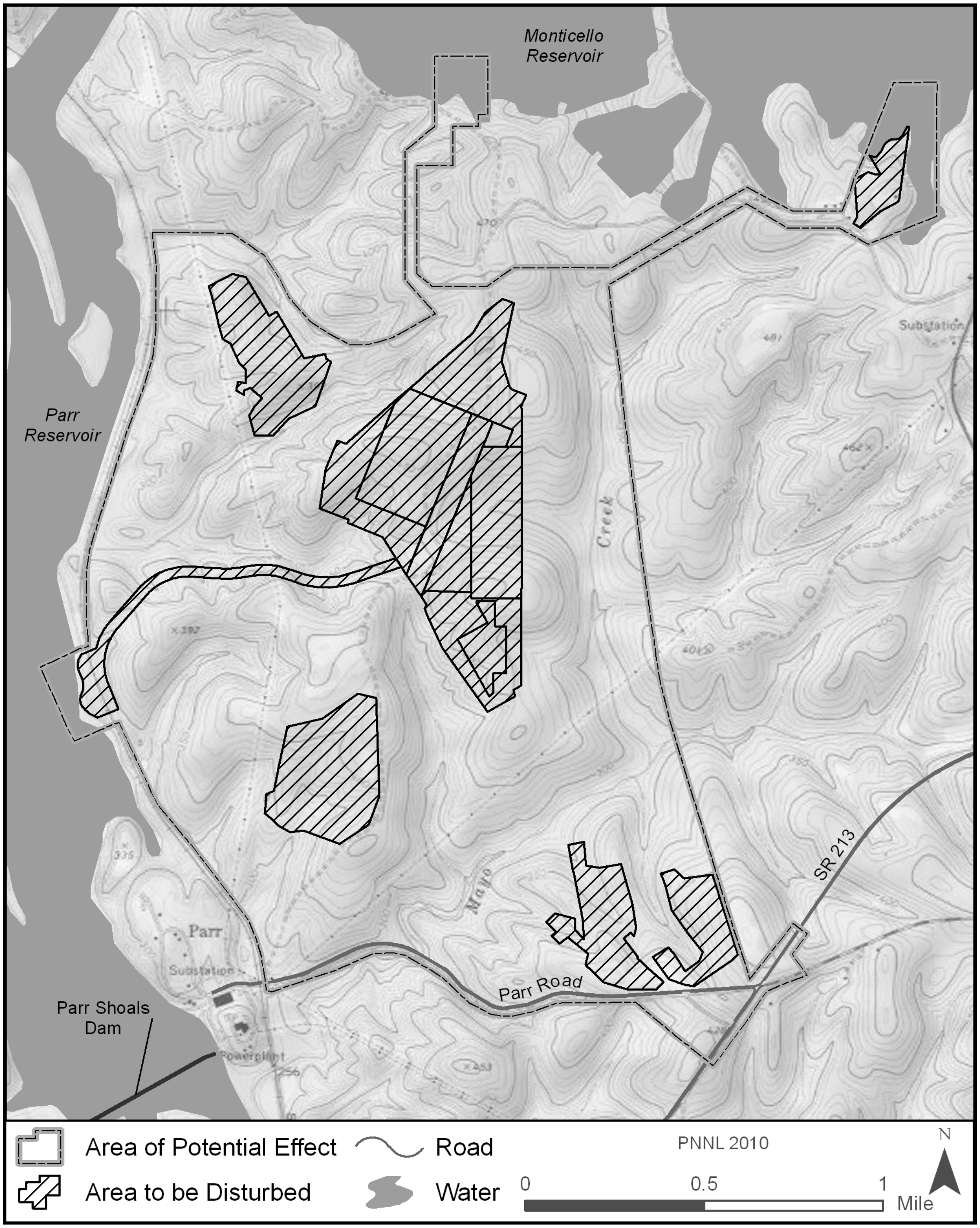

Figure 2-20. Area of Potential Effect for the VCSNS Site Units 2 and 3

conducted for the Parr Hydroelectric Project, which was constructed in part to supply cooling water for VCSNS Unit 1 (NRC 2004; SCE&G 2009a; NSA 2007a). Six archaeological sites consisting of lithic material, but lacking in any intact archaeological deposits as a result of erosion, transmission-line maintenance activities, and agricultural practices (38FA30, 38FA38, 38FA39, 38FA40, 38FA44, 38FA47), were located on SCE&G property (Teague 1979; SCE&G 2009a; NSA 2007a). None of the sites was formally evaluated for eligibility for listing in the National Register of Historic Places (NRHP or the National Register) (Teague 1979; SCE&G 2009a). Teague's report indicates that the 38FA30 site was not located again and most of the archaeological artifacts (lithic tools and debris associated with the Middle Archaic period) at the remaining five sites were collected (Teague 1979). In Teague's report, sites 38FA38, 38FA39, and 38FA40 are depicted as being within SCE&G's APE, but outside of areas to be disturbed by VCSNS Units 2 and 3 building activities (NSA 2007a and South Carolina Department of Archives and History [SCDAH] records). Archaeological site 38FA164 is located outside of the APE and consists of a prehistoric lithic scatter and one historic artifact; the site was recorded on SCE&G property in 1984 and was recommended as not eligible for listing in the National Register (SCDHPT 1984; NSA 2007a; SCE&G 2009a; and SCDAH records).

Between 2006 and 2009, SCE&G contracted with R.S. Webb and Associates (Webb) and New South Associates (NSA) to conduct archaeological investigations for proposed VCSNS Units 2 and 3; the investigations resulted in extensive archaeological survey of the project APE (Webb 2006; NSA 2007a, b; NSA 2008; NSA 2009a, b). Areas not surveyed include areas previously disturbed during Unit 1 building activities such as the raw-water intake and pipeline route and the location of the New Nuclear Deployment Office (SCE&G 2009n). In 2006, Webb completed an archaeological inventory of the land around the site of the proposed meteorological tower for SCE&G. Webb identified archaeological site 38FA322, a multi-component site containing prehistoric archaeological material and domestic debris associated with the early 19th to mid-20th century. Early 19th century historic maps indicate that General John Pearson's house may have been located in the vicinity of site 38FA322. The presence of early 19th century artifacts and foundation stones discovered by Webb's archaeological investigation at 38FA322 resulted in Webb's conclusion that these materials may be associated with the location of General Pearson's house (Webb 2006 submitted by SCE&G [2009n]). Webb recommended that the site was ineligible for listing in the National Register due to lack of integrity. On August 16, 2006, the South Carolina SHPO sent a letter concurring that archaeological site 38FA38 is not eligible for the National Register (SCDAH 2006b). It was later confirmed that this letter mistakenly referred to site 38FA38, which was corrected by a new letter sent to the NRC issued on October 20, 2009 further clarifying that it is site 38FA322 that has been determined to be ineligible for the National Register not site 38FA38 (SCDAH 2009b).

On July 27, 2006, the South Carolina SHPO requested that additional testing be conducted at site 38FA322 to evaluate it for National Register eligibility (SCDAH 2006a). Webb (2006) completed 26 shovel tests recovering artifact assemblages associated with the Middle Archaic period and domestic-related artifacts associated with the 19th to mid-20th century (Webb 2006).

Webb concluded that because historic maps indicate that General Pearson's house was located in the area, the foundation remnants at site 38FA322 "may have been General Pearson's house" (Webb 2006). However, Webb recommended that 38FA322 was ineligible for listing in the National Register due to lack of integrity of the multiple components of the site as a result of heavy disturbance by historic agriculture activities and modern silviculture activities (Webb 2006). The report was revised accordingly. The South Carolina SHPO concurred with this recommendation and that the proposed meteorological tower would not result in direct or visual effects on historic properties (SCDAH 2006a).

In 2006, NSA delineated the boundary of and recorded site 38FA330, a cemetery associated with General John Pearson whose grave is marked by a monument installed by the Daughters of the American Revolution (DAR) (NSA 2006 submitted by SCE&G (2009n). Also in 2006, NSA completed an archeological survey of 428 ac of 515 ac of land planned for improvements associated with the proposed VCSNS Units 2 and 3 (NSA 2007a) locating seven new archaeological sites (38FA323–38FA330) and six isolated finds consisting of lithic and ceramic material and historic debris (Table 2-47). Eighty-seven acres of land were not surveyed because the area had been used by SCE&G in the past for fill for Unit 1 and was extensively disturbed (NSA 2007a). None of the newly recorded sites or isolates was recommended as eligible by NSA due to the lack of integrity of the sites resulting from soil disturbance from historic logging activities in the area (NSA 2007a). The 2007 report also evaluated the National Register eligibility of 38FA330 (the Pearson Cemetery) and the DAR monument recommending both as being eligible (NSA 2007a).

In 2007, NSA conducted additional field surveys of approximately 1311 ac of SCE&G land also planned for improvements associated with proposed VCSNS Units 2 and 3 (NSA 2007b), recording 19 new archaeological sites (38FA331–38FA349) and 24 isolated finds consisting of prehistoric lithic flakes, ceramics, and historic ceramics, and horseshoes (NSA 2007b)(see Table 2-47). None of the newly recorded sites or isolates was recommended as eligible by NSA due to the lack of integrity of the sites resulting from soil disturbance from historic logging activities in the area (NSA 2007a). However, site 38FA349 (a historic tree carving associated with the Civilian Conservation Corps camp at Parr), was recommended for preservation. On April 9, 2007, SCE&G sent a letter to the South Carolina SHPO (SCE&G 2007d) indicating that three Phase 1 surveys had been completed for proposed VCSNS Units 2 and 3 (referring to Webb 2006 and the two surveys completed by NSA [2007a, b]). In the letter, SCE&G expressed concurrence with NSA's and SCE&G's recommendation for National Register eligibility of site 38FA330 (the Pearson Cemetery) and the associated DAR monument, their decision to protect the Pearson cemetery, and a finding of no adverse effect. On April 27, 2007, the South Carolina SHPO responded with a request to review the cultural resources survey reports referenced in SCE&G's April 9, 2007 letter (SCDAH 2007a). Having received these reports, the South Carolina SHPO sent another letter to SCE&G concurring with these recommendations and findings (SCDAH 2007b). The South Carolina SHPO also recommended

Table 2-47. VCSNS Archaeological Sites Identified – Phase I/II Investigations

Site	Site Type	Age	Work Effort	SCDHPT/Teague/ Webb/NSA Recommended NRHP Status	Location	SHPO Concurrence/ Comment[a]
38FA30	Unknown.	Unknown	Phase 1	Not intact or relocated	Outside APE.	None
38FA38	Located at base of transmission-line tower. Lithic flakes and tools all of which were collected.	Middle	Phase 1	Not intact or relocated	Inside APE but outside areas to be disturbed. Exact location is unknown and was not relocated.	None
30FA39	Located along dirt access road. Lithic flakes and projectile point. Projectile point was collected.	Middle Archaic	Phase 1	Not intact or relocated	Inside APE but outside areas to be disturbed. Exact location is unknown and was not relocated.	None
30FA40	Located at base of transmission-line tower. Lithic flakes and projectile point. Projectile point was collected.	Middle Archaic	Phase 1	Not intact or relocated	Inside APE but outside areas to be disturbed.	None
38FA44	Located on a knoll. 12 lithic flakes, 9 were collected.	Unknown	Phase 1	Not intact	Outside APE.	None
38FA47	Located on a hilltop. 12 lithic flakes, 5 were collected.	Unknown	Phase 1	Not intact	Outside APE.	None
38FA164	Lithic scatter and one historic ceramic fragment	Unknown	Phase 1	Not eligible	Outside APE.	None
38FA322	Multicomponent site. Prehistoric lithic debris, and historic domestic debris. Former homestead of General Pearson	Middle Archaic, Mississippian, mid-19th/Early 20th Century	Phase 1	Not eligible. No effect on historic properties	Within APE and inside areas to be disturbed.	Concur. No effect on historic properties. No further work needed

Table 2-47. (contd)

Site	Site Type	Age	Work Effort	SCDHPT/Teague/ Webb/NSA Recommended NRHP Status	Location	SHPO Concurrence/ Comment[a]
38FA323	Prehistoric Scatter/House Site	Unknown Prehistoric/ Early to Late 19th Century	Phase I	Not eligible. No effect on Historic Properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA324	Prehistoric Scatter/House Site	Unknown Prehistoric/ Early to Late 19th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA325	Isolated Prehistoric Find/Historic Scatter	Unknown Prehistoric/ Mid-19th to early 20th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA326	Unidentified Historic Structure	Unknown Historic	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA327	Prehistoric Scatter/Historic Scatter	Late Archaic-Woodland/ Early 20th Century	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed

Table 2-47. (contd)

Site	Site Type	Age	Work Effort	SCDHPT/Teague/ Webb/NSA Recommended NRHP Status	Location	SHPO Concurrence/ Comment[a]
38FA328	House Site	Late 19th to Early 20th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA329	Lithic Scatter	Late Archaic-Early Woodland	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA330	General Pearson Cemetery	Early to Late 19th Century	Phase I and delineation of cemetery boundary.	Eligible	Within APE but outside areas to be disturbed. Site would be avoided and protected.	Concur. No adverse effect on historic properties. Recommend protective covenant.
38FA331	Historic House Site/Prehistoric Lithic Scatter	19th–20th Century/ Late Archaic	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA332	Historic Artifact Scatter	19th–20th Century/	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed

Table 2-47. (contd)

Site	Site Type	Age	Work Effort	SCDHPT/Teague/ Webb/NSA Recommended NRHP Status	Location	SHPO Concurrence/ Comment[(a)]
38FA333	Prehistoric Lithic Scatter	Unknown Prehistoric	Phase I	Not eligible. No effect on Historic Properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA334	Prehistoric Artifact Scatter/Historic Isolate	Late Archaic to Middle Woodland/ 20th Century	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA335	Prehistoric Artifact Scatter	Unknown Prehistoric	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA336	Prehistoric Lithic Scatter/Historic House Site	Middle Archaic/ 19th–20th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA337	Prehistoric Sherd Scatter	Unknown Prehistoric	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA338	Prehistoric Lithic Scatter/Historic Isolate	Middle Archaic/17th 18th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed

Table 2-47. (contd)

Site	Site Type	Age	Work Effort	SCDHPT/Teague/ Webb/NSA Recommended NRHP Status	Location	SHPO Concurrence/ Comment[a]
38FA339	Prehistoric Lithic Scatter/Historic Artifact Scatter	Middle Archaic/ 19th–20th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA340	Prehistoric Artifact Scatter/Historic Isolate	Late Paleo-Indian–Late Archaic/19th–20th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA341	Historic House Site	19th–20th Century	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA342	Prehistoric Lithic Scatter/Historic Isolate	Late Pale-Indian-Early Archaic/ 20th Century	Phase I	Not eligible. No effect on Historic Properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA343	Prehistoric Lithic Scatter	Early-Middle Archaic	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA344	Prehistoric Lithic Scatter	Early Woodland	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed

Table 2-47. (contd)

Site	Site Type	Age	Work Effort	SCDHPT/Teague/ Webb/NSA Recommended NRHP Status	Location	SHPO Concurrence/ Comment[(a)]
38FA345	Prehistoric Lithic Scatter	Early-Middle Archaic	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA346	Prehistoric Lithic Scatter	Unknown Prehistoric	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA347	Historic House Site	19th–20th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No Further Work Needed
38FA348	Historic Stone Piles	Unknown Historic	Phase I	Not eligible. No effect on Historic Properties	Within APE but outside areas to be disturbed.	Concur. No effect on Historic Properties. No Further Work Needed
38FA349	Historic Tree Carving	20th Century	Phase I	Not eligible, but recommend preservation.	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed above and beyond the recommended preservation.

Table 2-47. (contd)

Site	Site Type	Age	Work Effort	SCDHPT/Teague/ Webb/NSA Recommended NRHP Status	Location	SHPO Concurrence/ Comment[(a)]
38FA359	Historic Home Site	Early to Mid-20th Century	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA360	Prehistoric Ceramic Scatter	Middle Woodland	Phase I and Phase II	Eligible.	Within APE but outside areas to be disturbed. Site would be avoided and protected from road improvements	Concur. No adverse effect to historic properties if the site is avoided.
38FA361	Prehistoric Lithic Scatter	Early to Middle Archaic	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA362	Prehistoric Lithic Scatter	Late Archaic	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA363	Historic Home Site	Late 19th to Early 20th Century	Phase I	Not eligible. No effect on historic properties	Within APE and within areas to be disturbed.	Concur. No effect on historic properties. No further work needed

Table 2-47. (contd)

Site	Site Type	Age	Work Effort	SCDHPT/Teague/ Webb/NSA Recommended NRHP Status	Location	SHPO Concurrence/ Comment[(a)]
38FA364	Historic Home Site	Early to Mid Twentieth Century	Phase 1	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA365	Prehistoric Lithic Scatter	Middle Archaic	Phase I	Not eligible. No effect on historic properties	Within APE but outside areas to be disturbed.	Concur. No effect on historic properties. No further work needed
38FA366	Prehistoric Lithic Scatter	Unknown	Phase I	Potentially eligible. Site would be avoided.	Within APE but outside areas to be disturbed. Would be avoided.	Concur. No effect on historic properties. No further work needed

(a) See Section 4.6 for a discussion on SHPO consultation
APE = Area of Potential Effect
NSA = New South Associates
NHRP = National Register of Historic Places
SCDHPT = South Carolina Department of Highways and Public Transportation

that a preservation covenant be recorded to protect site 38FA330 and the DAR monument (SCDAH 2007b). In addition, the SHPO recommended that a Programmatic Agreement be developed to last the lifetime of the COLs issued for VCSNS Units 2 and 3 (SCDAH 2007b). Further discussion is provided in Section 4.6 on the development of this agreement. Sites 38FA38, 38FA39, and 38FA40 are located within NSA's 2007 survey area, but apparently were not located again. Having been collected in 1979 and with minimal integrity or presence of archaeological deposits, the tangible evidence of these sites is no longer present (Teague 1979; NSA 2007a).

In 2008, NSA conducted a third archaeological survey of 232 ac on the VCSNS site planned for improvements and 5800 ft of planned road improvements (NSA 2008) submitted by SCE&G (2009n). Eight new archaeological sites (38FA359–38FA366) and three isolated finds consisting of prehistoric lithic material were recorded. Two were recommended as potentially eligible: site 38FA360, a Middle Woodland period prehistoric ceramic scatter, and site 38FA366, a prehistoric lithic scatter (see Table 2-47). Avoidance was recommended at both of these sites and if avoidance was not possible it was recommended that Phase II testing occur to officially evaluate their eligibility for listing in the National Register (NSA 2008). The remaining six archaeological sites and isolated finds were recommended as not being eligible because of their lack of integrity due to heavy disturbance of these sites (NSA 2008). SCE&G concurred with NSA's findings and forwarded these to the South Carolina SHPO (SCE&G 2008a). The South Carolina SHPO concurred with the recommendations made by NSA (SCDAH 2009a).

While conducting surveys at the VCSNS site, NSA was unable to re-locate sites 38FA38, 38FA39, and 38FA40, despite Teague having reported them to be within the project APE but outside of the areas to be disturbed. Site files at SCIAA listed the location of the sites as questionable due to a gap in time between the date of survey (1972) and the date of reporting (1979) (NSA 2009d). NSA was unable to re-locate archaeological sites 38FA38, 38FA39, and 38FA40 to correlate them with those reported by Teague (1979) due to "significant discrepancies in location, size, and cultural components." With concurrence from the SCIAA site files manager, it was decided to assign new site numbers to all archaeological sites located by NSA on the VCSNS site (NSA 2009d).

Because site 38FA360 was located in an area that may be affected by road widening, Phase II archaeological testing was completed by NSA in 2008 (NSA 2009a). Based on the results of the Phase II testing, NSA concluded and recommended that 38FA360 be determined eligible for listing in the National Register for its potential to yield information regarding Middle to Late Woodland settlement systems (NSA 2009a). Specifically, the site contained archaeological material associated with four to five households including ceramics and lithic material. NSA recommended that the site be preserved in place and if it could not be protected that the site be mitigated (NSA 2009a). SCE&G concurred with NSA's findings and forwarded them to the South Carolina SHPO (SCE&G 2009r). The South Carolina SHPO concurred with the recommendations made by NSA and recommended that the site be avoided or that a Memorandum of Agreement be developed with a data-recovery plan if the site could not be avoided (SCDAH 2009a).

In 2009, NSA inventoried a 5-ac area proposed for road improvements along SC-213 for archaeological resources (NSA 2009b). One isolated historic ceramic was recorded. NSA concluded that the proposed improvements would not affect historic properties (NSA 2009b). SCE&G concurred with NSA's findings and forwarded them to the South Carolina SHPO (SCE&G 2009s). SHPO concurred with the identification of APE and historic properties identified within the APE and the finding that no historic properties would be affected (SCDAH 2009c).

Also in 2009, a 7.7-ac area in the vicinity of the proposed water-treatment plant was inventoried for cultural resources via surface inspection and shovel testing (SCE&G 2009t; NSA 2009c). Old car parts were noted, but not formally recorded. No archaeological sites were recorded by this survey. The South Carolina SHPO concurred with NSA's assessment that no historic properties would be affected by this activity (SCDAH 2009d).

In summary, a total of 43 archaeological sites have been recorded by these investigations and are listed in Table 2-47. Of these, 39 archaeological sites are located within the VCSNS site APE, most of which have been recommended as ineligible for listing in the National Register. Four archaeological sites have either been recommended as National Register eligible – 38FA330 (General Pearson Cemetery) and 38FA360; potentially eligible – 38FA366; or recommended for preservation – 38FA349. Of the remaining 35 archeological sites recorded and recommended as ineligible for listing in the National Register, 14 would actually be affected by building activities associated with VCSNS Units 2 and 3.

No aboveground structures have been identified within the project APE. Consultations conducted by SCE&G and NSA with the Fairfield County Museum, Fairfield County Archives, and the South Carolina SHPO indicate that no knowledge of significant standing structures within the project APE or within the vicinity of the project APE (SCE&G 2009h, j). The Mayo family cemetery is located 1.5 mi south of proposed VCSNS Units 2 and 3 and is marked on plant layout maps and protected by SCE&G (SCE&G 2009a). There are 20 National Register-listed standing structures within 10 mi of the APE, 13 of which are located within Fairfield County (SCE&G 2009a).

2.7.3 Historic and Cultural Resources Within Transmission-Lines

Both SCE&G and Santee Cooper completed siting studies for the proposed transmission lines associated with VCSNS Units 2 and 3 (Pike 2010; MACTEC 2009). The proposed transmission rights-of-way are described in Section 2.2.2. Both SCE&G and Santee Cooper completed literature reviews for areas within 1.2 mi of the proposed transmission-line rights-of-way, using known cultural resources data from the SCIAA and the SCDAH (FP&S 2008; MACTEC 2008).

Before completing siting studies, SCE&G contracted with NSA to complete a literature search for all National Register-listed properties within the counties through which SCE&G expected the transmission-line rights-of-way to pass (NSA 2007c) submitted by SCE&G (2009n). NSA identified 353 National Register-listed sites (NSA 2007c). As part of SCE&G's revised transmission-line siting study SCE&G contracted with Brockington Cultural Resources Consulting, which completed a review of the SCDAH and SCIAA cultural resources databases to identify previously recorded archaeological sites and above-ground resources located within 1.2 mi of and within existing rights-of-way. Specifically, the report identified known archaeological sites and above-ground resources recorded after 1989 and their National Register eligibility, all National Register-listed cultural resources (archaeological, structures, and districts), and all cultural resource investigations completed since 1989 located within 1.2 mi lines that compose SCE&G's proposed rights-of-way (VCSNS-Killian, VCSNS-St. George No. 1 and No. 2, and VCSNS-Lake Murray No. 2 transmission-line rights-of-way). The report did not include surveys conducted prior to 1989 due to survey methodology and standards being outdated. Twenty-two archaeological sites and one historic district have been identified within SCE&G's right-of-way (Pike 2010). A total of 245 above-ground resources and 255 archaeological sites have been previously recorded within the total study area.

Santee Cooper also completed desktop assessments using available GIS cultural resources data and literature reviews for areas within 1.2 mi of the proposed transmission-line rights-of-way, using known cultural resources data from the SCIAA and the SCDAH (MACTEC 2009). Santee Cooper contracted with TRC Companies Inc. (TRC), which summarized similar data for its proposed rights-of-way (VCSNS-Varnville and VCSNS-Flat Creek) (TRC 2008). This study indicates that there are National Register-eligible and -listed above-ground resources and archaeological resources within 1.2 mi of Santee Cooper's proposed transmission-line rights-of-way (MACTEC 2009).

However, none of SCE&G's or Santee Cooper's proposed transmission-line rights-of-way has been systematically surveyed for cultural resources (SCE&G 2010b), so the current data set based on literature reviews is informative, but does not provide specific identification of cultural resources that could be affected by transmission-line installation. The USACE, SCE&G, and the SHPO have entered into a management agreement, which describes what future cultural resources survey and management efforts will be undertaken and how they will be performed for the SCE&G transmission-line rights-of-way (SCE&G 2009h, j; USACE 2011a). The USACE, Santee Cooper, and the SHPO have entered into a management agreement that describes what future cultural resources survey and management efforts will be undertaken and how they will be performed for the Santee Cooper transmission-line rights-of-way (SCE&G 2009h, j; USACE 2011b).

2.7.4 Consultation

In January 2009, the NRC initiated consultation with the South Carolina SHPO, the Advisory Council on Historic Preservation (ACHP), and four American Indian Tribes (see Appendix B for a complete list of contacts). The letters informed consulting parties that the NRC is coordinating compliance with Section 106 of the NHPA through NEPA. The ACHP responded, indicating that NRC must also consult with the South Carolina SHPO and notify the ACHP in consultation with SHPO if NRC concludes that there is a finding of adverse effect on historic properties resulting from the issuance of the COLs for proposed VCSNS Units 2 and 3 (ACHP 2009). No responses to these letters were received from American Indian Tribes.

The NRC conducted a public scoping meeting in Winnsboro, South Carolina, on January 27, 2009, and one in Blair, South Carolina, on January 28, 2009. No comments or concerns regarding historic and cultural resources were made at these public scoping meetings. During the scoping period, the NRC received one written comment from an individual indicating that a relative is buried at the VCSNS site. The staff responded that locations of known cemeteries have been identified on the SCE&G property and are marked on SCE&G plant layout maps. No building or operational activities are planned to occur near these cemeteries.

In April 2010 in accordance with 36 CFR 800.2(c), the NRC conducted follow-on consultation with the South Carolina SHPO, the ACHP, and the four American Indian Tribes seeking comments on the conclusions and a finding of no adverse effect in the draft EIS. On May 25, 2010, the South Carolina SHPO replied with its concurrence (SCDAH 2010). (See Appendix F for a copy of this letter and Section 4.6 for additional discussion of this correspondence).

2.8 Geology

A detailed description of geological, seismological, and geotechnical conditions at the VCSNS site is provided in Section 2.5 of the VCSNS FSAR (SCE&G 2010d) submitted as part of the COL application. A description of the hydrogeological setting of the proposed site is addressed in the ER (SCE&G 2010a) and described in Section 2.3 of this EIS. In addition to the site characterization conducted originally for VCSNS Unit 1, results of the SCE&G subsurface investigations performed as part of the applicant's safety analysis for this COL application (Section 2.5 of the FSAR) provide further definition of the site geology. These descriptions are based on published geologic reports of the region and site-specific characterization activities that were conducted during construction of Unit 1 and as part of the preapplication activities for proposed VCSNS Units 2 and 3 (SCE&G 2010a, d). The NRC staff's SER will provide a detailed description of the VCSNS site vicinity and document the NRC staff's independent assessment of the applicant's detailed analysis and evaluations of geological, seismic, and geotechnical data.

The VCSNS site is located on the eastern edge of the Piedmont physiographic province (see Figure 2-9), approximately 20 mi northwest of the fall line that delineates the boundary with the Coastal Plain physiographic province (SCE&G 2010d). Regionally, the Piedmont physiographic province is generally characterized by rolling hills with greater relief than the adjacent Coastal Plain physiographic province to the southeast and less relief than the Blue Ridge physiographic province to the northwest (Figure 2-9). According to the FSAR (SCE&G 2010d), "[t]he site topography is characteristic of the region, consisting of gently to moderately rolling hills and generally well-drained mature valleys." The elevation at the site ranges from "approximately 560 feet to 210 feet above MSL" (SCE&G 2010a). In addition, the FSAR states that "[t]he local drainage pattern is generally dendritic, with subtle trellis patterns that are likely the result of regional bedrock structure and joint systems" (SCE&G 2010d).

"Most of the local terrain is mantled by residual soils and saprolite that overlie igneous and metamorphic bedrock at depth" (SCE&G 2010d). As described by SCE&G, "[t]he residual soil and saprolite predominantly consist of red to reddish-brown stiff clayey and silty soils with varying sand content" with a combined thickness ranging "from about 25 to 70 feet at Units 2 and 3 (SCE&G 2010d). Depths to sound bedrock range "from about 40 to 75 feet in the vicinity of Units 2 and 3" (SCE&G 2010d).

Based on the borehole characterization at the VCSNS Units 2 and 3 site, in addition to earlier subsurface characterization around VCSNS Unit 1 that included extensive excavations, SCE&G describes the most common rock types at the site as being granitic (granodiorite and quartz diorite) as part of the Winnsboro plutonic complex (SCE&G 2010d). Less common rock types found in the area are older amphibolite-grade metamorphic rocks (biotite, hornblende gneiss, and amphibolite schist), into which the Winnsboro pluton intruded, and migmatites, which form from the partial melting of rocks from high-temperature metamorphism (SCE&G 2010d).

In FSAR Section 2.5.1.2.5 (SCE&G 2010d), SCE&G describes the economic geologic resources in the area and states that "[w]ithin 25 miles of the site, there are numerous active and abandoned mines and quarries." SCE&G also stated that "[n]o mining operations (other than borrow of surficial soils) or excessive extraction and/or injection of groundwater occur or have occurred within the site area that could affect site area geologic conditions" (SCE&G 2010d).

2.9 Meteorology and Air Quality

The following three sections describe the climate and air quality of the VCSNS site. Section 2.9.1 describes the local and large-scale climate of the region and area in the immediate vicinity of the site, Section 2.9.2 describes the air quality of the region, and Section 2.9.3 describes atmospheric dispersion at the site. Section 2.9.4 describes the meteorological monitoring program at the site.

2.9.1 Climate

The VCSNS site has a humid subtropical climate (Koeppe and De Long 1958) with mild winters and hot humid summers. Air masses may approach the region from any direction. During the summer, high pressure off the coast of the eastern continental United States leads to southwesterly winds over South Carolina leading to large amounts of low-altitude moisture (LCD 2007). This semi-permanent feature also blocks many summer-time cold fronts. During the winter, the Appalachian Mountains frequently block the cold air associated with winter-time storm systems. The closest first-order weather station with long periods of record is in Columbia, South Carolina, about 26 mi southeast of the site. This station provides a good indication of the general climate at the site because of its proximity and similarities in topography and vegetation. The closest National Weather Service Cooperative Network Station is a short distance away on the Parr Reservoir. Other National Weather Service Cooperative Network Stations include Little Mountain, South Carolina, approximately 9 mi southwest of the site, and Winnsboro, South Carolina, approximately 15 mi northeast of the site. The VCSNS site is located near the Monticello and Parr reservoirs in an area of rolling hills (SCE&G 2010a). The proposed site is on a ridge between these two reservoirs.

The following statistics were derived from local climatological data for Parr, Little Mountain, Winnsboro, and Columbia. The mean daily maximum temperatures at Columbia range from 92°F in August to 55°F in January, while daily minimum temperatures range from 71°F in August to 34°F in February (LCD 2007). While not identical to the conditions at Columbia, the average temperatures at Parr, Winnsboro, and Little Mountain range from 0.5°F larger to -3°F smaller than the observations at Columbia (NCDC 2004). Monthly average wind speeds at Columbia range from about 6 mph in the summer to about 7 mph in the winter and early spring. Approximately 33 percent of the annual precipitation occurs during the months of June, July, and August. Large amounts of precipitation can occur in the late summer and early fall, due to tropical storms that move through the region. Snow can occur, but accumulations are small, and the normal amount of snowfall is only 2 in.

The relative humidity in Columbia varies with both the time of day and the season. The smallest values of relative humidity occur during the late winter and through the spring. The highest normal relative humidity is 76 percent and occurs in August. The lowest normal relative humidity is 62 percent and occurs in April. The daily range of relative humidity is much larger than the month-to-month changes. On a daily basis, the highest relative humidity occurs in the early morning hours, ranging from peak values of 92 percent during the summer and fall to 83 percent in the winter; the lowest relative humidity occurs in the early afternoon and is generally between 60 percent and 30 percent (LCD 2007).

On a larger scale, climate change is a subject of national and international interest. The recent compilation of the state of knowledge in this area by the U.S. Global Change Research Program [GCRP], a Federal Advisory Committee (Karl et al. 2009), has been considered in preparation of this EIS. Projected changes in the climate for the region over the period encompassing the licensing action (i.e., to the period of 2040 to 2059 in the GCRP report) include an increase in average temperature of 2 to 3°F; a decrease in precipitation in the winter, spring, and summer; and a small precipitation increase in the fall. Changes in climate during the life of proposed Units 2 and 3 could result in either an increase or decrease in the amount of runoff; the divergence in model projections for the southeastern United States precludes a definitive estimate (Karl et al. 2009).

Based on the assessments of the GCRP and the National Academy of Sciences' National Research Council, the EPA determined that potential changes in climate caused by greenhouse gas (GHG) emissions endanger public health and welfare (74 FR 66496). The EPA indicated that, while ambient concentrations of GHGs do not cause direct adverse health effects (such as respiratory or toxic effects), public health risks and impacts can result indirectly from changes in climate. As a result of the determination by the EPA and the recognition that mitigative actions are necessary to reduce impacts, the review team concludes that the effect of GHG on climate and the environment is already noticeable, but not yet destabilizing. In CLI-09-21, the Commission provided guidance to the NRC staff to consider carbon dioxide and other GHG emissions in its NEPA reviews and directed that it should encompass emissions from constructing and operating a facility as well as from the fuel cycle (NRC 2009b). NRC Staff Memorandum (NRC 2010c) provides additional guidance to NRC staff on consideration of GHGs and carbon dioxide in its environmental reviews. The review team characterized the affected environment and the potential GHG impacts of the proposed action and alternatives in this EIS. Consideration of GHG emissions was treated as an element of the existing air quality assessment that is essential in a NEPA analysis. In addition, where it was important to do so, the review team considered the effects of the changing environment during the period of the proposed action on other resource assessments.

2.9.1.1 Wind

The prevailing wind direction at Columbia is from the west-southwest. At the VCSNS Units 2 and 3 meteorological tower, the prevailing wind direction at 10 m above the ground is also from the west-southwest, but northwesterly winds occur approximately 20 percent of the time (SCE&G 2010a). Observations made at the VCSNS Unit 1 meteorological tower are somewhat different. During the same 1-year period, northwesterly winds are less common and northeasterly winds are more common than at the VCSNS Units 2 and 3 meteorological tower (SCE&G 2010a). This can be explained by the proximity of the Unit 1 tower to the Monticello Reservoir, which can lead to lake breezes associated with differences in the relative heating rate of the land and water (e.g., Ahrens 1988), and also changes in low-altitude wind speed because of the smoother surface of the water compared to the land. There is also a small ridge to the northwest of the tower that leads to some channeling of the low-altitude winds. The

VCSNS Units 2 and 3 meteorological tower is located away from the Monticello Reservoir on a plateau that slopes gently to the west and south.

2.9.1.2 Atmospheric Stability

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

Conditions at the VCSNS site are generally neutral or slightly stable (occurring nearly 63 percent of the year). Unstable or stable conditions occur onsite 16 percent or 21 percent of the year, respectively. While stable conditions can occur at any time during the year, they are more common in the winter, spring, and fall. For example, during the winter, stable or very stable conditions occur more frequently, approximately 23 percent of the time, while during the summer stable conditions are observed 16 percent of the time (SCE&G 2010a).

The presence of the Monticello and Parr reservoirs has little impact on the stability observed at the VCSNS Units 2 and 3 meteorological tower because the tower is approximately 1 mi south of the Monticello Reservoir and 1 mi east of the Parr Reservoir. In contrast, the static stability at the VCSNS Unit 1 meteorological tower is influenced by its close proximity to the Monticello Reservoir and associated differences in the reservoir and land temperatures. When the water in the reservoir is warmer than the surrounding land, and the winds are blowing from the water towards the Unit 1 tower, then conditions at the meteorological tower are less stable than they would otherwise have been. This condition is most common in the fall. At the Unit 1 tower, moderately to extremely stable conditions were observed 16 percent of the time during the fall, while at the Units 2 and 3 tower, stable conditions were observed 26 percent of the time. If the winds are blowing in the opposite direction, then conditions at the tower are more stable than the conditions over the reservoir. In fact, conditions over the reservoir could even be unstable while conditions at the tower would be stable. When the water is cooler than the land, the conditions are reversed; in situations when the wind is blowing from the water to the land then conditions at the tower could be more stable than they would have otherwise been.

2.9.1.3 Temperature

The temperature measured at the 33-ft level of the VCSNS Units 2 and 3 meteorological tower is considered to be representative of the VCSNS site. Temperature data from the tower for the

January 1, 2007 through December 31, 2007 time period show the daily average temperature ranges from a low of 30.4°F in January to a high of 90.4°F in August. During this 12-month period, the absolute minimum temperature was 20.5°F and the absolute maximum temperature was 99.7°F. These temperatures are consistent with long-term values for Columbia.

2.9.1.4 Atmospheric Moisture

The moisture content of the atmosphere can be represented in a variety of ways, the most common being relative humidity and dewpoint. Both the dew-point temperature and relative humidity are reported at the VCSNS site. For the period from January 1, 2007 through December 31, 2007, the daily average relative humidity ranged from a low of 23 percent in June to a high of 98 percent in January. These values are more extreme than those reported at Columbia, South Carolina, but this is likely due to the short period of record at the VCSNS Units 2 and 3 tower. South Carolina has suffered a severe drought from 1998 through 2002 (Crouch 2006) and during 2007–2008 (NCDC 2009a).

In Part 2 of the VCSNS COL application FSAR, the applicant presented the site characteristics for a number of meteorological variables. Most of these site characteristics are conservatively bounded by the Advanced Passive 1000 (AP1000) pressurized water reactor Design Control Document (DCD) site parameters, with the exception of the wet-bulb temperature. In FSAR Table 2.0-201, the applicant presented site characteristic dry-bulb and wet-bulb temperatures that were recorded at the National Weather Service observation station in Columbia, South Carolina. These temperatures included the 100-year return period dry-bulb temperatures with the maximum coincident in time wet-bulb temperatures and the 100-year return period noncoincident wet-bulb temperatures. The applicant stated that the 100-year return period noncoincident wet-bulb temperature of 87.3°F exceeds the AP1000 DCD site parameter value of 86.1°F (SCE&G 2010d). The applicant's value bounds the staff's independently calculated 100-year return period noncoincident wet-bulb temperature, and is, therefore, acceptable to the staff.

The applicant stated that due to the exceedence of the noncoincident wet-bulb temperature site characteristic, an exemption from 10 CFR Part 52, Appendix D, Section IV.A.2.d, pursuant to 10 CFR 52.7 and 10 CFR 52.93 and a departure from the parameters listed in AP1000 DCD Table 2-1 are necessary. Details about the departure from the DCD (VCS DEP 2.0-2) and associated exemption for the maximum noncoincident wet-bulb air temperature of 87.3°F can be found in Part 7.B.3 of the VCSNS COL application (SCE&G 2010f). The staff has determined that the applicant's stated maximum noncoincident wet-bulb air temperature of 87.3°F is appropriate for characterizing the VCSNS site.

2.9.1.5 Severe Weather

The site can experience severe weather in the form of thunderstorms, hail, tornadoes, hurricanes, and snow and ice. While thunderstorms can occur during any month of the year at the VCSNS site, they are much more common in the late spring and summer. On average there are 52 days per year during which thunder is heard at the First Order Station in Columbia, South Carolina; of these 52 days, 37 of them occur during the period from May through August.

Tornadoes occur with some frequency. A total of 79 tornadoes were reported in a 1° latitude by 1° longitude box that includes the VCSNS site during the period from January 1, 1950 through August 2003 (Ramsdell Jr. and Rishel 2007). The total probability of a tornado strike at the site is 0.00768 yr^{-1} (Ramsdell Jr. and Rishel 2007). The strongest tornado reported in Fairfield County was an F4 (wind speeds of 207–260 mph) tornado on March 28, 1984. This tornado led to 5 deaths and 49 injuries. All other tornadoes reported in Fairfield County were F2 (wind speeds of 113–157 mph) or smaller (NCDC 2009b).

Snow can occur during the months of December, January, February, and March. The average snowfall at Columbia, South Carolina, is 2.1 in. The maximum monthly snowfall was 16 in., which was observed in February of 1973 (LCD 2007). Ice storms can occur when rain falls through cold air that is trapped against the Appalachian Mountains. Freezing precipitation is observed to occur on approximately 4 days per year (NCDC 2000).

Because of its location on the Atlantic Coast of the United States, South Carolina is susceptible to hurricanes, tropical storms, and tropical depressions. The VCSNS site is sufficiently far inland that the majority of hurricanes weaken before reaching the site. Only hurricanes Hugo in 1989, Able in 1952, and an unnamed storm in 1893 were of hurricane strength when they passed within 50 nautical mi of the site (NOAA 2009). Focusing on the period from 1952 to 2006, a total of 17 hurricanes, tropical storms, and tropical depressions have passed within 50 nautical mi of the site (NOAA 2009). Before 1952, storms were not named, which may have led to double counting when a storm moved slowly through the area or changed strength.

2.9.2 Air Quality

The discussion on air quality includes the six common “criteria pollutants” for which the EPA has set national ambient air quality standards (ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead). The air quality discussion also includes heat-trapping GHGs (primarily carbon dioxide), which have been the principal factor causing climate change over the last 50 years (Karl et al. 2009).

The VCSNS site is located in Fairfield County, South Carolina, which is in the Columbia Intrastate Air Quality Control Region (AQCR) (40 CFR 81.108). In addition to Fairfield County, this AQCR consists of Lexington, Newberry, and Richland Counties. The Columbia Intrastate

AQCR is bordered by the Metropolitan Charlotte Interstate AQCR to the north, the Camden-Sumter Intrastate AQCR to the east, the Augusta (Georgia)-Aiken (South Carolina) Interstate AQCR to the south, and the Greenwood Intrastate AQCR to the west. All of the counties in the Columbia Intrastate AQCR are in compliance with the National Ambient Air Quality Standards (NAAQSs) for all criteria pollutants (40 CFR 81.341). Part of York County, which is located in the Metropolitan Charlotte Interstate AQCR, has been designated as nonattainment for ozone (8-hour standard). This area is located approximately 35 mi north of the VCSNS site.

There are no mandatory Class 1 Federal Areas where visibility is an important value within 100 mi of the VCSNS site.

The EPA revised the 8-hour ozone standard in 2008, decreasing it from 0.08 ppm to 0.075 ppm (73 FR 16436). This change will result in changes in the definition of nonattainment areas for ozone. On September 16, 2009, the EPA indicated that the new standards would be reconsidered and final designation would be made in August 2011 (EPA 2009b). Because the VCSNS site is within an attainment area for ozone, a conformity analysis, which is used to determine if a Federal action conforms to any applicable State implementation plans, is not required. If the attainment status of Fairfield County changes, the need for a conformity analysis will be revisited. Carbon dioxide concentration has been building up in the earth's atmosphere since the beginning of the industrial era in the mid-1700s, primarily due to the burning of fossil fuels (coal, oil, and natural gas) and the clearing of forests. Human activities have also increased the emissions of other GHGs such as methane, nitrous oxide, and halocarbons. These emissions are thickening the blanket of heat-trapping gases in the earth's atmosphere, causing global surface temperatures to rise (Karl et al. 2009)

2.9.3 Atmospheric Dispersion

Atmospheric dispersion factors (χ/Q values) are used to evaluate the potential consequences of routine and accidental releases at the VCSNS site. SCE&G used meteorological data from the period January 1, 2007 through December 31, 2008 to develop the atmospheric dispersion factors.

The long- and short-term atmospheric dispersion estimates were made using the meteorological data that were collected onsite at the VCSNS Units 2 and 3 meteorological tower. Short-term estimates are made using the PAVAN model (Bander 1982). PAVAN implements the guidance set forth in Revision 1 of Regulatory Guide 1.145 (NRC 1982) and uses joint frequency distributions of the wind direction, wind speed, and atmospheric stability to provide relative air concentrations of an atmospheric contaminant. Long-term dispersion estimates are made using the XOQDOQ model (Sagendorf et al. 1982), which was designed for evaluating routine releases of radionuclides from commercial nuclear power stations in accordance with Revision 1 of Regulatory Guide 1.111 (NRC 1977). The XOQDOQ model uses meteorological data collected at the VCSNS Units 2 and 3 meteorological tower and computes the annual average relative air concentrations at a number of receptors of interest, including the highest concentration at Unit 3 (when Unit 2 is operational and Unit 3 is under construction) (SCE&G 2010a), along the dose evaluation periphery, at the nearest residence, at the nearest meat animal, at the nearest milk animal, and at the nearest vegetable garden. The maximum annual average atmospheric dispersion and deposition factors are reported in Table 2-48.

Table 2-48. Maximum Annual Atmospheric Dispersion and Deposition Factors for the Dose Evaluation Periphery, Nearest Residence, Nearest Meat Animal, Nearest Milk Animal, and Nearest Vegetable Garden

Type of Location	Direction from Site	Distance (mi)	χ/Q (sec/m^3; No Decay)	χ/Q (sec/m^3; 2.26-Day Decay)	χ/Q (sec/m3; 8-Day Decay)	D/Q (1/m^2)
Dose evaluation periphery	ENE	0.50	—	—	—	1.6×10^{-8}
	SE	0.50	5.8×10^{-6}	5.8×10^{-6}	5.3×10^{-6}	—
Residence	ENE	1.30	—	—	—	3.3×10^{-9}
	SE	1.68	8.7×10^{-7}	8.6×10^{-7}	7.3×10^{-7}	—
Meat animal	WNW	1.74	4.6×10^{-7}	4.5×10^{-7}	3.8×10^{-7}	—
	NE	2.14	—	—	—	1.4×10^{-9}
Milk animal	W	4.14	1.7×10^{-7}	1.7×10^{-7}	1.3×10^{-7}	2.7×10^{-10}
Vegetable garden	E	1.23	—	—	—	3.1×10^{-9}
	SE	1.68	8.7×10^{-7}	8.6×10^{-7}	7.3×10^{-7}	—

Source: SCE&G 2009q, 2010a.

SCE&G provided the staff with meteorological data for the 2-year period from January 1, 2007 through December 31, 2008 (SCE&G 2009q, 2010a). The staff used these data to independently estimate atmospheric dispersion factors for the site. The staff viewed the meteorological site and instrumentation, reviewed the available information on the meteorological measurement program, and evaluated data collected by the program. Based on this information, the staff concludes that the program provides data that represent the affected environment onsite meteorological conditions as required by 10 CFR 100.20. The data also provide an acceptable basis for making estimates of atmospheric dispersion for the evaluation of the consequences of routine and accidental releases required by 10 CFR 50.34 and 10 CFR Part 50, Appendix I.

2.9.4 Meteorological Monitoring

A meteorological monitoring program has existed at the VCSNS Units 2 and 3 site since January 2007. The initial instrumentation was installed to provide the onsite meteorological information required for licensing Units 2 and 3. The instrumentation is described in SCE&G's ER (SCE&G 2010a). The tower location was selected to be representative of the conditions at the proposed location for Units 2 and 3, and is located approximately 3500 ft south-southeast of the site of the proposed two units. Measurements made at the tower include wind speed, wind direction, relative humidity, and temperature at three levels (10, 30, and 60 m). The measurements are made in accordance with Regulatory Guide 1.23 (NRC 2007a). In addition to the meteorological tower associated with Units 2 and 3, a separate meteorological tower has been operated in support of Unit 1 for the entire period of record of the Units 2 and 3 tower. Differences in the wind speed, wind direction, and stability measured with the two towers are discussed in Sections 2.9.1.1 and 2.9.1.2.

2.10 Nonradiological Environment

This section describes aspects of the environment at the VCSNS site and within the vicinity of the site associated with nonradiological human health impacts. It provides the basis for evaluation of impacts on human health from building and operation of the proposed Units 2 and 3. Building activities have the potential to affect public and occupational health, create impacts from noise, and affect the health of the public and workers by transportation of construction materials and personnel to the VCSNS site. Operation of the proposed Units 2 and 3 has the potential to affect the public and workers at the VCSNS site from operation of the cooling system, noise generated by operations, electromagnetic fields (EMFs) generated by transmission systems, and transportation of operations and outage workers to and from the VCSNS site.

2.10.1 Public and Occupational Health

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

2.10.1.1 Air Quality

Public and occupational health can be affected by changes in air quality from activities that contribute to fugitive dust, vehicle and equipment exhaust emissions, and automobile exhaust from commuter traffic (NRC 1996; 1999[(a)]). Air quality for Fairfield County is discussed in Section 2.9.2. Fugitive dust and other particulate matter (including particulate matter smaller than 10 μm and particulate matter smaller than 2.5 μm) can be released into the atmosphere during any site excavations and while grading is being conducted. Most of these activities that generate fugitive dust are short in duration, over a small area, and can be controlled by watering unpaved roads, stabilizing construction roads and spoil piles, and other BMPs described in Section 4.4.1.3 (SCE&G 2010a). Mitigation measures to minimize and control fugitive dust are

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

required for compliance with all Federal, State, and local regulations that govern such activities (NRC 1996; SCE&G 2010a).

Exhaust emissions during normal plant operations associated with onsite vehicles and equipment as well as from commuter traffic can affect air quality and human health. Nonradiological supporting equipment (e.g., diesel generators, fire-prevention pump engines), and other nonradiological emission-generating sources (e.g., storage tanks) or activities are not expected to be a significant source of criteria pollutant emissions. Diesel generators and supporting equipment would be in place for emergency use only but would be started regularly to confirm that the systems are operational. Emissions from nonradiological sources of air pollution are permitted by SCDHEC, as described in the South Carolina Code of Laws 48, Chapter 1, (SC Code Ann. 48-1 2008) and any applicable Federal regulatory requirements. Based on estimates provided by SCE&G, the annual releases of criteria pollutants at the VCSNS site related to the operation of the onsite generators would be minimal based on the infrequent use (approximately 4 hours per month) of the four standby generators and the four ancillary diesel generators; the projected emissions are discussed in Section 5.7.2. These emission sources are not expected to significantly affect ambient air quality levels at the VCSNS site or in the vicinity of the site.

2.10.1.2 Occupational Injuries

In general, occupational health risks to workers and onsite personnel engaged in activities such as building, maintenance, testing, excavation, and modifications are expected to be dominated by occupational injuries (e.g., falls, electric shock, and asphyxiation) or occupational illnesses. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates (BLS 2008). The U.S. Bureau of Labor Statistics (BLS) provides reports that account for occupational injuries and illnesses as total recordable cases, which includes cases that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. The State of South Carolina also tracks the annual incidence rates of injuries and illnesses for utility system construction. These records of statistics are used to estimate the likely number of occupational injuries and illnesses for the proposed new units. Occupational injury and fatality risks are reduced by strict adherence to NRC and Occupational Safety and Health Administration safety standards, practices, and procedures to minimize worker exposures. Appropriate State and local statures also must be considered when assessing the occupational hazards and health risks associated with the VCSNS site. SCE&G has developed and implemented a worker health and safety program with a goal of zero accidents. SCE&G will require all contractors and subcontractors to have and implement a health and safety program that, at a minimum, meets the same requirements as SCE&G's health and safety program. SCE&G will require construction contractors and subcontractors to develop and implement safety procedures with the intent of preventing injuries, occupational illnesses, and deaths (SCE&G 2010a).

2.10.1.3 Etiological Agents

Public and occupational health can be compromised by activities that encourage the growth of disease causing microorganisms (etiological agents). Thermal discharges from Units 2 and 3 into Parr Reservoir (SCE&G 2010a) have the potential to increase the growth of thermophilic microorganisms in receiving waterbodies. The types of organisms of concern for public and occupational health include enteric pathogens (such as *Legionella* spp.), and free-living amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms can result in potentially serious human health concerns, particularly at high exposure levels.

A review of the outbreaks of human waterborne diseases in South Carolina indicates that the incidence of most of these diseases is not common. Available data assembled by the U.S. Centers for Disease Control and Prevention (CDC) for the years 1996 to 2007 (CDC 1997, 1998, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2007) report only two occurrences of waterborne outbreaks of disease from recreational water in the State of South Carolina. From 1989 to 2000, the CDC surveillance system for waterborne-disease outbreaks documented 24 fatal cases of primary amebic meningoencephalitis (a disease caused by *Naegleria fowleri*) in the United States, most occurring in southern states during the months of July and September (CDC 2008). Outbreaks of Legionellosis, Salmonellosis, or Shigellosis that occurred in South Carolina were within the range of national trends (CDC 1997, 1998, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2007) in terms of cases per 100,000 population or total cases per year, and the outbreaks were associated with pools, spas, or lakes.

Epidemiological reports from the State of South Carolina indicate a very low risk of outbreaks from thermophilic microorganisms associated with recreational water (CDC 2006). Two SCDHEC water-quality monitoring stations along Parr Reservoir located in or near recreation areas monitor for species that are indicators for the presence of other pathogens that may be present in the water. The main recreational activities associated with Parr Reservoir are fishing and hunting (SCE&G 2010a). There are no public swimming beaches along Parr Reservoir. No reported cases of Legionellosis, Salmonellosis, or Shigellosis occurred in Fairfield County in 2006 (CDC 2006).

Naegleria fowleri is common in freshwater ponds, lakes, and reservoirs throughout the southern states. While it is possible that the thermal discharge from Units 2 and 3 could have an impact on the abundance of this organism, the affected area of Parr Reservoir would be relatively small under normal operating conditions at most times of the year. In addition, because there are no swimming beaches on Parr Reservoir and limited public access to the outfall area, the likelihood for recreational exposure is expected to be minimal. Based on the historically low risk of diseases from etiological agents in South Carolina, the limited extent of thermal impacts in Parr Reservoir, and the limited opportunities for public exposure, the review team concludes that the impacts on human health would be minimal, and that mitigation would not be warranted.

2.10.2 Noise

Existing sources of noise at the VCSNS site are those associated with operation of Unit 1, including transformers and other electrical equipment, circulating-water pumps, and the public address system. Additional sources for background noise at the site include railroad operations (~1 mi to the west) and from the Parr Combustion Facility (1.4 mi to the south-southeast of the site) (SCE&G 2010a). The nearest residence to the site is approximately 5800 ft away (SCE&G 2010a). SCE&G states in its ER that it has never received a complaint about the noise produced by Unit 1 (SCE&G 2010a).

Activities associated with building the new units at the VCSNS site would have peak noise levels that may exceed 100 decibels on the A-weighted scale (dBA) on the site. Noise levels would be attenuated by distance and obstacles such as buildings, vegetation, and topography. Noise from traffic along the access routes to the sites may intermittently exceed levels acceptable for residential areas. These impacts would be highly concentrated in the area immediately proximate to the site or the site access roads. However, sensitive noise receptors closest to the site are likely to experience intermittent and irritating, but temporary, noise pollution during the peak of construction and preconstruction activities. A decrease of 10 dBA in noise level is generally perceived as cutting the loudness in half. At a distance of 50 ft from the source these peak noise levels would generally decrease to the 8- to 95-dBA range and at distance of 400 ft; the peak noise levels would generally be in the 60- to 80-dBA range. For context, the sound intensity of a quiet office is 50 dBA, normal conversation is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA (Tipler 1982). Regulations governing noise associated with the activities at the VCSNS site are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910, *Occupational Health and Safety Standards*, and 40 CFR Part 204, *Noise Emission Standards from Construction Equipment*. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors.

2.10.3 Transportation

According to the ER (SCE&G 2010a) current primary road access to the VCSNS site is via CR-311 (Ollie Bradham Boulevard), a two-lane paved road. CR-311 intersects SC-215 approximately 1.5 mi east of Unit 1. Parr Road and South Lake Access Road would be upgraded to accommodate increased traffic when the project is built, and approximately 3/4 mi of the South Lake Access Road would be relocated to run parallel to and east of the existing railroad spur into the site, terminating at the VCSNS Units 2 and 3 discharge structure. SC-215 has a north-south orientation and is used by employees traveling from Richland and Fairfield Counties.

Employees traveling from Richland and Lexington Counties may use U.S. Highway 176 (US-176) north to SC-213, which intersects SC-215 2 to 3 mi south of the VCSNS site. The site is also accessed by a railroad spur connected to the Norfolk Southern line. The existing railroad line would be rerouted through a fabrication and laydown area between the new units and the cooling towers, and would be supplemented with an additional railroad spur. A new spur also may be routed into the unloading areas at the concrete batch plant. Norfolk Southern Railway's existing railroad line also may require upgrades to support the heaviest loads. Upgrades may include installing new ballast or rail sections on the existing railroad bed. There is no direct access to the site via the Broad River.

2.10.4 Electromagnetic Fields

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

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMFs associated with transmission lines (NRC 1996). Objects near transmission lines can become electrically charged by close proximity to the electric field of the line. An induced current can be generated in such cases, where the current can flow from the line through the object into the ground. Capacitive charges (which involve storing electric charge) can occur in objects that are in the electric field but isolated from the ground. A person standing on the ground can receive an electric shock from coming into contact with such an object because of the sudden discharge of the capacitive charge through the person's body to the ground. Such acute effects are controlled and minimized by conformance with National Electrical Safety Code criteria that limit the induced current due to electrostatic effects of 5 mA (SCE&G 2010a)

Long-term or chronic exposure to power transmission lines has been studied for a number of years. These health effects were evaluated in NUREG-1437, *Generic Environmental Impact Statement for License Renewal for Nuclear Plants* (GEIS) (NRC 1996) for nuclear power in the United States, and are discussed in the ER (SCE&G 2010a). The GEIS (NRC 1996) reviewed human health and EMFs and concluded the following:

> The chronic effects of electromagnetic fields (EMFs) associated with nuclear plants and associated transmission lines are uncertain. Studies of 60-Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. EMFs are unlike other agents that have a toxic effect (e.g., toxic

chemicals and ionizing radiation) in that dramatic acute effects cannot be forced and longer-term effects, if real, are subtle. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible.

2.11 Radiological Environment

A radiological environmental monitoring program (REMP) has been conducted around the VCSNS site since 1982, when VCSNS Unit 1 began operation. This program measures radiation and radioactive materials from all sources, including the existing unit at the VCSNS site. The REMP includes the following pathways: direct radiation, atmospheric, aquatic and terrestrial environments; and groundwater and surface water. A pre-operational environmental monitoring program was conducted beginning in 1979 to establish a baseline to observe fluctuations of radiation levels and radioactivity in the environment after operations began. After routine operation of Unit 1 started in 1982, the monitoring program continued to assess the radiological impacts on workers, the public, and the environment. The results of this monitoring are documented in annual reports titled "Annual Radiological Environmental Operating Report" (SCE&G 2006a, 2007a, 2008c, 2009k, 2010g) and "Annual Radioactive Effluent Release Report" (SCE&G 2006b, 2007b, 2008b, 2009l, 2010h) for the VCSNS site. These reports show that exposures or concentrations in air, water, and vegetation are comparable to, if not statistically indiscernible from, pre-operational levels, with minor exceptions. In 2009, tritium concentrations less than 1000 pCi/L were found in Monticello and Parr Reservoirs, at the Columbia Water Works, and in one groundwater well (SCE&G 2010g). These concentrations are well below the EPA drinking water standard of 20,000 pCi/L (40 CFR Part 141) and would result in doses well below the VCSNS effluent dose limits. In addition, cobalt-60 concentrations ranging from 14-31 pCi/Kg were found in sediments at two locations; these concentrations are right around the minimum detectable level (SCE&G 2010g). In addition, the VCSNS REMP has consistently observed the presence of fission product activity attributed to residual fallout from atmospheric weapons testing and the Chernobyl accident in environmental media, including sediment, fish, and grass (SCE&G 2009k).

The *U.S. Nuclear Regulatory Commission's Lessons Learned Task Force Report* (NRC 2006) made recommendations regarding potential unmonitored groundwater contamination at U.S. nuclear plants. In response to that report, SCE&G began additional groundwater sampling in various onsite locations that may be a source of groundwater contamination around Unit 1. The results of this additional groundwater sampling are summarized in the Annual Radioactive Effluent Release Reports (SCE&G 2008b, 2009l). Tritium concentrations in the range of 2000-3000 pCi/L were found in an onsite well located where condensate polisher resins were disposed in 1994; these concentrations are well below the EPA drinking water standard of 20,000 pCi/L (40 CFR Part 141).

2.12 Related Federal Project Activities and Consultations

The NRC staff reviewed the possibility that activities of other Federal agencies might affect the granting of a COL permit for VCSNS Units 2 and 3. 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)). After reviewing the Federal activities in the region surrounding the VCSNS site, the NRC staff determined that it would be advantageous for the USACE to become a cooperating agency for preparation of the EIS. As discussed in Chapter 1, the USACE is a cooperating agency for preparation of this EIS.

The Federal Power Commission (FPC, which became FERC) issued a license (Project Number 1894) to SCE&G on June 30, 1974, for the Parr Hydroelectric Project, which consisted of a set of related actions (elevation of Parr Shoals Dam, enlargement of Parr Reservoir, construction of the FPSF, impoundment of Frees Creek for Monticello Reservoir). The Federal Power Commission prepared an EIS for this major Federal licensing action that evaluated potential environmental impacts, including the inundation of 9350 ac of land (eliminating farmland, timber, wildlife habitat, and 25 homes) and enhanced recreational opportunities provided by the public recreational facilities at the expanded Parr Reservoir and new Monticello Reservoir. The FPC concluded that the loss of 9350 ac of farmland and wildlife habitat was significant (FPC 1974), but that, with prudent evaluation and selection of construction methods and project operation, no serious cumulative adverse environmental impacts were foreseen. The FPSF began commercial operation in 1978, four years before VCSNS Unit 1. The FERC license for the Parr Hydroelectric Project, including FPSF, expires on June 30, 2020. Under current rules, SCE&G will be required to file a Notice of Intent with FERC by the year 2015 declaring whether or not it intends to renew the license for the hydroelectric project. At least 2 years before the current FERC license expires (i.e., before June 30, 2018), SCE&G will be required to file an application for a license renewal.

Federal activities within the 50-mi radius of VCSNS include the Sumter National Forest managed by the U.S. Department of Agriculture, the Congaree Swamp National Monument managed by the U.S. Department of Interior, and the United States Army's 52,000-ac Fort Jackson southeast of Columbia. Fort Jackson employs 4000 civilians and is the largest and most active Initial Entry Training Center in the Army, training 19,000 each year. Fort Jackson has added several new schools and training institutions, including the Soldier Support Institute, the Chaplains Center and School, and the U.S. Department of Defense Polygraph Institute. Shaw Air Force Base is located in Sumter, South Carolina, outside of the Central Midlands region but within the 50-mi radius of VCSNS site.

The NRC is required under NEPA Section 102(c) (NEPA 1969) 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. The NRC is consulting with the FWS and NMFS. Consultation correspondence is listed in Appendix F.

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

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

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

33 CFR Part 325. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Part 325, "Processing of Department of the Army Permits."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

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3.0 Site Layout and Plant Description

The site of proposed Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3 (referred to as the proposed Units 2 and 3) is located in Fairfield County in central South Carolina. South Carolina Electric and Gas (SCE&G), acting for itself and as an agent for Santee Cooper (the State-owned electric and water utility, formally called South Carolina Public Service Company), applied to the U.S. Nuclear Regulatory Commission (NRC) for combined construction permits and operating licenses (COLs) for VCSNS Units 2 and 3. In addition to the COL application, SCE&G also applied for a Department of the Army (DA) permit from the U.S. Army Corps of Engineers (USACE) to conduct activities that result in alteration of waters of the United States, including wetlands. The proposed new units would be situated wholly within the existing VCSNS site and located approximately 1 mi to the south-southwest of existing Unit 1. The site is situated approximately 26 mi northwest of the State capital Columbia, South Carolina.

This chapter describes the key plant characteristics that are used to assess the environmental impacts of the proposed action. The information is drawn from SCE&G's Environmental Report (ER) (SCE&G 2010a), its Final Safety Analysis Report (FSAR) (SCE&G 2010b), and supplemental documentation from SCE&G (SCE&G 2009a, b, c, d, 2010c, d).

Whereas Chapter 2 of this environmental impact statement (EIS) describes the existing environment of the proposed site and its vicinity, this chapter describes the physical layout of the proposed plant. This chapter also describes the physical activities involved in building and operating the plant. The environmental impacts of building and operating the plant are discussed in Chapters 4 and 5, respectively. This chapter is divided into four sections. Section 3.1 describes the external appearance and layout of the proposed plant. Section 3.2 describes the major plant structures and distinguishes structures that routinely interface with the environment from those that minimally or temporarily interface with the environment. Section 3.3 describes the activities involved in building or installing each of the plant structures. Section 3.4 describes the operational activities of the plant that interface with the environment. References cited are listed in Section 3.5.

3.1 External Appearance and Plant Layout

The VCSNS site currently contains one pressurized light water reactor and associated facilities (VCSNS Unit 1) and is located on the southern shore of Monticello Reservoir (NRC 2004). Proposed VCSNS Units 2 and 3 would be located approximately 1 mi south of Unit 1 (Figure 3-1). All systems and structures directly supporting power generation by Units 2 and 3 would be built with new independent facilities; none would be shared with Unit 1. However, SCE&G noted that existing infrastructure such as administrative buildings, warehouses, and the training center, would be modified to accommodate Units 2 and 3 and the existing unit (SCE&G 2010a).

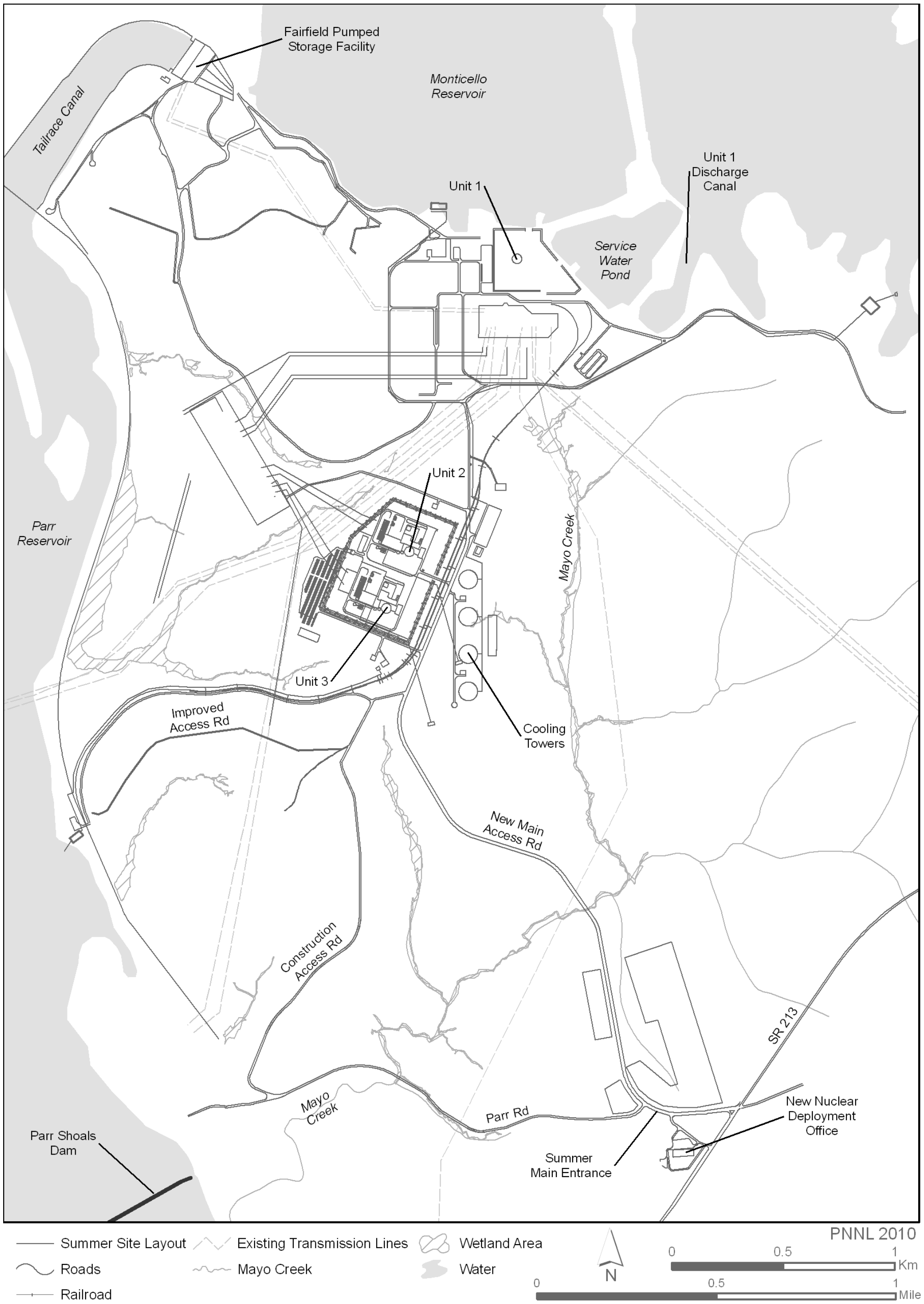


Figure 3-1. VCSNS Site Layout

The proposed location of the VCSNS Units 2 and 3 would have a design site grade of 400 ft North American Vertical Datum 1988 (NAVD88). SCE&G (2010a) states that the "center point of Unit 2 containment would be approximately 1600 ft west and 4300 ft south of the center point of Unit 1 containment" and the "center point of Unit 3 containment would be approximately 900 ft south-southwest of the center point of Unit 2." The containment vessel, shield building, and auxiliary building make up the "nuclear island," which is one of five principal structures of the standard Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactor proposed for VCSNS Units 2 and 3. The other four principal structures of an AP1000 unit are the turbine, diesel generator, radwaste, and annex buildings.

The footprint area of each new unit is adjacent to, but separate from, the other. The area required for the proposed two power-generating units is approximately 47 ac. Each new VCSNS reactor unit would be supported by two mechanical draft cooling towers, each approximately 70 ft high and 275 ft in diameter. The total area required for four cooling towers and associated structures for the circulating-water system (CWS) would be approximately 38 ac (SCE&G 2010a). A conceptualization of proposed Units 2 and 3 superimposed on the site is shown in Figure 3-2.

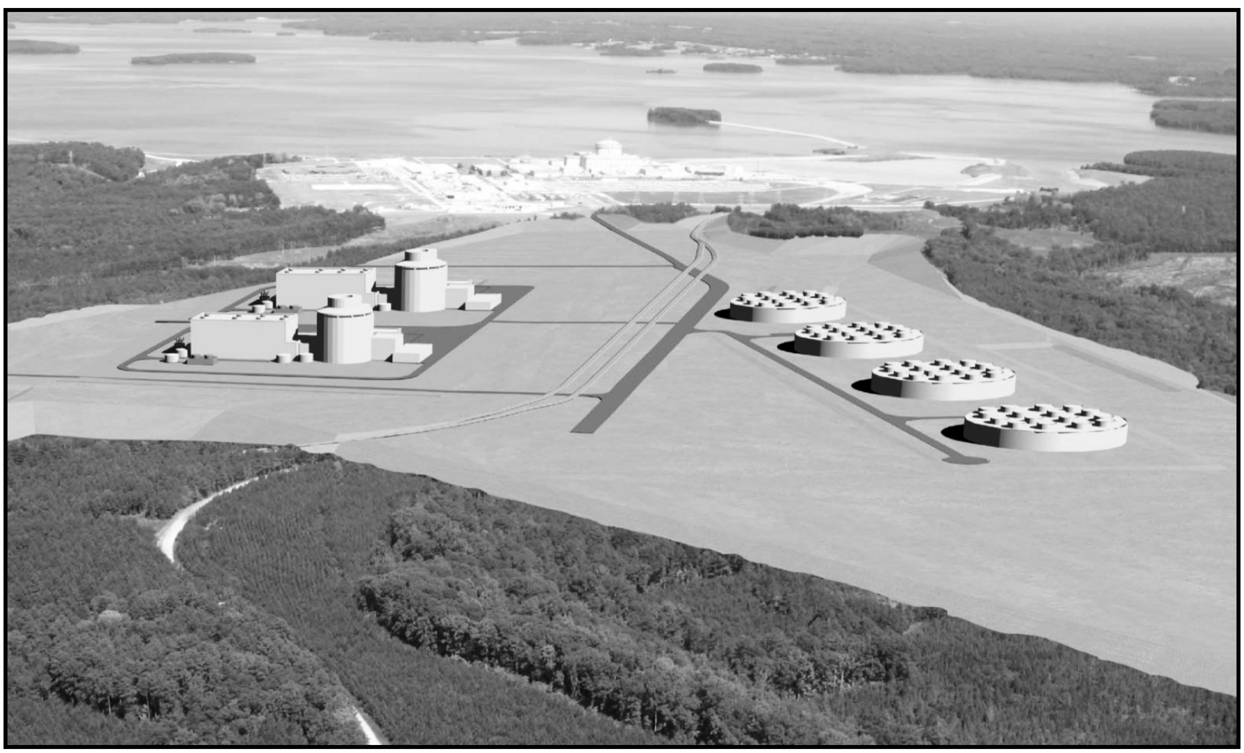


Figure 3-2. Conceptualization of Proposed Units 2 and 3 Superimposed on the VCSNS Site (SCE&G 2009e)

3.2 Proposed Plant Structures

This section describes each of the major plant structures: the reactor power system, structures that would have a significant interface with the environment during operation, and the balance of plant structures. All of these structures are relevant in the discussion of the impacts of building proposed Units 2 and 3 in Chapter 4. Only the structures that interface with the environment are relevant to the operational impacts discussed in Chapter 5.

3.2.1 Reactor Power Conversion System

SCE&G has proposed building and operating two Westinghouse AP1000 reactor steam electric generating systems at the VCSNS site. On January 27, 2006, the NRC issued the final design certification rule for the AP1000 in the *Federal Register* (71 FR 4464) based on Revision 15 of the AP1000 Design Control Document (DCD). Each applicant or licensee intending to construct and operate a plant based on the AP1000 design may do so by referencing its design certification rule, as set forth in Appendix D to Title 10 of the Code of Federal Regulations (CFR) Part 52.

Westinghouse is requesting to amend the AP1000 DCD. As mentioned in Section 1.1.4, the reactor design referenced in the application is Revision 17 of the certified design (Westinghouse 2008). The amended application is currently undergoing review. The status of the amended DCD review is available at www.nrc.gov. Figure 3-3 is an illustration of the reactor power-conversion system. Each AP1000 reactor is connected to two steam generators that transfer heat from the reactor core, converting feed water to steam that drives high-pressure and low-pressure turbines, thereby creating electricity. Steam that has passed through the turbines is condensed back to water that is heated and pumped back to the steam generators, repeating the cycle. The AP1000 design has a thermal power rating of 3400 MW(t), with a design gross-electrical output of approximately 1200 MW(e). The estimated station and auxiliary service load is 93 MW(e) for each proposed new unit at the VCSNS site, for a net electrical output of 1107 MW(e) per unit (SCE&G 2010a).

3.2.2 Structures with a Major Environmental Interface

The review team divided the plant structures into two primary groups: those that interface with the environment and those that are internal to the reactor and associated facilities but without direct interaction with the environment. Examples of interfaces with the environment are withdrawal of water from the environment at the intake structures, release of water to the environment at the discharge structure, and release of excess heat to the atmosphere. The structures or locations with environmental interfaces are considered in the review team's assessment of the environmental impacts of facility construction and preconstruction, and facility operation in Chapters 4 and 5, respectively. The power-production processes that would occur within the plant itself and that do not affect the environment are not relevant to a National Environmental Policy Act of 1969, as amended (NEPA) review and are not discussed further in

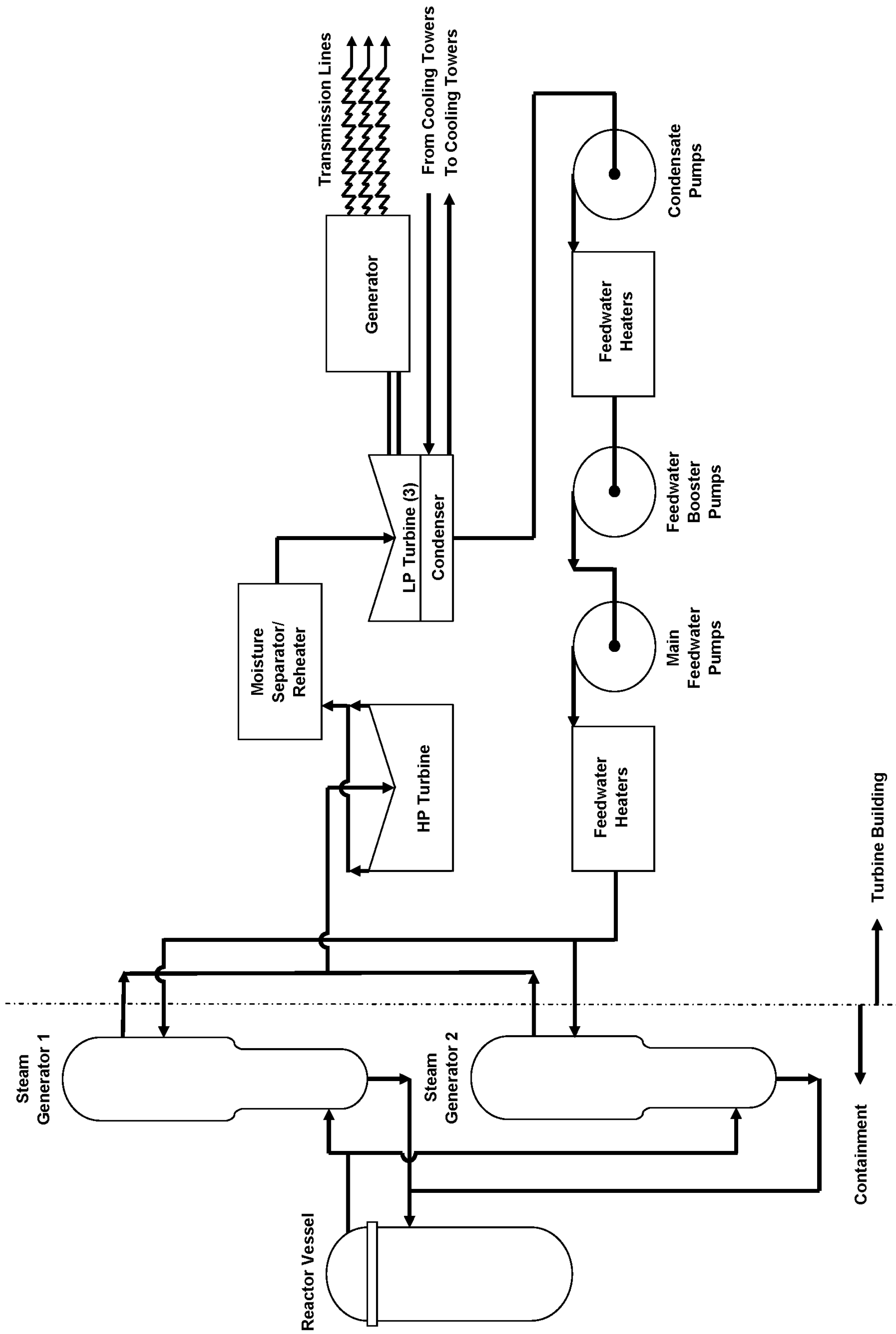


Figure 3-3. AP1000 Power Conversion Diagram (SCE&G 2009e)

this EIS. However, such internal processes are considered by the NRC staff in the Westinghouse AP1000 design certification documentation and in NRC safety reviews of the SCE&G COL application. This section (3.2.2) describes the structures with significant plant-environment interfaces. The remaining structures are discussed in Section 3.2.3, inasmuch as they may be relevant in the review team's consideration of impacts discussed in Chapter 4 of this EIS. Figure 3-4 illustrates the VCSNS site layout with a grid overlay to reference the locations of various plant structures and activity areas as they are described in the following sections. Existing Unit 1 is located primarily in the C2 quadrant. Proposed Units 2 and 3 structures are located primarily in the C3 and C4 quadrants.

3.2.2.1 Landscape and Stormwater Drainage

Landscaping and the stormwater-drainage system affect both the recharge to the subsurface and the rate and location at which precipitation drains into adjacent creeks and streams. Impervious areas eliminate recharge to aquifers beneath the site. Pervious areas managed to reduce runoff and maintained free of vegetation would experience considerably higher recharge rates than adjacent areas with local vegetation. The stormwater-management system, including site grading, drainage ditches, and swales, provides a safety function to keep locally intense precipitation from flooding safety-related structures.

The stormwater-retention basins in the immediate vicinity of the location of proposed Units 2 and 3 are shown in Figure 3-5. The proposed site is on top of a hill and stormwater would drain away from the site in several directions and into several unnamed creeks to the west and into Mayo Creek to the east. Once drainage enters Mayo Creek it would flow south, then west around the southern base of the powerblock area.

3.2.2.2 Cooling System

The cooling system represents the largest interface between the plant and the environment. Makeup water would be provided to the plant through an intake structure on Monticello Reservoir. A portion of the makeup water would be returned to the environment via the discharge structure on Parr Reservoir. The remaining portion of the water would be released to the atmosphere via evaporative cooling through mechanical draft cooling towers.

These components represent interfaces between the plant and the environment. This section describes the components of the proposed cooling system based on the information provided by SCE&G in its ER (SCE&G 2010a) and FSAR (SCE&G 2010b).

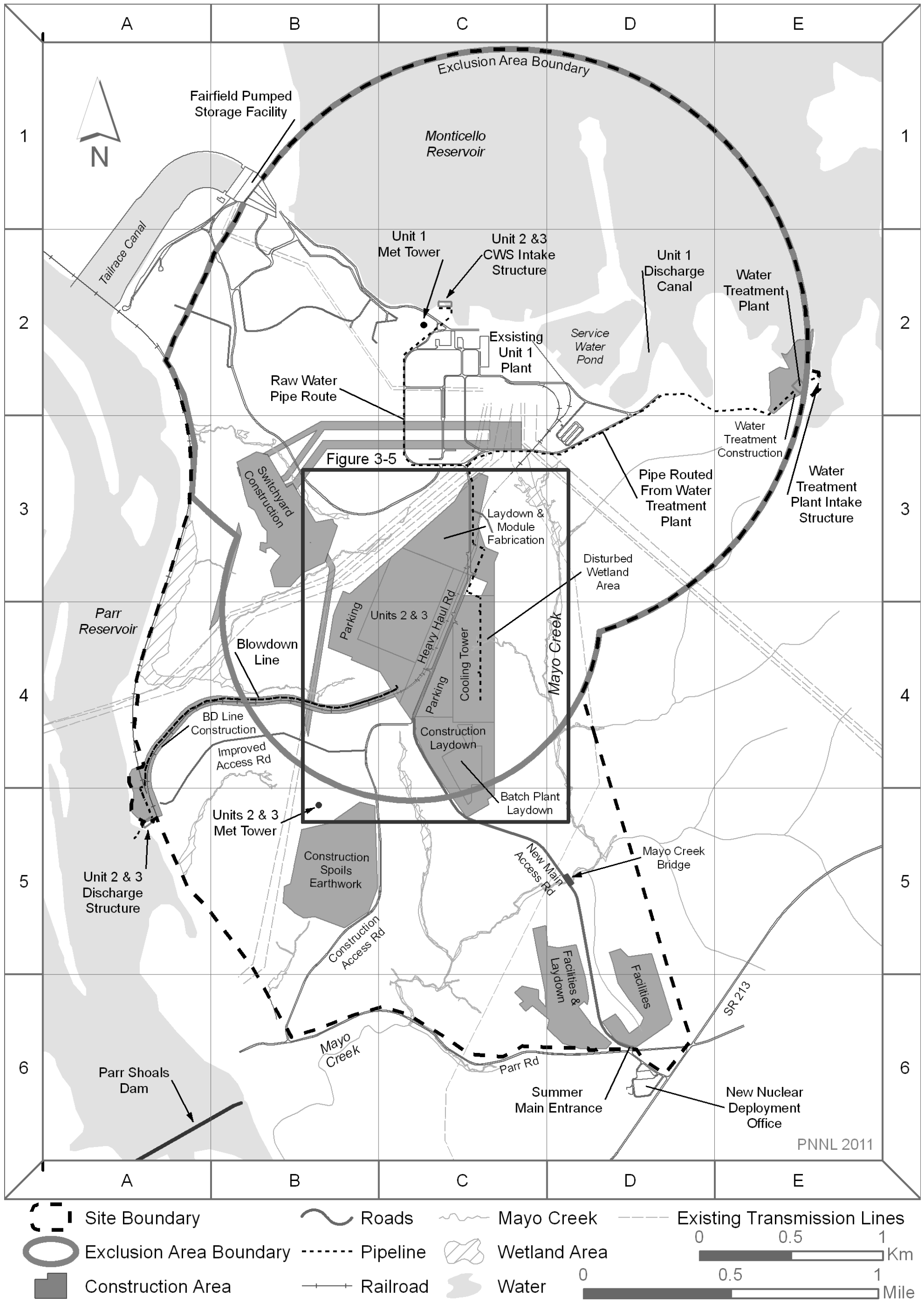


Figure 3-4. VCSNS Site Layout Showing Major Structure and Activity Areas for Proposed Units 2 and 3

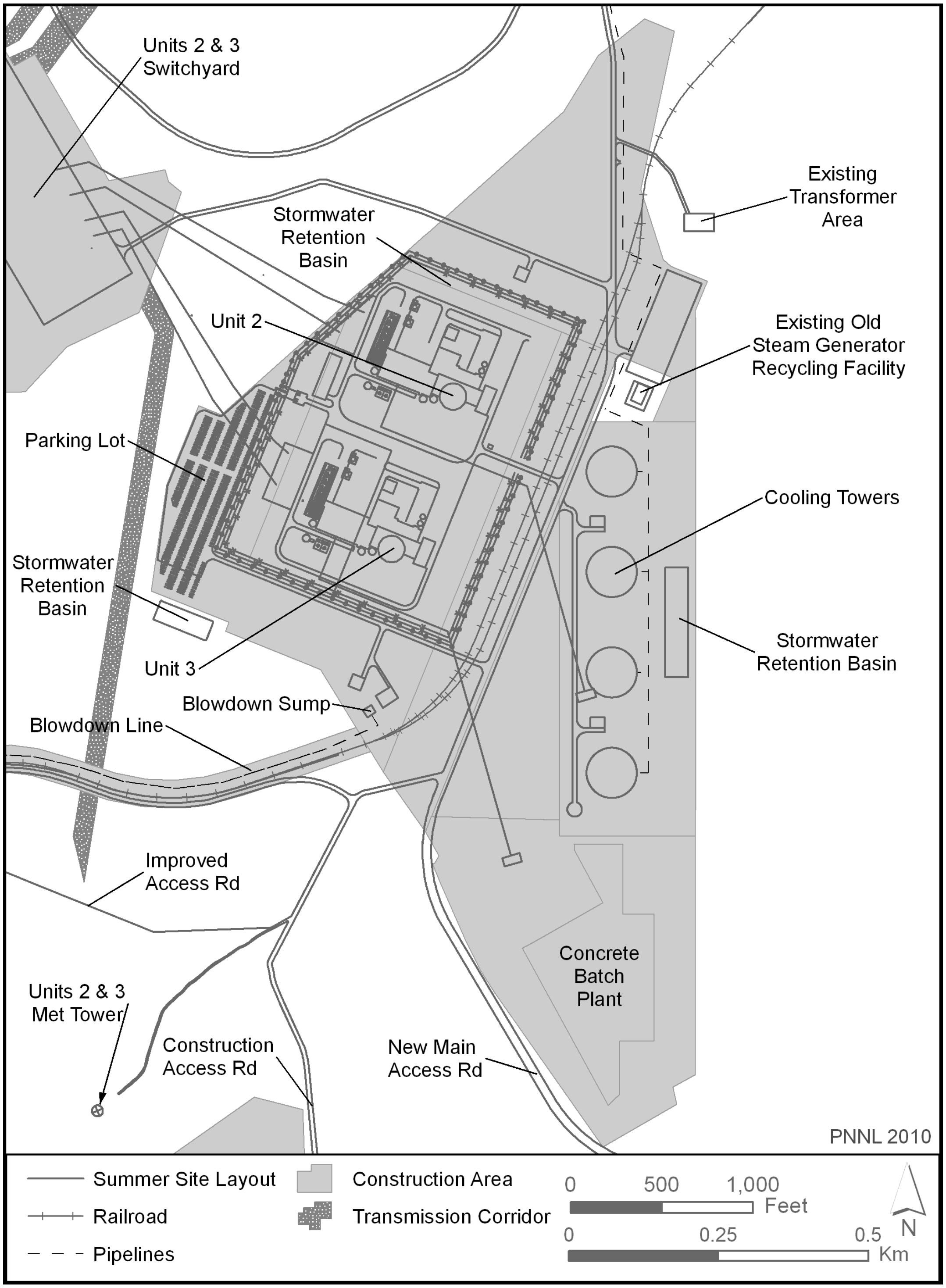


Figure 3-5. Site Layout Closeup

Cooling-Water Intake Structures

VCSNS Units 2 and 3 would obtain water for the cooling-water systems from Monticello Reservoir. Two new intake structures are proposed: one for makeup water for the CWS cooling towers and one for makeup water for the service-water system (SWS) cooling tower and for the potable, fire-protection, and demineralized water systems. The CWS intake would be the larger of the two and would be located on the shore of Monticello Reservoir approximately 1250 ft west of the Unit 1 intake (Figure 3-4, grid reference C2). This intake would be constructed of concrete; it would be approximately 60 ft long and 75 ft wide. It would house six raw-water pumps (three per AP1000 unit), each in an individual pump bay with a dedicated trash rack for coarse-debris removal and a traveling screen for fine-debris removal. A plan view of the CWS intake system's six pump bays is shown in Figure 3-6. A cross-sectional view of one pump bay is shown in Figure 3-7.

The intake structure for the water-treatment plant proposed for providing SWS makeup water, and other miscellaneous treated-water systems (potable, fire protection, demineralized water systems) would be located in Monticello Reservoir approximately 5500 ft east of the Unit 1 intake (Figure 3-4, grid reference E2). This proposed intake structure consists of a 255-ft-long, 17-ft-wide access pier extending approximately 200 ft into the reservoir, a 14-in.-diameter intake pipe suspended from the pier, and a cylindrical concrete wet well approximately 10 ft in diameter (SCE&G 2009d). The wet well is a chamber set in the reservoir to collect the water to be pumped to the water-treatment plant; the end of the intake pipe extends into the wet well. Screens in the side of the wet well allow water to pass through but exclude debris.

Discharge Structure

Water released from proposed Units 2 and 3 would flow through a pipeline to a discharge structure (outfall) on the eastern shore of Parr Reservoir, approximately 5000 ft west-southwest of Units 2 and 3. The pipeline would be routed along the rail corridor between VCSNS Units 2 and 3 and Parr Reservoir (Figure 3-4, grid references A4, B4, C4). The proposed discharge structure consists of a valve box and weir chamber housed in a structure 20 ft wide, 60 ft long, and approximately 23 ft deep, situated mostly below grade on the shoreline (Figure 3-8). Effluent would exit the weir chamber through a 36-in.-diameter discharge pipe to a diffuser line containing multiple ports that discharge approximately 3 ft above the bottom of Parr Reservoir. The proposed diffuser design has 20 ports, each with an inside diameter of 7 in., spaced 3.67 ft apart (on center), and alternately opening upstream and downstream. The diffuser line would be approximately 70 ft long; the main pipe and bottom part of each diffuser port would be sunk into the bottom of the reservoir and stabilized with riprap (Figure 3-9) (SCE&G 2010a).

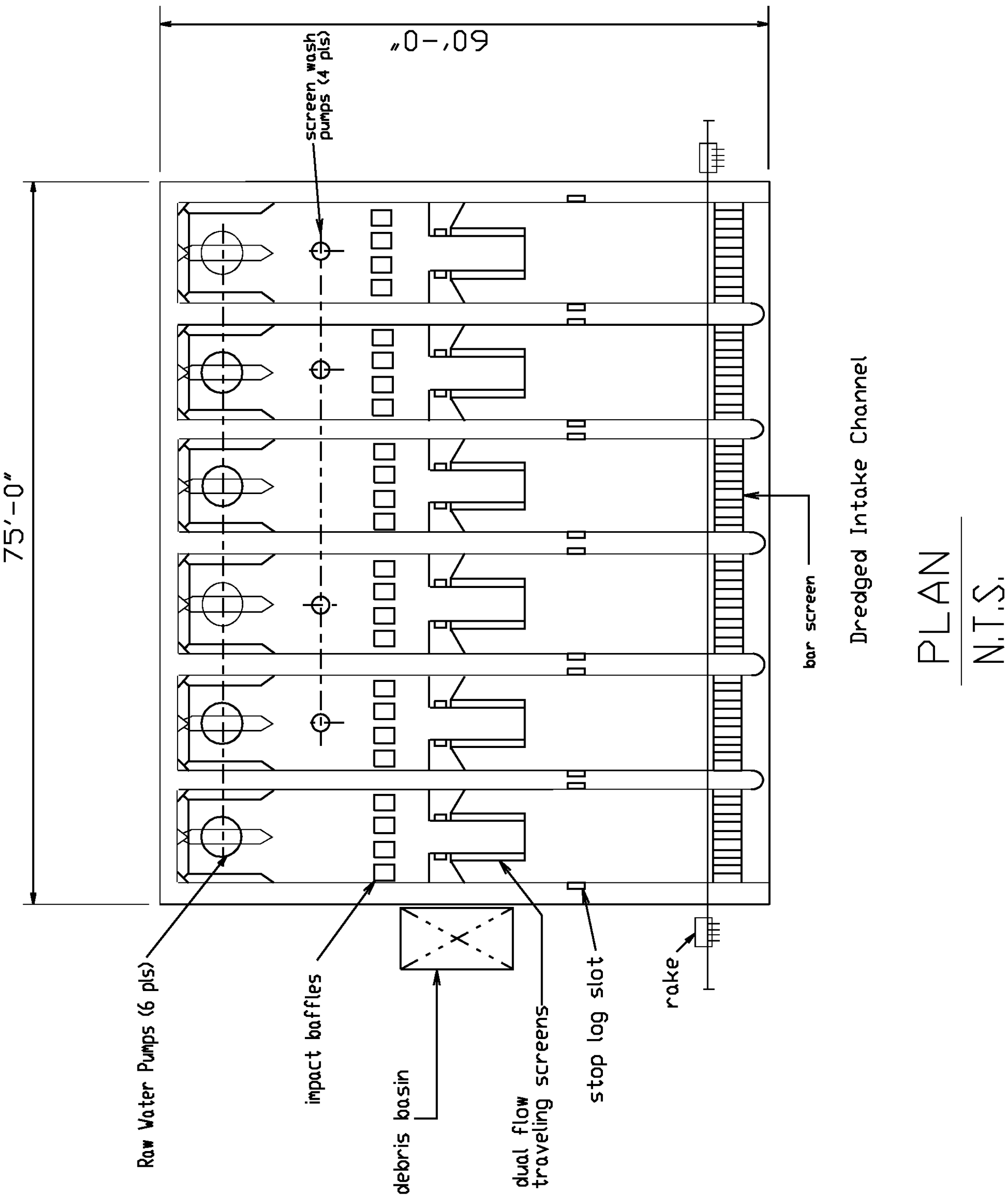


Figure 3-6. Plan View of the Circulating-Water System Intake Structure (SCE&G 2009e)

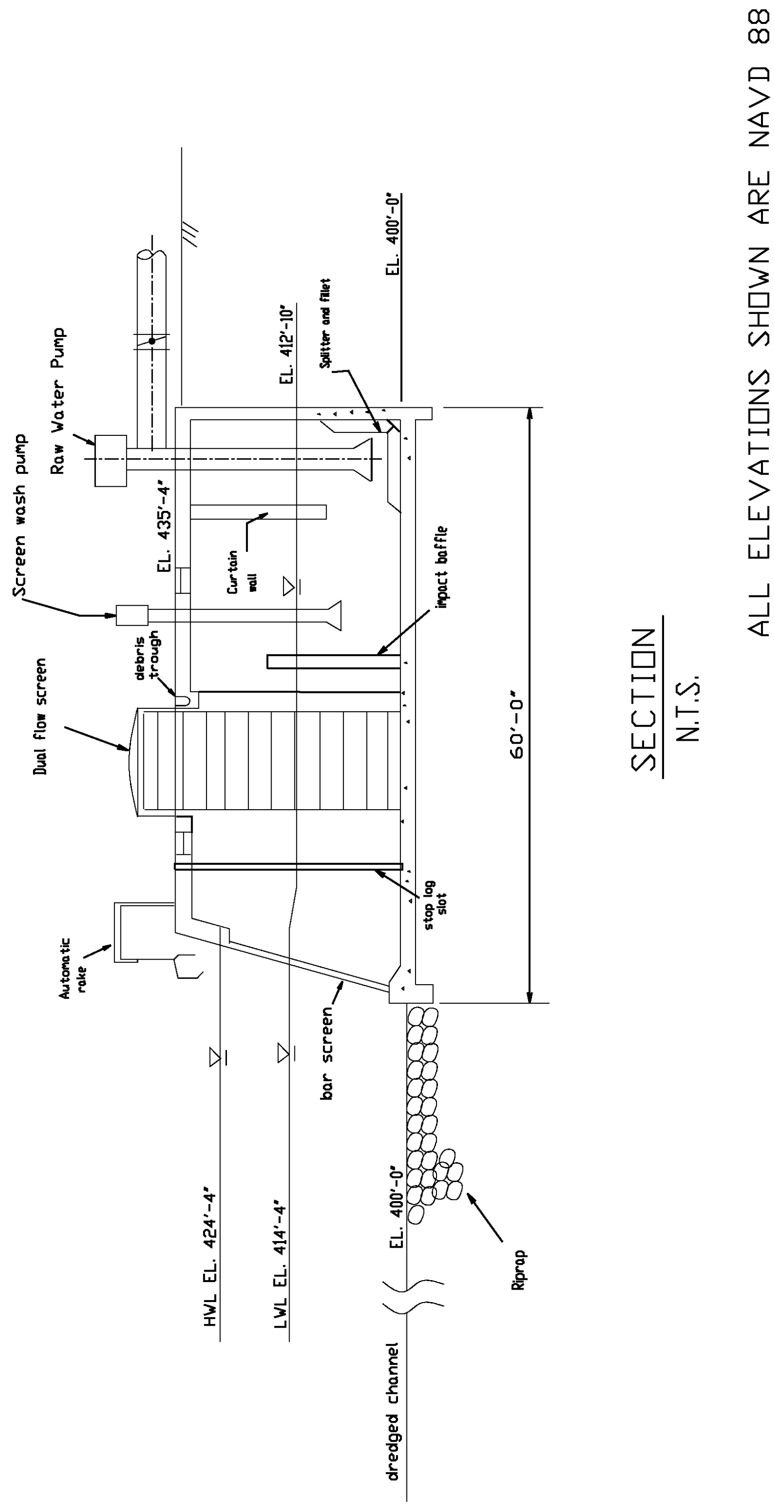


Figure 3-7. Cross-Section View of the Circulating-Water System Intake Structure (SCE&G 2009e)

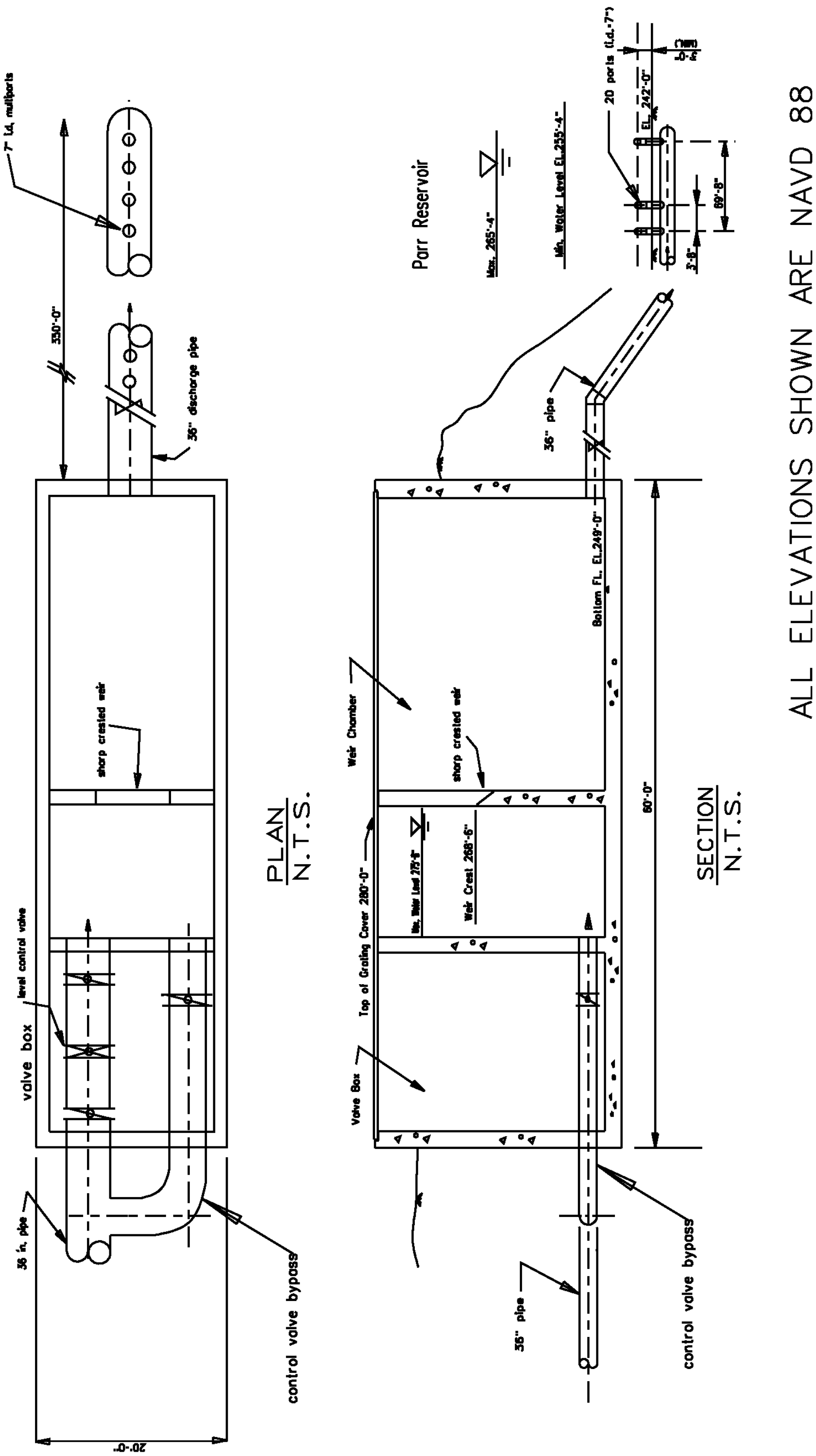


Figure 3-8. Plan and Cross-Section Views of the Outfall Discharge System (SCE&G 2009e)

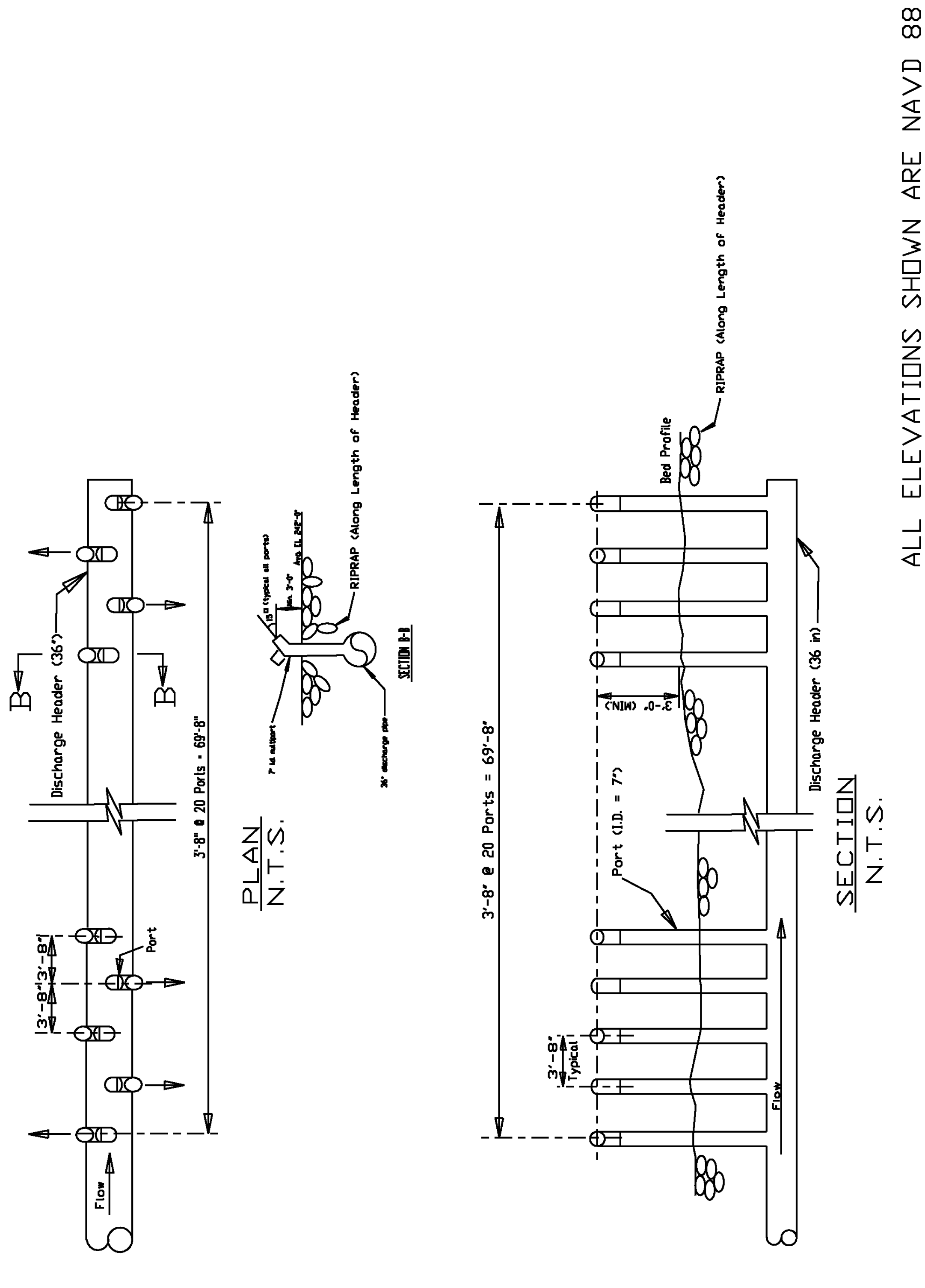


Figure 3-9. Plan and Cross-Section Views of the Outfall Discharge Ports (SCE&G 2009e)

Cooling Towers

Proposed Units 2 and 3 would use closed-cycle cooling towers to dissipate heat from both the CWS and the SWS. As described in Section 3.1, each unit requires two cooling towers for the CWS; these are mechanical draft towers with circular concrete shells, approximately 275 ft in diameter at the base and 70 ft high, including the fans on top. In each tower, fans blow air across water sprayed through fine nozzles, removing heat from the water and rejecting that heat to the atmosphere. The four towers would be aligned north-south, located to the east, and extending slightly farther south of Units 2 and 3 (Figure 3-5). Each new unit would also have one cooling tower for the SWS, rectangular in shape, located adjacent to the AP1000 turbine building. These would also be mechanical draft cooling towers, each divided into two cells.

3.2.2.3 Other Structures with a Permanent Environmental Interface

Roads, railroad lines, and buildings are the additional structures with a permanent environmental interface that would be built on the proposed site. Proposed new buildings associated with proposed Units 2 and 3 include the water-treatment plant, sanitary waste-treatment plant, and power transmission system.

Roads

An existing road network on the VCSNS site would provide access to and between the existing facilities. To support proposed Units 2 and 3, existing roads would be improved, and approximately 6 mi of new road would be constructed. New roadways would include an approximately 1.5-mi main access road from State Highway 213 (SC-213) near SCE&G's New Nuclear Deployment Office to Units 2 and 3, a 0.33-mi heavy-haul road between the laydown and fabrication areas, a 1.5-mi access road between the Units 2 and 3 cooling towers and the raw-water intake structure on Monticello Reservoir, and a perimeter road around the new units. Parr Road and much of the existing access road between Parr Road and VCSNS Unit 1 would be upgraded for use as the main access for Units 2 and 3 building materials and worker traffic. In the vicinity of the new units, this access road would be rerouted to the east side of the rail line into the site (SCE&G 2010a).

Railroad Lines

SCE&G owns a spur railroad line connecting the VCSNS site to the Norfolk Southern Railroad's main line along the Broad River. The VCSNS railroad line, which terminates at Unit 1, would be rerouted and another spur added between the new units and their cooling towers (Figure 3-4, grid reference C4). SCE&G indicated that another spur might be added to serve the concrete batch plant, which would be located south of the site of the proposed cooling towers along the new main access road (Figure 3-5).

Water-Treatment Plant

A new water-treatment plant would be built near the proposed treatment plant intake on Monticello Reservoir approximately 1.5 mi northeast of VCSNS Units 2 and 3 (Figure 3-4, grid reference E2) (SCE&G 2010a). Water would be pretreated as necessary at this treatment plant prior to supplying the plant service, potable, fire protection, and demineralized water systems.

Diesel-Generator Building

Diesel generators would be installed on the site to provide a backup source of power when the normal power source is disrupted. Combustion emissions would be released to the atmosphere from the generators only during emergency operations and periodic testing. Two diesel generators would be located in the AP1000 diesel-generator building; ancillary diesel generators would be located in the AP1000 annex building (SCE&G 2010a).

Turbine Building

The AP1000 turbine building would be a metal-sided rectangular structure rising 146 ft above grade, oriented with its long axis radiating from the containment structure. The turbine building would have a drain system that discharges to a wastewater retention basin connected to the blowdown sump, and a vent system for the condenser and turbine.

Radioactive Waste Facility

The AP1000 radioactive waste facility would be a steel-framed structure with a height of approximately 36 ft above grade. It would house the holding and processing systems for low-level liquid radioactive waste and solid radioactive waste. It also would house the collection and processing system for gaseous radioactive waste. Radioactive waste management is described in more detail in Section 3.4.3. Packaged solid wastes and liquid mixed wastes would be stored in the radioactive waste facility until shipment offsite for further processing or disposal. The environmental interfaces for the radioactive waste-treatment facility would be liquid effluent discharges to the blowdown discharge line, gaseous effluent venting, and solid waste handling for offsite shipment.

Sanitary Waste-Treatment Plant

SCE&G plans to build a new sanitary waste-treatment plant to support proposed VCSNS Units 2 and 3. It would be sized to serve the operational workforce of both units (approximately 800 workers) and would likely be built in the vicinity of Units 2 and 3. Effluent from the sanitary waste-treatment plant would be discharged to the blowdown sump where it would be mixed with cooling-tower blowdown before being discharged to Parr Reservoir (SCE&G 2010a).

Power Transmission System

In Sections 2.2.2 and 3.7 of its ER and in submittals describing selected transmission-line routes (SCE&G 2010a, c; MACTEC 2009; Pike 2010), SCE&G described the power transmission system that would connect proposed VCSNS Units 2 and 3 to the power grid. A new 230-kV switchyard occupying about 28 ac would be constructed approximately 1000 ft northwest of Units 2 and 3 (Figure 3-4, grid reference B3). Once the switchyard is completed, it would be fenced off to limit access; the switchyard is considered to minimally interface with the environment during normal operation. Several transmission lines would be built on the VCSNS site to connect the new 230-kV switchyard to existing transmission lines and to the Unit 1 switchyard (Figure 3-4, grid reference C2). Table 3-1 lists the proposed new 230-kV transmission lines for VCSNS Units 2 and 3.

Table 3-1. Summary of New 230-kV Transmission Lines for Proposed VCSNS Units 2 and 3

Transmission Line	Owner	Total Length (mi)	Length in Existing Rights-of-Way (mi)	Length Parallel and Adjacent to Existing Rights-of-Way (mi)	Length of New Rights-of-Way (mi)
VCSNS onsite connector lines	SCE&G	5	0	0	5
VCSNS-Killian	SCE&G	37	31	0	6
VCSNS-Lake Murray No. 2 and VCSNS-St. George No. 1 common corridor	SCE&G	22	22	0	0
VCSNS-St. George No. 2 (between VCSNS site and common corridor with VCSNS-St. George No. 1)	SCE&G	18	18	0	0
VCSNS-St. George No. 1 and No. 2 common corridor (Lake Murray to St. George substation)	SCE&G	76[(a)]	76[(a)]	0	0
VCSNS-Flat Creek	Santee Cooper	72	55	17	0
VCSNS-Varnville	Santee Cooper	167	144	22	0.5

Sources: FP&S 2008; MACTEC 2008, 2009; SCE&G 2010a, c; SCE&G 2010c; Pike 2010

(a) VCSNS-St. George No. 1 and St. George No. 2 common corridor length obtained by difference: total line length for St. George No. 1 of 98 mi, less 22 mi shared with VCSNS-Lake Murray No. 2, is 76 mi; total line length for St. George No. 2 of 94 mi, less 18 mi between VCSNS site and beginning of common corridor with St. George No. 1, is also 76 mi.

Transmission lines and corridors are considered to interface with the environment during operation because there are potential continuing impacts from electric fields, noise, and corridor maintenance. Each new unit would be connected to the new switchyard by two overhead lines. Three overhead lines would connect the new switchyard with the existing Unit 1 switchyard. Ten 230-kV transmission lines (eight owned by SCE&G, two owned by Santee Cooper) and one 115-kV line presently connect the Unit 1 switchyard with the regional transmission system. However, the existing transmission system at VCSNS does not have the capacity to support proposed VCSNS Units 2 and 3.

As noted in Section 2.2.2, six new 230-kV lines (three for each unit) would be required to connect the new units to the regional power grid. The proposed routes of the new transmission lines are described in Section 2.2.2 and shown in Figure 2-5. Where possible, the new lines occupy, expand, or parallel existing transmission-line corridors (SCE&G 2010c; MACTEC 2009; Pike 2010). The VCSNS-Lake Murray No. 2, VCSNS-St. George No. 1, and VCSNS-St. George No. 2 lines were routed within existing rights-of-way, and VCSNS-St. George No. 1 and VCSNS-St. George No. 2 lines share a common corridor for most of their length (Pike 2010). The longest proposed new line, VCSNS-Varnville, would be routed within existing rights-of-way except for about 23 mi of new right-of-way, and the majority of new right-of-way is located parallel and adjacent to existing rights-of-way (MACTEC 2009). The VCSNS-Flat Creek line would require 17 mi of new right-of-way, all of which is located parallel and adjacent to existing rights-of-way (MACTEC 2009). The VCSNS-Killian line would be routed within existing rights-of-way except for the last 6 mi between Blythewood and Killian, which would be a new right-of-way that is not parallel or adjacent to existing rights-of-way (see Figure 2-5).

Most of the new lines would connect to existing substations or switchyards, but one new substation and several substation additions and upgrades would be needed to support VCSNS Units 2 and 3 (SCE&G 2010d). SCE&G proposes to build a new substation on approximately 14 ac of SCE&G-owned property near St. George, South Carolina, to connect the new double-circuit VCSNS-St. George line. The Lake Murray, Winnsboro, and Varnville substations would be enlarged by approximately 2.1 ac, 1.5 ac, and 4.1 ac, respectively. The Killian, Pomaria, Sandy Run, Richburg, and Flat Creek substations would be upgraded within existing footprints, so they would not require additional acreage (SCE&G 2010d). As with the onsite switchyard, the substations are considered to minimally interface with the environment once they are built.

Structures associated with the transmission-line corridors are support towers and access roads. Where a new line would be sited alongside an existing corridor, that corridor might require widening and/or moving of existing structures (widths of the existing corridors vary from 50 ft to 240 ft). While the specific structure design depends on the terrain and engineering properties of the soil along the route, all tower structures would be designed so that span clearances meet or exceed National Electrical Safety Code standards, and all structures would be properly grounded (SCE&G 2010a). Towers on the two Santee Cooper lines would be either H-frame or single-pole design (MACTEC 2009). Single poles range from 55 ft to 80 ft tall and would usually be spaced 400 ft to 500 ft apart; the H-frame poles can be 75 ft to 110 ft tall and spaced 700 ft to 800 ft apart (MACTEC 2009). SCE&G expects to use single steel or concrete poles, which are standard for its 230-kV lines. These poles are typically 85 ft to 105 ft tall, and spaced 500 ft to 800 ft apart depending on the topography and land cover (FP&S 2008).

3.2.2.4 Other Structures with a Temporary Environmental Interface

Some temporary plant-environment interfacing structures would need to be removed before proposed Unit 3 operation commences. These include a concrete batch plant, a temporary sewage treatment plant, and dewatering systems. The impacts from the operation and installation of these structures are discussed in Chapter 4.

Concrete Batch Plant

A concrete batch plant would occupy approximately 12 ac located south of the VCSNS Units 2 and 3 cooling towers, adjacent to the new main access road and a 28-ac laydown area (Figure 3-4, grid references C4, C5). This area would house the equipment and facilities needed for delivery, materials handling and storage, and preparation of concrete. Water for the concrete batch plant would come from the Jenkinsville Water District until the planned water-treatment facility for Units 2 and 3 is completed and operational (SCE&G 2010a).

Temporary Sanitary Waste-Treatment Plant

A temporary sanitary waste-treatment plant would be placed near the main building-support area (Figure 3-4, grid reference D6). This treatment plant would serve approximately 350 workers in the support area (onsite workers would be served by portable toilet facilities and by the proposed permanent sanitary waste-treatment system when that system becomes operational) (SCE&G 2010a). The discharge location for the temporary sanitary waste-treatment plant would be finalized as part of the National Pollutant Discharge Elimination System (NPDES) permitting process; proposed locations are Mayo Creek, Parr Reservoir, or the Broad River (SCE&G 2010a).

Dewatering Systems

Dewatering is expected to be a localized activity associated with dredging or excavation (SCE&G 2010a). Submersible pumps would be used to dewater the shoreline areas at the intake and discharge structure locations; these pumps would discharge to the adjacent surface water. Deep excavation in the powerblock region might require temporary installation of dewatering sumps and pumps, which would discharge to the stormwater-management system.

3.2.3 Structures with a Minor Environmental Interface

The structures described in the following sections would have minimal environmental interface during plant operation.

3.2.3.1 Nuclear Island and Annex Building

Each AP1000 nuclear island would consist of a containment building, a shield building, and an auxiliary building. The foundation for the nuclear island would be an integral base mat that supports these buildings. The steel containment structure would be completely surrounded by the shield building and the auxiliary building. The containment foundations would be approximately 40 ft below grade. The construction materials would be “architecturally similar to Unit 1” (SCE&G 2010a), i.e., generally concrete or steel, for a similar external appearance. The tallest building would be the shield building at approximately 229 ft above grade; the auxiliary building would be approximately 80 ft above grade. The annex building would be a concrete-and-steel structure that would rise to a height of approximately 81 ft above grade and provide personnel access to the plant and house plant-support systems and equipment.

3.2.3.2 Cranes and Footings

A 250-ft-tall crane on a concrete footing would be used to erect Units 2 and 3. Other cranes may be used for materials handling and erection.

3.2.3.3 Pipelines

New pipelines would be constructed to convey water from the raw-water intake to the proposed Units 2 and 3 cooling towers, from the water-treatment plant intake to the water-treatment plant, from the water-treatment plant to the Units 2 and 3 SWS, from the various water systems to the blowdown sump, and from the blowdown sump to the discharge structure on Parr Reservoir. The locations of these structures and the pipeline routes are shown in Figure 3-4 and Figure 3-5. The blowdown discharge pipe would be 36-in. in diameter and would be buried in a trench parallel to the railroad line.

3.2.3.4 Support, Laydown, and Spoils Areas

Multiple construction support and laydown areas would be established to support fabrication and erection activities and might be maintained as laydown areas for future maintenance and refurbishment of the plant. In Revision 2 of its ER, SCE&G provided an updated construction utilization plan that consolidated several of the laydown and spoils areas into fewer construction support areas (SCE&G 2010a). Two construction support areas located near the facility entrance on either side of the new main access road, just north of the existing New Nuclear Deployment Office, would contain temporary offices, warehouses, and sanitary, craft, and training facilities (Figure 3-4). Other laydown, fabrication, parking, and support areas would range in size from 14 ac to 62 ac. Earthwork and dredge spoils would be placed in a 62-ac spoils area located approximately 4500 ft south of Units 2 and 3, (Figure 3-4, grid reference B5).

3.2.3.5 Parking

Parking areas would be created to support the construction workforce and some parking would be retained for the operating workforce once plant installation is completed. Temporary parking areas would be in the vicinity of the plant, support, and laydown areas identified in Figure 3-4. The permanent parking area for the operating workforce would be approximately 800 spaces, located west of VCSNS Units 2 and 3 (Figure 3-4).

3.2.3.6 Miscellaneous Buildings

A variety of small miscellaneous buildings would exist throughout the site to support worker, fabrication, building, and operational needs (e.g., shop buildings, support offices, warehouses, and guard houses). Some buildings may be temporary and would be removed after the plant begins operation.

3.3 Construction and Preconstruction Activities

The NRC's authority is limited to construction activities that have "a reasonable nexus to radiological health and safety or common defense and security" (72 FR 57416), and the NRC has defined "construction" within the context of its regulatory authority. Examples of construction (defined at 10 CFR 50.10(a)) activities for safety-related structures, systems, or components include driving of piles; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication or testing.

Other activities related to building the plant that do not require NRC approval (but may require a DA permit) may occur before, during, or after NRC-authorized construction activities. These activities are termed "preconstruction" in 10 CFR 51.45(c) and may be regulated by other local, State, Tribal, or Federal agencies. Preconstruction includes activities such as site preparation (e.g., clearing, grading, erosion control and other environmental mitigation measures); erection of fences; excavation; erection of support buildings or facilities; building service facilities (e.g., roads, parking lots, railroad lines, sanitary treatment systems, potable water system, transmission lines); and procurement or fabrication of components occurring somewhere other than the final, in-place location at the proposed site. Further information about the delineation of construction and preconstruction activities is presented in Chapter 4 of this EIS.

This section describes the structures and activities associated with building proposed Units 2 and 3. Table 3-2 provides general definitions and examples of activities that would be performed when building the new units. This section characterizes the activities for the principal structures to provide the requisite background for the assessment of environmental impacts; it is not intended to be a complete discussion of every activity or a detailed engineering plan.

Table 3-2. Descriptions and Examples of Activities Associated with Building Proposed Units 2 and 3

Activity	Description	Examples
Clearing	Removing vegetation or existing structures from the land surface.	Cutting planted pines from an area to be used for construction laydown.
Grubbing	Removing roots and stumps by digging.	Removing stumps and roots of pines logged from the construction laydown area.
Grading	Reforming the elevation of the land surface to facilitate operation of the plant and drainage of precipitation.	Leveling the site of the reactors and cooling towers.
Hauling	Transport of material and workforce along established roadways.	Driving on new access road by construction workforce.
Paving	Laying impervious surfaces, such as asphalt and concrete, to provide roadways, walkways, parking areas, and site drainage.	Paving the parking area.
Shallow excavation	Digging a hole or trench to a depth reachable with a backhoe. Shallow excavation may not require dewatering.	Placing pipelines; setting foundations for small buildings.
Deep excavation	Digging an open hole in the ground. Deep excavation requires equipment with greater vertical reach than a backhoe. Deep excavation generally requires dewatering systems to keep the hole from flooding.	Excavating the base mat for the reactor.
Excavation dewatering	Pumping water from wells or pumping water directly to keep excavations from flooding with groundwater or surface runoff.	Pumping water from reactor building deep excavation.
Dredging	Removal of substrates and sediment in navigable waters, including wetlands.	Preparing the location of the outfall diffuser in Parr Reservoir.
Spoils placement	Placement of construction (earthwork) or dredged material in an upland location.	Relocating dredge spoils from Parr Reservoir discharge area to an upland dredge disposal area.
Erection	Assembly of all modules into their final positions, including all connections between modules.	Using a crane to assemble reactor modules.
Fabrication	Creating an engineered material from the assembly of a variety of standardized parts. Fabrication can include conforming native soils to some engineered specification (e.g., compacting soil to meet some engineered fill specification).	Preparing concrete for pours; laying rebar for base mat.
Vegetation management	Thinning, planting, trimming, and clearing vegetation.	Maintaining the switchyard free of vegetation.
Filling a wetland or waterbody	Discharge of dredge and/or fill material into waters of the United States, including wetlands.	Placing fill material into wetlands to bring it to grade with the adjacent land surface.

3.3.1 Major Affected Areas

SCE&G has stated (SCE&G 2010a) that building activities for proposed Units 2 and 3 would occur within the boundaries of SCE&G's property (Figure 3-4), except for the new transmission lines described in Sections 2.2.2 and 3.2.2.3. Access roads for Units 2 and 3 would enter the property from the south; the railroad spur enters from the west. The blowdown discharge pipeline would share the railroad corridor between Units 2 and 3 and the discharge structure on Parr Reservoir. The intake structures would be on Monticello Reservoir at the north end of the property. The following sections briefly describe the construction and preconstruction activities associated with the structures described in Sections 3.2.2 and 3.2.3.

Landscape and Stormwater Drainage

Preparing to build and operate proposed VCSNS Units 2 and 3 would require land to be cleared and graded for the main reactor buildings and support facilities and additional space for material and equipment laydown areas. The details of the alterations are discussed in the following sections. After the site is graded, a stormwater-drainage system would be created around the facilities to direct stormwater away from the operational areas. Drainage ditches and pipes would route surface water to three water-retention and/or infiltration ponds. The locations of these ponds (retention basins) are shown in Figure 3-5.

Powerblock and Cooling Towers

Preparing the locations for the powerblock and cooling towers would be the largest and most complex activity on the site (Figure 3-5). Deep excavation and extensive fill placement and large-scale fabrication and erection activities would be involved in building the AP1000 units. The cooling towers would require extensive grading, filling (including a portion of a wetland), shallow excavation, and fabrication and erection activities. Building the diesel-generator facility would involve limited fabrication and erection. Various components would be hauled to the site by railroad and road. Railroads and roads would be built or upgraded on the VCSNS site, particularly in the immediate vicinity of Units 2 and 3 and their cooling towers.

Excavation Dewatering

Setting the reactor-shield building foundation would require excavation to about 40 ft to 50 ft below grade level. The water table in this area is about 27 ft to 34 ft below grade level (SCE&G 2010a). Dewatering systems would be installed if required. At a minimum, SCE&G expects to install drainage sumps at the bottom of the excavation to facilitate the removal of surface drainage. Water from the excavations would be pumped to the stormwater-management system (SCE&G 2010a).

Shallow excavation for foundations for other buildings and trenching for pipelines are not expected to require dewatering.

Intake Structures

Installing the intake structure for the CWS would require excavation or dredging below the water level of Monticello Reservoir. Approximately 10,000 yd^3 of material would be removed from an approximately 25,000-ft^2 area (SCE&G 2009a, b). The dredged material would be relocated to the onsite spoils disposal area (Figure 3-4, grid reference B5). SCE&G has proposed the placement of a temporary cofferdam that would enclose an area to be excavated and dewatered to facilitate building the proposed intake structure, which would extend out into the Monticello Reservoir. The cofferdam would be surrounded by a turbidity curtain, which is a floating geotextile material designed to deflect and contain sediment within a limited area and provide sufficient residence time to settle soil particles, thereby minimizing sediment transport from a disturbed area adjacent to or within a body of water. Water removed from within the cofferdam would be discharged outside the cofferdam and inside the turbidity curtain (SCE&G 2010a).

Fabrication of the CWS intake structure would occur after excavation and dredging to reach the necessary elevation for the bottom of the structure. After excavation and dredging, the pump house would be erected and the necessary electrical systems and piping would be installed to create an operational intake structure.

Similar activities would be required to prepare for and fabricate the intake structure for the water-treatment plant intake on Monticello Reservoir. A cofferdam would be installed to allow dewatering of the work area; a turbidity curtain would be used to control suspended sediment during dewatering. Options considered by SCE&G include a rock-filled cofferdam enclosing the entire access pier and wet well structure, or a localized sheet-pile cofferdam enclosing only the wet well (SCE&G 2009d). This intake structure would also require installation of pilings to support the access pier. Piling installation would be done from within or from the top of the rock-filled cofferdam if that option was implemented, or from a barge platform if the localized cofferdam option was implemented. All wet well installation activities would occur within the cofferdam: a concrete foundation would be poured on compacted base material and the precast concrete wet well sections would be attached to the base.

Discharge Structure

Installation of the blowdown-discharge diffuser in Parr Reservoir would require the creation of an enclosure that can be dewatered and excavated or dredged. Sheet pile would be driven into the bottom of Parr Reservoir approximately 1.25 mi above Parr Shoals Dam to create the enclosure; it would extend 100 ft offshore to allow excavation of the reservoir bottom and emplacement of the diffuser pipe. Approximately 11,000 yd^3 of material would be removed from an approximately 24,000-ft^2 area (SCE&G 2009a, b). The dredged material would be relocated to the onsite spoils disposal area (Figure 3-4, grid reference B5).

Roadways

Building the heavy-haul road and the site-access roads would require clearing and grading of land along the proposed routes shown in Figure 3-4 (SCE&G 2010a). The new main access road would cross Mayo Creek just north of the construction-support area near the SCE&G New Nuclear Deployment office and approximately 1 mi southeast of proposed Units 2 and 3.

Railroad Lines

Relocating the existing rail line and adding any new rail spurs would require clearing, grading, and fill placement in the locations of the new rail lines.

Water-Treatment Plant

Building the water-treatment plant would involve shallow excavation, fabrication, and erection on a cleared, graded area.

Sanitary Waste-Treatment Plant

Building the sanitary waste-treatment plant would involve shallow excavation and limited fabrication and erection. The facility would be designed in accordance with industry standards and in compliance with the Clean Water Act and NPDES permit requirements.

Pipelines

Laying pipelines would occur in several areas on the site. The pipelines connecting the water-intake structure to the cooling-tower basins would run south from the intake structure along currently existing roads. The pipelines connecting the water-treatment plant to Units 2 and 3 would run west from the water-treatment plant along existing roads. The blowdown lines would run west from the cooling-tower basins along the rail corridor to Parr Reservoir and along the shoreline to the diffuser location approximately 1.25 mi above Parr Shoals Dam. The intake, treated-water, and discharge pipelines would generally be buried in trenches. Pipeline installation would require the clearing of land along the pipeline corridor and shallow excavation (trenching).

Concrete Batch Plant

Erecting the temporary concrete batch plant would occur on a cleared, graded area.

Construction Support and Laydown Areas

Establishing and preparing laydown areas would be necessary to stage activities. Prior to and during construction and preconstruction, materials would be brought to the site and stored in laydown areas. SCE&G expects to clear and grade laydown areas in various locations on the proposed VCSNS Units 2 and 3 sites. Support and laydown areas would be graded relatively level and covered with crushed stone or gravel. Normally only limited vegetation is allowed in laydown areas.

Parking

Parking areas would be graded and paved.

Miscellaneous Buildings

Excavating for shallow foundations would be required prior to fabrication and erection of miscellaneous buildings.

Switchyard

Clearing and grading approximately 47 ac of land would be required surrounding and including the proposed 230-kV switchyard. Electrical switching structures would be erected and the switchyard would be fenced (SCE&G 2010a).

Transmission Lines

Installation of transmission lines would require the removal of trees and shrubs along portions of the transmission-line corridor, movement of construction equipment, and shallow excavation for the foundations of the transmission-line towers.

Cranes and Crane Footings

Fabrication of footings and erection of cranes would be necessary to build the larger plant structures.

3.3.2 Summary of Resource Commitments During Construction and Preconstruction

Table 3-3 provides a list of the significant resource commitments of construction and preconstruction. The values in the table combined with the affected environment described in Chapter 2 provide the basis for the impacts assessed in Chapter 4. These values were stated in the ER and supplemental information (SCE&G 2010a, c; Pike 2010), and the review team has confirmed that the values are not unreasonable.

Table 3-3. Summary of Resource Commitments Associated with Proposed Units 2 and 3 Construction and Preconstruction

Resource Areas	Value	Parameter Description
All resource areas	123 mo (10.25 yr)	Duration of construction and preconstruction activities for two AP1000 units
Land use, terrestrial ecology, historic and cultural resources (site and vicinity)	556 ac	Disturbed area footprint: 180 ac temporarily disturbed
Land use, terrestrial ecology, historic and cultural resources (offsite, transmission lines)	12 mi	Length of new transmission-line corridors: 5 mi onsite connector lines; 6 mi on Killian line; less than 1 mi on Varnville line
	39 mi	Length of new transmission-line right-of-way that would parallel or widen existing corridor: 17 mi on Flat Creek line, 22 mi on Varnville line
	ranging from 50 ft to 250 ft	Final width of new and expanded corridors (assuming these would be similar to existing corridors)
Hydrology – groundwater	40 ft to 50 ft below grade	Excavation depth to which dewatering would be required
Hydrology – surface water, aquatic ecology	420 gpm (1 cfs)	Water supply (maximum) obtained from Monticello Reservoir and Jenkinsville Water District
	17,500 gpd (12.1 gpm, 0.03 cfs)	Effluent discharge to surface water, temporary sanitary waste-treatment plant
Transportation, air quality	2170 workers	Average workforce over 10-year period: first quarter of year 2 through fourth quarter of year 11; number of workers is above average for 5.5 years from the first quarter of year 5 through the second quarter of year 10
Socioeconomics	3600 workers	Maximum workforce: peak occurs in year 6; more than 3000 workers would be onsite from the third quarter of year 5 to the second quarter of year 9
Terrestrial ecology, nonradiological health, socioeconomics	108 dBA	Peak noise level
	60-80 dBA	Noise level 400 ft from activity

3.4 Operational Activities

The operational activities considered in the review team's environmental review are those associated with structures that interface with the environment, as described in Section 3.2.2. Examples of operational activities are withdrawing water for the cooling system, discharging blowdown water and sanitary effluent, and discharging waste heat to the atmosphere. Safety activities within the plant are discussed by the applicant in the FSAR portion of its application (SCE&G 2010b). The results of NRC's safety review will be documented in its Safety Evaluation Report.

The following sections describe the operational activities, including operational modes (Section 3.4.1), plant-environment interfaces during operations (Section 3.4.2), and the radioactive and nonradioactive waste-management systems (Sections 3.4.3 and 3.4.4), and summarize the values of resource parameters likely to be experienced during operations in Section 3.4.5.

3.4.1 Description of Operational Modes

The operational modes for proposed Units 2 and 3 considered in the assessment of operational impacts on the environment (Chapter 5 of this EIS) are normal operating conditions and emergency shutdown conditions. These are considered the conditions under which maximum water withdrawal, heat dissipation, and effluent discharges occur. Cooldown, refueling, and accidents are alternate modes to normal plant operation during which water intake, cooling-tower evaporation, water discharge, and radioactive releases may change from nominal conditions.

3.4.2 Plant-Environment Interfaces During Operation

This section describes the operational activities related to structures with an interface to the environment.

3.4.2.1 Intake Structures

Monticello Reservoir would be the source of water involved in the operation of proposed Units 2 and 3. Water would be pumped from Monticello Reservoir to supply cooling water to Units 2 and 3 at the CWS intake and to supply other plant water systems at the water-treatment plant intake structures described in Section 3.2.2.2. Under normal operating conditions for both units, the CWS withdrawal rate would be approximately 36,000 gpm; the maximum combined pumping rate to supply both units with raw makeup water would be approximately 59,000 gpm. The water withdrawal rate for the water-treatment plant would be approximately 1000 gpm under normal conditions and 3000 gpm maximum. The normal case assumes the cooling towers are operating at four cycles of concentration; the maximum assumes the cooling towers are operating at two cycles of concentration. The systems would be operated at four cycles of concentration unless high suspended solids concentrations in Monticello Reservoir occurred. Under elevated suspended solids conditions, two cycles of concentration would be used to prevent scale formation or deposition from degrading tower performance (SCE&G 2010a).

Each CWS intake pump would be protected by a debris-exclusion system consisting of a bar screen to trap large debris and a dual-flow traveling screen to filter out fine debris. The intake-approach channel and pump-bay structures are designed so that the maximum through-screen velocity would be less than 0.5 fps at the minimum water elevation in Monticello Reservoir. At the water-treatment plant intake, the end of the intake pipe would be inside a concrete wet well (a chamber used to collect liquid) in Monticello Reservoir. Screens in the side of the wet well allow water to pass into the wet well while excluding debris. The maximum through-screen velocity at the water-treatment plant intake would also be less than 0.5 fps at the minimum water elevation in Monticello Reservoir (SCE&G 2010a; SCE&G 2009d).

3.4.2.2 Cooling Towers

Waste heat is a byproduct of normal power generation at a nuclear power plant. VCSNS Units 2 and 3 would each have two closed-cycle wet-cooling towers to dissipate heat from the CWS to the atmosphere. Two CWS cooling towers are designed to dissipate a heat load of 7.63×10^9 Btu/hr (1.53×10^{10} Btu/hr for both units) (SCE&G 2010a). Each unit would also have one SWS cooling tower, which, during normal operation, is expected to dissipate a heat load of 1.03×10^8 Btu/hr through one of its two cells. If increased cooling capacity were needed, such as during plant cooldown, both cells would be used to dissipate a maximum heat load of 3.46×10^8 Btu/hr (6.92×10^8 Btu/hr maximum for both units) (SCE&G 2010a).

Excess heat in the cooling water would be transferred to the atmosphere by evaporative and conductive cooling in the cooling tower. In addition to evaporative losses, a small percentage of water would be lost in the form of droplets (drift) from the cooling towers, potentially causing visible plumes. Water lost to evaporation and drift is considered consumptive use because the water is not available for reuse. As with water withdrawal, the normal case assumes the cooling towers are operating at four cycles of operation and the maximum case assumes two cycles of concentration. SCE&G provided the following consumptive use rates in the ER (SCE&G 2010a). The CWS normal and maximum evaporation rates would be 27,160 and 29,400 gpm, respectively. The SWS normal and maximum evaporation rates would be 480 and 1380 gpm, respectively. The drift rates of 13 gpm for the CWS and 1 gpm for the SWS would not change with the number of cycles of concentration (SCE&G 2010a).

3.4.2.3 Discharge Structure

CWS and SWS Cooling-Tower Blowdown

The cooling water that does not evaporate or drift from the towers would be routed back to the cooling-tower basin at the base of each tower. The closed-cycle cooling-water loop is completed when cooled water is pumped from the cooling-tower basins back to the condenser and heat exchangers. Evaporation of water from the cooling tower increases the concentration of dissolved solids in the cooling-water system. To limit the concentration of dissolved solids, a portion of the cooling water would be removed as blowdown and replaced with makeup water from Monticello Reservoir. Some waste heat would be removed from the cooling system with the blowdown water. The maximum blowdown water temperature was estimated to be 91.8°F (SCE&G 2010a). SCE&G estimated the normal CWS blowdown flow rate to be 9041 gpm (maximum 29,387 gpm) and the normal SWS blowdown flow rate to be 159 gpm (maximum 459 gpm).

The blowdown water from each cooling tower would collect in a basin at the base of the tower. Time spent in the basin allows for settling of suspended solids, and chemical treatment if required, prior to discharging to the blowdown sump and eventually to Parr Reservoir. SCE&G plans to maintain the chemical concentration factor for the CWS cooling tower between two and four cycles of concentration. As noted previously, the CWS would be operated at four cycles of concentration unless high suspended solids concentrations in Monticello Reservoir occurred. If suspended solids were elevated, two cycles of concentration would be used to prevent scale formation or deposition from degrading tower performance (SCE&G 2010a). The estimated mean and maximum concentrations of chemicals in blowdown from proposed VCSNS Units 2 and 3 are tabulated below the applicable State water-quality criteria in Table 3-4.

Other Plant Wastewater

Miscellaneous low-volume wastewater would flow from various equipment and floor drains to building sumps. Sumps in the turbine building and diesel fuel oil area would discharge wastewater to an oil separator to isolate waste oil from wastewater. The turbine building sumps would be monitored for radioactive material; if detected then wastewater would be routed to the liquid radioactive waste-processing system. The common discharge piping of the sump pumps would also be monitored for radioactive material. If radioactive material was detected in this piping, the monitor alarm would trip the sump pumps and retention-basin pumps to isolate radioactive wastewater. Under normal conditions, nonradioactive wastewater would be pumped to a wastewater retention basin and mixed with cooling-tower blowdown in the blowdown sump (Figure 3-10). SCE&G estimated the normal wastewater discharge rate from the wastewater retention basin to be 144 gpm (maximum 431 gpm) (SCE&G 2010a).

Table 3-4. Water Quality of Proposed Units 2 and 3 Blowdown Effluent

Category		Constituent Concentration (µg/L)													
		Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
South Carolina PQLs[(a)]		5	50	0.1	5	10	20	2	50	10	0.0005	10	5	5	10
South Carolina CMCs for freshwater aquatic life[(b)]		340	—	0.53	—	3.8	—	14.0	—	—	1.6	150	—	0.37	0.37
South Carolina MCLs[(b)]		10	2000	5	100	—	—	—	—	—	2	—	50	—	—
Mean and maximum values calculated from SCDHEC and SCE&G monitoring[(c,d)]	Mean	0	18	0.1	5.0	0	241	2.0	1856	8.9	0.0005	9.2	0	5.0	4.2
	Max	0	18	0.1	5.0	0	600	2.0	1856	21	0.0005	10	0	5.0	24
Four-cycle concentration in blowdown at point of discharge[(d)]	Mean	0	71	0.4	20	0	962	8.0	7424	36	0.002	37	0	20	17
	Max	0	71	0.4	20	0	2400	8.0	7424	84	0.002	40	0	20	96
Diluted blowdown effluent concentration at Broad River's 7Q10 flow[(d)]	Mean	0	19	0.1	5.5	0	264	2.2	2034	9.8	0.00055	10	0	5.5	4.6
	Max	0	19	0.1	5.5	0	657	2.2	2034	23	0.00055	11	0	5.5	26
Diluted blowdown effluent concentration at Broad River's annual mean flow[(d)]	Mean	0	18	0.1	5.0	0	244	2.0	1881	9.0	0.00051	9.3	0	5.1	4.3
	Max	0	18	0.1	5.1	0	608	2.0	1881	21	0.00051	10	0	5.1	24

Source: Adapted from SCE&G 2010a

PQL = practical quantitation limit; MCL = maximum contaminant level; CMC = criterion maximum concentration; 7Q10 = lowest flow for 7 consecutive days expected to occur once per decade; MDL = method detection limit

(a) South Carolina Department of Health and Environmental Control (SCDHEC) 2008a

(b) SCDHEC Water Classifications and Standards Regulation (R. 61-68), effective April 25, 2008 (SCDHEC 2008b)

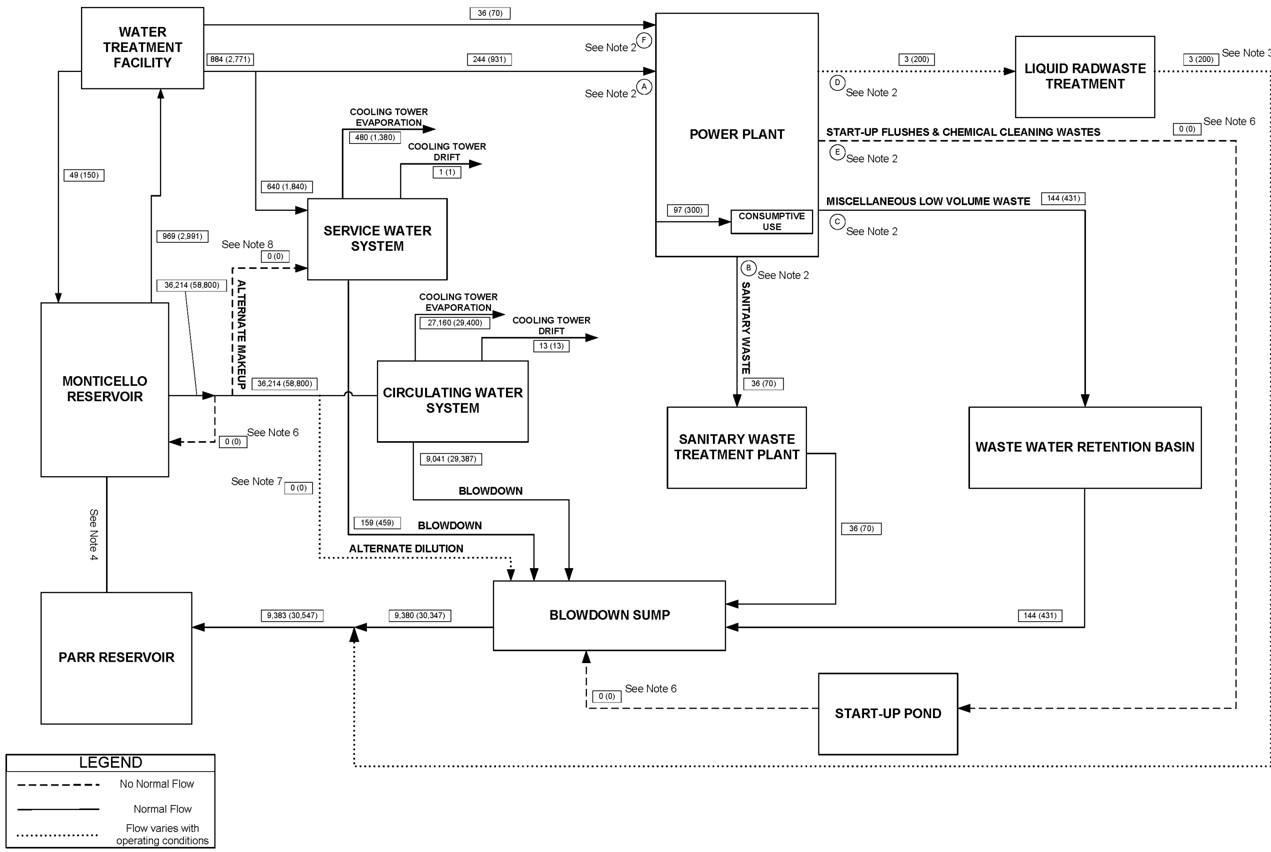
(c) Mean and maximum concentrations from SCDHEC monitoring at station B-327 (EPA 2006) and SCE&G monitoring of Monticello Reservoir (Table 2.3-32)

(d) A single analytical result with an MDL exceeding the applicable PQL was available for silver. SCE&G used a value for the incoming water concentration for sliver equal to the PQL of 5 µg/L. Although this value exceeds the relevant SCDHEC CMC, SCE&G does not believe the limited data for silver supports a conclusion that the water quality in Monticello Reservoir is degraded or that the blowdown effluent would degrade the water quality in Parr Reservoir. Future NPDES permit evaluations for the blowdown discharge would confirm protection of water quality.

Blowdown flow rate (normal) is 9383 gpm

Broad River at VCSNS 7Q10 382,800 gpm

Broad River annual mean flow at VCSNS 2,828,000 gpm



NOTES:

1. VALUES SHOWN AS XXX (XXX) ARE NORMAL (MAXIMUM) FLOW RATES IN GPM. THE FLOW RATE VALUES ARE FOR TWO AP1000 UNITS. FOR A FLOW STREAM SUMMARY AND ADDITIONAL NOTES, REFER TO THE PLANT WATER USE TABLE (TABLE 3.3-1).

2. THE WATER USE FOR THE POWER PLANT INTERNAL PROCESSES IS SHOWN ON FIGURE 3.3-2. SEE CORRESPONDING NODES (A THROUGH F) FOR STREAM INTERFACE POINTS.

3. THE SHORT TERM LIQUID WASTE DISCHARGE FLOW RATE MAY BE HIGHER. REGARDLESS, THE DISCHARGE RATE IS CONTROLLED TO BE COMPATIBLE WITH THE AVAILABLE DILUTION FLOW TO MAINTAIN THE EFFLUENT ACTIVITY LEVEL WITHIN REQUIRED LIMITS.

4. THE PARR RESERVOIR IS LOCATED ON THE BROAD RIVER. WATER IS TRANSFERRED BETWEEN THE MONTICELLO RESERVOIR AND THE PARR RESERVOIR VIA THE FAIRFIELD PUMPED STORAGE FACILITY.

5. ONLY RO/EDI WASTE STREAMS TO THE WASTE WATER SYSTEM ARE SHOWN. INTERNALLY RECYCLED STREAMS ARE NOT DEPICTED.

6. FLOW IS INTERMITTENT OR RECIRCULATED AND THEREFORE CONSIDERED ZERO.

7. FLOW VARIES AS REQUIRED TO ENSURE ADEQUATE DILUTION FOR LIQUID WASTE DISCHARGE WHEN BLOWDOWN FLOW IS NOT SUFFICIENT. FLOW RATE OF ALTERNATE DILUTION STREAM WHEN COMBINED WITH OTHER DISCHARGE STREAMS DOES NOT EXCEED MAXIMUM VALUE SHOWN FOR FINAL EFFLUENT DISCHARGE TO PARR RESERVOIR.

8. FLOW PATH PROVIDED FOR UNFILTERED RAW WATER FOR MAKEUP TO SERVICE WATER SYSTEM IS NOT NORMALLY USED.

Figure 3-10. Water-Use Summary Diagram (SCE&G 2009a)

The liquid radioactive waste-treatment system discharges to the blowdown pipeline downstream of the blowdown sump. SCE&G estimated the liquid radioactive waste-treatment system discharge flow rate to be approximately 3 gpm (maximum 200 gpm). However, the discharge flow rate would be adjusted to make sure radionuclide levels would be maintained below permitted discharge limits (SCE&G 2010a).

Sanitary Wastewater-Treatment Plant

The expected sanitary-system effluent flow rate is 36 gpm under normal operating conditions and 70 gpm maximum (SCE&G 2010a). Liquid effluent from the sanitary wastewater system would be discharged to the blowdown sump where it would be combined with cooling-tower blowdown water before being discharged to Parr Reservoir (Figure 3-10).

Sludge generated from the sanitary wastewater-treatment system would be disposed of in an approved manner, including shipment offsite or disposal at an approved onsite location. Nonradioactive waste management is described further in Section 3.4.4.

Water-Treatment Plant

The water-treatment plant that would provide treated water to other plant water systems (service, demineralized, potable, and fire protection water systems) would return 49 gpm of water to Monticello Reservoir under normal operating conditions and 150 gpm maximum (SCE&G 2010a). This effluent would discharge into the existing Unit 1 cooling-water discharge canal that discharges into Monticello Reservoir (Figure 3-1).

Stormwater-Management System

The stormwater-management system for proposed VCSNS Units 2 and 3 would be designed to direct runoff away from buildings via drainage ditches and swales to stormwater-retention basins. Water from the stormwater-retention basins (shown in Figure 3-5) would ultimately discharge to Mayo Creek to the east, an unnamed creek to the south, or an unnamed creek to the west. The two unnamed creeks flow into Parr Reservoir; Mayo Creek flows into the Broad River below Parr Shoals Dam. The design and operation of the stormwater systems for the proposed VCSNS Units 2 and 3 would comply with NPDES stormwater regulations administered by the SCDHEC.

3.4.2.4 Power Transmission System

As noted in Section 3.2.2.3, transmission lines and corridors are considered to interface with the environment during plant operation, because there are potential continuing impacts from electric fields, noise, and corridor maintenance. Corridor maintenance requires controlling woody vegetation and maintaining access roads. Both SCE&G and Santee Cooper have established procedures for transmission system inspection and for maintenance of transmission-line corridors using both chemical (U.S. Environmental Protection Agency [EPA]-registered herbicides) and mechanical (tree trimming, mowing, hand clearing) means of vegetation control (SCE&G 2009c, 2010a; Sott 2006; MACTEC 2008, Appendix B).

3.4.2.5 Emergency Diesel Generators

Proposed Units 2 and 3 would each have two 4000-kW standby generators and two 35-kW ancillary diesel generators. Emissions from these generators include particulates, sulfur oxides, carbon monoxide, hydrocarbons, nitrogen oxides, and carbon dioxide (SCE&G 2010a). When operated, the generators would produce gaseous emissions that would comply with all emissions standards, including EPA Tier 4 requirements governing diesel emissions being phased in over the 2009–2015 period. Gaseous releases would comply with levels permitted by the SCDHEC (SCE&G 2010a).

3.4.3 Radioactive Waste-Management System

Liquid, gaseous, and solid radioactive waste-management systems would be used to collect and treat the radioactive materials produced as byproducts of operating proposed Units 2 and 3. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as is 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"). The radioactive waste-management systems are not shared between the existing Unit 1 and proposed Units 2 and 3. Radioactive materials in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in AP1000s. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products would be contained in the sealed fuel rods, but small quantities could escape the fuel rods into the reactor coolant. Neutron activation of the primary coolant system would also add radionuclides to the coolant.

The Offsite Dose Calculation Manual (ODCM) for the VCSNS (SCE&G 2007) describes the methods and parameters used for calculating offsite radiological doses from liquid and gaseous effluents. The ODCM also describes the methodology for calculation of gaseous and liquid monitoring alarm/trip set points for release of effluents from VCSNS. Operational limits for releasing liquid and gaseous effluents are also specified in the ODCM to ensure compliance with NRC regulations.

The systems used to process liquid, gaseous, and solid wastes are described in the following sections. A more detailed description of these systems for proposed Units 2 and 3 can be found in Chapter 11 of the *AP1000 Design Control Document* (Westinghouse 2008). Solid radioactive wastes produced from operating proposed VCSNS Units 2 and 3 would be both dry and wet solids.

3.4.3.1 Liquid Radioactive Waste-Management System

The liquid radioactive waste-management system functions to control, collect, segregate, process, handle, store, and dispose of liquids containing radioactive material such that any discharged liquid effluents are below concentration levels specified in 10 CFR Part 20, Appendix B, Table 2 (Westinghouse 2008). The system uses several process trains consisting of tanks, pumps, ion exchangers, and filters and is designed to handle both normal and anticipated operational occurrences. Normal operations include processing of: (1) borated, reactor-grade waste water, (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.

Liquid waste is discharged in batches, with flow rates controlled during discharge to maintain acceptable concentrations when diluted by other nonradioactive liquid effluents, primarily cooling tower blowdown (SCE&G 2010a). The diluted liquid radioactive waste would be discharged into the blowdown discharge pipeline below the blowdown sump, and ultimately discharged to Parr Reservoir. The rate of discharge into the blowdown discharge pipeline is controlled and monitored to make sure the average annual effluent concentration limits from 10 CFR Part 20 are not exceeded. The calculated dose to the maximally exposed individual (MEI) from liquid effluents is evaluated in Section 5.9.2 of this EIS.

3.4.3.2 Gaseous Radioactive Waste-Management System

The gaseous radioactive waste-management system functions to collect, process, and discharge radioactive or hydrogen-bearing gaseous wastes. It is a once-through, ambient temperature, activated carbon delay system (Westinghouse 2008). Radioactive isotopes of iodine and the noble gases xenon and krypton are created as fission products within the fuel rods during operation. Some of these gases escape to the reactor coolant system through cladding defects and subsequently decay to stable isotopes and 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 containment during operation. The gaseous radioactive waste-management system is typically active only when monitored gaseous concentrations reach a given threshold. Waste gas flows through a guard bed that removes iodine, oxidizing chemicals, and moisture. From the guard bed it flows through two delay beds containing activated carbon that dynamically adsorbs and desorbs the gases, delaying them long enough for significant radioactive decay to occur. The gaseous system can only delay noble gases, not collect them. If noble gases monitored in the coolant reach a threshold value, then the reactor coolant is diverted to the liquid radioactive waste-management system where the noble gases can be collected using the degasifier.

Radioactive gaseous effluents from the system described above are discharged through the plant vent, which is on the side of the containment building about 183 ft above grade level (Westinghouse 2008). The rate of discharge into the atmosphere is controlled and monitored to verify that the average annual effluent concentration limits from 10 CFR Part 20 are not exceeded (SCE&G 2010a). The calculated dose to the MEI from gaseous effluents is evaluated in Section 5.9.2 of this EIS.

3.4.3.3 Solid Radioactive Waste Management System

The solid radioactive waste-management system functions to treat, temporarily store, package, and dispose of dry or wet solids. Solid radioactive wastes include spent ion-exchange resins, deep-bed filtration media, spent filter cartridges, dry active wastes, and mixed wastes. The system has a 60-year design objective and is designed to handle both normal and anticipated operational occurrences. The packaged wastes would be temporarily stored in the auxiliary and radwaste buildings prior to being shipped to a licensed disposal facility. The AP1000 solid waste-management system releases no gaseous or liquid effluent directly to the environment. This system discharges effluent through the liquid and gaseous waste-management systems.

The expected total annual volume of solid radioactive waste treated and shipped would be 1964 ft^3/yr from each unit with an expected total activity of radioactive material shipped from each unit of 1764 Ci/yr (SCE&G 2010a). The maximum total annual volume of solid radioactive waste shipped from each unit is estimated at 5717 ft^3/yr with a maximum total activity of radioactive material of 33,670 Ci/yr.

The storage and transportation of used reactor fuel is discussed in Chapter 6, Fuel Cycle, Transportation, and Decommissioning.

3.4.4 Nonradioactive Waste-Management Systems

The following sections provide descriptions of the nonradioactive waste systems proposed for VCSNS Units 2 and 3, including systems for chemical (including biocide), sanitary, and other effluents. All discharges to surface waters would be regulated by an NPDES permit that would limit the volume and constituent concentrations.

3.4.4.1 Effluents Containing Chemicals or Biocides

Water withdrawn from Monticello Reservoir for use in the CWS and the SWS would be treated with both biocides and other chemicals. The biocides would be used to control biofouling of the systems, and other chemicals would be added to control scaling, corrosion, and solids deposition (SCE&G 2010a). SCE&G estimated the amount, frequency of use, and concentrations of chemicals and biocides for proposed VCSNS Units 2 and 3 (Table 3-5). While some variation occurs in chemical treatment to meet particular water-use needs, plant effluents are required to be within regulated discharge limits (i.e., 40 CFR Part 423). Natural constituents in Monticello Reservoir in the vicinity of the VCSNS site are provided in Table 2-11. As described in Section 3.4.2, naturally occurring chemicals and trace minerals in the makeup water would be concentrated up to four times in the blowdown prior to discharge to Parr Reservoir (Table 3-4).

Table 3-5. Waste Stream Concentration of Water-Treatment Chemicals from Two Units

Chemical-Type / Specific	Frequency of Use	Concentration in Waste Stream
Biocide/sodium hypochlorite	1.5 hr/d	0.05 ppm residual chlorine
Algaecide/quaternary amine	Intermittent	<10 ppm
pH adjustment/sulfuric acid	Continuous	10 ppm
Corrosion Inhibitor/ortho-polyphosphate	Continuous	14.5 ppm
Silt dispersant/polyacrylate	Continuous	25 ppm
Scale inhibitor/phosphonate	Continuous	1.5 ppm
Coagulant/polyaluminum chloride	Intermittent	0.000042-0.00013 lb/gal
Anti-scalant/polyacrylate	Intermittent	150-450 ppm polyacrylate
Oxygen scavenging/hydrazine	2.5 hr/yr or 1.25 hr per shutdown	100 ppm hydrazine[(a)]
pH adjustment/ammonium hydroxide	20.7 hr/yr or 10.4 hr per shutdown	100 ppm ammonia[(a)]

Source: SCE&G 2010a
(a) If the steam generator is drained to the wastewater system.

3.4.4.2 Sanitary System Effluents

As described in Sections 3.2.2 and 3.4.2, a new sanitary wastewater-treatment plant would be installed to serve the operational needs of VCSNS Units 2 and 3. This plant would process sanitary water and waste to meet local and State regulations for effluent quality as specified in the NPDES permit (SCE&G 2010a). The sanitary wastewater-treatment plant would discharge 36 gpm of treated wastewater (70 gpm maximum) to the blowdown sump and thereafter to Parr Reservoir. Sludge from treatment plant holding tanks would be managed according to SCDHEC regulation, either by disposal in a landfill or onsite at a location approved by SCDHEC (SCE&G 2010a; SCDHEC 2009).

3.4.4.3 Other Effluents

The plant wastewater system is designed to manage liquid effluent streams that would contain pollutants from system flushing wastes during startup; oil, grease, and suspended solids from floor drains; corrosion and wear of plant piping and equipment; and liquid waste generated during maintenance or inspection activities. These waste streams would be collected in sumps, processed (e.g., through an oil separator), and discharged to a retention basin (normal plant wastewater) or pond (startup flushing) for settling of solids. Liquid from the retention basin (144 gpm normal, 431 gpm maximum) and startup pond (intermittent) would be pumped to the blowdown sump for discharge to Parr Reservoir (Figure 3-10).

The new water-treatment plant that would pretreat water for the SWS and other plant water systems would return 49 gpm water (150 gpm maximum) to Monticello Reservoir via the existing Unit 1 discharge canal (Figure 3-4, grid reference D2).

Nonradioactive solid wastes include typical solid waste (garbage, wood, paper, metal), and nonradioactive resins, filters, and sludge. SCE&G would recycle or recover scrap metal, aluminum, oil, antifreeze, batteries, cardboard, and paper. Nonradioactive resins would be disposed of in an industrial landfill. Oil and solids periodically collected from the wastewater processing system would also be shipped offsite for disposal. As noted above, sanitary treatment plant sludge would be applied at an SCDHEC-approved location onsite, or shipped offsite for disposal at a permitted facility (SCE&G 2010a).

Being classified as a large-quantity generator of hazardous waste, any such waste generated at the VCSNS site would be temporarily stored onsite and then disposed of offsite at a permitted facility (SCE&G 2010a). Hazardous wastes would be managed in compliance with Resource Conservation and Recovery Act and South Carolina Hazardous Waste Management Act requirements.

3.4.5 Summary of Resource Commitments During Operation

Table 3-6 provides a list of the significant resource commitments involved in operating Units 2 and 3. The values in the table, combined with the affected environment described in Chapter 2 of this EIS, provide a part of the basis for the operational impacts assessed in Chapter 5. These values were stated in the ER, and the review team has determined that the values are not unreasonable.

Table 3-6. Resource Commitments Associated with Units 2 and 3 Operation

Resource(s)	Value	Description
Hydrology-surface water, aquatic ecology	37,183 gpm (83 cfs)	Normal operational raw-water withdrawal from Monticello Reservoir, all cooling towers for both units operating at four cycles of concentration
	61,791 gpm (138 cfs)	Maximum operational water withdrawal from Monticello Reservoir, all cooling towers for both units operating at two cycles of concentration
Hydrology-surface water, meteorology-air quality	27,160 gpm (61 cfs)	Normal CWS evaporation rate
	29,400 gpm (66 cfs)	Maximum CWS evaporation rate
Meteorology-air quality, terrestrial ecology	13 gpm	Normal CWS drift rate
	13 gpm	Maximum CWS drift rate
Hydrology-surface water	27,751 gpm (62 cfs)	Normal consumptive water use (all systems combined)
	31,094 gpm (69 cfs)	Maximum consumptive water use (all systems combined)
Hydrology-surface water	9383 gpm (21 cfs)	Normal discharge flow rate to Parr Reservoir (all systems combined, 98 percent is blowdown)
	30,547 gpm (68 cfs)	Maximum discharge flow rate to Parr Reservoir (all systems combined, 98 percent is blowdown)
Hydrology-surface water, aquatic ecology	78.7°F 70.8°F to 86.6°F	Average blowdown temperature Range of modeled monthly blowdown temperatures
	91.8°F	Maximum blowdown temperature
Terrestrial ecology, meteorology-air quality	70 ft	CWS cooling-tower height
Terrestrial ecology	229 ft above plant grade	Tallest building height (shield building)
Socioeconomics	800 workers	Normal operating workforce for two units
	1000 workers	Additional workforce during periodic refueling outages lasting 3 to 5 weeks
Terrestrial ecology, nonradiological health, socioeconomics	71 dBA 55 dBA 55 dBA	CWS cooling-tower sound level at 200 ft CWS cooling-tower sound level at 1000 ft Diesel generators sound level at 1000 ft
Uranium fuel cycle, transportation, need for power	3400 MW(t)	Thermal power rating per unit
	1200 MW(e)	Gross electrical output per unit (87°F circulating water cold water temperature)
	93 MW(e)	Station load per unit
Uranium fuel cycle, transportation	93 percent	Expected annual capacity factor

3.5 References

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4.0 Construction Impacts at the VCSNS Site

This chapter examines the environmental issues associated with building the proposed nuclear reactor Units 2 and 3 at the Virgil C. Summer Nuclear Station (VCSNS) site as described in the application for combined construction permits and operating licenses (COLs) submitted to the U.S. Nuclear Regulatory Commission (NRC) by South Carolina Electric and Gas (SCE&G) (SCE&G 2008). As part of its application, SCE&G submitted an Environmental Report (ER) (SCE&G 2009a, 2010a), which discusses the environmental impacts of building, operating, and decommissioning proposed Units 2 and 3 and a Final Safety Analysis Report (SCE&G 2009b, 2010b), which addresses safety aspects of construction and operation.

In addition, SCE&G submitted the *Combined Application of South Carolina Electric and Gas Company for a Certificate of Environmental Compatibility and Public Convenience and Necessity and for a Base Load Review Order for the Construction and Operation of a Nuclear Facility in Jenkinsville, South Carolina*, to the Public Service Commission of South Carolina (PSCSC) on May 30, 2008. The final order provided by the PSCSC approving the combined application and Certificate of Environmental Compatibility and Public Convenience and Necessity (CPCN) was issued to SCE&G on March 2, 2009 (PSCSC 2009).

As discussed in Section 3.3 of this environmental impact statement (EIS), the NRC's authority related to building new nuclear generating units is limited to "activities that have a reasonable nexus to radiological health and safety and/or common defense and security" (72 FR 57416). Many of the activities required to build a nuclear power plant do not fall within the NRC's regulatory authority and, therefore, are not "construction" as defined by the NRC. Such activities are referred to as "preconstruction" activities in Title 10 of the Code of Federal Regulations (CFR) 51.45(c). The NRC staff evaluates the direct, indirect, and cumulative impacts of the construction activities that would be authorized with the issuance of a COL. The environmental effects of preconstruction activities (e.g., clearing and grading, excavation, and erection of support buildings) are included as part of this EIS in the evaluation of cumulative impacts.

As described in Section 1.1.3, the U.S. Army Corps of Engineers (USACE) is working as a cooperating agency on this EIS consistent with the Memorandum of Understanding (MOU) (USACE and NRC 2008). The NRC and USACE concluded that entering into a cooperative agreement on preparation of this EIS is the most effective and efficient use of Federal resources in the environmental review of impacts associated with building proposed Units 2 and 3 at the VCSNS site. The goal of this cooperative agreement is to develop one EIS that provides all of the environmental information and analyses needed by the NRC to make a license/permit decision and all of the information needed by the USACE to perform analyses, draw conclusions, and make a permit decision in the USACE's Record of Decision (ROD) documentation. To accomplish this goal, the environmental review described in this EIS was conducted by a joint NRC/USACE review team. The review team was composed of NRC staff, its contractor's staff, and USACE staff.

The information needed by the USACE includes information to perform (1) analyses to determine that the proposed action is the least environmentally damaging practicable alternative (LEDPA), and (2) its public interest assessment. To perform the public interest assessment, the USACE considers the following public interest factors: conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, and mineral needs.

Many of the impacts the USACE must address in its LEDPA analysis are the result of preconstruction activities. Also, most of the activities conducted by a COL applicant that would require a Department of the Army (DA) permit would be related to preconstruction. On March 2, 2010, SCE&G submitted an application to the USACE for a permit to conduct the following activities: filling, dredging, excavating, grading, removing or destroying vegetation, and building structures. The permit application was revised on December 16, 2010. A Public Notice advertising the revised application is being issued to coincide with the public availability of this EIS.

While both NRC and the USACE must meet the requirements of the National Environmental Policy Act of 1969, as amended (NEPA), both agencies also have additional requirements related to their permitting or licensing authorities. The NRC's regulatory authority is based on the Atomic Energy Act of 1954, as amended (42 USC 2011, et seq.). The USACE's regulatory authority related to the proposed action is based on Section 10 of the Rivers and Harbors Appropriations Act of 1899 (33 USC 403), which prohibits the obstruction or alteration of navigable waters of the United States without a permit from the USACE, and Section 404 of the Clean Water Act (33 USC 1251, et seq), which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE. Therefore, an applicant may not commence preconstruction or construction activities in jurisdictional waters, including wetlands, without a DA permit. The permit would typically be issued after the USACE's evaluation and public feedback in the form of public comments on its environmental review. Because the USACE is a cooperating agency under the MOU for this EIS, the USACE's ROD of whether to issue a permit will not be made until after public comment on the revised USACE permit application has been received and considered.

The collaborative effort of the NRC and the USACE in presenting their discussion of the environmental effects of building the proposed project, in this chapter and elsewhere, must serve the needs of both agencies. Consistent with the MOU, the staff of the NRC and the USACE collaborated in: (1) the review of the COL application and information provided in response to requests for additional information (developed by the NRC and the USACE) and (2) the development of the EIS. NRC regulations (10 CFR 51.45(c)) require that the impacts of preconstruction activities be addressed by the applicant as cumulative impacts in its ER. Similarly, the NRC's analysis of the environmental effects of preconstruction activities on each resource area would be addressed as cumulative impacts, normally presented in Chapter 7. However, because of the collaborative effort between the NRC and the USACE in this environmental review, the combined impacts of construction activities that would be authorized by the NRC with its issuance of a COL and the preconstruction activities are presented in this chapter. For each resource area, the NRC also provides an impact characterization solely for construction activities that meet the NRC's definition of construction at 10 CFR 50.10(a). Thereafter, both the assessment of the impacts of 10 CFR 50.10(a) construction activities and the assessment of the combined impacts of construction and preconstruction activities are used in the description and assessment of cumulative impacts in Chapter 7 of this EIS.

In addition to guidance provided in NUREG-1555, Environmental Standard Review Plan (NRC2000), staff used guidance provided in NRC Staff Memorandum Addressing Construction and Preconstruction Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues In Environmental Impact Statements (NRC 2010) to address preconstruction and construction activities and impacts (NRC 2010c). For most environmental resource areas (e.g., aquatic ecology), the impacts are not the result of either solely preconstruction or solely construction activities. Rather, the impacts are attributable to a combination of preconstruction and construction activities. For most resource areas, the majority of the impacts would occur as a result of preconstruction activities.

This chapter is divided into 13 sections. In Sections 4.1 through 4.8 and Section 4.10, the review team evaluates the potential impacts on land use, meteorology and air quality, water use and quality, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, nonradiological health effects, and nonradioactive waste. In Section 4.9, the NRC staff assesses the potential radiological health impacts to construction workers. An impact category level – SMALL, MODERATE or LARGE – of potential adverse impacts has been assigned by the review team for each resource area using the definitions for these terms established in Chapter 1. In some resource areas, for example, in the socioeconomic area where the impacts of taxes are analyzed, the impacts may be considered beneficial and would be stated as such. The review team's determination of the impact category levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades (discussed throughout this chapter), are implemented. Failure to implement these upgrades might result in a change in the impact category level. Possible mitigation of adverse impacts, where appropriate, is presented in Section 4.11. A summary of the construction impacts is presented in Section 4.12. Citations for the references cited in this chapter are listed in Section 4.13. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 7, 9, and 10 of this EIS.

The review team's evaluation of the impacts of construction of proposed VCSNS Units 2 and 3 draws on information presented in SCE&G's ER, supplemental documents, the USACE's permitting documentation, as well as other government and independent sources.

4.1 Land-Use Impacts

This section provides information about the land-use impacts associated with site-preparation activities and building of Units 2 and 3 at the VCSNS site. Topics discussed include land-use impacts at the site and in the vicinity of the site and land-use impacts within transmission-line corridors and on offsite areas.

4.1.1 The Site and Vicinity

VCSNS Units 2 and 3 would be located southwest of the existing Unit 1 on the VCSNS site. The VCSNS site encompasses about 3600 ac of land and water entirely owned by SCE&G. The review team estimates that roughly 556 ac at the site would be required for the new units, including all laydown areas and support functions, which would include onsite transmission-line improvements. Additional land disturbance would occur to install a new cooling-water makeup pipeline between VCSNS Units 2 and 3 and Monticello Reservoir. The location of Units 2 and 3 and supporting facilities is not classified as prime farmland. The site is not used as agricultural land or for mineral extraction, but is actively managed for forestry.

Impacts on specific land cover are reflected in the terrestrial habitat loss information presented in Section 4.3.1. Most of these losses consist of planted pine forest, including recently harvested planted pine forest, naturally vegetated pine forest, mixed pine-hardwood forest, and hardwood forest.

Based on SCE&G's ER and updated transmission-line information (SCE&G 2010a; Pike 2010) and the review team's characterization of site development activities in Section 3.3 of this EIS, the review team believes the following major activities would cause land-use impacts on the VCSNS site and in the vicinity:

- Approximately 290 ac would be permanently altered on the site to build VCSNS Units 2 and 3 and associated infrastructure. This would include all excavation, trenching, and dredging for new intake and blowdown pipelines and the new water-treatment facility. It also would include clearing land for the new switchyard (48 ac) and onsite transmission-line corridors to link the new switchyard to the Unit 1 switchyard and to provide corridors for lines exiting the VCSNS site (51 ac).

- Approximately 180 ac within the plant site would be altered for temporary laydown and spoils storage. This area would include the concrete batch plant, spoils deposition areas, and temporary site support areas.
- A new 1.5-mi, four-lane, paved, main access road would link Parr Road with the VCSNS Units 2 and 3 site, requiring approximately 18 ac on the site in addition to the affected areas above.
- A new 1.5-mi improved access road would link the Units 2 and 3 cooling-tower area to an intake structure at Monticello Reservoir, affecting about 3 ac of land on the site.
- Parr Road and South Lake Access Road would be upgraded to accommodate increased traffic, and approximately 3/4 mi of the South Lake Access Road would be relocated to run parallel to and east of the existing railroad spur into the site, terminating at the VCSNS Units 2 and 3 discharge structure. About 2 ac of land on the site would be affected to accommodate the upgrading.
- The existing railroad line would be rerouted through a fabrication and laydown area between the new units and the cooling towers, and would be supplemented with an additional railroad spur. A new spur also may be routed into the unloading areas at the concrete batch plant. Norfolk Southern Railway's existing railroad line also may require upgrades to support the heaviest loads. Upgrades may include installing new ballast or rail sections on the existing railroad bed, both on and off of the site. The review team expects these impacts to occur within the footprints described above.
- Dredging in Parr Reservoir (off of the site) would be required to establish the blowdown discharge for VCSNS Units 2 and 3. Dredge spoils would be disposed of in the onsite spoils disposal area about 0.5 mi east of the river (see Figure 3-4 and Figure 4-1). Acreage used for this spoils disposal area is counted in the acreage reported for laydown and spoils storage.
- Miscellaneous disturbance of as much as 60 additional acres on the site.

Approximately 0.66 ac of wetlands on the VCSNS site would be affected by developing the proposed new units and associated infrastructure. Wetland impacts are discussed in greater detail in Section 4.3.1.

Land-clearing activities would be mitigated to the extent possible. SCE&G would use best management practices (BMPs) during site development and would conform to all applicable laws and regulations. Examples of expected mitigation activities include wetland avoidance, use of stormwater-management systems, and implementation of spill containment controls before earth-disturbing activities begin. Site-development activities that would affect land use include clearing, grubbing, grading and excavating, and stockpiling soils. Re-vegetation would comply with site maintenance and safety requirements. Permanently disturbed locations would be stabilized and contoured in accordance with design specifications. Methods to stabilize areas and prevent

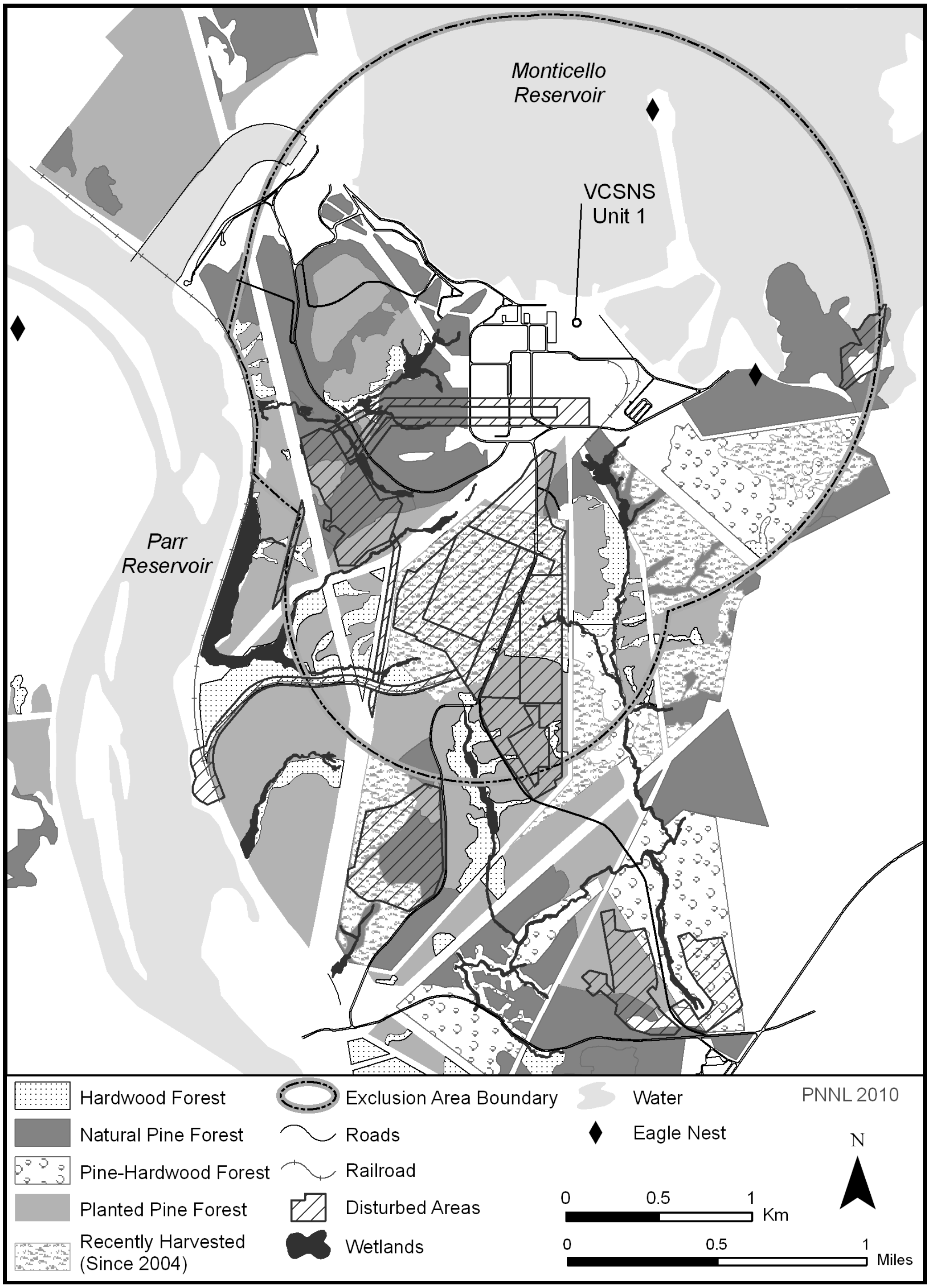

Figure 4-1. Habitats and Areas that Would Be Disturbed by the Development of the VCSNS Site

erosion or sedimentation would comply with accepted engineering, construction practices, and recognized environmental BMPs (SCE&G 2010a).

Based on information provided by SCE&G and the review team's independent evaluation, the review team recognizes that land-use changes on the VCSNS site would be substantial and notes several planned mitigation activities SCE&G would implement to lessen impacts.

New land-use impacts on the site were viewed by the review team in the context of the previous significant impacts from building Unit 1. The site has already been significantly altered by that development and the associated operations (timber harvesting, etc.), and the development of the site is consistent with current zoning ordinances, as described in Section 2.2.1. Therefore, the review team concludes that land-use impacts of the proposed action on the site and vicinity would be SMALL, and additional mitigation would not be warranted.

4.1.2 Transmission-Line Corridors and Other Offsite Areas

In its application for the two COLs, SCE&G proposed to build and operate two units at the VCSNS site, each with a rated net electrical output capacity of 1107 MW(e). As discussed in Section 2.2.2 of this EIS, the VCSNS site is connected to the regional power grid via existing 230-kV transmission lines (see Figure 2-4). As illustrated in Figure 2-5, six new 230-kV transmission lines (four single-circuit lines and one SCE&G double circuit line) are planned to connect VCSNS Units 2 and 3 to the grid. Two of these lines would be owned by Santee-Cooper (the State-owned electric and water utility, formally called the South Carolina Public Service Authority) and routed almost entirely within existing transmission-line corridors (MACTEC 2009). The existing corridors and transmission lines were originally built to support the operation of VCSNS Unit 1. The other four lines would be owned by SCE&G. The precise routing of the SCE&G lines has not been determined, but the review team believes the corridors identified in Figure 2-5 are representative of the eventual routing.

The PSCSC requires any jurisdictional utility (this applies to SCE&G but not Santee Cooper) proposing to build "major facilities," including transmission lines of 125 kV or more, to apply for a CPCN. PSCSC's rules are found in Title 58, Chapter 33, of the South Carolina Code of Laws (SC Code Ann. 58-33). An applicant for a CPCN must provide PSCSC with "a summary of any studies that have been made by or for applicant of the environmental impact of the facility …." The PSCSC may not grant a CPCN for the installation, operation, and maintenance of a major utility facility unless the applicant has adequately defined "the nature of the probable environmental impact" (SC Code Ann. 58-33-160(1)) and has determined that the impact on the environment is "…justified, considering the state of available technology and the nature and economics of the various alternatives" under consideration.

According to SCE&G, once the need for additional generating capacity has been demonstrated, and the size and location of generating units have been determined, SCE&G analyzes transmission system requirements (SCE&G 2010a). Once the utility determines desired grid termination and connection points, it initiates the siting process to develop transmission-line corridors. SCE&G completed an initial siting study (FP&S 2008), identifying conceptual transmission lines, which the review team relied upon for the draft EIS. Subsequently, they completed a second study (Pike 2010) of the precise routing expected to be required to connect Units 2 and 3 to the grid.

The review team expects that SCE&G transmission-line corridors planned to connect VCSNS Units 2 and 3 to the grid would require State certification, but the Santee Cooper lines would not require certification (SCE&G 2010a). Although the review team recognizes that State certification would not apply to Santee Cooper's proposed transmission system improvements, in siting the new transmission-line corridors, Santee Cooper would consult with the South Carolina State Historic Preservation Office (SHPO), the U.S. Fish and Wildlife Service (FWS), and the South Carolina Department of Natural Resources (SCDNR), and apply for a required permit. Santee Cooper's transmission lines have been included in the single comprehensive Federal permit application revised by SCE&G on December 16, 2010.

In siting new transmission lines, SCE&G has indicated a number of areas to be avoided in the transmission-line siting process, if possible, including buildings, mines, airports, military facilities, parks, and wetlands. For any wetlands that are encountered, installation of transmission lines would be conducted in accordance with necessary State and Federal regulations to protect wetland areas.

The SCE&G transmission-line siting process relied on public involvement in the early stages of the search for viable corridors (SCE&G 2010a). The public provided recommendations to SCE&G to help narrow the number candidate routes for potential corridors. A second public review of potential routes provided input to SCE&G to further refine the proposed corridors. The established siting process and State certification process help ensure that environmental factors are addressed in addition to engineering and cost factors. Although Santee Cooper is not subject to the same State regulations as SCE&G, it followed a similar process for siting new transmission facilities (SCE&G 2010a).

SCE&G characterized the planned routes of the six new transmission lines as follows (SCE&G 2010c):

1. VCSNS-Killian – This SCE&G line would be routed to the vicinity of Winnsboro, South Carolina, and then generally follow the Interstate 77 (I-77) corridor to connect to the existing Killian substation near Killian, South Carolina, southeast of the VCSNS and northeast of Columbia, South Carolina. Of the 37 mi length, all but the final 6 mi of this line would be routed within existing SCE&G corridors. New corridor is planned for the final 6 mi of the line, between Blythewood and Killian (SCE&G 2010c). Most of the new corridor would be located immediately adjacent to other existing rights-of-way such as roads or other utilities.

2. VCSNS-Flat Creek – This Santee Cooper line would connect to the existing Winnsboro substation near Winnsboro, South Carolina, then to the existing Richburg switching station near Great Falls, South Carolina, and finally to the existing Flat Creek substation west of Lancaster, South Carolina, running about 72 mi in length (SCE&G 2010c). About 17 mi of new corridor running immediately adjacent to the existing corridor would be required (MACTEC 2009).

3. VCSNS-Lake Murray No. 2 – This SCE&G line would connect to the existing Lake Murray switchyard for the McMeekin and Saluda Hydro stations near the eastern boundary of Lake Murray. About 22 mi of new line would be built within the existing Parr Hydro-Chapin and Saluda Hydro-Newberry corridors, and would be co-located with the proposed St. George 2 line (SCE&G 2010c).

4/5. VCSNS-St. George No. 1 and 2 – These SCE&G lines originate at the proposed VCSNS Units 2 and 3 switchyard and run generally south to a proposed new substation near St. George, South Carolina. The St. George No. 1 line would share the existing Parr Hydro-Chapin and Saluda Hydro-Newberry corridors with the new SCE&G Lake Murray No. 2 line to the Lake Murray substation near the eastern shore of Lake Murray. The St. George No. 2 line would run parallel with the existing Lake Murray No. 1 line from VCSNS Units 2 and 3 switchyard to the Lake Murray substation. The St. George No. 1 and 2 lines would intersect near the Lake Murray substation and run in a common corridor through existing rights-of-way to a proposed substation near St. George, South Carolina (Pike 2010). These transmission lines would require approximately 98 mi of corridor (SCE&G 2010c).

6. VCSNS-Varnville – This 167-mi Santee Cooper line would connect to the existing Pomaria substation, then to Sandy Run substation near Sandy Run, then to Orangeburg substation in Orangeburg, South Carolina, then to the proposed Byrds substation near St. George, and finally to the existing Varnville substation near Varnville, Hampton County, South Carolina (SCE&G 2010c). About 22 mi of new corridor running immediately adjacent to the existing corridor and about 0.5 mi of entirely new corridor would be required (MACTEC 2009).

The expected land-use impacts associated with these corridors are given in Table 4-1. For land-use impact analysis, the review team performed its own analysis of the affected acreage, based on geographic information system (GIS) data provided by the applicant (SCE&G 2010e, h). The review team used the specific GIS-based routes to determine what acreage would be affected, based on land-use and land-cover data from the U.S. Geological Survey (USGS 2001). The review team's analysis indicates that as much as 2445 ac of land may require vegetation clearing to develop the transmission system for VCSNS Units 2 and 3. Several factors offset this impact. All but 6.5 mi of the proposed corridors requiring some corridor expansion would be located immediately adjacent to an existing transmission-line corridor or other utility corridor. Of the expected 392 mi of new transmission-line corridors, over

346 mi would be placed within existing transmission-line corridors and not further fragment forest cover or other existing land uses. Corridors crossing agricultural areas would not remove affected land from agricultural production, although areas in the expected corridors currently used as tree farms that might be affected by corridor expansion activities may be converted to other agricultural production.

Table 4-1. Land-Use Impacts of the Proposed New Transmission-Line Corridors

Corridor Name	Termination Point	Total Corridor Length (mi)	Length Utilizing Existing Corridor (mi)	Length Requiring Expansion of Existing Corridor (mi)	Length Requiring New Corridor (mi)	Corridor width (ft)	Land-Use Impact (ac)
VCSNS-Killian	Killian Substation	37	31	0	6	120	365
VCSNS-Lake Murray No. 2 and VCSNS-St. George No. 1 common corridor	Lake Murray Switchyard	22	22	0	0	100	281
VCSNS-St. George No. 2 (between VCSNS site and common corridor with VCSNS-St. George No. 1)	Junction with St. George No.1 corridor	18	18	0	0	100	238
VCSNS-St. George No. 1 and No. 2 common corridor (Lake Murray to St. George substation)	St. George Substation (proposed)	76[(a)]	76	0	0	100	1186
VCSNS-Flat Creek	Flat Creek Substation	72	55	17	0	50-85	161
VCSNS-Varnville	Varnville Substation	167	144	22	0.5	50-125	214
Totals		392	346	39	6.5		2445

Sources: SCE&G 2010a, e, h; MACTEC 2009; Pike 2010. Totals are affected by rounding. Acreages are estimated, based on GIS data provided by SCE&G. Where no corridor-width data were available, the review team estimated uniform 100-ft corridor widths for consistency.

Table 4-1 indicates that land disturbance to install transmission lines would affect 2445 ac. Acreage impacts associated with using existing SCE&G corridors would result from re-clearing previously cleared corridors or portions of existing rights-of-way that were never cleared as part of previous transmission-line installations. Table 4-2 illustrates the expected impact of clearing corridors through recently expanded or entirely new segments right-of-way. Table 4-2 indicates that of the 2445 ac of land-use impacts expected from transmission-line installation, 426 ac would occur in entirely new or expanded corridor segments.

Table 4-2. Detailed Land-Use Impacts of New/Expanded Corridors

	Killian New Segment		Flat Creek New Segment		Varnville New Segment		Total New/ Expanded Corridor	
Land Use/Land Cover	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Fresh water	0.27	0.52	3.30	2.05	0.51	0.24	4.07	0.96
Marsh/emergent wetland	0.00	0.00	0.00	0.00	0.38	0.18	0.38	0.09
Swamp	0.03	0.06	0.00	0.00	1.94	0.91	1.97	0.46
Bottomland/floodplain forest	5.22	10.23	7.46	4.63	8.72	4.07	21.40	5.02
Wet scrub/shrub thicket	0.30	0.58	1.47	0.91	8.76	4.09	10.52	2.47
Dry scrub/shrub thicket	4.30	8.42	12.75	7.92	22.24	10.39	39.28	9.22
Open canopy/recently cleared forest	10.54	20.66	42.77	26.56	70.06	32.74	123.37	28.96
Closed canopy evergreen forest/woodland	4.64	9.09	22.25	13.82	12.57	5.87	39.46	9.26
Needle-leaved evergreen mixed forest/woodland	9.60	18.83	15.18	9.43	16.72	7.81	41.50	9.74
Pine woodland	0.00	0.00	0.39	0.24	0.00	0.00	0.39	0.09
Dry deciduous forest/woodland	4.52	8.86	0.00	0.00	0.46	0.22	4.98	1.17
Mesic deciduous forest/woodland	3.11	6.09	21.31	13.23	17.52	8.19	41.93	9.84
Dry mixed forest/woodland	0.19	0.38	0.00	0.00	0.08	0.04	0.28	0.07
Mesic mixed forest/woodland	0.00	0.00	0.26	0.16	2.17	1.01	2.43	0.57
Grassland/pasture	1.62	3.18	23.79	14.78	7.01	3.28	32.43	7.61
Cultivated land	1.89	3.70	7.12	4.42	44.86	20.96	53.86	12.64
Urban development	3.06	6.00	1.86	1.15	0.00	0.00	4.92	1.16
Urban residential	1.72	3.38	1.10	0.68	0.00	0.00	2.82	0.66
Total Acreage	51.0	100.00	161.0	100.00	214.0	100.00	426.0	100.00

Sources: SCE&G 2010a, e, h; MACTEC 2009; Pike 2010. Totals are affected by rounding. Acreages are estimated by the review team based on GIS data provided by SCE&G. Where no corridor-width data were available, the review team estimated uniform 100-ft corridor widths for consistency.

The most substantial land-use impacts would occur as a result of siting over 45 mi of entirely new or expanded transmission-line corridors in portions of the VCSNS-Killian, VCSNS-Varnville and VCSNS-Flat Creek corridors. The majority of these new portions would be adjacent to currently existing corridors. Clearing these new corridors would noticeably alter existing land uses on about 426 ac as current uses are converted to utility corridor use. The review team estimates, based analysis of GIS data supplied by the applicant (SCE&G 2010e, h), that about 204 ac of forested land, some of which is currently devoted to silviculture production, would be cleared and converted to utility use or compatible agricultural use. Minimal plots of land would be removed from agricultural production where new transmission towers would be sited. Land-clearing and transmission-line installation activities in the corridors would follow BMPs and forest clearing in wetlands would be mitigated to the extent required by the USACE. For example, agricultural access would not be precluded during the growing season.

Information about roads, housing, and indirect infrastructure impacts appears in Section 4.4 of this EIS. No impacts on offsite land uses (outside of the transmission-line corridors) are expected to result from the proposed action.

Based on information provided by SCE&G and the review team's independent review, the review team concludes that because installation of new transmission lines in 392 mi of corridor would require reconstruction of existing corridors and would convert land cover on about 2445 ac of land (1171 ac of forested land), these impacts would be locally noticeable to the general public. The new corridors have been sited in existing corridors or adjacent to existing corridors to the extent practicable. Therefore, the review team concludes the land-use impacts of transmission-line installation would be MODERATE, but additional mitigation beyond the applicant's commitments to use BMPs would not be warranted.

4.1.3 Summary of Land-Use Impacts During Construction and Preconstruction

The review team evaluated the construction and preconstruction activities related to building proposed VCSNS Units 2 and 3 and the potential land-use impacts at the site and vicinity, in the region, and in the potential transmission-line corridors. The review team determined that, because of the large amount of land owned by SCE&G at the VCSNS site and consistency with local zoning regulations, the land-use impacts of the proposed action would be SMALL at the site and in the vicinity, but MODERATE for proposed transmission-line corridors, because of the additional land required. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities and do not include transmission-line installation activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL. The NRC staff concludes that no further mitigation measures beyond SCE&G's commitments and mitigation required by the USACE would be warranted.

4.2 Water-Related Impacts

Water-related impacts involved in building a nuclear power plant are similar to impacts that would be associated with the development of any large industrial site, and not much different than those seen while building VCSNS Unit 1. Prior to initiating onsite activities, including any site-preparation work, SCE&G would be required to obtain the appropriate authorizations regulating alterations to the hydrologic environment. These authorizations would likely include the following:

- Permit pursuant to both Section 10 of Rivers and Harbors Appropriations Act of 1899 and Section 404 of the Clean Water Act issued by the Department of the Army
- Clean Water Act Section 401 Certification by the South Carolina Department of Health and Environmental Control (SCDHEC)
- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) and Industrial Stormwater Permits issued by SCDHEC
- Water and Sewer Connection Permits typically issued by a city, county or municipal district.

Hydrologic alterations are discussed in Section 4.2.1; water-use impacts are discussed in Section 4.2.2; water-quality impacts are discussed in Section 4.2.3; and water monitoring is discussed in Section 4.2.4. This section draws from material presented in SCE&G's ER (SCE&G 2010a).

4.2.1 Hydrologic Alterations

Activities associated with building the proposed VCSNS Units 2 and 3 would affect several bodies of surface water and the aquifers underlying the site. Affected bodies of surface water include Monticello Reservoir, Parr Reservoir, Mayo Creek, and the Broad River below Parr Shoals Dam. Building VCSNS Units 2 and 3 would require dredging for the installation of the blowdown discharge diffuser in Parr Reservoir and excavation and/or dredging for installation of the new intake structures for the circulating-water system and water-treatment plant on Monticello Reservoir. Other activities would require alteration of the land surface in the vicinity of the new units. The surface would be contoured to include surface-water drainage ditches and three stormwater-retention ponds to handle stormwater flows and allow suspended solids to settle prior to discharge to a waterbody. Other hydrologic alterations include clearing and grading for the new and upgraded roadways and for modifications to the railroad line (widening existing railroad line, rerouting, and adding a railroad spur). The railroad line to be widened is adjacent to a seasonal stream. The new main access road would cross Mayo Creek about 1 mi north of the main facility entrance. These land surface modifications would alter surface-water runoff flow patterns and would alter the infiltration properties of the land surface.

Intake structure sites on Monticello Reservoir would be dewatered with submersible pumps installed inside cofferdams. A well-point dewatering system may also be used to maintain a dry environment to allow for fabrication of each intake structure once excavation is completed. SCE&G plans to return this water to the reservoir via discharge behind a turbidity curtain. A turbidity curtain is a floating barrier of geotextile material designed to deflect and contain sediment within a limited area minimizing sediment transport within a body of water. SCE&G also indicated that dewatering activities to support open excavation, sheet-pile installation, or behind cofferdams may generate water that could be routed to a settlement basin (SCE&G 2010a).

Construction Impacts at the VC Summer Site

Hydrologic alterations to offsite surface waterbodies could occur during installation of the proposed new transmission lines discussed in Section 4.1.2. No surface water or groundwater would be used in the installation of these lines. Although the exact routes are not yet determined, proposed locations indicate the lines would cross numerous waterbodies and wetlands. BMPs would be applied for erosion and sedimentation control (SCE&G 2010a).

Onsite groundwater would not be used during construction and preconstruction activities for the proposed units, but it would be affected as a result of those activities. Conditions and activities that could affect groundwater levels and alter groundwater flow around VCSNS Units 2 and 3 include the following: site grading that includes in-filling to the east of the site for cooling towers, changes in the hydraulic properties of the site due to emplacement of fill (structural and common fill), changes in recharge due to impervious surfaces and stormwater basins, and dewatering during excavation (SCE&G 2009c). As described in Section 2.3.1.2 of this EIS, the site is located on a hilltop where, due to the location of the site within the Piedmont Physiographic Province, the water table forms a subdued reflection of the topography, resulting in a groundwater divide beneath the proposed Units 2 and 3 locations. Site grading, the decrease in groundwater infiltration and recharge through impervious surfaces, and routing of runoff to stormwater basins would alter the groundwater flow locally around the hilltop but would not affect the broader groundwater flow in the area, particularly on the other side of surrounding surface waterbodies. Excavation dewatering would lower the water-table elevation locally and reduce the hydrostatic pressures in the deeper bedrock aquifer. The impacts of excavation dewatering are discussed more fully in Section 4.2.2.2, but the low aquifer yields in the area and large distance to water-supply wells minimize the impact of this temporary groundwater alteration.

Offsite impacts on groundwater from activities on the hilltop around VCSNS Units 2 and 3 would be limited by the influence of local bodies of surface water along the project boundaries (Mayo Creek, Broad River, Parr Reservoir, and Monticello Reservoir). Alterations from excavation dewatering would be temporary with the aquifers recovering after pumping has stopped. Water from the powerblock excavations would be pumped to the stormwater-management system (SCE&G 2010a). Within this system, water would be routed to settlement basins before being discharged through an NDPES-permitted outfall.

In summary, the hydrologic alterations associated with construction and preconstruction activities on and in the vicinity of the VCSNS site would be limited to dredging for the intake and discharge structures, altering the surface topography, changes to runoff and infiltration characteristics (e.g., site grading, laydown yards, stormwater-collection trenches and basins), and dewatering the excavations for the nuclear island, intake structures, and discharge structures. Offsite hydrologic alterations are associated with the proposed new or expanded transmission-line corridors where they cross wetlands or surface waters. The impacts of hydrologic alterations resulting from both onsite and offsite activities would be localized and temporary, and the required permits, certifications, and stormwater pollution prevention plan (SWPPP) call for the implementation of BMPs to minimize impacts.

4.2.2 Water-Use Impacts

The impacts of building a nuclear power plant on water use are similar to impacts that would be associated with the development of any large industrial site. This section includes identification of the proposed activities associated with building VCSNS Units 2 and 3 that could affect water use, and analysis and evaluation of proposed practices to minimize adverse impacts on water use by these activities. The impacts on the use of surface water and groundwater are discussed in Sections 4.2.2.1 and 4.2.2.2, respectively. Information in this section is drawn from the ER and supplemental information provided by SCE&G (2009b, 2010a).

4.2.2.1 Impacts on Surface-Water Use

Monticello Reservoir would supply water for construction and preconstruction activities for VCSNS Units 2 and 3. Water needs for building activities at the site would be similar to typical uses of water for large industrial projects. These uses include dust abatement, concrete mixing, and potable water needs. Peak water needs during preconstruction and construction activities are estimated to be 420 gpm (approximately 1 cfs) SCE&G (2010a). Assuming complete consumptive use, the peak withdrawal represents less than 1 percent of the 7Q10 (lowest flow for 7 consecutive days expected to occur once per decade) flow of 853 cfs estimated for Broad River at the Alston gauging station (SCE&G 2010a). The 7Q10 flow is used to assess the impacts of alteration on flow during low-flow periods. Federal Energy Regulatory Commission (FERC) approval is required for the withdrawal for cooling water by additional power plants.

Until the proposed water-treatment plant is completed, water needed during construction and preconstruction activities would be supplied by the Jenkinsville Water Company. The Jenkinsville Water Company is a public source with enough excess capacity to meet the site's needs (SCE&G 2010a). In addition to groundwater wells in Fairfield County, the water company also purchases water from other nearby water systems including the Town of Winnsboro. The Town of Winnsboro has significant excess capacity from surface-water sources (more than 1 million gpd) (SCE&G 2010a; SCDNR 2005).

The impacts on surface water would be of limited duration. Peak water demands would represent a small portion of the available water. Based on the information provided by SCE&G and the above observations from the review team's independent evaluation, the review team concludes that the impacts on surface water use during construction and preconstruction activities for the proposed VCSNS Units 2 and 3 would be SMALL, and no mitigation would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of

NRC-authorized construction activities would be SMALL, and no mitigation measures would be warranted.

4.2.2.2 Impacts on Groundwater Use

SCE&G stated "[t]here are no plans to use local groundwater for construction or operations of VCSNS Units 2 and 3. Construction of Units 2 and 3 power blocks requires temporary dewatering of the power block area" (SCE&G 2009c). However, "[c]urrently the dewatering plans the EPC [Engineer, Procure, and Construct] contractor is developing are conceptual and details on rates, durations, and discharge locations are still being established" (SCE&G 2009d). Due to the low hydraulic conductivity of the subsurface materials at the site (as described in Section 2.3.1.2 of this EIS), the review team determined that the excavation dewatering would be temporary and localized with minimal offsite impact.

As stated in Section 2.3.2.2 of this EIS, currently the closest water-supply well to the site is at a private residence approximately 1 mi east of the site (SCE&G 2010a). The nearest groups of wells, used for residences and stores, are located 1.5 mi east of the site and 2.5 mi southeast of the site (SCE&G 2010a). The closest location at which a water-supply well could be installed near the facility is on the nearest site boundary approximately 0.75 mi to the southeast (SCE&G 2009c). As discussed in Sections 2.3.1.2 and 2.3.2.2, groundwater well yields, both regionally and locally, are generally less than 30 gpm.

As mentioned in the previous section, until the proposed water-treatment plant is completed, water needed during construction and preconstruction would also be supplied by the Jenkinsville Water Company which utilizes groundwater wells in Fairfield County and purchases water from nearby water systems using mainly surface water. The review team acknowledges that a portion of water supplied to VCSNS until the treatment plant is constructed could be provided from groundwater pumped by one or more of the regional water supply utilities. However, even if the entire water supply came from groundwater, the groundwater use would only occur until the water treatment plant was completed and would not exceed the existing water supply capacity of these utilities. Therefore, this groundwater use would not significantly alter the region's ability to meet groundwater demands.

Factors that limit the impacts of construction and preconstruction activities on groundwater use in the area are (1) limited and temporary excavation dewatering, which may be required for Units 2 and 3; (2) the low groundwater pumping rates due to the generally low permeability of the aquifers in this area; (3) the relatively large distances to local groundwater supply wells; and (4) the site location that is partially isolated hydrologically from offsite users by surface waterbodies (Mayo Creek, Broad River, Parr Reservoir, and Monticello Reservoir). As a result, the review team concludes that the groundwater use impacts of construction and preconstruction of VCSNS Units 2 and 3 would be SMALL and no mitigation would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction would be SMALL, and no further mitigation measures would be warranted.

4.2.3 Water-Quality Impacts

The impacts of building a nuclear power plant on water quality are similar to impacts that would be associated with the development of any large industrial site. This section includes identification of the proposed activities associated with building VCSNS Units 2 and 3 that could affect water quality, and analysis and evaluation of proposed practices to minimize adverse impacts on water quality by these activities. The impacts on surface water and groundwater are discussed in Section 4.2.3.1 and Section 4.2.3.2, respectively.

4.2.3.1 Impacts on Surface-Water Quality

The activities associated with building VCSNS Units 2 and 3 would occur close enough to Monticello Reservoir, Parr Reservoir, Broad River, and Mayo Creek that the impacts from these activities on the quality of surface water need to be considered. These impacts are discussed in SCE&G's ER (SCE&G 2010a).

Section 4.2.1 of this EIS discusses the impact of surface-water runoff and the discharge of water from dewatering activities. These activities are regulated by NPDES permitting, FERC approval, adoption of a SWPPP, use of BMPs (for example using silt fences and routing stormwater runoff to sediment-retention basins), and by USACE permit approval. Construction of the discharge structure within the FERC Project Boundary Line requires FERC approval.

Activities related to road and railroad spur improvement could potentially affect water quality in Mayo Creek or other small creeks on the property as land clearing and grading increase the potential for runoff and erosion. Other activities associated with building the proposed units would occur in areas that drain into Mayo Creek, its tributaries, or small unnamed creeks to the south and east of the proposed new facilities. SCE&G would use BMPs for soil erosion controls and comply with applicable regulations designed to prevent stormwater runoff from affecting the water quality in Mayo Creek and other small streams (SCE&G 2010a).

The temporary sewage-treatment plant in place during the building of VCSNS Units 2 and 3 would use sodium hypochlorite disinfection and process up to 17,500 gpd (12.15 gpm). The location of the treatment plant, the waterbody receiving its effluent, and the discharge location would be established as part of the NPDES permitting process (SCE&G 2010a).

New transmission lines would need to be installed. Tower and line installation activities would comply with State and Federal guidelines and BMPs would be used to minimize impacts on water quality from erosion and sedimentation.

Because the impacts of hydrologic alterations resulting from activities associated with building the proposed units would be localized and temporary, and because the required permits, certifications, and the SWPPP call for the implementation of BMPs to minimize impacts, the review team concludes that the impacts on surface-water quality from activities related to construction and preconstruction of VCSNS Units 2 and 3 would be SMALL, and no further mitigation beyond the actions stated would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the review team concludes that the impacts of NRC-authorized construction would be SMALL, and no further mitigation measures beyond the BMPs would be warranted.

4.2.3.2 Summary of Impacts on Groundwater Quality

SCE&G committed to quickly cleaning up “minor spills of diesel fuel, hydraulic fluid, or lubricants” which would “mitigate impacts to local groundwater because spills would be quickly attended to and not allowed to penetrate into the groundwater” (SCE&G 2010a). SCE&G also developed a spill prevention plan as a part of the SWPPP, which is a condition of the stormwater discharge permit issued by SCDHEC. The spill prevention plan lists BMPs that are implemented to minimize the potential for releases of pollutants during preconstruction and construction that would be followed as required by SCDHEC.

Factors that limit the impacts of preconstruction and construction activities on groundwater quality in the area are 1) SCE&G’s BMPs for spill prevention and control as mentioned above; 2) the relatively large distances to local groundwater supply wells; and 3) the partial isolation of the site from offsite users by surface waterbodies (Mayo Creek, Broad River, Parr Reservoir, and Monticello Reservoir). As a result, the NRC staff concludes that the impacts of construction and preconstruction on groundwater quality would be SMALL and no further mitigation would be warranted. Therefore, the impacts of NRC-authorized construction would be SMALL, and no further mitigation would be warranted.

4.2.4 Water Monitoring

SCE&G outlines monitoring programs for hydrologic and chemical monitoring in Sections 6.3 and 6.6 of its ER for proposed VCSNS Units 2 and 3 (SCE&G 2010a). The SCDHEC requires NPDES permitting for projects that disturb more than 1 ac of land. The NPDES permit covers the monitoring of stormwater discharges from the areas associated with building the proposed units. To obtain an NPDES permit a SWPPP must be filed. The SWPPP developed by SCE&G would include a description of visual inspection actions to detect erosion and provide effective sediment control. The SWPPP also would include a description of sediment control BMPs. The approval of the SWPPP precedes the issuance of the NPDES permit, which would typically describe the monitoring locations and frequency. In addition, SCE&G indicated it would use the NPDES monitoring program for Unit 1 to detect any water-quality changes that might be caused by activities associated with building the proposed units (SCE&G 2010a). The current NPDES monitoring program for VCSNS Unit 1 includes 11 existing outfalls.

SCE&G outlines groundwater monitoring programs for hydrologic and chemical monitoring in Sections 6.3 and 6.6 of its ER for proposed VCSNS Units 2 and 3 (SCE&G 2010a). SCE&G installed 31 monitoring wells to characterize the groundwater flow in the vicinity of proposed VCSNS Units 2 and 3 as part of preapplication site characterization activities. Four of the wells have been retained for future groundwater monitoring (SCE&G 2009e). These four wells are located outside the footprint of the nuclear island (see Figure GW-11-1 in SCE&G 2009e). SCE&G indicated that it would add other groundwater monitoring wells based on any needs identified during discussions with the SCDHEC during final design and permitting (SCE&G 2009e).

4.3 Ecological Impacts

This section describes the potential impacts on ecological resources from building the proposed VCSNS Units 2 and 3, including the installation of new transmission lines to connect the units to the grid. The section is divided into two subsections: terrestrial impacts and aquatic impacts.

4.3.1 Terrestrial and Wetland Impacts

This section provides information about the construction and preconstruction activities for proposed VCSNS Units 2 and 3 and their associated impacts on the terrestrial ecosystem. Topics discussed include terrestrial resource impacts on the VCSNS site and in areas associated with the expansion of the transmission system to include six new 230-kV transmission lines. SCE&G stated it would develop and follow a Construction Environmental Controls Plan, which would include compliance with applicable local, State, and Federal ordinances, laws, etc. to prevent or minimize potential impacts (SCE&G 2010a). Other environmental-management controls, such as meeting the requirements of existing permits and use of BMPs, would be implemented through existing SCE&G VCSNS procedures and modified as necessary. The plan would cover topics such as protection of sensitive resources, stormwater management, erosion and sediment control, noise and vibration, air quality (fugitive dust), spill prevention and response, and cleanup and restoration. In addition, all construction personnel would be required to take environmental awareness training covering the aforementioned topics prior to being allowed to work onsite (SCE&G 2010a).

4.3.1.1 Terrestrial Resources – Site and Vicinity

A majority of the site-preparation and project-development activities for proposed VCSNS Units 2 and 3 would occur in areas previously disturbed during construction of Unit 1. Impacts from development of VCSNS Units 2 and 3 and associated areas would result from the clearing and grading of approximately 556 ac on the VCSNS site (SCE&G 2010a; Pike 2010). A portion of the 556 ac would be used for temporary facilities, laydown areas, and spoils-disposal areas (SCE&G 2010a). Approximately 120 ft of shoreline on the Parr Reservoir would be temporarily disturbed to install the blowdown discharge structure, and installation of the raw- (makeup-) water intake from Monticello Reservoir would temporarily disturb approximately 175 ft of shoreline (SCE&G 2010a). Approximately 51 ac of the total 556 ac would be cleared of forest and planted in grass, and maintained in an early successional grassland or shrub/scrub vegetation community to connect the proposed six new 230-kV transmission lines (Pike 2010; MACTEC 2009).

Impacts on Habitats

Affected habitats would include forested land and wetlands.

<u>Forest</u>

The review team used GIS data provided by the applicant (see Figure 4-1) to estimate the grading, clearing, and excavation related to the development of VCSNS Units 2 and 3, site structures, and roadways (SCE&G 2010d, e). These activities would disturb approximately 258 ac of forested habitat, which would result in the permanent removal of approximately 124 ac of planted pines, 91 ac of naturally vegetated pines, 26 ac of pine-hardwoods, and 17 ac of hardwood. The remaining approximately 298 ac consists of 175 ac of recently cleared pine forest and 123 ac of open, nonforested areas would be disturbed during development, including approximately 18 ac for the access road and 10 ac for the water-treatment plant (SCE&G 2010d, e); see Figure 4-1). The permanent loss of approximately 258 ac of forest is less than 1 percent of the available approximately 51,000 ac of mixed forest in the vicinity of the VCSNS site (SCE&G 2010d, e). Proposed VCSNS Units 2 and 3 would occupy an area dominated by planted loblolly pine (*Pinus taeda*) with a few small stands of hardwood forest present. The proposed site for the cooling-tower development area contains a small stand of naturally vegetated loblolly pine, planted pine, and a few small hardwood stands in the more mesic sites along streams and ravines (Tetra Tech NUS, Inc. 2009b; SCE&G 2002; SCE&G 2010a).

<u>Wetlands</u>

Site-preparation and site-development impacts on wetlands on the VCSNS site may include filling, clearing of vegetation, sedimentation, erosion, and alterations to hydrology. SCE&G stated that it has sited the proposed facilities and infrastructure in a way that would minimize impacts on wetlands and wildlife habitat, and that impacts on wetlands that occur near areas of site preparation and development would be minimized by using established BMPs (SCE&G 2010a). SCE&G has established 50-ft buffered streamside management zones onsite that would be protected in accordance with BMPs such as the use of a silt fence and spill control techniques established by the South Carolina Forestry Commission (Figure 4-2) (SCFC 1994; SCE&G 2010a). Site preparation for the cooling towers would fill and permanently remove

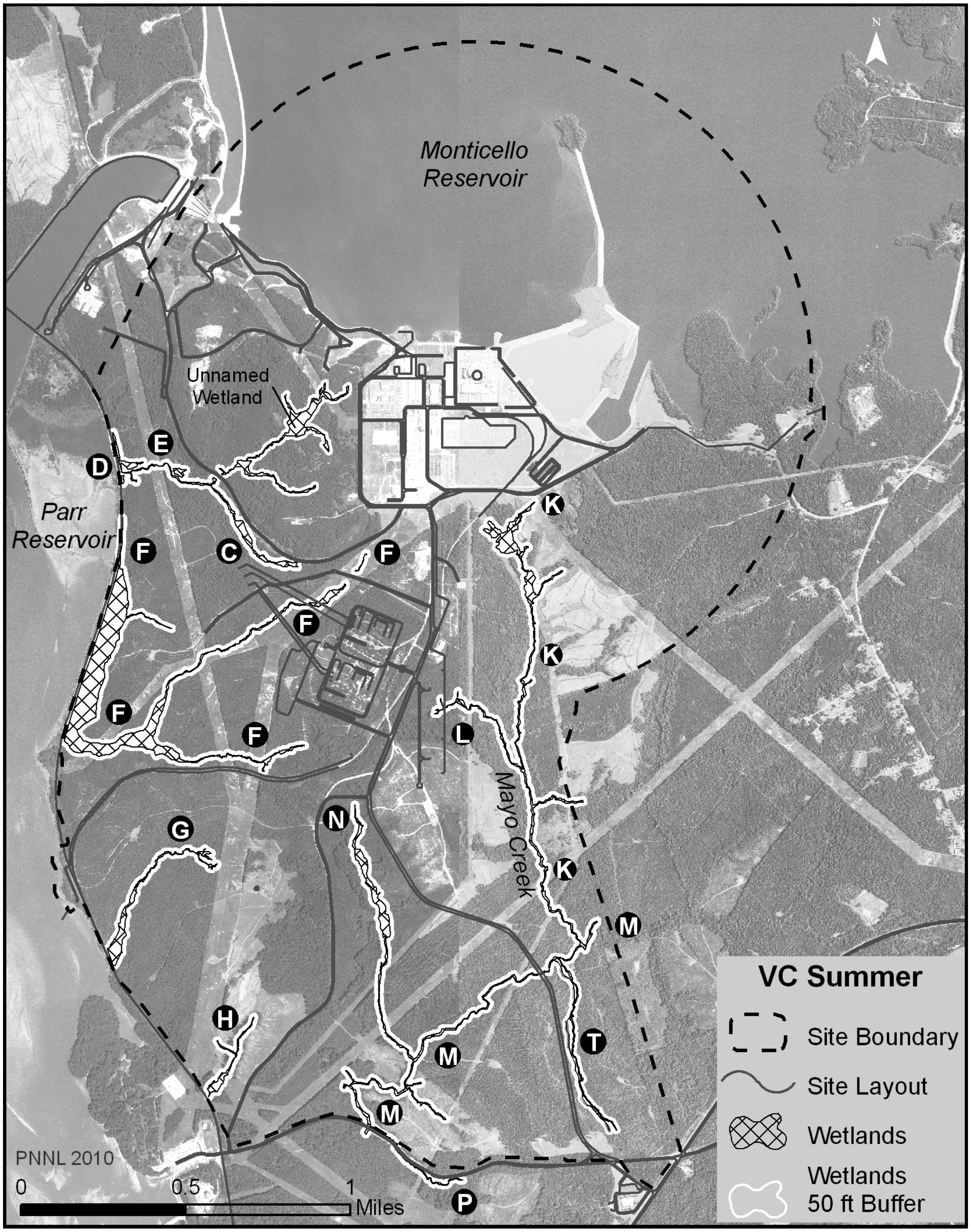

Figure 4-2. Streams and Wetlands, Including a 50-ft Buffer, on the VCSNS Site (letters in circles identify streams)

approximately 0.26 ac of wetland "L" associated with a small stream that is an unnamed tributary to Mayo Creek (Figure 4-2) (SCE&G 2009f). Vegetation clearing needed to connect transmission lines onsite would affect approximately 0.4 ac of forest cover in wetland F, which would be cleared and maintained as nonforested wetland (SCE&G 2010d, e).

SCE&G has conducted wetland delineations on the site and received a Jurisdictional Determination from the USACE on June 29, 2009. The USACE issued the Jurisdictional Determination based on an onsite inspection, review of soil survey information, aerial maps, and other relevant information sources (USACE 2009). SCE&G (2009n) states the following:

> To provide compensatory mitigation for unavoidable jurisdictional waters impacts associated with the proposed project, SCE&G would likely propose to purchase adequate credits from an approved mitigation bank in the service territory in which impacts are proposed. If such a bank does not exist, mitigation credits could be purchased from another bank as deemed appropriate by the regulatory agencies. SCE&G may also propose to provide mitigation credits by conducting certain activities on company-owned property in close proximity to proposed jurisdictional waters impacts as deemed appropriate by the regulatory agencies.

The proposed cooling-tower blowdown line and raw-water intake structures were sited in a way that would minimize impacts on wildlife habitat and wetlands. The blowdown line would be routed along an existing railroad corridor and the intake structure would be sited adjacent to the existing intake in an area with no wetlands (SCE&G 2010a). A sheet-pile cofferdam and dewatering system would be used to facilitate construction of the intake and discharge structures. Erosion and sediment control measures such as a turbidity curtain would be used and other BMPs would be used when needed (SCE&G 2010a). All excavated and dredged material would be transported to an onsite spoils area. Thus, impacts on terrestrial habitats associated with the intake and discharge installation activities would be minimal.

Cleared and disturbed lands resulting from site-preparation and site-development activities are vulnerable to significant soil erosion due to wind and water forces. Appropriate measures and controls to limit soil erosion during these activities would be taken to stabilize these areas, prevent erosion and sedimentation, and reduce runoff as required by applicable laws, regulations, and permit requirements, and recognized BMPs would be used for all proposed activities (SCE&G 2010a).

Due to the existence of similar habitats onsite and the large amount of those habitats surrounding the VCSNS site, impacts due to from habitat in loss from the site-preparation and site-development footprint for Units 2 and 3 and associated areas are expected to be minimal.

Impacts on Wildlife

Impacts from proposed VCSNS Units 2 and 3 and supporting facilities on wildlife habitat would be unavoidable. Site-preparation and site-development activities that would affect wildlife at the VCSNS site include loss of habitat (temporary and permanent), presence of humans, heavy equipment operation, traffic, noise, avian collisions, outdoor lighting, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the development areas. Larger and more mobile animals would likely flee the area, while less mobile animals such as reptiles, amphibians, and small mammals such as the beaver (*Castor canadensis*), would be at greater risk of incurring mortality. Although the surrounding forest and wetland habitat would be available for displaced animals, the movement of wildlife into surrounding areas would increase competition for available space and could result in increased predation and decreased fecundity for certain species. These conditions could lead to a temporary localized reduction in population size for particular species. When site-preparation and site-development activities are completed, species that can adapt to disturbed or developed areas may readily recolonize portions of the site where suitable habitat remains, is replanted, or restored.

Increased traffic in the area from site-preparation and site-development activities would increase roadway mortality due to forced movement of wildlife into traffic areas as individuals flee construction areas. Mammals such as white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), eastern cottontail rabbit (*Sylvilagus floridanus*), and eastern gray squirrel (*Sciuris carolinensis*) would likely suffer increased roadside mortality (Forman and Alexander 1998). The review team concludes that these impacts would not be detectable beyond the local vicinity and would not destabilize regional wildlife populations.

Noise from site-preparation and site-development activities 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 adapt to such noise (Larkin 1996). Development activities that would generate noise include operation of equipment such as jackhammers, pile drivers, and heavy construction vehicles. Short-term noise levels from development activities onsite could be as high as 108 dBA (SCE&G 2010a). However, that level would not extend far beyond the boundaries of the project site. The predicted noise level range from development activity is approximately 55 to 84 dBA at a distance of 400 ft from each activity (SCE&G 2010a). The threshold at which birds and small mammals are startled or frightened is 80 to 85 dBA (Golden et al. 1980). The review team expects that noise levels associated with creation of the transmission-line corridor would be similar to noise levels associated with development activities at the VCSNS site (which is below threshold levels for wildlife at 400 ft) but would be incurred for a more limited duration at any given location. Thus, impacts on wildlife from noise are expected to be negligible.

Avian collisions with fabricated structures such as large cranes and other construction equipment are a result of numerous factors related to species characteristics, such as flight behavior, age, habitat use, seasonal habits, and diurnal habits, as well as to environmental characteristics such as weather, topography, land use, and the orientation of the structures (Manville 2005). Most authors on the subject of avian collisions with utility structures agree that collisions are not a biologically significant source of mortality for thriving populations of birds with good reproductive potential (Brown 1993). The NRC (1996) reviewed monitoring data concerning avian collisions at nuclear power plants with large cooling towers and determined that the overall avian mortality rate is low, therefore avian collisions are not expected to be significant.

Refueling stations, fuel storage, and the storage of other liquids during site-preparation and development activities also pose a threat to local surface waters used by wildlife on the site. However, SCE&G has established environmental controls to keep such liquids from escaping containment, thereby minimizing mortality and morbidity of wildlife (SCE&G 2010a). BMPs related to the management of effluent and stormwater runoff as required by the Stormwater Management Plan and the SCDHEC NPDES permit would also limit these impacts.

Impacts on habitats and wildlife related to site-preparation and site-development include direct mortality from land clearing, increased traffic, noise, and chemical spills. Displacement of individuals, increased competition, and lost productivity could also result from construction and preconstruction activities. However, the review team does not expect these activities to be measurable at a population level beyond the project site. The review team has determined that the site-preparation and site-development-related impacts of habitat loss, noise, avian collisions, and increased traffic may adversely affect onsite wildlife. However, these impacts would be temporary, minor, and mitigated. Development of proposed VCSNS Units 2 and 3 would be done according to Federal and State regulations, permit conditions, existing procedures, and established BMPs. Waterways and wetlands would be avoided to the extent possible (SCE&G 2010a). Therefore, the review team concludes that site-preparation and site-development impacts on wildlife habitat on the proposed VCSNS site would be localized.

4.3.1.2 Terrestrial Resources – Transmission Lines

This section assesses impacts on terrestrial resources expected to occur from site-preparation and site-development activities within the proposed transmission system corridors. Impacts on habitats and wildlife from development of the new transmission lines required for VCSNS Units 2 and 3 would vary depending on the site-preparation and site-development activities required for the specific lines serving each unit.

Impacts on Habitats

The review team examined potentially affected habitats within the proposed SCE&G and Santee Cooper transmission-line corridors. As described in Sections 2.2.2 and 3.2.2.3, a total of six new offsite 230-kV transmission lines would be needed to distribute the power generated by the proposed Units 2 and 3 at the VCSNS site. Santee Cooper would develop and maintain two of the lines, and the other four would be developed and maintained by SCE&G in three corridors.

Where the proposed new transmission lines would be built entirely within existing corridors that are currently maintained edge to edge, habitat impacts would be limited to temporary, light disturbance of grassland and scrub that are already subject to routine maintenance to exclude tall trees (Pike 2010; MACTEC 2009). The review team estimated impacts on forested habitat within the proposed new transmission-line corridors by overlaying the applicant-provided GIS layer of the proposed corridors onto USGS land-use land-cover data from 2001 (SCE&G 2010e, h; USGS 2001). Much of the forest habitat requiring clearing lies within proposed new rights-of-way, although some forest cover within existing rights-of-way that is not presently managed edge to edge would also require clearing. In those areas the impacts on forests and wetlands would be minimized by implementation of BMPs (Pike 2010; MACTEC 2009). All work performed by SCE&G and Santee Cooper would be done in compliance with applicable Federal, State, and local laws, regulations, and permit requirements.

Wetland delineations were performed in all proposed corridors by SCE&G and Santee Cooper in 2010 and 2008, respectively, and were reviewed and verified by the USACE (USACE 2010).

<u>Wetland Impacts</u>

The proposed VCSNS-Killian line would be 37 mi long and would require approximately 6 mi of new corridor to be cleared on the Killian substation end of the line (Pike 2010). This new corridor would not be adjacent to existing transmission line corridors. The total acreage of wetlands present in the VCSNS-Killian corridor is approximately 31.2 ac, of which approximately 15.5 ac would be converted from forested to nonforested wetlands (USACE 2010). The VCSNS-Lake Murray No. 2 line has been routed entirely within existing transmission-line rights-of-way, although portions of those existing rights-of-way would have to be cleared of forest vegetation (Pike 2010). Because the entire VCSNS-Lake Murray No. 2 line resides within Fairfield, Richland, and Lexington Counties (the same counties used in the site and vicinity analysis for VCSNS Units 2 and 3 in Section 4.3.1) the habitat types and wildlife are generally similar(Pike, 2010). The total acreage of wetlands present in the VCSNS-Lake Murray No. 2 corridor is approximately 7.7 ac, of which approximately 5.9 ac would be converted from forested to nonforested wetlands (USACE 2010). The proposed VCSNS-St. George No. 1 and No. 2 lines have also been routed entirely within existing rights-of-way, although portions of those existing rights-of-way would have to be cleared of forest vegetation. The total acreage of wetlands present in the VCSNS-St. George No.1 and No. 2 corridors is approximately 186.9 ac, of which approximately 16 ac would be converted from forested to nonforested wetland (USACE 2010).

The Santee Cooper lines are routed within existing transmission-line corridors with the exception of approximately 39 mi that would require a new corridor (MACTEC 2009). Most of the new corridor would be located adjacent to existing transmission-line corridors, but approximately 0.5 mi of the Varnville line would require new corridor not adjacent to or within existing corridors (MACTEC 2009). The total acreage of wetlands present in the VCSNS-Flat Creek corridor is 12.5 ac of which approximately 0.8 ac would be converted from forested to nonforested wetlands (; USACE 2010). The total acreage of wetlands present in the VCSNS-Varnville corridor is 354 ac, of which approximately 5.5 ac would be converted from forested to nonforested wetlands (MACTEC 2009; USACE 2010).

Forest Impacts

Development of new corridors and use of existing corridors would result in approximately 1171 ac of forest clearing (see Table 4-3 for additional detail) (SCE&G 2010d, e). These impacts result from clearing within new corridors and re-clearing previously cleared corridors or portions of existing rights-of-way that were never cleared as part of previous transmission line installations.

Table 4-3. Summary of Forest and Wetland Impacts in Proposed Transmission-Line Corridors

Transmission Line	Total Length (mi)	Total Area (ac)[(a)]	Total Forested Area (ac)[(b)]	Total Wetland Area (ac)[(c)]	Wetland Area in New Right-of-Way (ac)[(c)]	Forested Wetland Area to Be Cleared, New and Existing Right-of-Way (ac)[(c)]
VCSNS-Killian	37	365	171	31.2	16.6	15.5
VCSNS-Lake Murray No. 2 and VCSNS-St. George No. 1 common corridor	22	281	175	7.7	0	5.9
VCSNS-St. George No. 2 (between VCSNS site and common corridor with VCSNS-St. George 1)	18	238	158	2.9	0	0.1
VCSNS-St. George No. 1 and St. George	76	1186	495	184	0	15.9

No. 2 common corridor (Lake Murray to St. George)						
VCSNS-Flat Creek	72	1094	81	12.5	0.8	0.8
VCSNS-Varnville	167	2539	91	354	5.5	5.5

Source: MACTEC 2009; SCE&G 2010a; Pike 2010; USACE 2010
(a) Source: USACE 2010.
(b) Source: Tables 2-2 and 2-3, which characterize the representative land uses in the potentially affected transmission-line corridors for SCE&G's and Santee Cooper's corridors, (length and total acreage)
(c) Wetland areas from USACE (2010)
(d) Some of the forested wetland areas subject to clearing are within proposed new right-of-way lands, and the remainder are within uncleared portions of existing rights-of-way lands.

Summary of Overall Transmission Line Impacts on Habitats

SCE&G and Santee Cooper stated that all clearing would be done using BMPs and that no mechanized clearing or grubbing would be necessary (MACTEC 2009; Pike 2010). Site-preparation and structure installation activities that would occur in the existing transmission-line corridors that may cause temporary impacts would be limited to replacement of existing structures and installation of new lines. SCE&G and Santee Cooper stated that it would install new structures on or adjacent to existing footprints whenever possible and that disturbance from these activities would not create impacts greater than those that already occur during ongoing transmission-line corridor maintenance activities (Pike 2010; MACTEC 2009). Both entities have stated they would take measures to minimize impacts on wetlands by following recommendations from the USACE to mitigate temporary impacts from site preparation and structure installation such as the use of mulches, hay bales, silt fences, and other erosion-control methods. Engineering controls and existing procedures are also in place to address unavoidable disturbances. All work performed by SCE&G and Santee Cooper would be done in compliance with applicable Federal, State, and local laws, regulations, and permit requirements. Based on the large amount of new corridor clearing and subsequent impacts on wetlands and streams, the review team concludes that the impacts on habitats from clearing the new transmission-line corridors and upgrading existing corridors for the proposed transmission lines would be noticeable.

The combined length mileage of new or expanded (widened) transmission-line corridors for both SCE&G and Santee Cooper would be approximately 45 mi. A total of 43.7 ac of wetlands (all palustrine), and approximately 1171 ac of forests would be subject to clearing impacts (USACE 2010). Potential impacts on terrestrial habitats from upgrading transmission lines in existing and currently maintained transmission-line corridors would be minimal, and mitigation beyond the use of standard BMPs would not be warranted. Potential impacts on terrestrial habitats from clearing in existing and new corridors would be noticeable, but mitigation beyond the wetland mitigation required by the USACE and the use of standard BMPs would not be warranted.

Impacts on Wildlife

Wildlife present in the transmission-line corridors during the proposed work would be subjected to many of the same types of impacts described for the proposed VCSNS site. Some wildlife would perish or be displaced during clearing of new transmission-line corridors, and, as a consequence of habitat loss and fragmentation, competition for remaining resources could increase. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, which would be displaced to adjacent habitats. Undisturbed land adjacent to the corridors could provide habitat to support displaced wildlife, but increased competition for available space and resources could reduce population levels. Wildlife would also be subjected to impacts from construction noise and traffic, and birds could be injured if they collide with new transmission towers and conductors or the equipment used to install these components. Noise levels associated with the building of the transmission lines would be similar to or less than and of shorter duration than noise levels associated with construction at the proposed VCSNS site, and would be below disturbance threshold levels for wildlife at about 400 ft (SCE&G 2010a; MACTEC 2008). Thus, the impact on wildlife from noise is expected to be temporary and minor. The potential for traffic-related wildlife mortality is expected to be low because construction crews would be small and dispersed over very large geographic areas (MACTEC 2008; FP&S 2008). Avian mortality resulting from collisions with structures and equipment during transmission-line development would represent a small hazard for bird populations, particularly when compared to impacts resulting from habitat loss (Manville 2005; MACTEC 2008; FP&S 2008). The review team expects that noise levels associated with creation of the transmission-line corridor would be similar to noise levels associated with development activities at the VCSNS site and would be below threshold levels for wildlife at 400 ft.

The creation of new transmission-line corridors could be beneficial for some species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer, northern bobwhite (*Colinus virginianus*), eastern meadowlark (*Sturnella magna*), and the gopher tortoise (*Gopherus polyphemus*). Birds of prey, such as red-tailed hawks (*Buteo jamaicensis*) and great-horned owls (*Bubo virginianus*), would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in a herbaceous or scrub-shrub condition that could provide foraging habitat for wading birds. However, fragmentation of forests could affect species that are dependent on large tracts of continuous forested habitat. All work in the proposed transmission-line corridors would be done according to Federal and State regulations, permit conditions, existing procedures, and established BMPs. Because SCE&G and Santee Cooper have procedures in place to minimize impacts on wildlife and habitats, and both plan to use existing footprints for new structures, the potential impacts of construction in existing corridors would be minimal. Because of the substantial amount of new transmission-line corridors and the number of acres affected within all the corridors required for this proposed project, the review team concludes that the terrestrial resources within and adjoining the new transmission-line rights-of-way would be altered noticeably.

4.3.1.3 Important Terrestrial Species and Habitats

This section describes the potential impacts on the important species identified using NRC criteria (NRC 2000) in Section 2.4.1 resulting from development of VCSNS Units 2 and 3 and associated transmission lines.

Important Species – Site and Vicinity

No Federally or State-listed species are known to occur on the VCSNS site. There are no areas designated as critical habitat on and in the vicinity of the VCSNS site. The delisted bald eagle (*Haliaeetus leucocephalus*) is known to occur on the VCSNS site and is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Two active bald eagle nests are known to occur on or in the immediate of the VCSNS site; one is located on SCE&G property north of existing Unit 1 on a jetty that extends into Monticello Reservoir, and the other is located west of Parr Reservoir less than 1 mi from the western boundary of the SCE&G property (see Figure 4-1). Proposed site-preparation and site-development activities would not encroach upon either nest because they would take place well beyond the 660-ft buffer recommended for commercial construction activities near active bald eagle nests (FWS 2007). Therefore, the potential to disturb eagles using these two nest sites would be minimal.

Important Species – Transmission Lines

The transmission lines associated with the proposed project would not travel through any areas designated or proposed by the FWS as “critical habitat” for endangered or threatened species (Palmetto 2010; MACTEC 2010). However, several Federally and State-listed species inhabit counties crossed by the proposed transmission-line corridors. A complete list of Federally and State-listed species that are known to occur in counties crossed by transmission lines associated with the project is given in Table 2-17. This list was compiled from the SCDNR Natural Heritage Database (SCDNR 2010a) and the FWS list (FWS 2010). Targeted ground surveys for threatened and endangered species were conducted in September, October, and November 2010 (Palmetto 2010; MACTEC 2010); the surveys and findings are described in Section 2.4.1 of this EIS.

The proposed transmission lines would travel through a variety of habitats that support large and small game as well as waterfowl species. Because most of the new transmission lines would be constructed within or adjacent to existing corridors for operation of VCSNS Units 2 and

3, no substantial additional impacts would be expected to occur on any commercially or recreationally important species as a result of transmission-line building and upgrading activities in those corridors.

No areas designated or proposed by the FWS as “critical habitat” for threatened or endangered species occur on or immediately adjacent to the proposed transmission-line corridors (MACTEC 2009; Pike 2010). None of the proposed new transmission lines would cross State or Federal parks, wildlife refuges, wildlife management areas, or preserves. Because SCE&G and Santee Cooper have procedures in place to minimize impacts on important species and habitats, the potential impacts of site preparation and development in existing corridors would be minimal. However, as described above, a substantial length of new corridor is required to accommodate the proposed new transmission lines, which would noticeably but not substantially alter the regional landscape. The review team therefore concludes that the terrestrial resource impacts resulting from activities associated with the site-preparation and development work within the proposed transmission-line corridors would be regionally noticeable due to the total acreage of forests, including forested wetlands, that would be cleared.

4.3.1.4 Terrestrial Monitoring

SCE&G has stated that it would not conduct any monitoring of terrestrial resources during site preparation and development at the VCSNS site and associated transmission-line corridors (SCE&G 2010a). The USACE may, however, require monitoring of certain wetland mitigation activities.

4.3.1.5 Potential Mitigation Measures for Terrestrial Impacts

Mitigation measures for terrestrial impacts related to site preparation and development include the implementation of BMPs and performance of wetland mitigation, which are described in the previous sections.

4.3.1.6 Summary of Impacts on Terrestrial Resources

Based on information provided by SCE&G and the review team’s independent evaluation, the review team has determined that the impacts from site preparation and development on terrestrial resources on the VCSNS site, including permanent and temporary losses of forests and wetlands, would be localized and would not noticeably alter the ecology of the surrounding landscape. The affected terrestrial habitat types are common in the surrounding landscape, and much of the affected habitat consists of planted pine forest and successional vegetation on soils previously disturbed during development of VCSNS Unit 1. SCE&G stated that it would work with the USACE to determine appropriate mitigation through the permitting process of Section 404 of the Clean Water Act (33 USC 1251, et seq.), which prohibits the discharge of dredged or fill material into waters of the United States. The impact on wildlife at the population level (including Federally and State-listed species), would be minimal.

SCE&G and Santee Cooper have both identified BMPs they use on the site (SCE&G 2010a) and in the transmission-line corridors and which they would use throughout the development and maintenance of the proposed facilities. Each utility also has stated that it would adhere to all applicable permit requirements. Because SCE&G and Santee Cooper have established procedures for minimizing impacts on important species and habitats, the potential impacts of transmission-line development in existing corridors would be minimal. However, some new corridor would be developed for transmission lines. The review team concludes that the terrestrial resource impacts associated with the development of the new transmission line corridors would noticeably alter the terrestrial ecological character of the surrounding landscape, primarily due to clearing of forest cover within and adjacent to existing corridors and forest fragmentation caused by new corridors not adjacent to existing corridors.

Based on information provided by SCE&G and the review team's independent evaluation, the review team concludes that the impacts of construction and preconstruction activities on terrestrial ecology resources on the VCSNS site would be SMALL. No further mitigation beyond that discussed above would be warranted. Based on the above analyses, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction activities on terrestrial ecological resources would be SMALL on the VCSNS site. The NRC staff also concludes that further mitigation beyond that stated above would not be warranted.

Based on information provided by SCE&G and the review team's independent evaluation, the review team concludes that the offsite terrestrial ecological impacts from preconstruction activities related to the development of the proposed transmission lines would be MODERATE. The greatest potential for regionally noticeable terrestrial ecological impacts would be from forest clearing within and adjacent to existing corridors and fragmentation of forest cover caused by clearing for new transmission-line corridor. The review team also concludes that further mitigation beyond that stated above would not be warranted. The Limited Work Authorization (LWA) rule specifically indicates that transmission lines are not included in the definition of construction. Therefore, no noticeable offsite terrestrial ecological impacts would result from NRC-authorized construction activities.

4.3.2 Aquatic Impacts

Impacts on aquatic resources stemming from site-preparation activities for VCSNS Units 2 and 3 would include activities associated with the three main waterbodies at the site. As described in Sections 3.2 and 3.3, a discharge structure would be built at Parr Reservoir. A raw-water intake structure and a water-treatment plant intake structure would be installed at Monticello Reservoir. Site preparation activities for building the cooling towers would result in the filling of a seasonal headwater tributary to Mayo Creek. The locations of these structures and associated activity areas are shown in Figure 3-4. Additional aquatic impacts may include nonpoint source pollution in the form of stormwater runoff from site-preparation areas, preparation of new transmission-line corridors, and widening of existing transmission-line corridors. All work would be conducted in accordance with Clean Water Act Section 401 and 404 regulations (40 CFR 230).

4.3.2.1 Aquatic Resources – Site and Vicinity

Parr Reservoir

Construction and preconstruction activities associated with installation of the discharge structure in Parr Reservoir include dredging and pile driving, which can cause noise impacts as well as increased sedimentation and runoff. The specifications pertaining to the discharge structure have not been finalized, but the proposed shoreline disturbance area is estimated to include 120 linear ft, the structure is 20 ft wide with 50 ft of disturbance on either side (SCE&G 2010a). All dredge and excavated materials would be disposed of at the upland location on the VCSNS site shown in Figure 3-4. Installation of the discharge structure would require permanent filling of 0.02 ac of open water and temporary impacts on 0.10 ac of open water from dredging and backfilling within a temporary sheet-pile cofferdam (SCE&G 2011). The 36-in.-diameter blowdown discharge pipe and associated diffuser line would extend approximately 100 ft from the shoreline into the reservoir and would be stabilized with riprap. The diffuser line would contain multiple ports with the discharge points approximately 3 ft above the bottom of the reservoir (SCE&G 2010a).

Activities associated with the installation of the blowdown line and discharge structure include pile driving and excavation of the land extending from the uplands to the water's edge to facilitate an adequate slope of the blowdown line (SCE&G 2010a). Preparation and installation of the discharge structure at Parr Reservoir include installation of sedimentation and turbidity control structures such as turbidity curtains and cofferdams, excavation and dredging in the vicinity of the diffuser structure, and disposal of dredged materials (SCE&G 2010a).

Monticello Reservoir

The installation of two water-intake structures on the Monticello Reservoir may affect aquatic biota. Dredging activities in these locations may temporarily increase turbidity, siltation, and noise. As described in Sections 3.2.2 and 3.3.1, SCE&G has proposed to install a new raw-water intake structure approximately 1250 ft west of the existing VCSNS Unit 1 intake structure to supply makeup cooling water for Units 2 and 3. The raw-water intake structure for VCSNS Units 2 and 3 would be constructed of concrete and would be approximately 60 ft long and 75 ft wide (SCE&G 2010a). All dredged materials would be disposed of at the upland location on the VCSNS site shown in Figure 3-4. Installation of the new raw-water intake structure would require 0.11 ac of permanent filling of open water and 0.07 ac of temporary impacts to open water from dredging and backfilling within Monticello Reservoir (SCE&G 2011). Proposed activities associated with the installation of a new raw-water intake structure include the installation of a sheet-pile cofferdam and the subsequent dewatering of the construction area (SCE&G 2009a). Plans include the installation of a turbidity curtain around the perimeter of the installation area prior to the installation of the cofferdam (SCE&G 2010a). Turbidity curtains are often used in conjunction with activities that cause increased sedimentation and turbidity and are a tool for implementing BMPs (Francingues and Palermo 2005).

The water for plant operations (service water system and potable, fire protection, and demineralized water systems) would also be derived from Monticello Reservoir, but would be obtained from the water-treatment plant intake structure to be installed approximately 5500 ft east of the existing VCSNS Unit 1 intake structure (see Section 3.3.1 and Figure 3-4) (SCE&G 2010a). SCE&G has proposed two options for building the water-treatment plant intake structure, both of which necessitate using barges as work platforms and installation of a cofferdam and turbidity curtain. The deployment of barges into Monticello Reservoir may require modifications of up to 100 ft of shoreline, which may result in the removal of rip-rap or other bank-stabilizing structures. Both options would also require the installation of a maintenance access pier approximately 17 ft wide extending approximately 200 ft from the shoreline into Monticello Reservoir. Installation of the new water-treatment plant intake structure would require temporary impacts on 0.66 ac of open water for dredging and backfilling, and 0.01 ac of permanent impact on open waters by filling within Monticello Reservoir (SCE&G 2011). Compliance in both installation and design would be in accordance with USACE requirements and FERC permitting (SCE&G 2009j).

Onsite Streams

Site-preparation activities associated with onsite streams include permanent and temporary impacts on aquatic environments. The designated location of cooling towers associated with VCSNS Units 2 and 3 would require filling Stream L, a seasonal headwater stream that drains into Mayo Creek Figure 4-2) (SCE&G 2010a). Filling of this headwater stream would result in the permanent loss of 774 linear ft of stream habitat (SCE&G 2009k, f). The proposed location for the Units 2 and 3 switchyard would be adjacent to Stream C. The lines connecting the Units 2 and 3 switchyard to the Unit 1 switchyard would cross Stream/Wetland C and affect 0.4 ac of wetland via clearing activities. Furthermore, the connector lines would affect 6.2 ac of upland habitat via hand-clearing activities that would occur within 100 ft of the stream/wetland boundary (Pike 2010).

Localized, temporary site-preparation impacts on onsite streams include the widening of an existing railroad spur right-of-way adjacent to a seasonal stream and the construction of a new bridge at Mayo Creek. SCE&G has proposed to widen an existing railroad spur right-of-way to make room for railroad upgrades and the new blowdown line associated with VCSNS Units 2 and 3. Site-preparation activities associated with the expansion of the railroad line right-of-way are proposed to occur adjacent to a seasonal stream for approximately 0.5 mi (SCE&G 2010a). Impacts associated with widening the right-of-way, upgrading the railroad spur, and installing a new 36-in.-diameter blowdown line adjacent to the seasonal stream may result in increased runoff to, and sedimentation in, the stream, resulting in degradation of habitat and lower dissolved oxygen levels. The development of a new four-lane road connecting the site-preparation area associated with VCSNS Units 2 and 3 to State Highway 213 (SC-213) includes plans for a new bridge crossing that would span Mayo Creek (SCE&G 2010a). Although temporary, aquatic impacts associated with bridge installation include an increased potential for runoff and sedimentation. The SCDHEC regulates activities related to stormwater management and sediment control (SCDHEC 2008). SCE&G (20010a) has recognized the aquatic ecosystem implications of runoff generated from site-preparation activities at the VCSNS site and has acknowledged the necessity of compliance with practices and permits such as a SWPPP and a general NPDES permit for industrial stormwater. Impacts from runoff and in-water installation activities would be mitigated through use of temporary culverts and BMPs such as the use of cofferdams and turbidity (silt) curtains (SCE&G 2010a).

As described in Section 3.2.2, the proposed location of VCSNS Units 2 and 3 is on the top of a hill, and stormwater would drain away from the site in several directions. A stormwater-management system would be installed (SCE&G 2010a). Installation would include site grading, ditches, swales, and basins. The current and proposed stormwater-retention basins in the immediate vicinity of the site are shown in Figure 3-5. Outflow from these basins would eventually drain into several unnamed creeks to the west and into Mayo Creek to the east. Once drainage enters Mayo Creek it would flow south, then west around the southern base of the powerblock area (SCE&G 2010a).

To minimize sedimentation and impacts on water quality, SCE&G intends to conduct land clearing activities during dry periods (SCE&G 2010a).

4.3.2.2 Aquatic Resources – Transmission Lines

The delivery of power associated with proposed VCSNS Units 2 and 3 would require upgrading existing transmission-line corridors and installing new transmission lines and substations. With regard to the delivery of power, two entities, SCE&G and Santee Cooper, are responsible for identifying the proposed locations associated with new and upgraded transmission lines. In total, six new 230-kV lines are proposed for the transmission of electricity associated with VCSNS Units 2 and 3 (SCE&G 2010c; Pike 2010; MACTEC 2009).

Impacts on the waterways associated with transmission-line activities include erosion of soils, potential for pollutant discharge from equipment, and temporary disturbance and/or displacement of aquatic biota. Both SCE&G and Santee Cooper would implement BMPs to minimize adverse conditions for aquatic biota and habitats during transmission-line installation. Examples of BMPs to minimize impacts on streams and open water include establishment of sediment basins, sediment traps, and silt fences to control and divert runoff away from streams, and maintenance of stream buffers (Pike 2010). In addition, both Santee Cooper and SCE&G have acknowledged the need to acquire State and Federal permits and incorporate BMPs and SWPPPs into said permits (MACTEC 2008, 2009; Pike 2010). SCE&G stated that it "will comply with the S.C. Stormwater Management and Sediment Reduction Act related to water quality protection and will comply with the recommendations of various regulatory agencies, including the S.C. Department of Natural Resources, S.C. Department of Health and Environmental Control, the U.S. Army Corps of Engineers, etc." (Pike 2010).

SCE&G Transmission Lines

Four lines occupying three corridors would be required to carry the SCE&G-owned transmission lines as described in Section 4.1.2. These lines would occupy an estimated 147 mi of existing transmission-line corridors and 6 mi of new corridor. In addition, 5 mi of onsite connector lines would cross 11 streams to connect the VCSNS Unit 1 switchyard with the switchyard for VCSNS Units 2 and 3 (Pike 2010). The 22-mi segment of VCSNS-Lake Murray No. 2 and VCSNS-St. George No. 1 corridor would not include any new corridor development. However, the VCSNS-Killian line would require approximately 6 mi of new corridor and use 31 mi of existing transmission-line corridor (SCE&G 2010c). The VCSNS-St. George No. 2 line would occupy 18 mi of existing corridor and the VCSNS-St. George No. 1 and No. 2 lines are proposed to share a common corridor that extends 76 mi (Pike 2010). Activities associated with the SCE&G transmission system would include clearing land, building a new substation, installing new poles, hanging new lines, and upgrading existing lines. The SCE&G transmission system would include 209 stream and river crossings throughout the Piedmont and Coastal Plain ecoregions of South Carolina (Figure 4-3; Table 4-4). An estimated five percent of the total SCE&G water crossings are associated with the new 6 mi segment of the VCSNS-Killian transmission-line corridor (review team analysis of GIS-based routing data supplied by the applicant).

SCE&G intends to clear vegetation within 100 ft of waterbodies within the new 120-ft-wide VCSNS-Killian transmission-line corridor as well as within SCE&G unmaintained existing corridors (100 ft wide) (Table 4-4). Because SCE&G has proposed to follow State and Federal guidelines, implementation of BMPs (e.g., leaving low-growing vegetation intact to provide stream buffer zones, hand clearing vegetation in forested wetlands, and leaving root zones intact) will further minimize impacts on waterbodies during transmission system installation activities (Pike 2010). No direct impacts on the waterbodies are anticipated, but indirect impacts (e.g., potential for reduced shading and increased sedimentation) on waterbodies would likely occur in habitats that shift from forested to nonforested habitats. Impacts associated with vegetation clearing are anticipated to result in minor, localized impacts in areas adjacent to aquatic habitats.

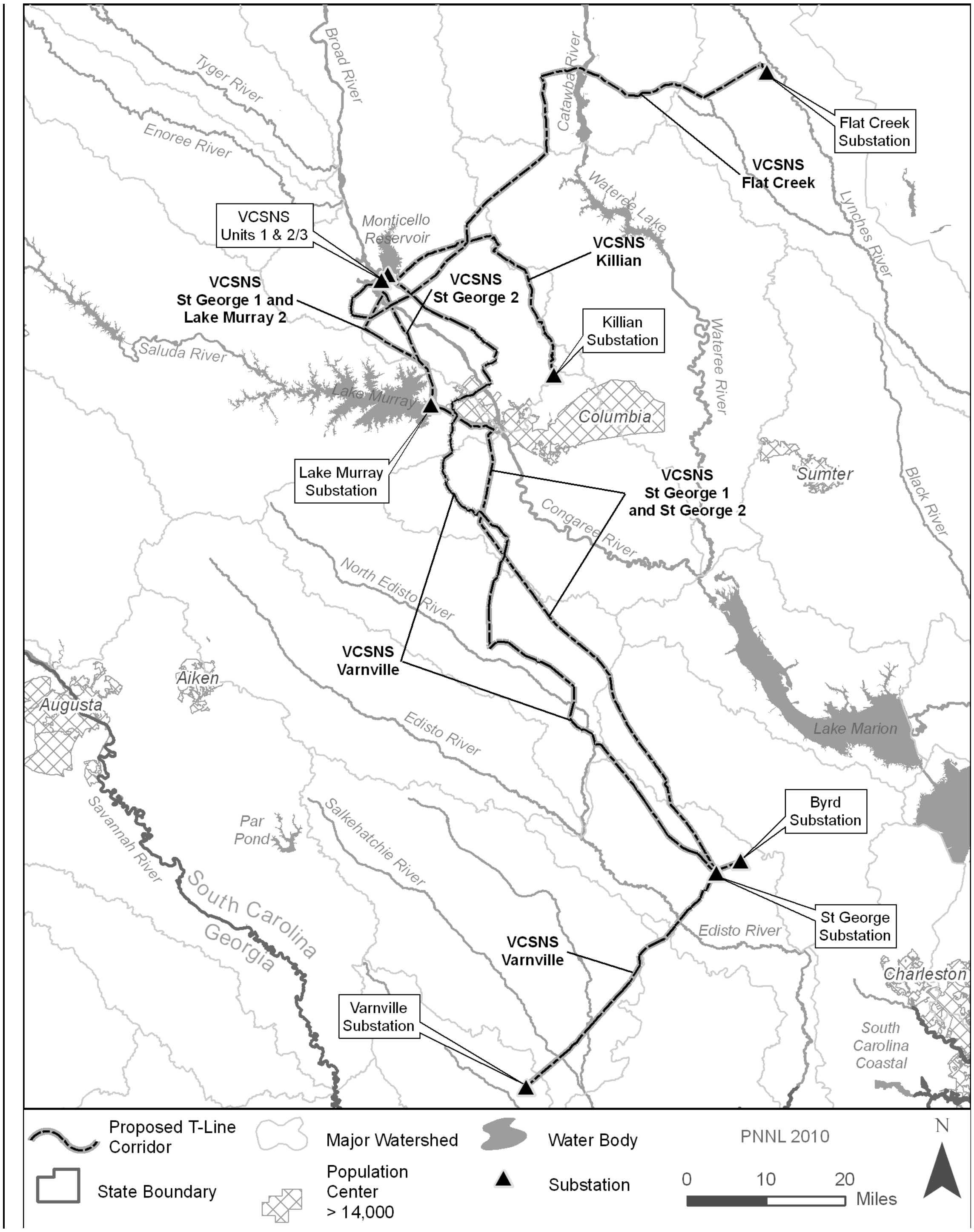

Figure 4-3. Proposed SCE&G and Santee Cooper Transmission-Line Corridors in Relation to Crossings of Major Waterbodies

Table 4-4. Stream Crossings, Open Water, Linear Feet of Stream, and Stream Area Associated with the SCE&G and Santee Cooper Transmission Lines

Transmission Line	Utility	Streams (linear feet)	Open Water (ac)	Number of Stream Crossings	Area to Be Cleared Within 100 ft of a Waterbody (ac)
Onsite Connector Lines	SCE&G	1555[(a)]	0	11[(a)]	6.2
VCSNS-Killian	SCE&G	5194	0.81	45	5.3
VCSNS-Lake Murray No. 2 and VCSNS-St. George No. 1 common corridor	SCE&G	5017	1.09	35	15.3
VCSNS-St. George No. 1 and VCSNS-St. George No. 2 common corridor	SCE&G	20,675	9.9	99	6.9
VCSNS-St. George No. 2	SCE&G	5339	0.35	30	2.2
Sub Total		*37,780*	*12.15*	*209*	*35.9*
VCSNS-Varnville Line	Santee Cooper	37,987	17.94	177	ND[(b)]
VCSNS-Flat Creek	Santee Cooper	26,491	14.45	151	ND[(b)]
Sub Total		*64,478*	*32*	*328*	ND[(b)]
Grand Total		***102,258***	***45***	***537***	***35.9***

Source: USACE 2010 except for onsite connector lines, and clearing within 100 ft of a waterbody.
Sources for onsite connector lines: SCE&G 2010e; USACE 2009, 2010.
Source for area to be cleared within 100 ft of a waterbody: Pike 2010.
(a) Onsite connector lines are located in areas covered by USACE's (2009) onsite wetland jurisdictional determination and offsite transmission-line determination (USACE 2010). Stream crossings and lengths for onsite connector lines were obtained by overlaying transmission-line and delineated wetlands GIS layers.
(b) ND = No data provided.

Santee Cooper Transmission Lines

Two transmission-lines would be installed by Santee Cooper: the VCSNS-Flat Creek and the VCSNS-Varnville line. The VCSNS-Flat Creek line, would extend 72 mi northeast from the VCSNS site to the existing Flat Creek substation, and require approximately 17 mi of new corridor running adjacent to existing corridor. The VCSNS-Varnville line, would extend 167 mi south from the VCSNS site to the existing Varnville substation, and require approximately 22 mi of new corridor running adjacent to existing corridor, and approximately 0.5 mi of new corridor not adjacent to existing corridor.

In total, Santee Cooper intends to install 39.5 mi of new transmission-line corridor with approximately 39 mi of the corridor occurring adjacent to existing corridors. Eighty-three percent (198 mi) of the new transmission lines would occur within existing transmission-line corridors. Activities associated with the installation of the Santee Cooper transmission lines would include clearing land, upgrading existing substations, installing new poles, replacing old poles, and hanging new lines on existing supports (MACTEC 2008, 2009). The proposed new 100-ft-wide transmission-line corridor associated with the VCSNS-Varnville line crossing Parr Reservoir would require the installation of concrete pile foundations within the reservoir, but no dredging would be required (SCE&G 2009g).

The Santee Cooper transmission lines would include 328 stream and river crossings throughout the Piedmont and Coastal Plain ecoregions of South Carolina (Figure 4-3; Table 4-4) (MACTEC 2008). An estimated 11 percent of the total Santee Cooper water crossings are associated with new transmission-line corridor (review team analysis of GIS-based routing data supplied by the applicant). Four of the transmission-line crossings would include new transmission-line corridors and are expected to span the Fishing Creek Reservoir (Catawba River impoundment), Parr Reservoir (Broad River impoundment), Little River, and Cedar Creek (MACTEC 2009). Only the Flat Creek transmission-line corridor would span a Federal navigable water and would require authorization under Section 10 of the Rivers and Harbors Act (SCE&G 2011). Three additional crossings of Federal navigable waters are planned on the VCSNS-Varnville line within existing transmission-line corridors: the North Fork Edisto River, the Edisto River, and the Salkehatchie River (SCE&G 2011). The Santee Cooper transmission lines are expected to cross South Carolina navigable waters at 18 locations (4 new and 14 existing) (MACTEC 2009).

The new corridor would run adjacent to the existing corridor that currently spans Parr Reservoir. The Fishing Creek Reservoir crossing would require a new, 85-ft-wide corridor that would be placed adjacent and parallel to the north of an existing Santee Cooper-maintained corridor (MACTEC 2009). Santee Cooper would prepare a SWPPP, in accordance with SCDHEC guidance (SCDHEC 2002), for minimization of impacts on sediment quality during installation activities (MACTEC 2009).

A combined 551 linear ft of forested stream habitat would be converted to nonforested stream habitat through preparation of the Varnville transmission-line corridor (MACTEC 2009). Clearing of vegetation associated with Santee Cooper transmission lines would occur within new transmission-line corridors (50 to 125 ft wide) as well as existing corridors (50 to 85 ft wide). Because Santee Cooper has proposed to follow State and Federal guidelines, implementation of BMPs (e.g., setting structures on banks to divert runoff, implementing erosion control techniques, manual clearing of vegetation in wetlands) would further minimize impacts on waterbodies during transmission system installation activities. No direct impacts on the waterbodies are anticipated, with the exception of installation of concrete footings in Parr Reservoir. However, indirect impacts (e.g., potential for reduced shading and increased sedimentation) on waterbodies would likely occur in habitats that shift from forested to nonforested habitats. Impacts associated with vegetation clearing are anticipated to result in minor, localized impacts on areas adjacent to aquatic habitats. Santee Cooper transmission lines would cross navigable waters of the State of South Carolina at 18 locations. Permitting approval for these crossings would be required by the USACE through Section 10 of the Rivers and Harbors Appropriations Act of 1899 (33 USC 403) and SCDHEC.

4.3.2.3 Important Aquatic Species and Habitats

One Federally listed endangered aquatic species, the Carolina heelsplitter (*Lasmigona decorata*), is listed as possibly occurring in Fairfield County, but is not known to occur at the VCSNS site. In total, seven Federally listed or proposed threatened or endangered aquatic species occur within counties proposed for siting of new transmission lines, including designated critical habitat for the Carolina heelsplitter. Several aquatic taxa within Fairfield and Newberry Counties are State species of concern. The list of taxa includes one freshwater fish, three freshwater mussels, and one crayfish. In addition, two species of invasive aquatic plant are known to occur at the VCSNS site. Impacts stemming from the various installation activities are dependent on the sensitivity of a species to localized disturbance, habitat associations typically made by a particular species, critical time periods associated with a species' life cycle, and the intensity and duration of the disturbance. Numerous aquatic biota are found within the vicinity of the VCSNS site. The following discussion includes aquatic species that are of conservation concern and are known or thought to exist in the vicinity of the VCSNS site.

Recreational Species

Both Parr and Monticello reservoirs support recreational fisheries for largemouth bass (*Micropterus salmoides*), sunfish (*Lepomis* spp.), and catfish (*Ictalurus* spp.). Except for catfish, these species have life histories that indicate known use of shallow-water habitats for reproduction and nesting activities. The use of turbidity curtains and cofferdams can minimize impacts on these shallow-water habitats. However, the timing of installation activities may have more detrimental effects on aquatic resources if performed during critical spawning seasons in mid to late spring. Because no exact schedule is given for installation activities associated with the raw-water and water-treatment plant intakes or the blowdown line for VCSNS Units 2 and 3, activities in these potential shallow-water habitat areas may affect recreational species.

Invasive Species

Alligatorweed (*Alternanthera philoxeroides*) has been identified as an aquatic invasive species by the South Carolina Aquatic Invasive Species Task Force. Alligatorweed is a rapidly colonizing aquatic plant that forms dense vegetative mats that can alter flow and inhibit the uptake of water by other plants (SCDNR 2008). Proliferation of this aquatic nuisance species can occur via disturbance if plants become fragmented and subsequently re-root (SCDNR

2006). Alligatorweed has been documented above and below the proposed discharge location in Parr Reservoir (SCE&G 2010a). In addition, water primrose (*Ludwigia uruguayensis*) occurs in Monticello Reservoir, and can be an invasive, colonizing plant capable of choking shorelines and clogging intake structures. Shoreline installation activities that result in the disturbance of alligatorweed or water primrose may result in these plant species spreading to other aquatic habitats if vegetative fragments become uprooted and established elsewhere.

Important Species

The three freshwater mussel species listed as State species of concern within the vicinity (Fairfield or Newberry Counties) of the VCSNS site include the eastern creekshell (*Villosa delumbis*), the eastern floater (*Pyganodon cataracta*), and the yellow lance (*Elliptio lanceolata*). It is unknown whether the eastern creekshell or the yellow lance occurs within the vicinity of the VCSNS site. However, a single eastern floater was collected near the proposed raw-water intake in Monticello Reservoir (CBS 2009). A more detailed mussel sampling survey may be necessary to determine the extent of eastern floater presence near the intake-installation area prior to installation activities. Potential impacts on populations of mussels in the area of the proposed intake include habitat loss, reproductive losses, and mortality associated with dredging.

The Carolina darter (*Etheostoma collis*) is listed as a State endangered species in Fairfield County and a State threatened species in Richland County (SCDNR 2010a). Due to the limited distribution of this freshwater fish, any development activities that result in an alteration of habitats used by the Carolina darter pose a threat to this species (Hayes and Bettinger 2006). The Carolina darter was not documented during the SCDNR 2000-2004 Broad River drainage aquatic surveys (Bettinger et al. 2003, 2006) within the vicinity of the VCSNS site (Tetra Tech NUS, Inc. 2007, 2009a; Quattlebaum 2008a, b; Normandeau 2007, 2008, 2009) and was not captured during the 1978-1984 survey efforts within Parr and Monticello reservoirs (Dames and Moore 1985). Therefore, there are no anticipated impacts expected from preparation or installation activities in VCSNS-associated waterbodies.

The robust redhorse (*Moxostoma robustum*) is not explicitly listed as a Federal or State species of concern in any of the counties traversed by transmission lines for VCSNS Units 2 and 3. However, this species has been designated as a species of highest conservation priority (Self and Bettinger 2006) and transmission-line routes are proposed to cross waterbodies in which this species has been known to occur. The Robust Redhorse Conservation Committee has implemented efforts to reintroduce this native species to river basins such as the Broad River by stocking rivers with robust redhorse fingerlings (Self and Bettinger 2006; Rohde et al. 2009). In 2008, SCDNR caught two robust redhorse while electrofishing for smallmouth bass (*Micropterus dolomieu*) in Monticello Reservoir (NRC 2009). Aquatic surveys in the vicinity of the VCSNS site resulted in the capture of two robust redhorse in the Parr Reservoir, representing 0.1 percent of the total catch (Quattlebaum 2008a; Normandeau 2008). The use of turbidity curtains and cofferdams for installation activities associated with the raw-water and water-treatment plant intakes or the blowdown line for VCSNS Units 2 and 3 can minimize impacts on aquatic habitats within Parr and Monticello reservoirs.

One eel and three fish species targeted for restoration in the Broad River basin have not been documented in the vicinity of the VCSNS site. However, it is possible that the American eel, American shad (*Alosa sapidissima*), blueback herring (*A. aestivalis*), and hickory shad (*A. mediocris*) may establish spawning habitat in Parr Reservoir following restoration activities. A total of 47 American shad were observed during the 2007, 2008, 2009 spring monitoring periods at the Columbia Dam Fishway and during the same monitoring periods, only two blueback shad were noted during 2009 (Kleinschmidt 2007, 2008, 2009). While these species have been documented at the Columbia Diversion Dam, access near the vicinity of the VCSNS site is prohibited by the Parr Shoals Dam. The use of turbidity curtains and cofferdams would minimize turbidity and sedimentation impacts downstream on spawning habitats. The timing of installation activities would occur in advance of the reestablishment of these species in Parr Reservoir (SCE&G 2010a; FWS 2001).

Federally Listed Species

The Carolina heelsplitter is the only Federally protected aquatic species that may reside in onsite creeks and streams in the vicinity of VCSNS. Six Federally protected aquatic species reside within the counties affected by transmission-line installation activities: the shortnose sturgeon (*Acipenser brevirostrum*), Carolina heelsplitter, and four species of sea turtle: loggerhead sea turtle (*Caretta caretta*), green sea turtle *(Chelonia mydas),* leatherback sea turtle *(Dermochelys coriacea), and* Kemp's ridley sea turtle *(Lepidochelys kempii*). The Atlantic sturgeon (*Acipenser oxyrinchus)* is not currently listed either Federally or by the State of South Carolina, but on October 6, 2010 it was proposed for listing as endangered under the Endangered Species Act (ESA) (75 FR 61904) and is therefore considered as part of the NRC review. As part of the NRC's responsibilities under Section 7 of the ESA, the review team has prepared a biological assessment (April 2010) and a supplement (February 2011) documenting potential impacts on the Federally listed and proposed threatened or endangered aquatic and terrestrial species as a result of the construction and preconstruction activities at the VCSNS site. Both the biological assessment and the supplement are included in Appendix F of this EIS, and the findings and determinations are summarized in this section.

The shortnose sturgeon is an amphidromous freshwater fish that spends a portion of its life cycle in freshwater environments and a portion in estuarine ecosystems (NOAA 1998). It is listed as a Federally endangered species and is reported to occur in seven counties proposed for transmission-line crossings: Calhoun, Colleton, Dorchester, Hampton, Lexington, Orangeburg, and Richland (Pike 2010; MACTEC 2009; FWS 2010; SCDNR 2010b). Shortnose sturgeon are not reported to occur in river systems that would be crossed by either the new or existing corridor associated with the SCE&G VCSNS transmission lines (Palmetto 2010). In addition, shortnose sturgeon are not reported to occur in new Santee Cooper corridors, but they occur in river systems spanned by existing Santee Cooper corridors (MACTEC 2010). For example, the existing Santee Cooper VCSNS-Varnville transmission-line corridor crosses the North Fork Edisto River in two locations: along the Lexington and Aiken County line to the southwest of Woodford, South Carolina and in Orangeburg County just southwest of the city of Orangeburg (Figure 4-3), both in the Upper Edisto River basin. Collins and Smith (1997) reported that shortnose sturgeon occupied the South Fork Edisto River, but there have been no specific reports of this species in the North Fork Edisto River. Because there are no physical barriers to migration from the Ashepoo-Combahee-Edisto basin to the North Fork Edisto River, shortnose sturgeon may inhabit this reach of the basin. Furthermore, the Santee Cooper VCSNS-Varnville transmission-line corridor crosses the Edisto River southwest of the St. George substation (Figure 4-3). A historical record exists for occurrence of shortnose sturgeon in Orangeburg County on the North Fork of the Edisto River (SCE&G 2010c). The implementation of BMPs associated with updating existing Santee Cooper VCSNS-Varnville corridor as outlined in Section 4.3.2.2 should minimize impacts on surface waters and habitat for the North Fork Edisto River and Edisto River.

The Atlantic sturgeon is not currently listed either Federally or by the State of South Carolina. However, on October 6, 2010, the Carolina and South Atlantic distinct population segments of the Atlantic sturgeon were proposed for listing as endangered under the ESA (75 FR 61904). In light of this proposed listing, the review team is now considering effects on the Atlantic sturgeon associated with transmission-line preparation activities. Atlantic sturgeon have not been reported to occur either in the vicinity of the VCSNS site or in river systems that would be crossed by new corridor associated with VCSNS Units 2 and 3 (Palmetto 2010; MACTEC 2010). However, Atlantic sturgeon may occur in waterbodies spanned by the existing Santee Cooper VCSNS-Varnville transmission-line corridors (MACTEC 2010).

The VCSNS-Varnville transmission-line corridor crosses the Edisto River southwest of the St. George substation (Figure 4-3), which is the only waterbody known to have reported occurrences of Atlantic sturgeon associated with the proposed VCSNS transmission-line systems for Units 2 and 3 (ASSRT 2007). The transmission-line corridor at this location is limited to updating corridor and would not include new corridors. The implementation of BMPs associated with updating existing corridors as outlined in Section 4.3.2.2 should minimize impacts on surface waters and habitat for the Edisto River.

The Carolina heelsplitter is a freshwater mussel that has endured significant habitat degradation by various development activities. Historically, the species was reported in small to large streams and rivers, and usually found in mud, muddy sand, or muddy gravel substrates along stable, well-shaded stream banks. It is listed as a Federally endangered species and is thought to be sensitive to sedimentation and pollutants in waterways (SCDNR 2009). Within the State of South Carolina, Chester and Lancaster Counties have been designated as having areas of critical habitat for the heelsplitter (Pike 2010; MACTEC 2010; FWS 2011; SCDNR 2010a). The Carolina heelsplitter is known to occur in three counties containing existing or proposed transmission-line corridors for VCSNS Units 2 and 3: Chester, Lancaster, and Richland. The Carolina heelsplitter is listed for Fairfield, Lexington, and Newberry Counties, which also contain existing and/or new transmission-line corridors for VCSNS Units 2 and 3 (Table 2-20) (67 FR 44502).

The Santee Cooper VCSNS-Flat Creek line would require a new corridor in Lancaster County near drainages known to support the Carolina heelsplitter. The known Gills Creek population are upstream from the location of the proposed new corridor; approximately 15 mi north and 12 mi northeast (MACTEC 2010). However, the existing VCSNS-Flat Creek corridor crosses a portion of Flat Creek in Lancaster County that is listed by FWS as critical habitat and supports the Lynches River / Flat Creek population of Carolina heelsplitter (67 FR 44502). The Carolina heelsplitter is also known to occur within 1 mi of the existing Santee Cooper VCSNS-Varnville and VCSNS-Flat Creek transmission-line corridors in Richland and Lancaster Counties, respectively (SCDNR 2010b). In Fairfield County, the Carolina heelsplitter was included in the habitat survey of 2.44 mi of the proposed new Santee Cooper corridor in Parr Reservoir. However, survey efforts did not identify the occurrence of Carolina heelsplitter, nor were any noteworthy habitat attributes that may support this species identified (MACTEC 2008, 2009). In addition, a portion of the SCE&G VCSNS-Killian transmission-line corridor falls within Fairfield County, near watersheds associated with Carolina heelsplitter habitat; however, Pike (2010) reported no occurrences of the heelsplitter associated with this transmission-line corridor. GIS-based analysis confirms no spatial overlap in known locations of this species and SCE&G transmission lines (SCDNR 2010b). The use of BMPs for activities associated with preparation and installation of new and unmaintained existing transmission-line corridors and upgrades to existing corridors are expected to limit potential impacts on these species and critical habitats for the Carolina heelsplitter.

The loggerhead sea turtle, green sea turtle, leatherback sea turtle, and Kemp's ridley sea turtle do not occur in counties associated with the proposed VCSNS Units 2 and 3 transmission-line corridors with the exception of Colleton County. Current siting plans for the Santee Cooper VCSNS-Varnville transmission-line corridor, as discussed in Section 2.4.2.2, do not occur near nesting beaches or near marine habitats used by sea turtles in Colleton County. Therefore, there is no potential for transmission-line preparation activities to affect these species.

4.3.2.4 Aquatic Monitoring During Site Preparation

SCE&G plans to perform preconstruction-related monitoring for water quality in accordance with Federal and State permitting requirements as specified by USACE and SCDHEC. Prior to building activities within transmission-line corridors, monitoring may include on-the-ground surveys to implement appropriate site-specific BMPs. Accidental spills during the building phase would be mitigated through a Spill Prevention, Control, and Countermeasures Plan

(SCE&G 2010a). Monitoring associated with the SWPPP may also be implemented during the preconstruction and construction phases of the project (SCE&G 2010a), and SCDHEC may require specific monitoring activities as a part of its permitting process to assess potentially affected areas such as waterbodies associated with the VCSNS Units 2 and 3 site and within transmission-line corridors. The USACE would conduct compliance monitoring during the building phase of the project relative to activities within permitted areas (e.g., streams, wetlands, transmission-line corridors) (SCE&G 2010a).

4.3.2.5 Summary of Impacts on Aquatic Resources

The review team has reviewed the proposed site construction and preconstruction activities associated with VCSNS Units 2 and 3 and the potential impacts on aquatic biota and critical habitat in the Broad River and Parr Reservoir, Monticello Reservoir, onsite streams, and waterbodies associated with transmission-line corridors. Site construction and preconstruction activities would ultimately be episodic, yet impacts would be greatest for nonmotile aquatic organisms.

Filling in of the headwaters for Stream L, which flows into Mayo Creek (Figure 4-2), would result in a noticeable change for that immediate area; however, water-quality impacts are likely to be negligible through the use of BMPs to control sedimentation. Aquatic biota residing in this portion of Stream L would either move downstream as filling activities commence, or be eliminated if prevented from moving downstream (SCE&G 2010a). The loss of habitat and potential loss of species are expected to be minimal when considering similar unaffected freshwater stream habitats in the region.

Installation of water-intake and discharge structures would result in temporary impacts at distinct locations within the Parr and Monticello reservoirs, but would be largely controlled by the use of BMPs associated with the management of water quality. By following State and Federal BMPs associated with water quality, the impacts associated with installing new transmission-line corridors and clearing vegetation within unmaintained existing corridor on aquatic biota would be short-term and localized. Based on this review, the review team concludes that the impacts resulting from the proposed preconstruction and construction activities would be minimal.

Based on the information provided by SCE&G and the above observations from the review team's independent evaluation, the review team concludes that the impacts on onsite aquatic biota during construction and preconstruction activities for the proposed VCSNS Units 2 and 3 would be SMALL, and no further mitigation measures would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL, and no further mitigation measures would be warranted.

Based on information provided by SCE&G and the above observations from the review team's independent evaluation, the review team concludes that impacts on offsite aquatic biota from preconstruction activities related to the development of the proposed associated transmission lines would be SMALL, and no further mitigation measures would be warranted. The LWA rule specifically indicates that transmission lines are not included in the definition of construction. Therefore, the NRC staff concludes that there would be no impacts on offsite aquatic biota associated with NRC-authorized construction activities.

4.4 Socioeconomic Impacts

Socioeconomic impacts may occur in the region surrounding the proposed site. This discussion emphasizes socioeconomic impacts from construction and preconstruction activities on the four-county area, including Fairfield, Lexington, Newberry, and Richland Counties, although it considers the entire 50-mi region surrounding the proposed VCSNS site.[a] The scope of the review is guided by the magnitude and nature of the expected impacts of the construction and preconstruction activities of the proposed project and by the site-specific community characteristics that can be expected to be affected by these activities.

Along with the region and the subset of the region mentioned above, the review team considered an additional subset of the region called the economic impact area. This area includes the same four counties identified above, which the review team concludes make up the functional economic region for current and future impacts tied to the VCSNS site. This economic impact area is discussed in terms of employment, income, and output impacts.

Very large projects, such as proposed VCSNS Units 2 and 3 can affect individual communities, the surrounding region, and minority and low-income populations. The evaluation here assesses the impacts of project-related activities and of the onsite workforce during the VCSNS construction and preconstruction activities on the communities and governmental jurisdictions within the vicinity of the VCSNS site; i.e., the region within 50 mi of the VCSNS site. Unless otherwise specified, the primary source of information for this section is the SCE&G ER (SCE&G 2010a). The review team's conclusions are based upon independent verification of SCE&G's information in the ER, visits to the site, vicinity, and region, and consultation with local officials.

(a) For the purposes of this EIS, the relevant region is limited to the area necessary to include social and economic base data for (1) the county in which the proposed plant would be located and (2) the specific portions of surrounding counties and urbanized areas (generally, up to 50 mi from the VCSNS site) from which the construction and/or operations workforce would be principally drawn, or that would receive stresses to community services by a change in the residence of construction and/or operations workers.

If the two COLs are approved, construction and preconstruction activities are planned to span a total of 123 months, with 30 months dedicated to site clearing and preparation, and 93 months for building Units 2 and 3 (SCE&G 2010a). The building of Units 2 and 3 would be staggered by 2 years, for a total construction and preconstruction period of 10.25 years (SCE&G 2010a). SCE&G estimates that the peak onsite workforce for proposed VCSNS Units 2 and 3 during construction and preconstruction activities would occur during 2013 and again during 2015 reaching a total of up to 3600 workers. The staggered construction and preconstruction periods would allow the peak workforce from Unit 2 to transfer to Unit 3 and then steadily decline until both units are ready for operation. SCE&G indicates the operations staff of 400 at each unit would be employed approximately 2 to 3 years before fuel loading of each unit, to allow time for simulator training and startup testing (SCE&G 2010a).

The VCSNS site and parts of the surrounding region have experienced significant growth over recent decades, and, as a result, the area has adjusted to providing services needed by in-migrating populations. The region has not been insulated from recent negative economic impacts from the current economic downturn.

The following sections describe the economic component of the physical impacts on the site (Section 4.4.1), demographic impacts on the community (Section 4.4.2), economic impacts (Section 4.4.3), and the impacts on infrastructure and community services (Section 4.4.4). The impacts on minorities and low-income populations are covered in Section 4.5 of this chapter.

4.4.1 Physical Impacts

Construction and preconstruction activities can cause temporary and localized physical impacts such as noise, odors, vehicle exhaust, light, 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 impacts that may affect people, buildings, and roads.

4.4.1.1 Impacts on Workers and the Local Public

The VCSNS site is in a rural setting, bounded on the north by Monticello Reservoir and on the west by the Broad River. To the west and south are forested and agricultural lands in which a few residences and small communities are located. The site is located entirely within Fairfield County. No significant industrial or commercial facilities are planned in the immediate vicinity of the site. SCE&G plans to use the existing transmission lines and facilities where possible, although six new 230-kV transmission lines would be needed to connect the new units to the SCE&G grid, requiring 100-ft widening of some existing transmission-line corridors or entirely new corridors in some cases (see Section 4.1.2).

SCE&G has indicated that, with the exception of transmission-line development, all construction and preconstruction activities would occur within the VCSNS site boundary and would be performed in accordance with applicable Occupational Safety and Health Administration (OSHA) standards, BMPs, and other applicable regulatory and permit requirements.

The people most vulnerable to noise, fugitive dust, and gaseous emissions resulting from construction and preconstruction activities include personnel working onsite, and people working or living immediately adjacent to the site. Based on the 2000 U.S. Census, an estimated 104 individuals lived within 1 mi of the VCSNS site (SCE&G 2010a). Given their proximity, the residents living directly adjacent to the VCSNS site in the town of Jenkinsville and unincorporated Fairfield County have the greatest potential for offsite exposure to aesthetic, noise, air quality, and light impacts from construction and preconstruction activities. The review team expects impacts from the increased and altered traffic patterns and resulting noise, emissions, and congestion, and from impacts caused by the presence of VCSNS project-related workers would extend farther from the VCSNS site, but are likely to be minimal and concentrated in the nearby communities and on the roadways within the vicinity of the site.

4.4.1.2 Noise Impacts

Noise is an environmental concern because it can cause adverse health effects, annoyance, and disruption of social interactions. Noise would result from clearing, earthmoving, foundation preparation, pile driving (if needed), concrete mixing and pouring, steel erection, and various stages of facility equipment fabrication, assembly, and installation, during which a substantial number of diesel- and gasoline-powered vehicles and other equipment would be used. Noise from the VCSNS site also would be generated by internal combustion engines, impact equipment (e.g., jackhammers, pile drivers), and other equipment such as grinders and saws, explosives, loudspeakers, alarms, and sirens. Noise levels (measured in decibels [dB]) increase logarithmically, not arithmetically, as pressure levels of separate sounds combine. This means that if one sound of 60 dB is added to another sound of 60 dB, the total is 63 dB, a 3-dB increase, and not 120 dB. The Federal Interagency Committee on Noise determined that project-related increases of 1.5 decibels on the A-weighted scale (dBA) (if the ambient level is above 65 Ldn [day night average sound level]) or 3 dBA (if the ambient level is below 65 Ldn) are considered “substantial.” In addition to routine noises, sudden, infrequent, short-term blasts of noise may be disruptive of sleep or have a “startle effect” on humans and wildlife that can result in significant annoyance to affected populations.

During construction and preconstruction activities, noise is expected to peak above 100 dBA at a 50-ft distance from the equipment, with multiple pieces operating simultaneously. The activities that produce noises in this range would be intermittent, although at points in the project, activities could be scheduled for 24-hour days, 7 days a week. It is expected that noise levels experienced by sensitive noise receptors outside of the exclusion area boundary would rapidly attenuate to below 50 dBA (SCE&G 2010a). Continuous noise would be lower. Because the site is surrounded by forests and moderate topography, the review team concludes that noise emanating from the project site could be somewhat muffled to surrounding communities and the associated impact would be minimal.

The majority of transmission lines that would be needed for VCSNS Units 2 and 3 already have been constructed, although some expansions and upgrades would need to be built. Limited maintenance activities in transmission-line corridors and improvements to towers, lines, and corridors would be undertaken as part of the project and would create short-term sources of noise in the corridors. Consequently, the review team concludes that noise impacts on surrounding communities from these activities during construction and preconstruction would be negligible.

4.4.1.3 Impacts on Air Quality

The VCSNS site is in Fairfield County, South Carolina, which is an attainment area for all criteria pollutants (40 CFR 81.108 and 81.341). The baseline air quality characteristics are described in Section 2.9.2 of this EIS. The Clean Air Act establishes National Ambient Air Quality Standards (NAAQSs), which include the following criteria pollutants:

- sulfur dioxide (SO_2)
- particulate matter (including PM_{10} and $PM_{2.5}$)
- carbon monoxide (CO)
- nitrogen dioxide (NO_x)
- ozone (O_3)
- lead (Pb).

Temporary and minor impacts on local ambient air quality could occur as a result of activities at the VCSNS site during construction and preconstruction. Fine particulate emissions (less than 2.5 microns in size; $PM_{2.5}$) and coarse particulate emissions (less than 10 microns in size; PM_{10}) including fugitive dust, would be generated during earthmoving and material-handling activities. Equipment and offsite vehicles used for hauling debris, equipment, and supplies also produce emissions. Given Fairfield County's attainment status for criteria pollutants, only particulate matter, oxides of nitrogen (a precursor to ozone) and carbon monoxide (combustion exhaust) are pollutants of primary concern for construction and preconstruction impacts at the VCSNS site. Several variables affect emissions; these variables include the type of vehicles, the timing and phasing of construction and preconstruction activities, and haul routes. The emissions and their impacts on air quality would be minimized through mitigating actions and compliance with all Federal, State, and local regulations that govern construction and preconstruction activities and emissions from construction vehicles.

SCE&G stated that it would identify specific mitigation measures to control fugitive dust (SCE&G 2010a). Mitigation measures would include any or all of the following:

- Stabilize access roads and spoil piles.
- Limit speeds on unpaved access roads.
- Periodically water unpaved access roads to control dust.
- Perform housekeeping (i.e., remove dirt spilled onto paved roads).
- Cover haul trucks.
- Minimize material handling (e.g., limit drop heights and double handling).
- Cease grading and excavation activities during high winds and extreme air pollution episodes.
- Phase grading to minimize the area of disturbed soils.
- Revegetate road medians and slopes.
- Phase construction and preconstruction activities to minimize daily emissions.
- Perform proper maintenance of construction vehicles to maximize efficiency and minimize emissions.

Local air quality could be affected by construction and preconstruction activities. Exhaust emissions from construction vehicles and equipment would generate small amounts of particulate matter, carbon monoxide, oxides of nitrogen, and volatile organic compounds. If construction and preconstruction activities include the burning of debris, refuse, or residual building materials, SCE&G has indicated that it would secure any required permits from the State or county and follow any pertinent local ordinances.

Therefore, although emissions from construction and preconstruction activities and equipment operation are unavoidable, the review team concludes that SCE&G's mitigation efforts would limit impacts on air quality to minimal levels during construction and preconstruction activities and would not warrant mitigation beyond the measures discussed for inclusion in the mitigation plans.

BMPs and control measures would be used to limit the impacts of emissions. The concrete batch plant would be operated in compliance with SCDNR regulations; use of the onsite plant would reduce emissions from trucks that otherwise would deliver concrete to the site. Control measures would include development and implementation of a plan to control fugitive dust; grading to promote drainage and minimize mud on vehicles; stabilization of ground surfaces as soon as practical after clearing (e.g., reseeding); wetting of bare ground and unpaved roadways during dry conditions; conduct of any burning in accordance with applicable regulations and forest fire-safety measures; and inspecting and servicing construction equipment regularly (SCE&G 2010a).

4.4.1.4 Impacts on Buildings

Only SCE&G buildings would be affected by construction and preconstruction activities at the immediate VCSNS site. Existing buildings at the site have been constructed to safely withstand any possible impact, including shock and vibration, from activities associated with additional development at the VCSNS site (10 CFR Part 50, Appendix A). Except for the existing structures on the VCSNS site, no other industrial, commercial, or recreational structures would be directly affected by the construction of the new facility.

The nearest residence is approximately 1.3 mi from the site and is not expected to be directly affected by construction and preconstruction activities (SCE&G 2010a). If blasting is necessary, the building(s) most vulnerable to shock and vibration would be the VCSNS-related facilities, which have been built to withstand forces in excess of those they would experience as a result of activities at the VCSNS site (SCE&G 2010a). Consequently, the review team concludes that the impacts on buildings would be minimal and would not warrant mitigation.

4.4.1.5 Transportation Impacts

This EIS assesses the impact of transporting workers and construction materials to and from the VCSNS site from three perspectives: the socioeconomic impacts, the air quality impacts of dust and particulate matter put into the air by vehicle traffic, and the potential health impacts caused by additional traffic-related accidents. The socioeconomic impacts are addressed here and in Section 4.4.4.1. The air quality impacts are addressed in Section 4.4.1.3, and the human health impacts are addressed in Section 4.8.

No new construction or major modification of public roads is planned and only minor repairs and maintenance of existing roadways are likely in preparation for site-development activities. The affected roads are primarily rural or county roads and do not support large volumes of daily traffic. Therefore, the review team concludes that the expected physical impacts on public roads and highways would be minimal and limited to wear and tear on the local roads from the increased traffic to the site.

The main railroad lines in central South Carolina are owned and operated by the Norfolk Southern Railroad. Material deliveries to support construction and preconstruction activities are expected to be made by railroad using the existing VCSNS railroad spur that enters the site at its southern boundary and extends to the central portion of the site. The Norfolk Southern line and the VCSNS railroad spur would experience increased use if materials are brought in by train. The review team expects that some upgrading of the railroad line would be required between the site and Peak, South Carolina. Because these modifications are expected to be made within the existing railroad bed and any new railroad line would be built within the VCSNS site only, the review team concludes that the impacts of railway upgrading would be minimal.

4.4.1.6 Impacts on Aesthetics

The VCSNS site is on a plateau above the Broad River and surrounded by lowlands, forested hills, and agricultural lands. The site is largely concealed from view by the surrounding forests. The 6800-ac Monticello Reservoir hosts numerous water sports and outdoor activities throughout the year and is surrounded by natural woodlands and low-density residential communities. Jenkinsville Park, approximately 2 mi east of the site, is the closest park. Any plumes and some construction equipment are likely to be visible from the reservoir. However, because Monticello Reservoir is north of the proposed facility, direct view of the VCSNS Units 2 and 3 site is blocked by forest from most points on the reservoir or screened by views of Unit 1.

Visual impacts are determined by assessing the consequences of actions on scenic quality, scenic value, and the sensitivity of the affected viewscapes (DOI 2008). Negative visual impacts from additional development on the VCSNS site would be lessened by topography and by the fact that low-profile cooling towers would be used. Visual impacts on neighboring residents and individuals using the reservoir caused by cranes and increased traffic would be temporary. As noted in Section 4.1.2, minor patches of agricultural land would be permanently removed from production as a result of locating new transmission towers, but the review team expects the siting process would result in mitigation or compensation to affected land owners. Therefore, the review team concludes that the impact of construction and preconstruction activities at the proposed VCSNS site on aesthetics and recreational opportunities would be minimal and would not require mitigation.

4.4.1.7 Summary of Physical Impacts

The review team has evaluated information provided by SCE&G, visited the site and its environs, and performed an independent review of the potential physical impacts of construction and preconstruction activities on the local area and region of the VCSNS site. The review team concludes that the expected physical impacts enumerated in the preceding sections would be SMALL and that mitigation beyond the strategies outlined by SCE&G in its ER would not be warranted.

4.4.2 Demographic Impacts on the Community

Socioeconomic impacts are the result of project expenditures and employment that change the employment and population levels of a community from baseline levels. Project expenditures and employment drive changes in population baselines by drawing new residents into an area and/or by preventing the departure of existing residents from an area. Growth in population and employment increase spending in the area, leading to increased demand for housing, education, and other facilities and services. The assessment of demographic impacts of the proposed VCSNS Units 2 and 3 construction and preconstruction activities is based on the consequences to the region and local communities of employment of an estimated peak of almost 3600 workers. An additional 800 operations workers also would be onsite for training purposes toward the end of construction and preconstruction activities.

All workers onsite during the project are included in the assessment of impacts of the NRC-authorized activities, whether "construction" workers or "operations" workers. The building of Units 2 and 3 would be staggered by 2 years for a total site construction and preconstruction period of 10.25 years. This schedule would allow for sustained peak employment as employees finishing Unit 2 are then transferred to Unit 3 as it is reaching its employment peak, followed by a gradual reduction in employment as both units are completed.

As discussed in Section 2.5 of this EIS, the region extends 50 mi from the site boundary. Although the review team considered the entire region within a 50-mi radius of the VCSNS site when assessing socioeconomic impacts of construction and preconstruction activities, the primary focus is on Fairfield, Lexington, Newberry, and Richland Counties, all of which are in South Carolina. Based on the size of the resident workforce within commuting distance of the VCSNS site, commuter patterns, and the distribution of residential communities in the area, the review team expects minimal demographic impacts on other counties within the region.

Based on this information, the review team anticipates that the majority of the construction and preconstruction workforce would not migrate into the economic impact area but already would live within a reasonable commuting distance. The review team examined the Final Environmental Statement (FES) issued for the Operating License for Unit 1 by NRC (NRC 1981). The timing of the FES was such that construction of Unit 1 was nearly complete and provided some ready observations to the NRC staff about the extent of the socioeconomic impacts. Based on a survey of Unit 1 construction workers, the NRC staff concluded that 80 percent lived within the 50-mi region, and that 50 percent lived in Lexington or Richland Counties (NRC 1981). While construction methods and skill sets have changed over the intervening years, the greater Columbia metropolitan area has also grown significantly. The review team would not expect significantly different settlement patterns during the Units 2 and 3 construction and preconstruction activities.

Over the past decade, the four-county area surrounding the VCSNS site has experienced strong population growth, creating many employment opportunities for construction workers in the area. Given the presence of a significant construction industry and related workforce in the region, the review team expects significant in-migration would be unlikely during construction and preconstruction activities (see Tables 2-30 and 2-31).

As discussed in Section 2.5, the baseline (without VCSNS Units 2 and 3) population of the region is expected to continue to grow at a steady rate (see Table 2-23). Based on regional growth since the Unit 1 construction, coupled with observed migration behavior during the Unit 1 construction, and typical outage workforce migration patterns, the review team concludes that 50 percent of the peak workforce or 1800 workers can be assumed to migrate into the four-county economic impact area. Potentially, it could be less than that amount, but 50 percent provides a reasonable assumption, given that the skills required for modern, large-scale construction projects have increased in complexity and finding sufficient numbers of appropriately skilled workers would require searching beyond the Columbia metropolitan area (SCE&G 2009d). Using the U.S. Census Bureau's estimated household size of 2.6 persons, 1800 in-migrating workers amount to 4680 in-migrating persons when families are considered. The specific community impacts resulting from potential demographic changes are discussed in Section 4.4.4. Table 4-5 highlights expected county-level demographic impacts.

Table 4-5. Expected Distribution of In-Migrating Construction Workers in the Region at Peak of Construction

County	Number of Current Unit 1 Operations Workforce	Percent of Current Unit 1 Operations Workforce	Number of Units 2 and 3 In-Migrating Construction Workforce	Number of In-Migrating People
Fairfield County	58	9.1	164	426
Lexington County	219	34.5	621	1615
Newberry County	115	18.1	326	847
Richland County	209	32.9	592	1540
Economic impact area	601	94.6	1703	4427
Other counties	34	5.4	97	253
Total	635	100.0	1800	4680

The review team anticipates that the majority of the in-migrating workers would move into Richland and Lexington Counties because of their relative proximity to the site, housing availability, and amenities. The review team estimated the baseline population of the four-county area would increase steadily over the 2010–2060 period (see Table 2-23). Therefore, based upon current and projected population levels, the expected increase in in-migrating workers and their families would represent a less than 1 percent increase over the region's projected 2010 population.

Because of the area's size, the review team expects that any demographic impacts from construction and preconstruction activities would be SMALL and temporary. Likewise, the review team expects that Fairfield and Newberry Counties would receive relatively few of the in-migrating workers and their families. Therefore, the review team anticipates any population impacts of construction and preconstruction activities in Fairfield and Newberry Counties would not be noticeable and the communities nearest the VCSNS site would likely experience SMALL and temporary demographic impacts.

4.4.3 Economic Impacts on the Community

This section evaluates the changes in employment, income, and output attributable to the VCSNS Units 2 and 3 construction and preconstruction activities in the four-county economic impact area.

4.4.3.1 Economy

The impacts of construction and preconstruction activities on the local and regional economy depend on the region's current and projected economy and population. Characteristics of the economy and workforce in the region are described in Section 2.5.2 of this EIS. At its peak, the construction- and preconstruction-phase workforce is estimated to require about 3600 workers. Construction and preconstruction activities would be staggered by 2 years between Units 2 and 3 to avoid dramatic swings in employment. The number of in-migrating workers would be affected to some degree by local training programs and other measures to prepare the local labor force. In its ER, SCE&G estimates that the Units 2 and 3 construction and preconstruction activities would last 30 months for preparation and grading and 93 months for building the new units, for a total project duration of 10.25 years (SCE&G 2010a).

The in-migration of approximately 1800 workers, most bringing their families, would create new indirect jobs in the area. Through a process called the "employment multiplier effect," a new (direct) job in a given area stimulates spending for goods and services that results in the economic need for a fraction of a new (indirect) job, typically in service-related industries. The cumulative effect of a new direct job workforce being added to an economy induces the creation of a number of new indirect jobs. The ratio of new jobs (direct plus indirect) to the number of new direct jobs is called the "employment multiplier."

In addition, spending by construction workers and contractors during building stimulates additional spending through a second multiplier effect, where 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 "earnings multiplier." The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides regional multipliers for industry jobs and earnings and a custom set of multipliers was provided by BEA to SCE&G for the four-county economic impact area (SCE&G 2010a).

The Regional Input-Output Modeling System (RIMS II) employment multiplier for the economic impact area is 2.045, meaning that for each direct job created a total of 2.045 jobs (including the direct job) would be supported in the economic impact area. In the case of the VCSNS construction and preconstruction activities this means the 1800 direct jobs at the project peak would generate 1881 indirect and induced jobs in the four-county economic impact area. Only the in-migrating direct jobs are counted so that a net impact can be estimated. Other indirect and induced jobs are assumed to be allocated to area residents who would be leaving other jobs to take VCSNS-related employment. As a result, the direct employment of 3600 workers at the project peak would support a total of 3762 indirect jobs in the economic impact area. Because half of the workforce is expected to migrate to the area, only half of the direct and indirect employment supported by the project would count as an impact on the economic impact area.

Skilled workers required for construction and preconstruction activities at the proposed VCSNS Units 2 and 3 include electrical workers, welders, and pipe fitters. To obtain the necessary skilled and unskilled workers, construction companies are expected to recruit some employees from local technical school programs and to work with local and regional technical school programs and school administrators to expand offerings in the necessary technical and craft areas.

During visits to the area, the review team observed that job training programs are being implemented in the local area specifically to train workers for the VCSNS construction jobs and other similar jobs beyond the VCSNS project. Given the nature of the regional economy and the materials needed to construct proposed Units 2 and 3, only a relatively limited quantity of materials and services are expected to be purchased from within the economic impact area during construction and preconstruction activities.

The review team estimates that the average wage in the Columbia metropolitan area for these workers currently is about $37,000 per year or about $18.50 per hour, based on a 2000-hour work year, based on data from the Bureau of Labor Statistics (BLS 2008a). Assuming a benefits package that would double that annual amount to $74,000, the review team estimates that annual earnings at peak project employment would be about $266.4 million. That $266.4 million represents the direct income effect of the project to the economic impact area. Applying the income multiplier of 1.926 supplied to SCE&G from RIMS II, the earnings, including benefits, paid to the project workforce would result in generation of an additional $246.7 million annually in the economic impact area during peak employment years, for a total income effect of $513.1 million. As discussed with employment, the real impact would net out to about half ($256.5 million) because only half of the direct and indirect employment supported by the project would count as an impact to the economic impact area.

Combined with the indirect jobs created by the proposed action, this would likely have a positive effect on unemployment in the area during the early stages of the project when onsite employment would be increasing and would create business opportunities for housing and service-related industries, especially in Lexington and Richland Counties.

The review team concludes, based on its independent review of the likely economic effects of the proposed action that beneficial economic impacts of the proposed action would be experienced throughout the four-county economic impact area. Depending on actual worker relocation patterns, portions of Fairfield, Lexington, Newberry, and Richland Counties would expect temporary positive economic and employment impacts on the local economy during construction and preconstruction activities. Economic impacts elsewhere in the wider region would be smaller but beneficial.

4.4.3.2 Taxes

The tax structure of the region is discussed in Section 2.5 of this EIS. Several types of taxes would be generated during the construction and preconstruction activities, including income taxes on wages and salaries, sales and use taxes on corporate and employee purchases, and personal property taxes associated with employees.

Given that 50 percent of the peak project workforce already would live in the local area, and that the in-migrating workers would reside primarily in the four counties roughly in the same distribution as the current operations workforce for Unit 1, the review team expects no county in the economic impact area or the State to experience a significant change in its tax revenue streams during construction and preconstruction activities. To the degree that skilled workers from out of state are likely to relocate to the economic impact area during construction and preconstruction activities, the review team expects that a minimal increase in State income tax revenue would be generated from their salaries. However, the skilled craft jobs would account for a very small proportion of the overall workforce in the economic impact area, making a major State income tax revenue impact unlikely.

Because the number of new income tax payers in South Carolina resulting from the VCSNS project would not change noticeably in the context of the State's income tax base, the review team determined income tax revenue attributable to the VCSNS project also would be minimal. The review team estimates that $12−$15 million in annual income tax revenue would be attributable to construction and preconstruction during peak years of activity; however the overwhelming majority of that revenue would have been generated by the same workers, from employment some place in South Carolina other than at the proposed new units at the VCSNS site. Similarly, the review team assessed State sales tax impacts in the same context. Such revenue impacts only apply to the portion of the workforce that would be new to South Carolina and also would be minimal.

The in-migrating employees and contractors working at the VCSNS site during the project also would pay property taxes, State income taxes, real-estate transfer fees, and motor-vehicle taxes, which are collected by or on behalf of the State government and distributed to State agencies and minor jurisdictions, including schools. The economic impact area would experience an increase in sales and use taxes generated by retail expenditures (e.g., restaurants, hotels, merchant sales, food) by the construction and preconstruction workforce. SCE&G estimates that $11 million (2007 dollars) in annual sales tax revenue would be attributable to construction and preconstruction activities (SCE&G 2010a). The State also would experience an increase in the sales and use taxes collected from building materials and supplies purchased for the project and workers spending their incomes on goods and services in South Carolina. These revenues would likely be generally proportional to the wages paid to workers at proposed Units 2 and 3, increasing through the peak of construction and preconstruction activities and then declining until stabilizing after completion of these activities.

Although SCE&G currently pays property taxes on the existing land and improvements at the VCSNS site, the review team does not expect that there would be any increase in property taxes revenue until after construction and preconstruction activities are completed. Currently, taxes paid by SCE&G on the VCSNS site account for about 40 percent of Fairfield County's total annual property tax revenues. For the years 1999 to 2008, based on Table 2-33 of this EIS, SCE&G's share of Fairfield County's property tax revenue has been slightly declining. After completion, SCE&G would pay property taxes on the new VCSNS Units 2 and 3 facilities under a "fee in-lieu of tax" agreement with Fairfield County (SCE&G 2009k). These impacts are discussed in Section 5.4.3.2.

Based on this assessment, the review team concludes that the potential impact of taxes within the region because of the construction and preconstruction activities would be minimal and beneficial. The impact within Fairfield County, where the units would be located, also would be minimal and beneficial because the review team expects most tax impacts to occur during the operations phase.

4.4.3.3 Summary of Economic Impacts on the Community

The review team has reviewed information provided by SCE&G, visited the site and its environs, and performed an independent review of potential economic impacts of construction and preconstruction activities on the local area and region of the VCSNS site. The review team concludes that the expected economic impacts on the affected communities, enumerated in the preceding sections, would be SMALL and beneficial, and no further mitigation would be required.

4.4.4 Infrastructure and Community Service Impacts

Infrastructure and community services include transportation, recreation, housing, public services, and education, as described in the following sections.

4.4.4.1 Transportation Impacts

Railways, waterways, roads, and highways are the modes of transportation relevant to the VCSNS site.

Railways and Waterways

While the spur line from the Norfolk Southern railroad line may be used to bring in heavy construction materials, the review team does not anticipate its use to increase greatly. Some railroad upgrading may be required and new spur lines would be laid on the VCSNS site. No waterways would be used to transport construction materials to the site.

Roads and Highways

This section deals with the infrastructure impacts of the traffic generated by construction and preconstruction activities. The air quality impacts of transportation are addressed in Section 4.4.1.5 and the human health impacts are addressed in Section 4.8.3.

Construction- and preconstruction-related impacts on traffic are determined by five elements:

- the number and timing of worker vehicles on the roads per shift
- the number of shift changes for the workforce per day
- the number and timing of truck deliveries to the site per day
- the projected population growth rate in Fairfield County
- the current capacity and usage of the roads, including use by the existing operations workforce.

Based on South Carolina Department of Transportation (SCDOT) traffic data (see Table 2-34), SC-213 between the Newberry County line and SC-215 at Jenkinsville currently averages 2400 vehicles daily under normal circumstances. That number is well under the 8600-vehicle capacity suggested by level of service (LOS) “C”, which is the SCDOT standard for two-lane rural roadways (SCDOT 2009). SCDOT also indicates that SC-215 from the Richland County line to the junction with SC-213 averages 1600 vehicles daily under normal circumstances, also well under LOS “C” standards. The review team recognizes that many options exist to allow flexibility in organizing site shift schedules, and believes that a two-shift work schedule would be a realistic assumption for the VCSNS site for traffic impact analysis during construction and preconstruction activities. SCE&G suggested that under a two-shift option (two 12-hour shifts), total peak-hour traffic on SC-213 and SC-215 would be 2118 vehicles, of which 1800 would be associated with VCSNS Units 2 and 3 activities (SCE&G 2009k). Under that assumption, the annual average daily traffic (AADT) for each route would rise to 6000 for SC-213 and to 5200 for SC-215, still well within SCDOT capacity standards.

Under these assumptions, SCDOT daily road-capacity standards would not be exceeded, but would be exceeded during peak commute periods of the day such as shift changes (SCE&G 2010a), and the increase in traffic would be noticeable to local residents in the Jenkinsville area for the worker commuting hours during the period of peak building activity. The review team estimates volumes during construction and preconstruction activities would represent a 50-percent increase in AADT on SC-213 and a 125-percent increase in AADT on SC-215. The review team concludes that these impacts would be noticeable, especially during periods of shift change. These impacts would be further exacerbated by truck traffic and site delivery traffic that have no other route options available. Without mitigation, acute traffic impacts would increase during outage periods at Unit 1, when on average 655 additional workers, spread across a similar shift schedule, would travel to the site.

SCE&G states that it would develop a traffic-management plan prior to starting major construction and preconstruction activities. Planned mitigation measures could include establishing centralized parking away from the site and using worker bus shuttle services, encouraging car pools, staggering shift schedules so that acute traffic impacts could be avoided, scheduling delivery services to occur at off-shift-change times, and establishing shuttle services from Columbia (SCE&G 2010a).

Based on information provided by SCE&G and the review team's own independent review, including visits to the site and affected communities, the review team concludes that during peak site employment, the traffic impacts from site-development activities for Units 2 and 3 (including the traffic impacts of Unit 1 outage workers) would have locally noticeable impacts in the immediate vicinity of the VCSNS site and the community of Jenkinsville and minimal impacts on other roadways in the region. These impacts would be largely temporary and of short duration, based on the size of the workforce during any one period, and would abate as construction and preconstruction activities wind down. SCE&G has identified several planned mitigation measures to minimize the impact. Therefore, the review team concludes that traffic impacts in the Jenkinsville area would be noticeable, but not destabilizing, in close proximity to the site, including the Jenkinsville community. The rest of the region would experience little to no traffic-related impacts.

4.4.4.2 Impacts on Recreation

As discussed in Section 2.5.2.4, a variety of recreation areas exist in the region, including State parks and public and private facilities that support outdoor activities such as recreational boating and fishing on the Monticello Reservoir, hiking, camping, and hunting. The review team expects that recreationists would not be precluded from hunting, fishing, or other outdoor recreation activities in the vicinity of the site as a result of construction and preconstruction activities.

The review team concludes that at least half of the construction workers and their families would be from within the region and therefore would have no net effect on the usage rates for local recreational facilities. Given the large population of the 50-mi region and the relatively small number of expected in-migrating workers relative to each county's population, the review team expects some minimal increase in recreation site usage rates due to the in-migrating worker families and mitigation would not be warranted.

4.4.4.3 Housing Impacts

Regional housing characteristics and availability are described in Section 2.5.2.5 and Table 2-35. The proximity of a number of population centers to the VCSNS site, including the City of Columbia, adds flexibility to the provision of housing in the vicinity of the site. The urban areas of Columbia, Lexington, and West Columbia – all within reasonable commuting distance to the site – add to this flexibility. Given the number of new jobs that would be created by the construction and operation of proposed VCSNS Units 2 and 3, and the availability of heavy construction workers within the region (see Table 2-31), the demand for housing by in-migrating workers would not put significant pressure on the local housing supply.

The greater Columbia metropolitan area has sufficient housing available for rent or purchase, as is typical of most developing urban areas. If a significant number of workers migrate into the area, the region would be able to provide housing for the workers and their families. The four-county area surrounding the VCSNS site has demonstrated that it can meet the housing demands of a growing population over the past decade during which it experienced steady growth. Housing data for this area in 2000 indicate that there were 21,848 vacant housing units, or 8.8 percent of the county's total housing stock. Renter-occupied housing accounted for 70,549 or 31.2 percent of the area's total occupied housing stock (see Table 2-35). Based on county population projections, the review team believes that population growth will remain steady in this area for the 2010–2060 period, necessitating continued expansion of the area's housing stock (see Table 2-23).

The boom-and-bust nature of large-scale construction projects aggravates the housing impacts in local communities. The typical pattern begins when in-migrating workers and their families (along with local residents with enhanced economic resources because of project- and worker-related jobs and expenditures) increase the demand for housing. Increased demand creates upward pressure on both the housing supply and prices in the local area. When construction ends, most in-migrating workers leave and local indirect jobs also are lost. Because a considerable construction workforce already lives locally, many of these impacts could be avoided. Additionally, the high population growth rate in the region would mitigate much of the economic decline after the completion of construction. Planning and zoning activities since the completion of Unit 1 are likely to prevent adverse impacts from haphazard housing practices like informal recreational vehicle camping, living out of vehicles, etc. Finally, the review team believes that while recent economic events have depressed the national economy, this economic downturn is temporary, and current long-term growth projections are still reasonable.

Based on the information provided by SCE&G and NRC's own independent review, the review team concludes that the housing-related impacts of the proposed VCSNS Units 2 and 3 construction and preconstruction activities would be minimal and temporary for the region and the four-county area, with no particular concentration of impacts, and that no mitigation would be warranted.

4.4.4.4 Impacts on Public Services

This section describes the available public services and discusses the impacts of construction and preconstruction activities at the VCSNS site on water supply and waste treatment; police, fire, and medical services; education; and social services in the region.

Water Supply Facilities

Like VCSNS Unit 1, water for VCSNS Units 2 and 3 construction and preconstruction activities, including potable water and industrial use, would likely be obtained from Monticello Reservoir. As described in Section 3.2.2, a new water-treatment system supplied by Monticello Reservoir would be developed to serve Units 2 and 3. Monticello Reservoir has a total storage capacity of 400,000 ac-ft (130,341 million gallons) and a usable volume of 45,000 ac-ft (14,663 million gallons) that is maintained by pumping from the Broad River via the Fairfield Pumped Storage Facility. The peak withdrawal rate during construction and preconstruction activities from Monticello Reservoir is estimated to be 420 gpm (SCE&G 2010a). This withdrawal rate is less than 1 cfs, and, conservatively assuming complete consumptive use, represents about 0.1 percent reduction of Broad River flow under very low-flow conditions (1 cfs out of 853 cfs). Until the proposed water-treatment system for Units 2 and 3 is operational, water for construction and preconstruction would be obtained from the Jenkinsville Water District, a public source with enough excess capacity to meet this additional demand (SCE&G 2010a). Therefore, the review team concludes that impacts on the site potable water system would be minimal.

Monticello Reservoir supplies water to VCSNS Unit 1, but is not a source for any public water systems. As discussed in Section 4.2.2, the review team does not expect construction and preconstruction activities to affect groundwater or wells in the region. The review team concludes that there would be minimal impacts on public water systems and private wells in the vicinity due to water demands onsite.

The location and capacity of water and wastewater systems serving the communities in the four-county area are described in Section 2.5.2.6. These communities are expected to provide a majority of the construction and preconstruction workers, minimizing the need for additional water supplies. The review team expects impacts on public water systems from in-migrating workers and their families to be minimal, because large concentrations of workers relocating to any single locality within the four-county area are not likely, and most of the communities in the four counties have excess capacity within their water-treatment facilities (see Table 2-37).

Wastewater-Treatment Facilities

The municipal wastewater-treatment facilities affected by the in-migration of population because of the VCSNS Units 2 and 3 construction and preconstruction activities are described in Section 2.5.2.6. As indicated previously, the majority of the workforce is expected to come from within the region, while the majority of in-migrating workers would relocate to communities in the four-county area. The region surrounding the VCSNS site has experienced steady and significant population growth in the past decade, and as a result, water districts in the region have developed wastewater-treatment plants capable of absorbing the increased demands (see Table 2-38). SCE&G expects to construct a new sanitary waste-treatment system to service site-development activities for Units 2 and 3 (see Section 3.2.2). The review team expects minimal impacts on wastewater-treatment facilities from the Units 2 and 3 construction and preconstruction activities and no mitigation would be warranted.

Police, Fire, and Medical Facilities

The Fairfield County Sheriff's Department and local police departments provide law-enforcement services in Fairfield County. The Fairfield County Sheriff's Department has jurisdiction in the unincorporated areas of the county and is the designated emergency response police enforcement provider. Current growth trends in property tax revenue, illustrated in Table 2-33, suggest that demands for any new services associated with construction and preconstruction activities would be readily absorbed by the increase in revenue associated with general growth in the local area. The review team concludes that the impact on law enforcement and firefighting services would be minimal and no mitigation would be warranted.

Residents in the four-county area are served by several hospitals, a number of clinics, and private practice doctors and dentists. Within the region surrounding the VCSNS site, Richland County acts as a central hub for healthcare services with several large medical centers in the Columbia area. The capacities for each of these medical centers can be found in Section 2.5.2.6. For this reason, the review team concludes that there would be no significant impacts on medical facilities and on resident healthcare services in the region.

Social Services

The review team anticipates that demands placed on social services related to construction and preconstruction activities would occur in proportion to workforce residence patterns. Therefore, no single county would experience significant increases in demand for social services compared to any other. The review team believes the fact that Fairfield County is the host county of the VCSNS site does not imply that Fairfield County would receive any more impact on its social services infrastructure than any other county in the four-county area.

Workforce training programs currently getting underway are expected to mitigate some demands on some income-based social services. The enhanced employment opportunities created by the multiplier effect during construction and preconstruction activities may provide some benefits to the disadvantaged population served by the South Carolina Department of Social Services. Increasing populations will most likely result in increased demand for non-income-related health services, such as aid for children with special needs. However, such increases would constitute only a minor part of the overall availability of these services. As the project nears completion and direct and indirect jobs are lost, demands on social services may trend back to their original levels. The review team concludes that the impact on social services within any given county in the local area would be minimal.

4.4.4.5 Impacts on Education

Within the four-county area there are 168 public schools serving almost 111,000 students, with an average student-to-teacher ratio of 13.3 to 1, well below the State-mandated ratio maximum of 28:1. The total number of students in the public school systems surrounding the VCSNS site has grown over the past decade as the population of the region as a whole has grown. The largest public school districts in the area plan to construct new schools prior to the start of VCSNS Units 2 and 3 activities. Based on information in Table 4-5, the number of in-migrating workers and their families will most likely be minimal and would be dispersed across the four-county area in roughly the proportion of the current operations workforce for Unit 1. The review team believes that project-related students that would enter the local school systems already have been factored into current growth projections. Therefore, the review team determined the impact of these new students on the education system in the four-county area would be minimal and no mitigation would be warranted.

4.4.4.6 Summary of Infrastructure and Community Service Impacts

The review team has evaluated information provided by SCE&G, visited the site and its environs, and performed an independent review of potential infrastructure and community service impacts of construction and preconstruction activities on the local area and region of the VCSNS site. The review team concludes that the expected infrastructure and community service impacts on the affected communities, enumerated in the preceding sections, would be SMALL, with one exception. The review team concluded that transportation impacts for a limited number of people living and working along the roadway network in the Jenkinsville community would be MODERATE. The review team also concluded that no further mitigation would be warranted for socioeconomic impacts, beyond SCE&G’s commitments.

4.4.5 Summary of Socioeconomic Impacts During Construction and Preconstruction

Based on the discussion in the preceding sections, the review team concluded that the socioeconomic impacts of construction and preconstruction activities would be SMALL, with one exception. The review team concludes that transportation impacts for a limited number of people living and working along the roadway network in the Jenkinsville community would be MODERATE. The review team also concludes that no further mitigation would be warranted for socioeconomic impacts, beyond SCE&G's commitments.

Based on the conclusions above, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL, with one exception. The NRC concluded that no further mitigation would be warranted for those impacts.

The review team concludes that the transportation impacts along the roadway network in the Jenkinsville community would be MODERATE. To determine the portion of this impact attributable to NRC-authorized construction activities, the NRC staff assumes, based on SCE&G's characterization of construction-related labor hours (SCE&G 2010a), 80 percent of traffic-related impacts over the life of the project would be associated with NRC-authorized construction activities. Using this allocation, the NRC staff estimates that VCSNS construction activities would lead to an increase of traffic on SC-213 of 40 percent above baseline conditions during peak project employment. The impact on SC-215 would be a 100-percent increase in traffic above baseline conditions. SCE&G has committed to extensive traffic-mitigation activities noted in Section 4.4.4.1, which would reduce the potential traffic impacts in the Jenkinsville area. Traffic levels associated with NRC-authorized construction activities would not exceed State capacity standards for two-lane highways. However, the NRC staff concludes that the traffic impacts in the Jenkinsville area from NRC-authorized construction activities still would be MODERATE, and additional mitigation measures beyond SCE&G's commitments would not be warranted.

4.5 Environmental Justice Impacts

The review team evaluated whether the health or welfare of minority and low-income populations in the communities identified in Section 2.6 of this EIS could be affected by disproportionately high and adverse impacts from building VCSNS Units 2 and 3 at the proposed site. The review team (1) identified all potentially significant pathways for human health and welfare effects, (2) determined the impact of each pathway for populations, and (3) determined whether the characteristics of the pathway or special circumstances of the minority and low-income populations would result in a disproportionately high and adverse impact. To perform this assessment, the review team followed the methodology described in

Section 2.6.1. In the context of construction and preconstruction activities at the VCSNS site, the review team considered the questions outlined in Section 2.6.1.

Research of population data indicated several census blocks within the vicinity of the VCSNS site and region having a minority population representing over 50 percent of the total population. Therefore, the review team concluded that more research into these populations and potential pathways was warranted. Upon further investigation, the review team determined that the population within the vicinity of the site, while not identified through the review criteria discussed in Section 2.6.1, included a high proportion of low-income people, as well. Furthermore, these minority and low-income communities exhibit additional unique characteristics and practices (subsistence fishing and hunting and personal vegetable gardening) that further identify them as being vulnerable to disproportionately high and adverse impacts. Therefore, the review team determined that the high proportion of minority and low-income people living in the vicinity of the VCSNS site and Jenkinsville creates a potential for a disproportionate impact.

Environmental justice impacts are described in the following sections, including the impacts on health (Section 4.5.1), physical and environmental (Section 4.5.2), subsistence and special conditions (Section 4.5.3) and socioeconomic impacts (Section 4.5.4). Environmental justice impacts are summarized in Section 4.5.5.

4.5.1 Health Impacts

Section 4.9 of this EIS assesses the radiological doses to construction workers and concludes that the doses would be within NRC and U.S. Environmental Protection Agency (EPA) dose standards. Section 4.9 further concludes that radiological health impacts on the construction workers for proposed VCSNS Units 2 and 3 would be SMALL. In addition, there would be no radioactive material on the construction site except for small sources such as those commonly used by radiographers; therefore, there would be no radiation exposure to members of the public living near the construction site. Based on this information, the review team concludes there would be no disproportionately high and adverse impact on low-income or minority members of the construction workforce or the local population.

Section 4.8 of this EIS assesses the nonradiological health effects for construction workers and the local population from fugitive dust, noise, occupational injuries, and transport of materials and personnel. In Section 4.8, the review team concludes nonradiological health impacts on construction workers and the local population would be SMALL. While the review team found evidence of unique characteristics and practices in the minority or low-income populations near the site, no practices or characteristics were found that would result in differential nonradiological health impacts compared to the general population. Based on this information, the review team concludes there would be no disproportionately high and adverse impact on low-income or minority members of the construction workforce or the local population.

4.5.2 Physical and Environmental Impacts

Except for the final phases of construction and preconstruction activities, just before the fuel is loaded into the reactor, construction of a nuclear power plant is very similar in environmental effects to the construction of any other large-scale industrial project. The three primary pathways in the environment for impacts to occur are via soil, water, and air. The potential impacts on each of these pathways, along with noise and socioeconomic impacts are discussed below.

4.5.2.1 Soil-Related Impacts

Construction and preconstruction activities at the VCSNS site represent the largest source of soil-related environmental impacts. However, while construction and preconstruction activities would disrupt large volumes of soil, the effects would be primarily localized and would have little migratory ability and would diminish to imperceptible levels beyond the site boundary. The planned use of BMPs at the site would mitigate these effects. Soil disruption within local communities attributable to any induced development activities would be limited, similar to normal ongoing activities, and dispersed geographically. As discussed in Section 2.6.3 of this EIS, while the review team found evidence of unique practices (private vegetable gardening) for the high proportion of low-income communities in the vicinity of the site and near Jenkinsville, the review team did not find any pathway that could result in different soil-related impacts compared to the general population. Given these factors, the review team concludes that soil-related environmental impacts during construction and preconstruction activities would impose no disproportionately high and adverse impacts on minority and low-income populations.

4.5.2.2 Water-Related Impacts

Water-related environmental impacts include erosion-related degradation of surface water and the introduction of anthropogenic substances into surface water and groundwater. Such impacts attenuate rapidly with distance and would reach near background levels beyond the site boundary. No local minority or low-income communities were found to use the Broad River as the source of their water. As analyzed in Section 4.2, the review team expects SMALL impacts on the Broad River or Monticello Reservoir from sediments and contaminants.

Onsite groundwater would not be used as a water-supply source during construction and preconstruction activities, and there would be no discharges to the groundwater environment. Any necessary dewatering of the excavation would be localized, temporary, and limited in impact to areas within the site boundary. Consequently, the impacts of the proposed action on groundwater quality would be negligible, localized, and temporary. As discussed in Section 2.6.3 of this EIS, the review team found evidence of some subsistence fishing in the vicinity of the site and near Jenkinsville, but did not identify any construction or preconstruction pathway that could result in different water-related impacts compared to the general population.

Therefore, the review team concludes that the potential for minor negative impacts from surface-water or groundwater sources would not cause water-related disproportionately high and adverse impacts on minority and low-income populations.

4.5.2.3 Air Quality Impacts

Air quality impacts attenuate rapidly with distance from the source. Based on the findings in Section 4.4.1.3, motor-vehicle exhaust and dust from onsite construction and preconstruction activities would cause minor and localized air quality impacts that would not extend beyond the site boundaries. However, traffic-related air quality impacts would be more apparent within the vicinity of the site or the site access roads. While minority and low-income populations have been identified in the vicinity of the site and the site access roads, air quality impacts would be limited in duration to the peak employment period while building the proposed project and only to short periods of time during worker commutes.

Air quality impacts from construction and preconstruction activities at the site are at a distance from sensitive receptors and as a result are projected to cause minor localized adverse impacts on air quality at peak employment. These impacts would be highly localized and limited to the VCSNS site and local transportation routes leading to the site. Other than their location along access roads that may become congested, the review team did not identify evidence of any other unique characteristics or practices in the environmental justice community that may result in different impacts compared to the general population. Given the attenuation due to distance, the limited duration of construction and preconstruction activities, and the highly localized nature of the impacts, the review team concludes that construction and preconstruction activities would cause minor, but not disproportionately high adverse impacts on air quality for minority and low-income populations.

4.5.2.4 Noise Impacts

Section 4.4.1.2 of this EIS describes the review team's evaluation of noise impacts on surrounding communities from construction and preconstruction activities. These impacts were determined to be negligible. As stated in that analysis, noise levels from construction and preconstruction activities may exceed 100 dB within the site, but would be attenuated by distance and obstacles such as buildings, vegetation, and topography. Noise from traffic along the access routes to the sites may intermittently exceed levels acceptable for residential areas. However, these impacts would be more noticeable within the vicinity of the site or the site access roads. Sensitive noise receptors closest to the site are likely to experience intermittent, but temporary, noise pollution during the peak of construction and preconstruction activities.

Other than their location within the site vicinity, the review team did not identify evidence of unique characteristics or practices in the environmental justice community that may result in different noise-related impacts compared to the general population. Adverse noise impacts attenuate rapidly with distance and would not extend beyond this limited geographic area. Given the noise attenuation due to distance and physical obstructions, the limited duration of peak construction and preconstruction activities, and the highly localized nature of the activities (immediate proximity to the site), the review team concludes that construction and preconstruction activities would cause minor, but not disproportionately high and adverse noise impacts on minority and low-income populations.

4.5.3 Subsistence and Special Conditions

The NRC's environmental justice methodology includes an assessment of affected populations of particular interest or with unusual circumstances, such as minority communities that are exceptionally dependent on subsistence resources or identifiable in compact locations such as American Indian settlements. As discussed in Section 2.6.3, the review team was also made aware of anecdotal evidence of private vegetable gardens and subsistence fishing among the low-income populations in the vicinity of the VCSNS site (NRC 2010). However, under closer investigation, no pathways were identified from construction and preconstruction activities that would modify or disrupt these subsistence uses. The review team also searched locally for evidence of subsistence fishing and hunting and could not identify any concentration of these activities that would be affected by construction and preconstruction activities at the site. Nor did the review team identify any unusual resource dependencies such as plants with religious or economic significance or any key transportation routes that might be disrupted by construction and preconstruction activities. Therefore, the review team concludes that there would be no disproportionately high adverse impacts on the subsistence activities of minority or low-income populations from construction and preconstruction activities for VCSNS Units 2 and 3.

4.5.4 Socioeconomics

The four-county economic impact area has sufficient housing available and has experienced levels of growth such that in-migrating workers would not have a noticeable impact on housing prices or availability in any affected county.

Other than their location along access roads that may become congested, the review team did not identify evidence of any other unique characteristics or practices in the environmental justice community that may result in different impacts compared to the general population. With respect to the natural or physical environment, the review team determined that traffic during construction and preconstruction has the potential for adverse impacts on residents in the vicinity of the VCSNS site and in Jenkinsville. As discussed in Section 4.4.4.1, while daily road capacity standards would not be exceeded by the maximum building related traffic (daily commute times during peak building activity), peak-hour traffic levels would exceed current State management standards (SCE&G 2010a), and construction worker traffic would constitute a 50-percent increase in average daily traffic along SC-213 and a 125-percent increase along

SC-215. The review team anticipates that because the traffic-related impacts are temporary and of short duration in nature, they would be noticeable but not destabilizing to the Jenkinsville community. Without mitigation, acute traffic impacts would increase further during outage periods at Unit 1, when on average 655 additional workers, spread across a similar shift schedule, would travel to the site.

SCE&G states that it would develop a traffic-management plan prior to starting major construction and preconstruction activities, including a possible centralized parking lot that would transport workers to and from the VCSNS site, encouraging car pools, staggering shift schedules and delivery services and establishing shuttle services from Columbia (SCE&G 2009a). However, even with the proposed mitigation, given the communities in the vicinity of the VCSNS and Jenkinsville exhibit such high proportions of minority and low-income people, the review team determined that there could still be a disproportionately high and adverse impact on minority and low-income communities in the vicinity of the VCSNS site.

The actions to be taken by SCE&G, together with the intermittent and limited duration characteristics of commuter traffic, led the review team to determine that there would be a noticeable but not destabilizing impact on those minority and low-income populations.

4.5.5 Summary of Environmental Justice Impacts During Construction and Preconstruction

Given the magnitude of the impacts that would generally be attenuated due to distance, the limited duration of construction and preconstruction activities, and the highly localized nature of the impacts, the review team concludes that construction and preconstruction activities would cause SMALL, but not disproportionate, impacts on health, physical and environmental resources, subsistence and special conditions, and socioeconomics. The review team determined in Section 4.4.4.1 that traffic impacts related to construction and preconstruction activities would be noticeable in the Jenkinsville area. This area was identified in the review team’s analysis, described in Section 2.6, as having minority populations that meet the definition of environmental justice populations, and through review team site visits as having a significantly high proportion of low-income households, as well. Therefore, the review team concluded there could be traffic-related disproportionately high and adverse impacts on minority and low-income populations found in the Jenkinsville area. However, the review team believes that because the traffic-related impacts would be temporary and of short duration in nature, and would be mitigated to some extent by SCE&G commitments, they would be noticeable but not destabilizing to the Jenkinsville community. Therefore, the review team concludes that the environmental justice impacts from construction and preconstruction activities related to traffic would be MODERATE.

The review team concluded that there were disproportionately high and adverse impacts from construction and preconstruction activities on minority and low-income populations, and that the impacts would be noticeable but not destabilizing. The environmental justice impacts could not be entirely avoided by the applicant's mitigative measures; therefore, the review team determined that the remaining traffic-related impacts would be MODERATE. As discussed in Section 4.4.5, the NRC staff assumes that 80 percent of the traffic impact is associated with NRC authorized construction activities. Furthermore, the portion of total construction and preconstruction traffic-related impacts attributable to NRC-authorized construction activities still would be noticeable but not destabilizing to the Jenkinsville community. Therefore, the NRC staff concludes that the environmental justice impacts from NRC-authorized construction activities related to traffic would be MODERATE.

The review team determined there are no other pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionate and adverse environmental or health impacts as a result of the project. Therefore, the NRC staff concludes there are no other health, physical or environmental pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionate and adverse environmental or health impacts as a result of the NRC-authorized construction activities.

4.6 Historic and Cultural Resources

The National Environmental Policy Act of 1969, as amended (NEPA) requires that Federal agencies take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966, as amended (NHPA), also requires Federal agencies to consider impacts on those resources if they are eligible for listing in the National Register of Historic Places (such resources are referred to as "Historic Properties" in NHPA). As outlined in 36 CFR 800.8, "Coordination with the National Environmental Policy Act of 1969," the NRC is coordinating compliance with Section 106 of the NHPA in fulfilling its responsibilities under NEPA.

Construction and preconstruction of new nuclear power plants can affect either known or undiscovered cultural resources. In accordance with the provisions of NHPA and NEPA, the NRC and USACE are required to make a reasonable and good faith effort to identify historic properties in the Area of Potential Effect (APE) and, if such properties are present, determine whether any significant impacts are likely to occur. Identification of historic properties is to occur in consultation with the State Historic Preservation Office (SHPO), American Indian Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to describe potential mitigation. As part of the NEPA/NHPA integration, if no historic properties (i.e., places eligible for listing in the National Register or meeting the NEPA definition of important) are present or affected, the NRC and the USACE are still 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.

4.6.1 Onsite Cultural and Historic Resources Impacts

For a description of the historic and cultural resource information about the VCSNS site, see Section 2.7 of this EIS. As explained in Section 2.7, previous cultural resource identification efforts resulting in the identification of a total of 39 archaeological sites within the VCSNS site APE, most of which have been recommended as ineligible for listing in the National Register. Four archaeological sites have either been recommended as National Register eligible, 38FA330 (General Pearson Cemetery) and 38FA360; potentially eligible, 38FA366; or recommended for preservation, despite not being considered potentially eligible for inclusion in the National Register, 38FA349.

These four archaeological sites are located within the project APE but outside of the proposed footprint of disturbance identified by SCE&G (SCE&G 2009h). SCE&G currently has protective measures in place for these resources, including fencing at the Pearson Cemetery, temporary fencing at 38FA360, and delineation of all four sites as sensitive areas on management maps and plant layout and design drawings (SCE&G 2009l, m). Proposed signage would read "Environmentally Sensitive Area, Do Not Disturb" (SCE&G 2009m). These protective measures would be identified and added to SCE&G's Environmental Management Plan for VCSNS Units 2 and 3 (SCE&G 2009m). In addition, SCE&G would provide cultural awareness training for all workers including awareness of signage and inadvertent discovery procedures for Unit 1, which would also be applied to Units 2 and 3 and would be described in SCE&G's Environmental Management Plan (SCE&G 2009l, m, n). These procedures indicate that work would stop and the SHPO would be contacted if inadvertent discovery of cultural resources occurs (SCE&G 2009m, n). The South Carolina SHPO, in a letter to SCE&G, concurred with a finding of no adverse effect to archaeological sites 38FA330 and 38FA360 based on protective and avoidance measures being implemented by SCE&G, but would like to see the protective and avoidance measures formalized in a Programmatic Agreement (SCE&G 2009o). The SHPO also indicated that if archaeological site 38FA366 cannot be avoided, additional archaeological testing would need to occur to evaluate the site for National Register eligibility. The SHPO also concurred in a letter to SCE&G with a finding of no historic properties affected for the 35 archaeological sites that are not eligible (SCE&G 2009o).

To address the SHPO's request for a Programmatic Agreement, SCE&G has entered into a management agreement with the USACE and the SHPO to formalize avoidance and protective measures listed above as well as any updates made to the Environmental Management Plan regarding cultural resources awareness training and inadvertent discovery procedures (USACE 2011a).

Construction Impacts at the VC Summer Site

The review team analyzed the construction and preconstruction activities related to building the proposed VCSNS Units 2 and 3 and the potential historic and cultural resources impacts. The review team has also considered the signed management agreement between SCE&G, the SHPO, and the USACE that formalizes the protection and avoidance measures being undertaken by SCE&G to ensure protection of the onsite cultural resources (USACE 2011a).

For the purposes of NHPA 106 consultation, based on the (1) protective measures that SCE&G will undertake to avoid adversely affecting sites 38FA330 and 38FA360, (2) project design and avoidance measures that SCE&G will undertake to avoid adverse impacts on sites 38FA366 and 38FA349, (3) SCE&G's reliance on inadvertent discovery procedures if ground-disturbing activities discover cultural or historic resources, and (4) the NRC's and USACE's cultural resources analysis and consultation, the NRC and USACE conclude a finding of no adverse effect to 38FA330 and 38FA360. In addition, the NRC and USACE conclude a finding of no effect to historic properties for 38FA366 (lithic scatter) and FA349 (tree carving), because these sites have not been determined eligible for the National Register of Historic Places, and the sites would be outside the areas to be disturbed. By correspondence dated May 25, 2010, the South Carolina SHPO concurred with NRC's finding provided that the management agreement is in place (see Appendix F for a copy of this letter) (SCDAH 2010).

The General Pearson Cemetery and the Daughters of the American Revolution monument are examples of cultural resources located within the APE that would not be physically affected by the proposed action, but the potential visual impacts of the proposed action are sufficient to alter noticeably important attributes of the resources. The proposed action would alter noticeably the landscape and environment surrounding these cultural resources. The grading and excavation that would occur from preconstruction activities as well as the erection of various buildings to support the new reactor would modify the visual landscape that is considered to be an important attribute of these resources. Important attributes of these cultural resources include the following:

- context and landscape of the surrounding area
- relationship of the cemetery and landmark with regional history, settlement patterns, and use of the land
- the integrity of the site and the viewshed.

Protective measures and avoidance plans, which are described in the management agreement, have been developed in consultation with the SHPO and the USACE so that these impacts can be minimized (USACE 2011a). The signed management agreement formalizes and enforces these protective measures.

For the purposes of the review team's NEPA analysis, based on the (1) protective measures that SCE&G would undertake to avoid adversely affecting 38FA330 and 38FA360, (2) project design and avoidance measures that SCE&G would undertake to avoid adverse impacts to 38FA366 and FA349, (3) SCE&G's reliance on inadvertent discovery procedures should ground-disturbing activities discover cultural or historic resources, and (4) the review team's cultural resources analysis and consultation, the review team concludes that the historic and cultural resources impacts from construction and preconstruction activities would be MODERATE and no further mitigation beyond that described above would be warranted.

Based on the above analysis, and because the visual impacts on the resources are primarily from preconstruction, and thus not part of the NRC action, the NRC staff concludes that the minor visual impacts from NRC-authorized construction activities on historic and cultural resources would be SMALL and no further mitigation would be warranted.

4.6.2 Offsite Cultural and Historic Resource Impacts

Visual impacts from transmission lines may result in significant alterations to the visual landscape within the geographic area of interest. Visual impacts on cultural resources could be unavoidable if significant cultural resources where the historic setting and character of the resource are important attributes associated with that resource are located within the geographic area of interest. Given the length of new transmission lines and the possibility of finding significant cultural resources along the transmission lines, some impacts on cultural resources may be unavoidable. The potential for visual impacts exists and in the absence of more detailed information, these impacts cannot be evaluated with certainty.

SCE&G and Santee Cooper have worked with the SHPO and the USACE to each write a management agreement that details cultural resources requirements, including completion of cultural resource surveys of transmission-line corridors once the routes are finalized. Two separate management agreements between SCE&G, the SHPO, and the USACE and between Santee Cooper, the SHPO, and the USACE have been completed and signed (USACE 2011a, b). These agreements formalize how these cultural resource investigations and possible mitigations would be carried out in consultation with the SHPO. The review team has reviewed impacts related to installation of the proposed transmission lines. The review team has considered the management agreements between the SHPO, SCE&G, and Santee Cooper that formalize the cultural resources review process prior to installation of the transmission lines.

For the purposes of the review team's NEPA analysis, based on the (1) SCE&G's and Santee Cooper's management agreements with the SHPO and the USACE, as described above and (2) the review team's cultural resources analysis, preconstruction activities associated with transmission lines have the potential to impact cultural resources. Impacts could be SMALL if there are no significant alterations to the cultural environment. If these activities result in significant alterations to the cultural environment, the impact could be greater.

According to 10 CFR 50.10 (a) (2) (vii), transmission lines are not included in the definition of construction and are not an NRC-authorized activity. Therefore, the NRC considers the transmission lines outside the NRC's APE and not part of the NRC's consultation.

For the purposes of NHPA 106 consultation, the USACE has considered the impacts related to the installation of the proposed transmission lines. On May 25, 2010, the South Carolina SHPO replied with its concurrence with the finding of "no adverse effect" based on the recommendations to fence and avoid known historic properties and to develop management plans to address the indirect and unknown effects of transmission-line construction (see Appendix F for a copy of this letter) (SCDAH 2010).

4.7 Meteorological and Air Quality Impacts

Sections 2.9.1 and 2.9.2 describe the meteorological characteristics and air quality at the VCSNS site. The primary impacts of the building two new units on local meteorology and air quality would be from dust from land clearing and building activities, open burning, emissions from equipment and machinery, concrete batch-plant operations, and emissions from vehicles used to transport workers and materials to and from the site.

4.7.1 Construction and Preconstruction Activities

Development activities planned for the VCSNS site would result in temporary impacts on local air quality as a result of emissions associated with construction and preconstruction 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 by wind blowing over recently disturbed or cleared areas. In addition to the fugitive dust emissions associated with grading and the movement of construction vehicles, there would be fugitive dust emissions associated with the operation of a concrete batch plant.

The SCDHEC regulates air quality control for the State of South Carolina as set forth in Section 48-1-110, 1976 Codes of South Carolina and in the South Carolina Air Quality Control Regulation 61-62.1, Section II. A permit for dust generated by building activities may be required and the need for it would be determined on a case-by-case basis (SC Code Regulations 61–62.1). SCE&G stated in its ER (SCE&G 2010a) that it would develop a dust-control plan that would include specific dust-mitigation measures. The plan would include techniques such as imposing speed limits on unpaved construction roads, minimizing material handling, covering haul trucks, wetting potential source areas during dry periods, limiting grading and excavation activities during high winds or periods of poor air quality, and revegetation of road medians and slopes (SCE&G 2010a). A permit from the SDCHEC may also be required for operation of the batch plant.

Exhaust emissions from construction vehicles and equipment would also generate smaller amounts of particulate matter. These emissions would contain carbon monoxide, oxides of nitrogen, and volatile organic compounds. As discussed in Section 2.9.2, Fairfield County is considered to be in attainment for all criteria pollutants for which NAAQSs have been established (40 CFR 81.341). Effective May 27, 2008, the EPA changed the NAAQS for ozone from 0.08 to 0.075 ppm (73 FR 16436). The State of South Carolina has recommended that parts of Lexington and Richland Counties (which are in the Columbia Intrastate Air Quality Control Region [AQCR]) be designated as nonattainment (SCDHEC 2009). On September 16, 2009, the EPA indicated that the new ozone standard of 0.075 ppm would be reconsidered and final designation would be made in August 2011 (EPA 2009a). These changes could result in additional restrictions of nitrogen oxide emissions within Fairfield County and the need for additional permits.

Preoperational activities would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-year construction period and typical construction practices, the review team estimates that the total construction equipment CO_2 emission footprint for building two nuclear power plants at the VCSNS site would be of the order of 70,000 metric tons (an emission rate of about 10,000 metric tons annually, averaged over the period of construction), as compared to a total United States annual CO_2 emission rate of 6,000,000,000 metric tons (EPA 2009b). Appendix J provides the details of the review team estimate for a reference 1000-MW(e) nuclear power plant. Based on its assessment of the relatively small construction equipment carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction and preconstruction activities would not be noticeable and additional mitigation would not be warranted.

In general, emissions from construction and preconstruction activities (including greenhouse gases) 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. In its ER, SCE&G lists several strategies that may be used to limit the impact further, including staggering the use of equipment and keeping equipment in good working order. A mitigation plan could also include strategies to reduce CO_2 emissions, including keeping equipment in good working order, reducing idling time, using clean diesel technologies, or using alternative fuel vehicles. The review team concludes that the impacts from VCSNS Unit 2 and 3 construction and preconstruction activities on air quality would not be noticeable because appropriate mitigation measures could be adopted.

4.7.2 Transportation

This EIS assesses the three impacts of transporting workers and materials to and from the VCSNS site: the socioeconomic impacts, potential health impacts from additional traffic-related accidents, and the air quality impacts of dust and gaseous emissions released into the air by vehicle traffic. Only the air quality impacts are discussed in this section. The socioeconomic impacts are described in Section 4.4.1.3, and health effects from accidents are described in Section 4.8.3.

In the ER, SCE&G estimated that during the period of peak development there would be 3600 workers split equally among four shifts, or 900 workers per shift (SCE&G 2010a). Using a conservative assumption of one worker per vehicle in its transportation analysis, SCE&G estimated that an additional 1800 vehicles (900 leaving and 900 arriving) would be added to the roadway system during a shift change. In addition to the construction workers, SCE&G estimated increased traffic from approximately 100 daily truck deliveries that would occur at the site (SCE&G 2010a). As described in Section 2.9, Fairfield County is currently an attainment area for all criteria pollutants. The impact of emissions from an additional 1800 vehicles (900 per shift) would be localized and temporary and have little impact on the regional air quality. Some communities near the construction site, such as Jenkinsville, would experience significant increases in traffic and associated increases in the amount of particulate and gaseous emissions. SCE&G has committed to developing a project-management traffic plan that includes a number of potential mitigation measures, including a centralized parking area away from the site and shuttling construction workers to the site in buses or vans, encouraging carpools, staggering construction shifts, and/or establishing a shuttle service from the Columbia area (SCE&G 2010a).

Construction workforce transportation would also result in greenhouse gas emissions, principally CO_2. Assuming a 7-year construction period and a typical workforce, the review team estimates that the total construction workforce CO_2 emission footprint for building two nuclear power plants at the VCSNS site would be of the order of 300,000 metric tons (an emission rate of about 43,000 metric tons annually, averaged over the period of construction); again, this is compared to a total United States annual CO_2 emission rate of 6,000,000,000 metric tons (EPA 2009b). Several of the strategies described in the project-management traffic plan, such as the use of carpools or shuttle services, would also lead to reduced CO_2 emissions. Appendix J provides the details of the review team estimate for a reference 1000-MW(e) nuclear power plant. Based on its assessment of the relatively small construction workforce carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction workforce transportation would not be noticeable and additional mitigation would not be warranted.

Based on SCE&G's commitment to developing a construction traffic-management plan and the potential mitigation measures listed in the ER, the review team concludes that the impact on the local air quality (including the effects of greenhouse gas emissions) from the increase in vehicular traffic related to construction and preconstruction activities would be temporary and minimal because appropriate mitigation measures would be adopted.

4.7.3 Summary of Meteorological and Air Quality Impacts

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions during VCSNS site-development activities and determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of VCSNS site development on air quality from emissions of criteria pollutants and CO_2 emissions are SMALL and that no further mitigation is warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the air quality impacts of NRC-authorized construction activities would also be SMALL; the NRC staff also concludes that no further mitigation, beyond the applicant's commitments, would be warranted.

4.8 Nonradiological Health Impacts

SCE&G indicated that the physical impacts of construction and preconstruction, including public health, occupational health, and noise, would be minimal and discussed them qualitatively in Sections 4.4.1 and 4.7 of its ER (SCE&G 2010a). This section focuses primarily on the area near the VCSNS site; however, preconstruction activities would also occur in the transmission-line corridors.

The nonradiological impacts on health are described in the following sections, including impacts on public and occupational health (Section 4.8.1), the impacts of noise (Section 4.8.2), and the impacts of transporting construction materials and personnel to and from the proposed site (Section 4.8.3). Nonradiological health impacts are summarized in Section 4.8.4.

4.8.1 Public and Occupational Health

This section includes a discussion of the impacts of construction and preconstruction activities on public health and on VCSNS site worker health. Section 2.10 provides background information on the affected environment and nonradiological health at and within the vicinity of the VCSNS site.

4.8.1.1 Public Health

The principal source of potential physical impacts on the public from construction and preconstruction activities at the VCSNS site (including associated transmission-line corridors) would include dust and vehicle exhaust (including exhaust from haul vehicles) as sources of air pollution during site preparation (SCE&G 2010a). SCE&G would impose operational controls to mitigate dust emissions, using methods such as watering unpaved roads and exposed soils (when surface is dry), stabilizing construction roads and spoil piles, and phasing grading activities and ceasing them during high winds and/or during extreme air pollution episodes (SCE&G 2010a).

Engine exhaust would be minimized by maintaining fuel-burning equipment in good mechanical order and by phasing activities to minimize daily emissions. SCE&G (SCE&G 2010a) would follow applicable Federal, State, and local emission requirements as they relate to open burning or the operation of fuel-burning equipment. SCE&G would obtain appropriate Federal, State, and local permits and operating certificates as required. VCSNS Units 2 and 3 would be located in Fairfield County, South Carolina, which is part of the Columbia Intrastate AQCR (40 CFR 81.108 and 81.341). Fairfield County is classified as an attainment area under the NAAQSs established by the Clean Air Act (SCE&G 2010a).

The public would not be allowed close to the proposed plant site. The nearest publicly accessible area is approximately 0.5 mi from the work site (other than transmission lines), and the nearest residence is approximately 1 mi from the proposed Units 2 and 3 site (SCE&G 2010a). Given the fugitive dust suppression and vehicle exhaust emission mitigation measures discussed above and the general public's distance away from the VCSNS site, the review team concludes that the impacts on nonradiological public health from construction and preconstruction activities would be negligible. No further mitigation beyond that discussed above would be warranted.

4.8.1.2 Construction Worker Health

Human health risks to construction workers and other personnel working onsite are attributable mostly to occupational injuries (e.g., falls, electrocution, asphyxiation, and burns). SCE&G has an industrial safety program and a Safety Services Department that uses procedures and provides training to all employees and contractors to make sure that all workers onsite are trained in all appropriate safety requirements (SCE&G 2010a).

In addition to proposed onsite construction and preconstruction activities, SCE&G and Santee Cooper have planned six new transmission lines. Most of them would be built within existing transmission-line corridors, but certain segments of some lines would be built in new corridors adjacent to existing corridors. In addition, two new switchyards, one onsite and one offsite, would be built. The transmission lines and associated switchyards would be built in accordance with the National Electrical Safety Code and applicable construction standards and codes (SCE&G 2010a).

According to the U.S. Bureau of Labor Statistics (BLS), the construction industry continues to have the greatest number of fatalities of industries in the private sector. In 2008, most fatalities in South Carolina were due to falls, exposure to harmful substances or environments, and transportation incidents (BLS 2008c). Nonfatal injury and illness rates from 2007 for construction workers, including specialty trade contractors, averaged 5.4 percent (BLS 2008b). The maximum construction workforce for proposed VCSNS Units 2 and 3 and related facilities would be 3600 during an expected period from 2008 through completion of the project in 2019 (SCE&G 2010a).

Based on the mitigation measures identified by SCE&G in its ER, the permits and authorizations required by State and local agencies, the safety training that would be conducted by SCE&G and its contractors, and the review team's independent evaluation, the review team concludes that the potential nonradiological impacts of construction and preconstruction activities on construction worker health would be minimal. No further mitigation beyond those discussed above would be warranted.

4.8.2 Noise Impacts

Development of a nuclear power plant project is similar to other large industrial projects, and it involves many noise-generating activities. Regulations governing noise from construction and preconstruction activities are generally limited to worker health. Federal regulations governing 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 construction equipment including compressors. Neither Fairfield County nor the State of South Carolina has regulations or guidelines for noise (SCE&G 2010a).

Activities associated with building of two new units at the VCSNS site would have peak noise levels as high as 108 dBA up close and 82 dBA at 100 ft away (SCE&G 2010a). A 10-dBA decrease in noise level is generally perceived as cutting the loudness in half. At a distance of 50 ft from the source, these noise levels would generally decrease to the 73- to 102-dBA range, and at a distance of 400 ft, the noise levels would generally be in the 55- to 73-dBA range (SCE&G 2010a). 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 10 ft) is listed as 110 dBA, and the pain threshold is 120 dBA.

The exclusion area boundary of the VCSNS site would be greater than 0.5 mi in all directions from the center of construction and preconstruction activities for Units 2 and 3 (SCE&G 2010a). A 100-dBA noise level at 50 ft from an activity would be expected to decrease to less than 55 dBA at the exclusion area boundary (SCE&G 2010a). 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 55 dBA at the nearest residence, which is approximately 1 mi from the development area (SCE&G 2010a). These estimates do not account for the noise attenuation offered by vegetation and topography.

Construction and preconstruction activities would be expected to take place 24 hours per day, 7 days per week during peak activity periods. However, the ER (SCE&G 2010a) lists a number of measures that could be taken to mitigate the potential adverse effects of 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),[a] 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 was based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG-0586, Supplement 1, is stated as follows:

> The noise impacts...are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts...are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

Considering the anticipated low noise levels, the temporary nature of construction and preconstruction activities, and the location and characteristics of the VCSNS site, and the distances of the nearest residence and other sensitive noise receptors from the VCSNS site, the review team concludes that the noise impacts from construction would be minimal, and additional mitigation beyond the actions identified above would not be warranted.

4.8.3 Impacts of Transporting Construction Materials and Construction Personnel to the Proposed Site

This EIS assesses the impact of transporting workers and construction materials to and from the proposed VCSNS site and alternative sites from the perspective of three areas of impact: the socioeconomic impacts, the air quality impacts of dust and particulate matter emitted by vehicle traffic, and the potential health impacts due to additional traffic-related accidents. The human health impacts are addressed in this section, while the socioeconomic impacts are addressed in Section 4.4.1.3, and the air quality impacts are addressed in Section 4.7.2.

The general approach used to calculate the nonradiological impacts of fuel and waste shipments (see Section 6.2 of this EIS) is the same as that used for the transportation of construction materials and construction personnel to and from the VCSNS site and alternative sites. However, preliminary estimates are the only data sources available to estimate the demand for these transportation services. The assumptions made to fill in reasonable estimates of the parameters needed to calculate nonradiological impacts are discussed below.

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

Construction material requirements are based on information taken from the ER (SCE&G 2010a). SCE&G (2010a) estimated that constructing one new Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactor unit requires up to 75,000 yd^3 of concrete, 23,000 T of structural steel and rebar, 6,500,000 linear ft of cable, and 137,500 linear ft of piping. These quantities would be doubled to account for a two-unit plant. Additional information needed to develop the nonradiological impact estimates are as follows:

- It was assumed that maximum shipment capacities are ~13 yd^3 of concrete, 11 T of structural steel, and 3300 linear ft of piping and cable per shipment. It was assumed that these materials would be transported to the site in levelized annual quantities over a 5-year period, based on the estimated construction schedule given in the ER (SCE&G 2010a). (Operation costs are frequently expressed as levelized cost of electricity, which is the price per kWh of producing electricity, including the amounts needed to cover operating costs and annualized capital costs.)
- The number of construction workers was estimated to peak at 3600 (SCE&G 2010a). This value represents the peak workforce for construction of two units simultaneously. For a single plant, the peak construction workforce was estimated to be 1800 workers per year. Conservatively assuming that each vehicle carries one worker to the site, there would be about 1800 vehicles per day per unit. Each person was assumed to travel to and from the VCSNS site 250 days per year.
- Average shipping distances for construction materials were assumed to be 50 mi one way. The average commute distance for construction workers was assumed to be 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 South Carolina were used for construction material shipments, typically conducted in heavy-combination trucks. The data provided by Saricks and Tompkins (1999) are representative of heavy-truck accident rates and do not specifically address the impacts associated with commuter traffic (i.e., workers traveling to and from the site). However, a single source that provided all three rates to estimate the impacts from worker transportation to and from the site was not available. A South Carolina-specific fatality rate for all traffic for the years 2003 to 2007 was used to develop representative commuter traffic impacts (DOT 2009a). The average fatality rate for the 2003 to 2007 period in South Carolina was used as the basis for estimating South Carolina-specific commuter injury and accident rates. Adjustment factors were developed using the national 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 South Carolina-specific fatality rate to approximate the injury and accident rates for commuters in the State of South Carolina.

- The Saricks and Tompkins (1999) accident rates were taken from the Motor Carrier Safety Administration. The U.S. Department of Transportation (DOT) Federal Motor Carrier Safety Administration evaluated the data underlying these rates and determined that they were under-reported. To account for the under-reported accident, injury, and fatality rates from Saricks and Tompkins (1999), the review team adjusted them using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI 2003). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 percent and 36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively, to account for the under-reporting. These adjustments were applied to the construction materials that are transported by heavy-truck shipments similar to those evaluated by Saricks and Tompkins (1999) but not to commuter traffic accidents.

The estimated nonradiological impacts of transporting construction materials to the proposed VCSNS site and of transporting construction workers to and/or from the site are shown in Table 4-6. Round-trip distances were used in the assessment. The estimates would be approximately doubled for construction of two units at the VCSNS site but because two units are being constructed simultaneously, the peak construction worker demands for the two units occur in different years. As discussed above, the peak construction workforce would be 3600 workers, so the peak nonradiological impact estimates would be double the estimates listed in Table 4-6. Note that the nonradiological impacts are dominated by the transportation of construction workers to and/or from the VCSNS site. The estimated total annual construction fatalities represent less than a 3-percent increase above the average 14 traffic fatalities per year that occurred in Fairfield County, South Carolina, between 2003 and 2007 (DOT 2009b). This represents a small increase relative to the current traffic fatality risks in the area surrounding the proposed VCSNS site. Nonradiological impacts for the alternative sites range from less than a 1-percent increase for the Cope alternative site to about a 7-percent increase in nonradiological fatalities for the Saluda alternative site relative to the average traffic fatalities in their respective counties from 2003 to 2007 (DOT 2009c, 2009d, 2009e, 2009f). Because these increases are small relative to the baseline traffic fatalities (that is, before the plants are constructed) in the counties where SCE&G has proposed to build the new plants, the review team concludes that the impacts of transporting construction materials and personnel to the proposed VCSNS site and alternative sites would be minimal, and mitigation would not be warranted.

Table 4-6. Annual Nonradiological Impacts of Transporting Workers and Construction Materials to and/or from the VCSNS Site for a Single AP1000 Reactor

	Accidents per Year Per Unit	Injuries per Year Per Unit	Fatalities per Year Per Unit
Workers	$5.5 \times 10^{+1}$	$2.5 \times 10^{+1}$	3.8×10^{-1}
Materials			
Concrete	8.6×10^{-2}	6.1×10^{-2}	4.8×10^{-3}
Rebar, structural steel	3.1×10^{-2}	2.2×10^{-2}	1.7×10^{-3}
Cable	3.0×10^{-2}	2.1×10^{-2}	1.6×10^{-3}
Piping	6.3×10^{-4}	4.4×10^{-4}	3.5×10^{-5}
Total – construction	$5.5 \times 10^{+1}$	$2.5 \times 10^{+1}$	3.8×10^{-1}

4.8.4 Summary of Nonradiological Health Impacts

The review team concludes that nonradiological health impacts on construction workers at the VCSNS site, operations workers at the existing VCSNS Unit 1 site, and the local population from fugitive dust, occupational injuries, noise, and transport of materials and personnel would be SMALL, and additional mitigation beyond the actions identified above would not be warranted. Based on the above analyses, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the nonradiological health impacts of NRC-authorized construction activities would be SMALL. The NRC staff also concludes that further mitigation beyond the measures stated above would not be warranted.

4.9 Radiological Health Impacts

The sources of radiation exposure for construction workers include direct radiation exposure, exposure from discharges of liquid radioactive waste, and exposure from gaseous radioactive effluents from existing VCSNS Unit 1 during the construction phase, the impacts of which are described in the following sections and summarized in Section 4.9.5. For the purposes of this discussion, construction 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. SCE&G noted that all major construction and preconstruction activities are expected to occur outside of the VCSNS Unit 1 site protected area boundary, but inside the restricted area boundary (SCE&G 2010a).

4.9.1 Direct Radiation Exposures

In its ER (SCE&G 2010a), SCE&G identified three sources of direct radiation exposure from nuclear facilities within the VCSNS site: (1) the reactor building for existing Unit 1, (2) a planned independent spent-fuel storage installation (ISFSI), and (3) the old steam generator recycle facility. In addition, there may be direct radiation to workers finishing construction of Unit 3 from Unit 2 when it begins operation. At certain times during construction, SCE&G would also receive, possess, and use specific radioactive byproduct, source, and special nuclear material in support of construction and preparations for operation. These sources of low-level radiation are required to be controlled by the applicant's radiation protection program and have very specific uses under controlled conditions. The staff did not identify any additional sources of direct radiation during the site visit or during document reviews.

Recent surveys of the area around the old steam generator recycle facility show that readings around this building are not significantly different than background radiation levels. Direct radiation from either Unit 1 or the old steam generator recycle facility was determined to not be a significant source of dose to the construction workers (SCE&G 2010a).

SCE&G indicated the planned ISFSI would be located on the shore of Monticello Reservoir next to Unit 1, more than 4000 ft from the construction site for Units 2 and 3 (SCE&G 2010g). SCE&G concluded the direct radiation dose to construction workers from the ISFSI would be negligible based on experience at operating ISFSIs at nuclear power plants (SCE&G 2010a). The NRC staff agrees that the direct radiation dose rate to construction workers from an ISFSI located near Unit 1 would be negligible because of the large distance.

SCE&G used fenceline thermoluminescent dosimeters (TLDs) and environmental TLDs to measure direct radiation levels at locations in and around the VCSNS site protected area (SCE&G 2010a). Environmental TLDs are located at the exclusion area boundary around the VCSNS Unit 1 site, at an inner ring near the site boundary, and at locations at various distances from the plant (SCE&G 2007). The TLDs are read quarterly and measure the contribution to dose from any source, including natural background, the current reactor building, and the old steam generator recycle facility. The TLD monitoring system includes locations that are representative of the proposed construction site. The environmental TLD results at the old steam generator recycle facility (the location closest to proposed Units 2 and 3) were comparable to TLD results at control locations.

SCE&G estimated the maximum direct radiation dose for continuous occupancy would be 1 mrem/yr from Unit 1, and an additional maximum of 1 mrem/yr from Unit 2 after it begins operation. Adjusting for a 2000-hour work year gives a maximum estimate of 0.46 mrem/yr to a construction worker. The dose to construction workers from byproduct, source, and special nuclear material is expected to have a negligible contribution to this value.

The staff reviewed the potential locations for exposures and recent records of dose rates, the locations of the TLDs, and the method to estimate doses to construction workers from direct radiation. Based on that review, the NRC staff concludes the direct radiation dose rate to construction workers would be low.

4.9.2 Radiation Exposures from Gaseous Effluents

Radioactive gaseous effluents from VCSNS Unit 1 are released from three points: the Main Plant Vent, the Reactor Building Purge Exhaust, and the Oil Incineration Facility. Releases from all of these points are considered to be ground-level releases (SCE&G 2010f). SCE&G estimated a dose to a maximally exposed individual (MEI) using 2005 gaseous effluent data, which are representative of recent years. The MEI is assumed to be located 1.2 mi east of Unit 1, and 0.2 mi east of the Unit 1 exclusion area boundary. SCE&G (2010a) estimated a maximum dose of 1.2 mrem annually to someone who was continuously present; correcting for a 2000-hour work year, the annual dose to a construction worker becomes 0.27 mrem. The NRC staff concludes this estimate of the dose to construction workers from the gaseous effluents from Unit 1 would be bounding.

Using 2 years' meteorological data and the XOQDOQ (Sagendorf et al. 1982) and GASPAR II (Strenge et al. 1987) codes, SCE&G estimated that the dose to a Unit 3 construction worker from gaseous effluent from Unit 2, once it begins operation, would be 0.45 mrem to the total body. The staff reviewed SCE&G's calculation and determined that the method used to estimate dose from gaseous effluents was acceptable. Combining 0.27 mrem from Unit 1 and 0.45 mrem from Unit 2, SCE&G gave a bounding estimate of the dose to construction workers on Units 2 and 3 of 0.72 mrem for a year from gaseous effluents.

4.9.3 Radiation Exposures from Liquid Effluents

Liquid radioactive effluents are discharged from Unit 1 to Monticello Reservoir, and SCE&G estimated the maximum dose to a construction worker due to liquid radioactive effluents from Unit 1 to be 0.0015 mrem to the total body (SCE&G 2010a). SCE&G used the LADTAP II code (Strenge et al. 1986) to calculate the total body radiation dose to a maximally exposed construction worker due to liquid radioactive effluents from Unit 2 after it begins operation to be 0.032mrem/yr to the total body (SCE&G 2010a). Adding the doses from Units 1 and 2 results in a dose of 0.033 mrem/yr to the total body.

Therefore, the dose to construction workers from liquid effluents would be negligible compared to the dose from direct radiation exposure.

4.9.4 Total Dose to Construction Workers

The maximum annual dose to a construction worker was estimated by SCE&G to be 1.2 mrem/yr, which is the sum of three pathways: (1) direct radiation (0.46 mrem), (2) gaseous effluents (0.72 mrem), and (3) liquid effluents (0.033 mrem) (SCE&G 2010a). This maximum dose assumes an occupancy of 2000-hr/yr. The NRC has established an annual dose limit to an individual member of the public of 100 mrem total effective dose equivalent. The NRC staff concludes the dose to construction workers would be well below the 100-mrem annual limit.

SCE&G estimates a peak loading of 3600 construction workers before Unit 2 startup and a peak loading of 3500 construction workers after Unit 2 begins operations. The total estimated collective dose for the maximum dose year would be 4.7 person-rem (SCE&G 2010a). The maximum annual dose to a construction worker is much smaller than the approximately 311 mrem/yr that U.S. residents receive on average from background radiation (NCRP 2009).

4.9.5 Summary of Radiological Health Impacts

The NRC staff concludes that the estimate of doses to construction workers during building of the proposed Units 2 and 3 are well within NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. Based on information provided by SCE&G and the NRC staff's independent evaluation, the NRC staff concludes that the radiological health impacts on workers for proposed Units 2 and 3 would be SMALL, and no further mitigation would be warranted. Radiation exposure from all NRC-licensed activities, including operation of VCSNS Unit 1, is regulated by the NRC. Therefore, the NRC staff concludes the radiological health impacts for NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted.

4.10 Nonradioactive Waste Impacts

The following sections provide descriptions of the potential environmental impacts from the generation, handling, and disposal of nonradiological waste during the building activities for VCSNS Units 2 and 3. Potential types of nonradioactive wastes expected to be generated, handled, and disposed of include construction debris, spoils, stormwater runoff, municipal and sanitary waste, dust, and air emissions. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

4.10.1 Impacts on Land

Building activities related to the proposed VCSNS Units 2 and 3 could result in solid waste materials like construction debris from excavation, land clearing, and dredge spoils. SCE&G plans to use excess excavation as backfill as needed during construction onsite. Remaining construction debris from excavation and land clearing would be disposed in one of the several construction and demolition debris landfills in the surrounding counties. SCE&G stated that there is adequate capacity at these construction and demolition debris landfills to handle the additional generated waste (SCE&G 2010a).

Spoils generated as a result of dredging the Monticello and Parr reservoirs for building activities associated with the intake and discharge structure for the new units, would be placed in a 5.5-ac upland spoils area near the discharge structure access road. The review team anticipates that disposal of all spoils resulting from dredging would comply with the DA Clean Water Act Section 404 permit.

SCE&G plans to minimize construction debris during building activities. One way is by ordering appropriate quantities of materials and returning any excess to the vendor (SCE&G 2010a). Other types of solid waste generated such as office waste, cardboard, and aluminum cans would be recycled (SCE&G 2010a).

Based on SCE&G plans to manage solid wastes in accordance with all applicable State, and local requirements and standards, and implement recycling and minimizing waste practices, the review team expects the impacts on land from nonradioactive wastes generated during the building activities of VCSNS Units 2 and 3 would be minimal, and no further mitigation would be warranted.

4.10.2 Impacts on Water

Surface water and groundwater have the potential to be affected due to the building activities of VCSNS Units 2 and 3. SCE&G will have to obtain a NPDES General Permit for Stormwater Discharges from Large and Small Construction Activities to minimize potential impacts on surface water and groundwater. As part of the permit, a SWPPP will be required. In addition, an erosion and sediment control plan would be a component of the NPDES permit. Water-use impacts and water-quality impacts during the development of VCSNS Units 2 and 3 are further discussed in Sections 4.2.2 and 4.2.3.

Onsite sanitary wastes generated during the building activities would be accommodated with a temporary sanitary waste-treatment plant. This treatment plant would serve workers in the support area while onsite workers would be served by portable toilet facilities (SCE&G 2010a). The discharge location for the temporary sanitary waste-treatment plant would be finalized as part of the NPDES permitting process; proposed locations are Mayo Creek, Parr Reservoir, or the Broad River (SCE&G 2010a). If additional sanitary waste provisions are necessary during building activities, SCE&G plans to provide restroom trailers units. Wastes associated with these units would be disposed of and transported according to local and State regulations and standards (SCE&G 2010a).

The public wastewater-treatment systems serving the four-county area (Fairfield, Lexington, Newberry, and Richland) have the excess capacity to meet the increased generation of wastewater by the in-migrating project workforce. The influx of workforce for construction of the proposed Units 2 and 3 is expected to reside in these four counties.

Currently, SCE&G has no plans to use groundwater during the construction phase. However, if the need for water in remote construction areas onsite becomes necessary, SCE&G plans to comply with local and State regulations and standards (SCE&G 2010a).

Based on the regulated practices for managing liquid discharges, including wastewater, and the NPDES permit with an approved SWPPP that SCE&G plans to implement for managing surface and groundwater, the review team expects that impacts on water from nonradioactive effluents when building VCSNS Units 2 and 3 would be minimal, and no further mitigation would be warranted.

4.10.3 Impacts on Air

As discussed in Sections 4.4.1, 4.5.2, and 4.7.1, fugitive dust and other generated emissions during site-development activities are to be managed. SCE&G plans to control these emissions through a dust control plan or similar document. Possible mitigation measures in this dust control plan would include: stabilizing construction roads and spoils piles, covering haul trucks, and watering unpaved construction roads to control dust. Equipment and vehicles used for site preparation and the increase in vehicle traffic of construction workers involved in building VCSNS Units 2 and 3 would result in increased emissions. Possible mitigation measures that would be used to limit these emissions are phase construction and performance maintenance on construction vehicles and equipment (SCE&G 2010a).

Based on the regulated practices for managing air emissions from construction equipment and temporary stationary sources, the review team expects that impacts on air from nonradioactive emissions during the building of VCSNS Units 2 and 3 would be minimal, and no further mitigation would be warranted.

4.10.4 Summary of Nonradioactive Waste Impacts

Solid, liquid, and gaseous wastes generated when building VCSNS Units 2 and 3 would be handled according to county, State, and Federal regulations. County and State standards and regulations for handling and disposal of solid waste would be obtained and implemented. An NPDES permit that would include a SWPPP for surface-water runoff and groundwater quality, and the use of temporary facilities for sanitary waste systems during the construction period would ensure compliance with the Clean Water Act and the State of South Carolina standards. Based on this information provided by SCE&G and the review team's independent evaluation, the review team concludes that nonradiological waste impacts on land, water, and air would be SMALL and that additional mitigation would not be warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the nonradioactive waste impacts of NRC-authorized construction activities would be SMALL. The NRC staff also concludes that no further mitigation would be warranted.

Cumulative impacts on water and air from nonradioactive effluents and emissions are discussed in Sections 7.2 and 7.6, respectively. For the purposes of Chapter 9, the review team expects that there would be no substantive differences between the impacts of nonradioactive waste for the proposed VCSNS Units 2 and 3 and the alternative sites and no substantive cumulative impacts that warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

4.11 Measures and Controls to Limit Adverse Impacts During Construction

A number of measures and controls are described by SCE&G (2010a) to limit the adverse impacts during construction, many of which are planned for incorporation into a Construction Environmental Controls Plan. The plan would include the following:

- a summary matrix of environmental requirements for project permits, including the titles of the individuals responsible for confirming compliance with each permit
- a training program for construction personnel that would be based on the specific requirements for each project. The training would include, but may not be limited to, general site maintenance, erosion and sediment control, the protection of sensitive areas, hazardous material and/or waste handling, spills prevention/response, and how to respond to such unanticipated discoveries as contaminated soils, archaeological artifacts, or tanks.
- periodic discussions of current and future construction activities and how to maintain environmental compliance during these activities
- field inspections to confirm adherence to environmental requirements for the project.

Table 4-7 summarizes the measures and controls to limit adverse impacts when building proposed Units 2 and 3 based on Table 4.6-1 in the ER (SCE&G 2010a) and other information provided by the applicant. Some measures apply to more than one impact category.

Many of the specific controls in the Construction Environmental Controls Plan would be based on measures prescribed by applicable Federal, State, and local ordinances, laws and regulations, existing permits and licenses for VCSNS Unit 1, and the incorporation of conditions of environmental permits for VCSNS Units 2 and 3 into construction contracts. Table 4.6-1 of the ER (SCE&G 2010a) lists specific measures and controls to be applied during construction at the site and vicinity relevant to land-use impacts, water-related impacts, ecological impacts, socioeconomic impacts, impacts from radiation exposure to construction workers, and nonradiological health impacts.

Table 4-7. Measures and Controls to Limit Adverse Impacts when Building Proposed VCSNS Units 2 and 3

Impact Category	Specific Measures and Controls
Land-use impacts	
Site and vicinity	Implement stormwater-management systems, groundwater monitoring wells, and spill-containment controls.
	Permanently disturbed locations would be stabilized and contoured in accordance with design specifications.
	Comply with applicable laws, regulations, permits, good engineering and construction practices, and recognized environmental BMPs.
	Follow South Carolina Storm Water Management Best Management Practices handbook and industry guidance.
	Locate all but intake and discharge structures outside of 100- and 500-year floodplains.
Transmission corridors and offsite areas	Incorporate recommendations of Federal and State agencies into route selections, including the recommendations of the South Carolina Department of Health and Environmental Control, South Carolina Department of Natural Resources, South Carolina Department of Archives & History, U.S. EPA, US Fish & Wildlife Service, U.S. Army Corps of Engineers.
	Site new corridors to minimize or avoid critical or sensitive habitats or species as much as possible.
	Site new corridors to avoid historical properties
	Before site disturbance, conduct archaeological surveys in accordance with management plans and ecological surveys as needed and determine site-specific erosion control measures.
Water-related impacts	
Hydrologic alterations	Comply with applicable laws, regulations, permits, sound engineering and construction practices, and recognized environmental BMPs.
	Follow BMPs for erosion control. Install drainage system to divert dewatering runoff to settling basin before discharge through a permitted NPDES outfall.
	Install cofferdams and turbidity curtains to minimize suspended sediment impacts in surface waters.
	Continue conducting hydrological monitoring to determine baseline hydrological conditions and detect changes.
	Implement BMPs for erosion and sedimentation control during installation of new transmission lines.

Table 4-7. (contd)

Impact Category	Specific Measures and Controls
Water-use impacts	Obtain FERC authorization for construction water use.
Water-quality impacts	Develop an erosion, sedimentation, and pollution control plan. Use BMPs, including structural (e.g., silt fences and sediment retention basins) and operational controls, to prevent movement of pollutants (including sediments) into wetlands and waterbodies.
	Obtain and comply with NPDES stormwater permit; conduct monitoring as required by the permit. Use NPDES monitoring program for Unit 1 to detect water-quality changes due to construction activities.
	Obtain and comply with Department of the Army permit.
	Develop and comply with approved Storm Water Pollution Prevention Plan and spill response plan. Quickly clean up any spilled fuel or oil. Follow South Carolina Storm Water Management Best Management Practices handbook and industry guidance.
	Install stormwater-drainage system and stabilize disturbed soils.
	Conduct shoreline construction when pool level of Parr Reservoir is low, to the extent practicable.
Ecological impacts	
Terrestrial and wetland ecosystems	Site structures to minimize impacts on wildlife habitat and wetlands. Site new transmission-line corridors to avoid sensitive habitats.
	Clear land according to Federal and State regulations and permits, SCE&G procedures, good construction practices, and established BMPs.
	Develop and comply with spill response plan. Schedule equipment maintenance procedures to minimize emissions and spills.
	Minimize fugitive dust by watering.
	Obtain and comply with Department of the Army permit; determine mitigation measures for impacted wetland areas in consultation with USACE.
	Install silt fencing or other controls to protect wetlands.
Aquatic ecosystems	Obtain and comply with NPDES stormwater permit; conduct monitoring as required by the permit. Use NPDES monitoring program for Unit 1 to detect water-quality changes due to construction activities. Develop and implement a construction Storm Water Pollution Prevention Plan.
	Prepare and implement Spill Prevention Control and Countermeasure Plan for construction activities. Restrict activities using petroleum products and solvents to designated areas that are equipped with spill containment.

Table 4-7. (contd)

Impact Category	Specific Measures and Controls
	Avoid wetlands, waterbodies, and sensitive areas when possible; plan transmission route to minimize impacts on wetland and waterbodies that must be crossed and use equipment specifically designed for work around wetlands and streams; install erosion controls; and implement BMPs to minimize impacts on aquatic ecosystems.
	Stabilize upslope and adjacent areas to shoreline construction sites with erosion-control devices and after construction, reseed the areas. Follow South Carolina Forestry Commission BMPs manual and SCDHEC handbook and field manual BMPs to prevent sediment loading and minimize soil disturbance.
	Before transmission-line construction, conduct surveys, as needed, and determine site-specific erosion control measures.
	If there is potential for construction of a new transmission line that could degrade habitat of a listed aquatic species, work closely with the State agency to develop a construction schedule and construction techniques that are protective of the habitat and species in question. Preserve vegetation in stream buffer zones to minimize disturbance of aquatic habitats.
Socioeconomic impacts	
Physical impacts	Train and appropriately protect construction workers to reduce the risk of potential exposure to noise, dust, and exhaust emissions. Regularly inspect and maintain equipment to include exhaust and noise aspects.
	Make public announcements or prior notification of atypically loud construction activities.
	Phase construction to minimize daily emissions. Restrict extreme noise-related activities to daylight hours. Restrict delivery times to daylight hours.
	Develop and implement a dust control plan that includes mitigation measures such as watering unpaved roads, stabilizing construction roads, phasing grading activities and ceasing them during high winds, limit speeds on unpaved roads, minimizing material handling, etc.
	Develop construction-management traffic plan before the start of construction. Post signs near construction entrances and exits to make the public aware of potentially high construction traffic areas.
	Minimize waste by using excavated material where fill is needed, ordering materials in appropriate quantities and returning overage to the vendor, and recycling scrap metal.
Social and economic impacts	Develop a construction-management traffic plan before the start of construction.
	Regularly communicate with local school authorities regarding construction worker influx.
	Coordinate with job-training institutions.

Table 4-7. (contd)

Impact Category	Specific Measures and Controls
Environmental justice impacts	Provide mitigating measures as for socioeconomic impacts.
Historic and cultural properties impacts	Consult State Historic Preservation Office (South Carolina Department of Archives and History). Developed management agreements.
	Before site disturbance, conduct archaeological surveys.
	Conduct awareness training for procedures associated with inadvertent discoveries.
	Develop and implement a procedure for construction activities that includes actions to protect cultural, historic, or paleontological resources.
	Continue to have a fence barrier around Pearson Cemetery.
	Continue any applicable mitigation measures for any National Register-eligible sites.
Air quality impacts	Implement dust-control plan.
	Stagger use of equipment and keep equipment in good working order.
Transportation	Develop project traffic-management plan.
Nonradiological health impacts	Train contractors on safety requirements to ensure contractors arriving onsite are adequately trained with regard to VCSNS safety requirements.
	Require construction contractors and subcontractors to develop and implement safety procedures.
	Implement noise mitigation to include restricting noise-related activities to daylight hours.
	Provide onsite services for emergency first aid, and conduct regular health and safety monitoring.
Radiological health impacts	None proposed (estimated exposure would be well below established limits to workers and members of the public)
Nonradioactive waste impacts	Liquid discharges would comply with the NPDES permit.
	A spill prevention and response plan would be implemented.
	A waste minimization plan would be implemented; personnel would be trained in proper handling and management of wastes, including hazardous waste.

4.12 Summary of Construction and Preconstruction Impacts

The impact levels determined by the review team in the previous sections are summarized in Table 4-8. The impact levels for NRC-authorized construction as evaluated in this chapter are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. Combined construction and preconstruction impact levels are similarly noted. Some impacts, such as the addition of tax revenue from SCE&G for the local economies, are likely to be beneficial impacts to the community.

Table 4-8. Summary of Impacts from Construction and Preconstruction of Proposed VCSNS Units 2 and 3

Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Land-use impacts	Construction and preconstruction impacts on land use would be limited. Preconstruction impacts involving land use attributable to the new transmission-line corridors would be noticeable. Land-use impacts on the site would be limited.	SMALL	SMALL for onsite; MODERATE for transmission lines
Water-related impacts			
Water use – surface water	Construction and preconstruction impacts on surface water use would be negligible.	SMALL	SMALL
Water use – groundwater	Construction and preconstruction impacts on groundwater use would be negligible.	SMALL	SMALL
Water quality – surface water	Construction and preconstruction impacts on surface and groundwater quality would be negligible.	SMALL	SMALL
Water quality – groundwater	Construction and preconstruction impacts on groundwater quality would be negligible	SMALL	SMALL
Ecological impacts			
Terrestrial and wetland ecosystems	Construction and preconstruction activities would have minimal impact on terrestrial ecological resources and habitat on the VCSNS site, but terrestrial habitats are expected to be noticeably altered where new transmission-line corridors are established.	SMALL	SMALL for onsite; MODERATE for transmission lines
Aquatic ecosystems	Construction and preconstruction activities would have minimal impact on onsite and offsite aquatic ecological resources and habitat.	SMALL	SMALL

Table 4-8. (contd)

Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Socioeconomic impacts			
Physical impacts	Construction and preconstruction physical impacts are minimal; unavoidable impacts would be limited by mitigation measures	SMALL	SMALL
Demography	Construction and preconstruction demographic impacts on the communities nearest VCSNS are expected to be small and temporary.	SMALL	SMALL
Economic impacts on the community	Construction and preconstruction economic and tax revenue impacts on the communities nearest VCSNS are expected to be small and temporary.	SMALL	SMALL
Infrastructure and community services	Construction and preconstruction traffic impacts would be noticeable but not destabilizing; other infrastructure and community services impacts are expected to be limited.	MODERATE for traffic impacts SMALL for other infrastructure and community service impacts	MODERATE for traffic impacts SMALL for other infrastructure and community service impacts
Environmental justice	Construction and preconstruction traffic-related impacts would be noticeable but not destabilizing to the Jenkinsville community. The review team expects impacts related to all categories except traffic to be minimal.	MODERATE for traffic impacts; SMALL for other environmental justice impacts	MODERATE for traffic impacts; SMALL for other environmental justice impacts
Health and environmental	Construction and preconstruction impacts could be adverse, but would not be disproportionate.	SMALL	SMALL
Historic and cultural resources	NRC-authorized construction activities represent only a part of the analyzed activities; nearly all impacts would be attributable to preconstruction activities. The NRC staff concludes that the potential impacts on historic and cultural resources from NRC-authorized construction activities would be SMALL. Construction and preconstruction activities would noticeably alter the resources within the Area of Potential Effect.	SMALL	MODERATE
Air-quality impacts	Construction and preconstruction impacts on air quality would be limited.	SMALL	SMALL
Nonradiological health impacts	Construction and preconstruction impacts on nonradiological human health are expected to be minimal.	SMALL	SMALL
Radiological health impacts	Exposures would be below NRC annual occupational and public dose limits.	SMALL	SMALL
Nonradioactive waste impacts	Impacts to land, water and air are expected to be minimal.	SMALL	SMALL

4.13 References

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5.0 Operational Impacts at the VC Summer Site

This chapter examines environmental issues associated with operation of the proposed new nuclear Units 2 and 3 at the Virgil C. Summer Nuclear Station (VCSNS) site for an initial 40-year period as described by South Carolina Electric and Gas (SCE&G). As part of its application for combined construction permits and operating licenses (COLs), SCE&G submitted an Environmental Report (ER) that discussed the environmental impacts of station operation (SCE&G 2009a, 2010a). In its evaluation of operational impacts, the review team composed of U.S. Nuclear Regulatory Commission (NRC) staff, its contractor staff, and U.S. Army Corps of Engineers (USACE) staff, relied on operational details supplied by SCE&G in its ER, SCE&G responses to NRC Requests for Additional Information (RAIs), and the review team's own independent review. Also consulted were permitting correspondences between SCE&G and the USACE, a cooperating agency in this action.

This chapter is divided into 13 sections. Sections 5.1 through 5.12 discuss the potential operational impacts on land use, water, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological and radiological health effects, postulated accidents, and measures and controls that would limit the adverse impacts of station operation during the 40-year operating period. In accordance with Title 10 of the Code of Federal Regulations (CFR) Part 51, impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned to each analysis. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such, as appropriate. The NRC staff's determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades, as discussed throughout this chapter, are implemented. Failure to implement these upgrades might result in a change in significance level. Possible mitigation of adverse impacts is also presented, where appropriate. A summary of operational impacts is presented in Section 5.13. The references cited in this chapter are listed in Section 5.14.

5.1 Land-Use Impacts

This section contains information about the land-use impacts associated with operation of proposed VCSNS Units 2 and 3. Section 5.1.1 discusses land-use impacts at the VCSNS site and in the vicinity of the site. Section 5.1.2 discusses land-use impacts with respect to offsite transmission-line corridors and offsite areas.

5.1.1 The Site and Vicinity

Onsite land-use impacts from operation of VCSNS Units 2 and 3 are expected to be minimal. The proposed units would use two mechanical draft cooling towers for each unit. As discussed in Sections 5.3.1.1 and 5.7.1 of this chapter, operation of the cooling system would have minimal impacts on vegetation, and fogging, icing, and drift impacts on land use also are expected to be minimal. Occasional dredging around the discharge diffuser pipe in the Parr Reservoir and the intake structure in Monticello Reservoir may be required during operations. SCE&G would follow generally accepted best management practices (BMPs) and all applicable regulations and permit conditions for disposal of dredging spoils at an onsite upland location.

Some offsite land-use changes can be expected as a result of operational activities. Possible changes include the conversion of some land in surrounding areas to housing developments (e.g., recreational vehicle parks, apartment buildings, single-family condominiums and homes, manufactured home parks) and retail development to serve plant workers. Property tax revenue from the addition of two new units could also lead to additional growth and land conversions in Fairfield County and surrounding counties as a result of infrastructure improvements (e.g., new roads, utility services). Additional information about operations-related infrastructure impacts is provided in Section 5.4. However, the review team assumes that any induced residential growth would be managed because the four counties in the economic impact area have comprehensive land-use plans in place. Fairfield County allows low-density residential development in the vicinity of the site, in accordance with its comprehensive land-use plan. Based on the existence and projected implementation of land-use plans, the information provided by SCE&G, and the NRC's own independent review, the review team concludes that the land-use impacts of operation would be SMALL, and additional mitigation would not be warranted.

5.1.2 Transmission-Line Corridors and Offsite Areas

Most land-use impacts in transmission-line corridors would occur during installation, rather than during operations. SCE&G and Santee-Cooper (the State-owned electric and water utility, formally called the South Carolina Public Service Authority) provide easements to allow agricultural activities under their transmission lines. Transmission-line corridor vegetation management practices are discussed in Section 5.3.1.2. Therefore, the review team concludes that the offsite land-use impacts of operations would be SMALL, and additional mitigation would not be warranted.

5.2 Water-Related Impacts

This section discusses water-related impacts on the surrounding environment from operation of the VCSNS Units 2 and 3.

Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting, objectives. At the VCSNS site, these objectives include recreation, visual aesthetics, reservoir ecology, and a variety of beneficial consumptive uses of water.

Water-use and water-quality impacts involved with operation of a nuclear plant are similar to the impacts associated with any large thermoelectric power generation facility. Accordingly, SCE&G must obtain the same water-related permits and certifications as any other large thermoelectric power generation facility. These include:

- Clean Water Act Section 401 Certification. This certification would be issued by the South Carolina Department of Health and Environmental Control (SCDHEC) and would confirm that operation of the plant would not conflict with State water-quality management programs.
- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) Discharge Permit. This permit would be issued by the SCDHEC and would regulate limits of pollutants in liquid discharges to surface water.
- Clean Water Act Section 316(a). This section regulates the cooling-water discharges to protect the health of the aquatic environment. The scope will be covered under the NPDES permit with the SCDHEC.
- Clean Water Act Section 316(b). This section regulates cooling-water intake structures to minimize environmental impacts associated with location, design, construction, and capacity of those structures. The scope will be covered under the NPDES permit with the SCDHEC
- South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act (SC Code Ann. 49-4). This act provides for the permitting of surface-water withdrawals greater than 3 million gallons per month.

Section 5.2.1 discusses the expected hydrologic alterations in surface water and groundwater related to operation of VCSNS Units 2 and 3. Water-use impacts are discussed in Section 5.2.2 for surface water (5.2.2.1) and groundwater (5.2.2.2). Water-quality impacts are discussed in Section 5.2.3 for surface water (5.2.3.1) and groundwater (5.2.3.2). Water monitoring is discussed in Section 5.2.4.

5.2.1 Hydrologic Alterations

The proposed VCSNS Units 2 and 3 would be positioned on a hilltop with natural drainage away from the facilities. Modifications of the land surface made during construction and preconstruction activities would alter the local hydrology. Specifically, surface water would be routed away from the nuclear plant through ditches described in the site layout plan. In addition, groundwater infiltration areas would be significantly different because of the large number of impervious surfaces that would decrease infiltration and the use of stormwater-retention basins that could locally increase infiltration. The aquifer beneath the VCSNS site is likely to be affected by the new hydrology for a period shortly after construction and preconstruction, but water levels would eventually equilibrate to the conditions of VCSNS Units 2 and 3 operations. The aquifer may also be locally affected to a small extent by the altered surface hydrology, although these impacts are not likely to have a significant impact on other adjacent permitted users.

The impact of the consumptive use of surface water by proposed Units 2 and 3 is evaluated in terms of the estimated reduction in flow in absolute and percentage terms for normal and maximum modes of operation and for long-term average flows and low flows in the Broad River. These flows are discussed in Section 5.2.2.1.

The quantitative measures used to assess the level of impact on water use are twofold: (1) the ability to discern the reduced flow from the historical flows determined using current U.S. Geological Survey (USGS) methods, and (2) the decreased ability of a hypothetical small downstream reservoir to serve hypothetical water users. These measures are discussed in Section 5.2.2.1.

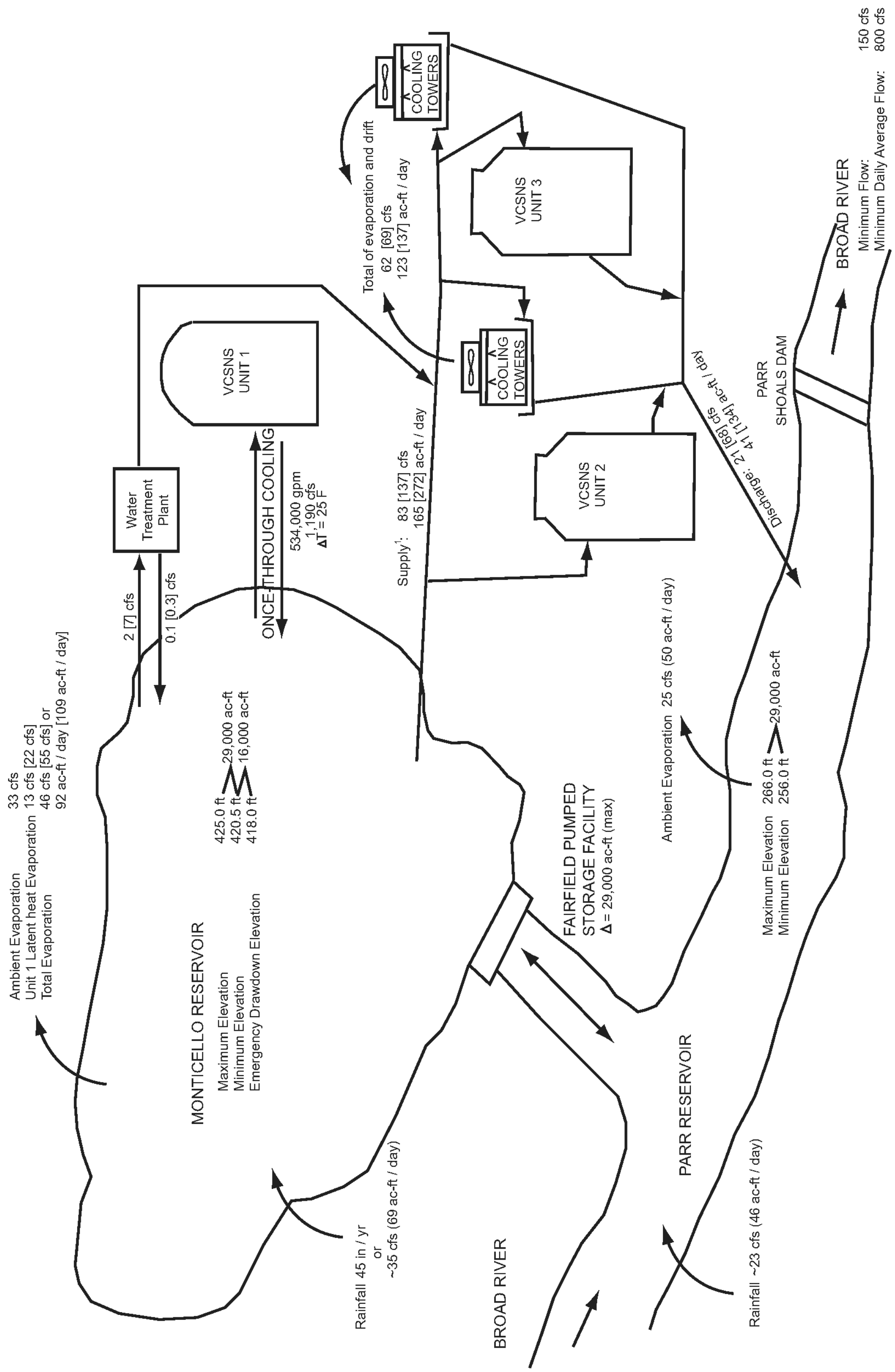
SCE&G stated that "groundwater would not be withdrawn for operational use by Units 2 and 3" (SCE&G 2010a). The hydrologic alterations of groundwater due to construction and preconstruction activities (e.g., site grading, changes in recharge, fill materials, excavation dewatering) are discussed in Section 4.2.1 of this environmental impact statement (EIS). Localized dewatering during operations may be required to reduce the water table to minimize seepage for below-grade portions of buildings. As mentioned by SCE&G (SCE&G 2010a), the pumping rates would be low due to the low permeability of the aquifers in this area (see Sections 2.3.1.2 and 2.3.2.2 of this EIS). Based on the low amount of groundwater pumping that may occur if dewatering is required, the review team concluded that any groundwater alterations at VCSNS Units 2 and 3 would be localized to the site.

5.2.2 Water-Use Impacts

A description of water-use impacts on surface water and groundwater is presented in the next sections. The water resource usage by VCSNS Units 2 and 3 operations is limited to the Monticello Reservoir and the Broad River/Parr Reservoir. Surface water would be used by VCSNS Units 2 and 3 for cooling and all other plant water needs. No local groundwater use is proposed. Information presented in the ER for VCSNS Units 2 and 3 (SCE&G 2010a), as well as other information obtained by the review team, and independent analysis performed by the review team were used to assess water-use impacts.

5.2.2.1 Impacts on Surface-Water Use

VCSNS Units 2 and 3 would withdraw water from Monticello Reservoir, which comes from the old Frees Creek basin and indirectly from the Broad River via the Fairfield Pumped Storage Facility (FPSF). Some of the water supplied to these units would be used consumptively (e.g., through evaporation). The Broad River, Parr Reservoir, and Monticello Reservoir are hydrologically connected by the FPSF. Cooling water blowdown would be discharged to Parr Reservoir. The VCSNS Unit 2 and 3 water-treatment facility would discharge to Monticello Reservoir. A diagram showing the direction and magnitude of flows between the Broad River, Parr Reservoir, Monticello Reservoir, VCSNS Unit 1, and the proposed VCSNS Units 2 and 3 is shown in Figure 5-1.



XX [XX] - Normal [Maximum]
Elevation Datum NGVD29
[1]Supply represents total water supply including amount from water treatment plant.

Figure 5-1. Diagram of the Broad River, Parr Reservoir, and Monticello Reservoir System (SCE&G 2009a)

Some water would be consumptively used by VCSNS Units 2 and 3. Operational surface-water withdrawals for the proposed VCSNS Units 2 and 3 are estimated to be between 83 cfs (normal operation) and 137 cfs (maximum use). Of these totals, between 62 cfs (normal operation) and 69 cfs (maximum use) of water would be consumptively used due to evaporation and drift related to the operation of the proposed cooling towers, while between 21 cfs (normal operation) and 68 cfs (maximum use) of water would be discharged to the Parr Reservoir just upstream of the Parr Shoals Dam. For comparison purposes, the long-term annual and lowest annual mean flows are reported for the Alston gauging station (nearest station downstream of VCSNS) as 6302 cfs and 2153 cfs, respectively. The estimated surface-water withdrawals for the proposed VCSNS Units 2 and 3 would be between 1 and 4 percent of the long-term annual mean of Broad River flows, while the actual surface-water consumptive use of VCSNS Units 2 and 3 would be around 1 percent of the long-term annual mean flow. For the lowest annual mean flow, the withdrawal percentages based upon normal and maximum use increase to between 2 and 6 percent, respectively, while consumptive use increases to around 3 percent. The consumptive surface-water use impacts of VCSNS Units 2 and 3 operations on Broad River flow are summarized in Table 5-1.

Table 5-1. Impacts of Proposed VCSNS Units 2 and 3 Water Use on Broad River Flow

Flow Characteristic	Broad River Flow at Alston (cfs)	Normal (max) Consumptive Use for Units 2 and 3 (cfs)	Difference in Broad River Flow Under Normal (max) Operating Conditions (Percent)
Long-term annual mean flow	6302	62 (69)	1 (1.1)
Lowest annual mean flow	2153	62 (69)	2.9 (3.2)
7Q10 flow	853	62 (69)	7.3 (8.1)

The 7Q10 flow (lowest flow for 7 consecutive days expected to occur once per decade) is also used to assess the impacts of alteration to flow during low-flow periods. The 7Q10 was reported by SCE&G to be 853 cfs in the absence of accounting for VCSNS Units 2 and 3 consumptive uses. Including the proposed VCSNS Units 2 and 3 consumptive use would reduce the 7Q10 flow to 791 and 784 cfs under normal and maximum use modes of operation or between a 7 to 8 percent reduction in 7Q10 flow.

When surface-water flow is at or above either the long-term annual or lowest annual mean flows, the percent reduction in the Broad River flow due to consumptive use related to the operation of the proposed VCSNS Units 2 and 3 (1 to 6 percent) would be minimal. Due to the seasonality of the Broad River flow, it is expected that the impacts would be larger in the summer than during the remainder of the year. At lower Broad River flows, SCE&G has suggested that, as a mitigative measure, some of the water-supply needs could be met by drawing from Monticello Reservoir storage instead of relying fully on the Broad River. The useable storage within Monticello Reservoir is 45,000 ac-ft.

The review team assessed the impact of the estimated maximum consumptive use of water of the proposed Units 2 and 3 (69 cfs) to assess the ability of the Broad River to satisfy current and likely future water demands. Based on a combination of existing historical flow records at the USGS Alston and Richtex gauges, the maximum consumptive use represents about 1 percent of the average annual flow (6155 cfs) and 1.6 percent of the flow during the lowest month average flow (4300 cfs) of the entire period of record (1925 to 1983). The consumptive water use of proposed Units 2 and 3 would fall within the range of uncertainty in typical streamflow measurements of a stream this size. Given the minor fractional reduction due to consumptive use, the review team determined that the impact of proposed Units 2 and 3 on the water resources' ability to meet current water demands would be minimal.

The review team also assessed the impact of consumptive water use of the proposed plant with water demands that might occur toward the end of the plant's operating life in 2060. Because no precise method exists to project water demands out to 2060, the review team relied on population projections for 2060 for the primary counties in the Broad River basin (Cherokee, Chester, Fairfield, Greenwood, Richland, Spartanburg, Union, and York Counties). Based on the combined population growth for 2060 (discussed in Section 2.5.1.1, Table 2-23) and the per capita water-use requirements derived from annual South Carolina Water Use Reports (SCDHEC 2002, 2003a, b, 2004, 2005a, 2006a, 2007), the review team postulated a water requirement of 251,508 ac-ft/yr (350 cfs), assuming a linear relationship between growth in population and increase in surface-water use.

To confirm that a reliable water supply will continue to meet the postulated demand given the expected seasonal and annual variability of streamflows (see Section 2.9.1), the review team postulated a hypothetical off-stream reservoir sized to ensure that a steady future water demand would be reliably delivered. For the purposes of this analysis, streamflow withdrawals were limited in the critical months of July, August, and September so the median Broad River flows would not change. Withdrawals from the river were limited to 700 cfs (as a water-supply design parameter) and further limited to 479 cfs (to maintain a required minimum flow in the Broad River). These limitations represent a postulated set of requirements designed to allow for transfer of water from the Broad River to the hypothetical reservoir only under excess river flow conditions. The modeled reservoir size needed to satisfy the postulated steady future water demand was 55,000 ac-ft. The reliability of this reservoir to meet future water requirements (as identified above) was reduced from 99.65 percent to 99.61 percent when VCSNS Units 2 and 3 consumptive use was removed from the available supply. Based on the magnitude of the change the review team concluded that the impact of VCSNS Units 2 and 3 operation on future water-supply reliability would not be noticeable and mitigation would not be warranted.

VCSNS Units 2 and 3 operation would consumptively use only a small proportion of Broad River flow, and the review team's independent water-supply reliability analysis found that this consumptive use would not noticeably alter long-term regional water supply reliability even when considering potential future supply reduction because of climate change. Therefore, the review team concludes that the impacts of surface-water use by VCSNS Units 2 and 3 operations would be SMALL, and mitigation would not be warranted.

5.2.2.2 Impacts on Groundwater Use

As described in Section 5.2.1, groundwater would not be used for operation of proposed VCSNS Units 2 and 3, but some dewatering may be necessary to reduce below-grade seepage in buildings. Dewatering is currently used to reduce below-grade seepage in buildings around Unit 1 (using two wells at a combined rate of about 26 gpm as described in Section 2.3.2.2 of this EIS).

As stated in Section 2.3.2.2, the closest water-supply well to the site is currently at a private residence approximately 1 mi east of the site. The nearest groups of wells, used for residences and stores, are located 1.5 mi east of the VCSNS site and 2.5 mi southeast of the site (SCE&G 2010a). The closest water-supply well that could potentially be located near the facility is approximately 0.75 mi to the southeast at the site boundary (SCE&G 2009b). As discussed in Sections 2.3.1.2 and 2.3.2.2 of this EIS, yields from groundwater wells, both regionally and locally, are generally less than 30 gpm.

Similar to VCSNS Unit 1, a potable-water treatment plant that draws water from Monticello Reservoir would provide the potable water for Units 2 and 3 during operations (SCE&G 2009b, 2010a). SCE&G stated that they will not use water from a municipal system for operations (SCE&G 2010a). Therefore, water usage at the VCSNS site during operations would not affect municipal water suppliers who may draw water from groundwater sources.

Based on the low groundwater pumping rates needed for dewatering due to the generally low permeability of the aquifers in this area; relatively large distances to local groundwater supply wells; and the site location that is partially isolated from offsite users by surface waterbodies (Parr Reservoir, Mayo Creek, and Monticello Reservoir); the review team concludes that the impacts on groundwater use during the operation of Units 2 and 3 would be SMALL, and additional mitigation would not be warranted.

5.2.3 Water-Quality Impacts

This section discusses the impacts on the quality of water resources from the operation of proposed VCSNS Units 2 and 3. Surface-water impacts include thermal, chemical, and radiological wastes, and physical changes in the Monticello Reservoir and the Broad River and/or Parr Reservoir resulting from effluents discharged by the proposed nuclear plants. Section 5.2.3.1 discusses the impacts on surface-water quality and Section 5.2.3.2 discusses the impacts on groundwater quality.

5.2.3.1 Impacts on Surface-Water Quality

Impacts to surface water quality could result from blowdown discharge and stormwater runoff. Cooling towers concentrate solids and solutes from the raw makeup water during the process of evaporative heat loss. Other materials are introduced to the makeup water to inhibit scale, biofilm formation, and corrosion. These solids and solutes are contained in blowdown. Blowdown for the two proposed units at the VCSNS site would be discharged to Parr Reservoir. Stormwater runoff would be managed through engineering controls (SCE&G 2010a) based on BMPs as detailed in a stormwater pollution prevention plan (SWPPP).

The water-treatment methods to be used at VCSNS Units 2 and 3 are described in Section 3.4 and are likely to be similar to those used for VCSNS Unit 1. In addition to the anti-scalants, biocides, and corrosion inhibitors described above, additional water treatment would be achieved through the use of algaecides, pH adjusters, and silt dispersants (see Table 3-5). The VCSNS Units 2 and 3 cooling towers would operate by recycling cooling water two to four times, which would concentrate any material present in the makeup water. While the amount of these materials would not differ, the dissolved concentration in the blowdown discharge to Parr Reservoir would be two to four times the initial concentration in the makeup water. Intake concentrations are listed in Table 2-10 through Table 2-12; estimated concentrations in blowdown are provided in Table 3-4. An NPDES permit is required before blowdown effluent can be discharged, and discharges must be in compliance with the permit. When the blowdown discharge mixes with the much larger flow of the Broad River, the downstream Broad River concentration would approach that of the upstream concentrations.

Temperature standards for fresh waters as well as guidelines for determining whether a mixing zone needs to be created around a thermal discharge are established in State Regulation 61-68, "*Water Classifications and Standards*" (SCDHEC 2008) as follows: "…water temperature of all freshwaters which are free flowing [or lakes] shall not be increased more than 5°F (2.8°C) above natural conditions and shall not exceed 90°F (32.2°C) as a result of the discharge of heated liquids unless a different site-specific temperature standard as provided for in C.12 has been established, a mixing zone as provided in C.10 has been established, or a Section 316(a) determination under the Federal Clean Water Act has been completed" (SCDHEC 2008, at E(12)(a) and (c)). If a mixing zone is to be created, then its size should be minimized (SCDHEC 2008). For chronic mixing permit conditions, SCDHEC has established that a mixing zone be no larger than half the river width and extend a distance no further than twice the river width (SCDHEC 2005b). Based on the Parr Reservoir eastern channel width of 600 ft, the largest mixing zone size could be 300 ft across the channel and 1200 ft along the channel. SCE&G focused on simulations where either the 90°F or the +5°F criterion could be exceeded.

The blowdown discharge into Parr Reservoir would be, in most cases warmer than the ambient water. SCE&G used the Cornell Mixing Zone Expert System (CORMIX) modeling software, version 4.3, to estimate the thermal plume from the discharge in Parr Reservoir (SCE&G 2010a;

Toblin 2007). The blowdown flow and temperature were estimated using meteorological data, cooling tower performance curves, and historical Parr Reservoir water temperatures (Toblin 2007). The largest blowdown flow and the highest blowdown temperature that were estimated were 64 cfs and 91.75°F.

The review team independently conducted a thermal plume analysis to estimate the thermal plume's extent across the reservoir and to maximize the plume size estimate. Because no 7Q10 flow value is available for the Parr Shoals Dam, the review team estimated a value based on a nearby gauge. The Alston gauge is the nearest gauge downstream of the dam. The 7Q10 flow for the Broad River was estimated at Alston gauge as 853 cfs (USGS 2007). To correct for the increased flow associated with the 5.3 percent larger drainage area at the Alston gauge, the 7Q10 flow for Alston was reduced by 5.3 percent to provide a 7Q10 value for Parr Shoals Dam of 808 cfs. When the flow record was limited to the spring time period a higher low flow of 1469 cfs was reported (Toblin 2007). These flows (808 cfs for summer and 1469 cfs for spring) were used to estimate the blowdown thermal plume dimensions for the spring and summer conditions. The review team examined the temperature records computed using 3-month rolling temperature averages for spring and summer. From these averages, a conservatively low ambient temperature during the spring of 43.3°F and a conservatively high summer ambient temperature of 84.0°F were used to maximize the estimated difference between ambient water and plume water temperatures (in spring) as well as plume temperature itself (summer). To make the estimates conservative, the review team analysis used the maximum effluent discharge flow rate (blowdown plus other liquid effluents) and highest blowdown discharge temperature, low flow through Parr Reservoir, low ambient water temperatures in spring, and high ambient water temperatures in summer.

The review team's thermal plume analysis is based on the estimation of the completely mixed water temperature within a prescribed fraction of the cross section of Parr Reservoir. While the assumption of complete and instantaneous mixing is physically implausible, this approach is based exclusively on the principle of conservation of energy, and provides a bounding estimate of the portion of the water that could be raised to a specified temperature differential. The well-mixed assumption here extends the 5°F limit to be wider than it would actually be, because no accommodation is made for more of the heat to be stored at the core of the plume than at the edges. The review team's calculations are not designed to distinguish these plume features; estimated plume temperatures in the context of this discussion refer solely to the well-mixed, or average temperature within the plume. The analysis is based on the assumption that a portion of the cross section of the Parr Reservoir is significantly affected by the blowdown discharge. That is, a portion of the ambient flow is completely mixed with the blowdown discharge. That portion is based on specification of the fraction of affected width and depth. In all of the analysis, the plume is assumed to be mixed over one-half of the depth, meaning that the upper half of the water column will contain the thermal plume because of its buoyancy. A range of plume widths was examined (10 percent, 25 percent, and 50 percent of the channel width). A fraction of the ambient flow is assumed to be entrained into the blowdown discharge flow and which, when mixed, adjusts to combined water temperature above the ambient water temperature and below the blowdown discharge temperature. The differences between the estimated plume water temperature and the ambient water temperature as well as the overall plume temperature were computed for these conditions and summarized in Table 5-2 and Table 5-3.

Table 5-2. Estimated Spring and Summer Blowdown Plume Temperatures with Assumed Plume Thickness Equal to 50 Percent of Water Depth

	Plume Temperature (°F)			
	Spring (1469 cfs)		Summer (808 cfs)	
Plume Width	Normal Operation	Maximum Operation	Normal Operation	Max Operation
10% of channel width (60ft)	54	66	87	89
25% of channel width (150 ft)	48	56	85	87
50% of channel width (300ft)	46	51	85	86

Table 5-3. Estimated Blowdown Plume Temperature Rise Above Ambient Water for Spring and Summer with Assumed Plume Thickness Equal to 50 Percent of Water Depth

	Plume Temperature Above Ambient (°F)			
	Spring (43.3°F ambient)		Summer (84.0°F ambient)	
Plume Width	Normal Operation	Maximum Operation	Normal Operation	Maximum Operation
10% of channel width (60ft)	11	23	3	5
25% of channel width (150ft)	5	13	1	3
50% of channel width (300 ft)	3	8	1	2

During spring conditions, the difference between the plume water temperature and ambient water temperature exceeds 5°F. The review team increased the width of the modeled plume area to 75 percent of the channel width and found that the temperature difference was reduced to 5°F. When the blowdown discharge was reduced to 40 cfs from the more conservative value of 68 cfs, a 5°F temperature difference was estimated for a plume width that was 50 percent of the channel width.

After the publication of the draft EIS, SCE&G submitted an independent analysis to the State of South Carolina using the CORMIX code on the thermal impacts of the proposed discharge. Based on a review of the document submitted to the State of South Carolina (SCE&G 2011), the review team determined that the results were bounded by the review team's earlier independent assessment.

The discharge velocity is estimated to be in the range 2.3 to 3.8 fps (four-cycle operation) or 6.9 to 11.3 fps (two-cycle operation) at the diffuser ports (SCE&G 2010a). The ambient currents range from 0.2 to 0.6 fps for low and average flow conditions (SCE&G 2010a). The diffuser has an alternative port configuration to yield a net momentum balance of zero. SCE&G judged that the momentum would dissipate within a limited area estimated to be 0.3 acre adjacent to the diffuser (Toblin 2007). Within this zone some scouring of the reservoir bottom would be expected. Because Parr Reservoir is characterized as depositional, SCE&G determined that the scour caused by the diffuser would be minimal.

The discharges to Parr Reservoir and the much smaller discharges from the water-treatment plant to Monticello Reservoir have low projected contaminant levels that would be controlled through the NPDES permitting process. As such, the impacts on the water quality of the Broad River, Monticello Reservoir, and Parr Reservoir from proposed VCSNS Units 2 and 3 discharges are expected to be minor enough to not alter the SCDHEC 303(d) designated use of the three water resources and would comply with SCDHEC maximum contaminant levels (SCDHEC 2008;SCE&G 2010a).

Based on the review team's independent analysis of the temperature of, and chemical constituents in, plant discharges to Parr Reservoir and Monticello Reservoir, the review team concludes the impacts of the proposed Units 2 and 3 discharges on surface-water quality would be SMALL, and mitigation would not be warranted.

5.2.3.2 Impacts on Groundwater Quality

As discussed in Section 5.2.2.2, no groundwater would be used for the operation of VCSNS Units 2 and 3. Some localized dewatering may be necessary to reduce below-grade seepage in buildings. The small alterations of groundwater flow and usage during operations would not change groundwater quality.

SCE&G referred to its *Spill Prevention, Control, and Countermeasures Plan and Facility Response Plan*, as required by SCDHEC, that would "tend to mitigate impacts on local groundwater because spills are quickly attended to and not allowed to penetrate to groundwater" (SCE&G 2010a). Spills may include diesel fuel, hydraulic fluid, and lubricants (SCE&G 2010a).

Factors that limit the impacts of operations on groundwater quality in the area are (1) SCE&G's BMPs for spill prevention and control as mentioned above; (2) the relatively large distances to local groundwater supply wells; and (3) the partial isolation of onsite groundwater from offsite users by surface waterbodies (Parr Reservoir, Mayo Creek, and Monticello Reservoir).

Impacts on groundwater quality from the proposed operation of VCSNS Units 2 and 3 are limited by the lack of groundwater use and the factors identified above. Based on all these factors, the review team concludes that groundwater quality impacts of VCSNS Units 2 and 3 operations would be SMALL, and additional mitigation would not be warranted.

5.2.4 Water Monitoring

SCE&G stated that "[w]hile specific requirements for radiological, hydrologic, and chemical monitoring programs for operation of Units 2 and 3 have not yet been established, they are expected to be similar to and tiered from or added to the ongoing Unit 1 monitoring programs…" (SCE&G 2010a). SCE&G expects to work with SCDNR on the development of a surface-water-quality monitoring program to ensure that water quality will not be degraded as a result of operation of Units 2 and 3 (SCDNR 2010). SCE&G also provided a map showing four wells from the VCSNS Units 2 and 3 subsurface investigation program (described in Section 2.3.1.2) that would remain available for groundwater monitoring (SCE&G 2009c). These wells are outside the footprint of the nuclear island. Additional groundwater monitoring wells would be installed "based on any needs determined during detailed design and discussions with SC Department of Health and Environmental Control during site activity permitting" (SCE&G 2009c). SCE&G also committed to following the requirements for additional groundwater monitoring wells as part of the voluntary *Industry Ground Water Protection Initiative – Final Guidance Document* (NEI 2007) (SCE&G 2009d). Hydrologic monitoring of groundwater involves measuring groundwater levels in wells. The operational chemical monitoring program "…would be implemented to identify any changes in water quality that may result from the operation of the new units…" (SCE&G 2010a).

5.3 Ecological Impacts

This section describes the potential impacts on ecological resources from the operation of the two proposed new units at the VCSNS site and transmission-line operation, which includes transmission-line corridor maintenance. The impacts are discussed for terrestrial ecosystems, aquatic ecosystems, and threatened and endangered species.

5.3.1 Terrestrial and Wetland Impacts Related to Operation

Impacts on terrestrial communities and species that could result from operation of the proposed units are generally related to either cooling-system operations or transmission-system operations. The operation of the cooling towers transfers heat to the atmosphere in the form of water vapor and can result in icing, fogging, increased humidity, increased noise levels, and the deposition of dissolved solids (i.e., cooling-tower drift). There is also a risk of avian collision mortality with permanent structures.

5.3.1.1 Terrestrial Resources – Site and Vicinity

The impacts of the operation of proposed Units 2 and 3 on the VCSNS site and vicinity would be associated with the operation of four circular mechanical draft cooling towers (two per unit) (SCE&G 2010a). As described in Chapter 3 of this EIS, the proposed circulating-water system (CWS) for VCSNS Units 2 and 3 would return heated water from the heat exchangers to the cooling towers to transfer heat into the atmosphere. The cooling towers would each be 70 ft high with a base diameter of 275 ft (SCE&G 2010a). In this system, heat would be transferred to the ambient atmosphere in the form of water vapor and drift of small water droplets. Vapor plumes and water droplet drift may affect vegetation, such as native plant communities, ornamental vegetation, and crops, and water losses that cause reservoir draw-down could affect shoreline habitat. In addition, birds could collide with the mechanical draft cooling towers and other tall facility structures.

Impacts of Cooling Tower Operations

For each proposed unit, two mechanical draft cooling towers would be used to remove excess heat from the CWS by transferring it into the atmosphere. Through the process of evaporation followed by partial re-condensation, the total dissolved solids (TDS) concentration in the CWS would increase. Operation of the CWS would be based on four cycles of concentration, which means the TDS in the makeup water would be concentrated approximately four times before being released. A small percentage of the water in the CWS would be released into the atmosphere as fine droplets containing elevated levels of TDS that could be deposited on nearby vegetation. CWS water losses from drift would be minor in comparison to evaporation and blowdown discharge losses; the cooling-tower design drift rate would be 0.001 percent of the circulating-water flow (SCE&G 2010a).

Depending on the source of makeup water, the TDS concentration in the drift can contain high levels of salts, which, under certain conditions and for certain species, can be damaging. Vegetation stress can be caused by drift with high levels of TDS deposition, either directly by deposition onto foliage or indirectly from the accumulation in the soils. Vegetation adjacent to the proposed cooling tower locations is a mix of recently harvested and forested communities (planted pine, mixed pine-hardwood, hardwood) (SCE&G 2010a). SCE&G estimated the combined cooling-tower plumes to have a maximum deposition rate of 0.28 lb/ac/mo, and that maximum deposition would occur 3280 ft east of the towers and approximately 1000 ft east of the site boundary (SCE&G 2009e). General guidelines for predicting the effects of drift deposition on plants suggest that sensitive species have a threshold for visible leaf damage of 8.9 lb/ac/mo on leaves during the growing season (NRC 1996).[a] Because the maximum deposition for the proposed VCSNS is below the level that could cause leaf damage in many common species, the impacts would be negligible. No agricultural crops or silviculture in the region are expected to receive significant salt deposition from plume drift from proposed VCSNS Units 2 and 3. Where the maximum salt deposition is expected to occur, the maximum levels would be well below the levels known to cause adverse effects. In addition, the impact of drift on crops, ornamental vegetation, and native plant communities was evaluated for existing nuclear power plants (including plants with more than one cooling tower) in the *Generic*

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

Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) (NUREG-1437) and was found to be of minor significance (NRC 1996).

As described in Section 5.7.1, substantial fogging and icing are not expected to occur from the operation of the four proposed mechanical draft cooling towers for VCSNS Units 2 and 3 (SCE&G 2009e) and therefore would not be expected to affect habitat or wildlife. In addition, the potential for impacts related to cloud shadowing and increased precipitation are estimated to be minimal, and no adverse effects on terrestrial species or habitats are expected. Thus, the potential impacts on native plant communities, ornamental vegetation, and crops from the operation of cooling towers for proposed Units 2 and 3 would be minimal.

Bird Collisions with Cooling Towers and Structures

A potential for avian mortality due to collision with proposed nuclear power plant structures exists and could pose a threat to species in decline and to threatened or endangered species. The height of the cooling towers associated with proposed new VCSNS Units 2 and 3 would be approximately 70 ft. The NRC previously concluded that the relatively low height of mechanical draft cooling towers causes negligible mortality (NRC 1996). In addition, the NRC concluded that avian collisions are unlikely to pose a biologically significant source of mortality due to the small fraction of total bird mortality that has been attributed to collision with nuclear power plant structures (NRC 1996). Thus, the review team concludes that the potential for impacts on bird species from collisions with cooling towers for proposed Units 2 and 3 would be minimal.

Noise Impacts of Operation

Simultaneous operation of the four mechanical draft cooling towers for VCSNS Units 2 and 3 would generate approximately 71 dBA at 200 ft and 55 dBA at 1000 ft for each cooling tower (SCE&G 2010a). This is below the 80- to 85-dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Noise from operating mechanical draft cooling towers would not likely disturb wildlife in habitats away from the planned facilities and would not be expected to affect wildlife beyond 1000 ft. Thus, the potential impact on wildlife posed by incremental noise resulting from the operation of the four mechanical draft cooling towers for the proposed Units 2 and 3 and other facilities on the VCSNS site would be minimal, and additional mitigation would not be warranted.

Impacts of Increased Vehicle Traffic

Increased traffic associated with operation of proposed VCSNS Units 2 and 3 has the potential to increase wildlife mortality resulting from vehicle-wildlife interactions. An estimated 800 additional workers would be employed to operate proposed Units 2 and 3 and SCE&G has not determined the exact routes for access to the site. The Unit 1 workforce of 635 would access the site via State Highway 215 (SC-215) (SCE&G 2010a). The additional work trips during peak hours would occur on the rural roads and highways in the vicinity. Local wildlife populations could suffer declines if road-kill rates were to exceed the rates of reproduction and immigration. However, although road-kills occur frequently in the United States, they reportedly have minimal effect on wildlife populations (Forman and Alexander 1998). The review team concludes that these impacts would not be detectable beyond the local vicinity and would not destabilize regional populations.

Light Pollution During Facility Operation

Light pollution during facility operation could potentially affect wildlife on the VCSNS site by altering behavioral patterns such as bird flight direction that are influenced by photoperiod (period of daylight) (FWS 2008). Possible mitigation measures could include the use of lower-wattage lights, hooded or down-turned lights, and turning unnecessary lights off at night to minimize potential impacts on wildlife (FWS 2008). If mitigation measures such as those noted above were implemented the impacts from light pollution would be expected to be minimal.

5.3.1.2 Terrestrial Resources – Transmission Lines

Electric power transmission systems have the potential to affect terrestrial ecological resources through corridor maintenance, bird collisions with transmission lines and structures, electrocution, and electromagnetic fields (EMFs). A total of six new offsite 230-kV transmission lines would be needed to distribute the power generated by proposed Units 2 and 3 at the VCSNS site. Santee Cooper would maintain two of the lines, and the other four lines would be maintained by SCE&G in three corridors (one double-circuit line and two single-circuit lines; see details about transmission lines in Table 4-1). As indicated in Tables 2-2 and 2-3, there would be approximately 392 mi and 5703 ac of transmission-line corridor (SCE&G and Santee Cooper lines combined) that would be used to connect proposed VCSNS Units 2 and 3 to the regional grid (SCE&G 2010d; FP&S 2008; MACTEC 2009). A substantial portion of the new lines would be routed in existing corridors, but approximately 45 mi would be in new corridor (Pike 2010; MACTEC 2009).

Corridor Maintenance – Vegetation

Vegetation control in the transmission-line corridors would be the primary source of potential impacts on terrestrial resources. Both SCE&G and Santee Cooper have established maintenance procedures for power transmission systems (SCE&G 2006a; Sott 2006; MACTEC 2008). Transmission-line corridors must be kept clear of woody growth through maintenance practices that prevent growth from becoming a safety hazard or potentially interrupting service. SCE&G and Santee Cooper have maintenance cycles for tree trimming that range from 1 to 7 years depending on the activity. Both utilities use chemical and mechanical control methods appropriate for the location, terrain, and vegetation or habitat present. Chemical methods include the use of nonrestricted-use herbicides (only herbicides registered by the U.S. Environmental Protection Agency [EPA]) to control any vegetation that may interfere with the transmission-line corridor. In general, both companies spray herbicides on a 3-year rotation. The consistent use of herbicides results in the growth of low-growing, non-woody vegetation such as grasses and other native plants. Mechanical methods of vegetation control include hand clearing, pruning, mowing, and felling (SCE&G 2006a; Sott 2006; MACTEC 2008).

The impact of transmission-line corridor maintenance on wildlife and habitats, including floodplains and wetlands, was evaluated in the V.C. Summer supplement to the license renewal GEIS (NRC 2004a), and the impact was found to be of minimal significance at operating nuclear power plants with associated transmission-line corridors of variable widths (NRC 2004a). SCE&G and Santee Cooper have procedures in place that minimize adverse impacts on wildlife and important habitats such as floodplains and wetlands (SCE&G 2010a). Corridor-maintenance activities would be performed by Santee Cooper and SCE&G (in their respective corridors) in compliance with applicable Federal, State, and local laws, regulations, and permit requirements. Therefore, the potential effects on terrestrial species and habitats from transmission-line maintenance in existing and new transmission-line corridors would be minimal, and mitigation beyond the use of standard BMPs would not be warranted.

Avian Mortality Impacts from Power Transmission Lines

Potential avian impacts from operation of transmission lines include bird injury or morality through collision or electrocution. Avian interactions with power transmission lines and structures are species- and site-specific. The NRC's analysis in NUREG-1437 determined that bird collisions with transmission lines are of small significance at operating nuclear power plants, including transmission-line corridors with variable numbers of transmission lines (NRC 1996). In addition, the V.C. Summer supplement to the license renewal GEIS (NRC 2004a) stated that impacts from bird collisions were expected to be of small significance at all sites. SCE&G and Santee Cooper also stated that all new lines would be "raptor safe" under the guidelines recommended by the U.S. Fish and Wildlife Service (FWS) (FP&S 2008; MACTEC 2009). Thus, the addition of the proposed transmission lines along existing corridors would likely present few new opportunities for bird collisions. The addition of new corridors may lead to an additional number of collisions in that corridor; however, it would not be expected to cause a measurable reduction in bird populations. The review team concludes that the potential for impacts on birds due to collision with transmission lines for the proposed VCSNS Units 2 and 3 would be minimal, and additional mitigation would not be warranted.

Impacts of Electromagnetic Fields on Flora and Fauna

EMFs are unlike many other agents that have an adverse impact (e.g., toxic chemicals, ionizing radiation) in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NRC 1996, 2004a). The NRC reviewed biological and physical studies of

EMFs but found no consistent evidence linking harmful effects with field exposures (NRC1996, 2004a). The NRC determined that EMFs produced by operating transmission lines for existing nuclear power plants up to 1100 kV were not linked to significant harmful effects on flora (NRC 1996, 2004a). Minor damage to plant foliage and buds can occur near strong electric fields, caused by heating of the leaf tips and margins. Damage does not appear within the stem and root systems of the plants and would not significantly affect growth (NRC 1996, 2004a).

EMFs have been demonstrated to affect some fauna. Voltage buildup can affect the overall health of honeybee hives (NRC 1996, 2004a). Birds that nest within transmission-line corridors experience chronic EMF exposure, but lines energized at levels less than 765-kV do not affect terrestrial biota (NRC 1996, 2004a). Since 1997, over a dozen studies have been published that looked at cancer in animals that were exposed to EMFs for all or most of their lives (Moulder 2003). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2003).

The conclusion presented in the GEIS for license renewal stated that the impacts of EMFs on terrestrial flora and fauna appear to be of small significance at operating nuclear power plants, including power transmission systems with variable numbers of transmission lines (NRC 2004a). Therefore, the review team concludes that the increased EMF impact on flora and fauna posed by the operation of new 230-kV transmission lines proposed for the VCSNS project would be negligible, and additional mitigation would not be warranted.

Floodplains and Wetlands in Transmission-Line Corridors

The effects of maintaining transmission-line corridors on floodplains and wetlands were evaluated in the V.C. Summer supplement to the license renewal GEIS, and, although periodic vegetation control is necessary in wetlands under power lines, it can be carried out with minimal damage to the wetlands (NRC 2004a). In addition, SCE&G and Santee Cooper have procedures in place that minimize adverse impacts on important habitats such as floodplains and wetlands in transmission-line corridors and all maintenance activities would be performed in compliance with applicable Federal, State, and local laws, regulations, and permit requirements (SCE&G 2010a). Thus, the ecological impacts from maintenance operations on transmission-line corridors were found to be of small significance at operating nuclear power plants, including those of variable widths. The review team concludes that the incremental effects of maintaining the proposed transmission-line corridors on floodplains and wetlands would be minimal, and mitigation beyond use of standard BMPs would not be warranted.

5.3.1.3 Important Terrestrial Species and Habitats

This section discusses the potential impacts of operation of proposed VCSNS Units 2 and 3 on Federally and State-listed species, on the ecologically important species and/or habitats (including wetlands), and on commercially important species.

Important Terrestrial Species – Site and Vicinity

The Federally and State-listed species that potentially occur on the VCSNS site and in the four-county vicinity are described in Section 2.4.1.3 (Tables 2-16 and 2-17). Biologists conducted formal and informal surveys for species that could occur in terrestrial habitats or wetlands onsite as well as surveys of whether or not suitable habitat exists for species that may occur in those four counties. Surveys were conducted in 2002 (in support of license renewal), 2006, 2007, 2008, and 2009. Nine Federally or state listed species were identified by the FWS that could potentially exist in the vicinity or that historically occurred onsite or in the vicinity of the proposed project: Rafinesque's big-eared bat (*Corynorhinus rafinesquii),* bald eagle (*Haliaeetus leucocephalus),* red-cockaded woodpecker *(Picoides borealis),* wood stork (*Mycteria americana),* pine barrens treefrog *(Hyla andersonii),* smooth coneflower (*Echinacea laevigata),* Schweinitz's sunflower (*Helianthus schweinitzii),* rough-leaved loosestrife *(Lysimachia asperulifolia),* and Canby's dropwort *(Oxypolis canbyi*). The bald eagle was the only Federally listed species found on the VCSNS site during each survey. Although bald eagles were de-listed by the FWS in August 2007, the species is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Operation of Units 2 and 3 at the VCSNS site would not be expected to affect the Federally listed or State-listed species that are not found on the site or in the vicinity.

Game species, such as white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), and a variety of waterfowl species, are common inhabitants of the VCSNS site. Increased noise levels near the cooling towers may cause these wildlife species to avoid the immediate area and increased activity and traffic would also cause wildlife to avoid the habitats immediately adjacent to the proposed units. Drift, fogging, and icing are expected to cause negligible or no impacts on habitats and would not be expected to affect important game species. Although animals may avoid habitats adjacent to the new units during operations, the VCSNS property and surrounding landscape contain large expanses of terrestrial and aquatic habitat to which these species could relocate. Thus, operational impacts on commercially and recreationally important species would be minimal, and no mitigation would be warranted.

Important Terrestrial Habitats – Site and Vicinity

No areas designated by the FWS as “critical habitat” for threatened or endangered species, or State or Federal parks, wildlife refuges, or preserves occur on or immediately adjacent to the VCSNS site (SCE&G 2010a). However, as described in Section 2.4.1.3, Parr Reservoir, which is adjacent to the VCSNS site, is managed for wildlife by the South Carolina Department of Natural Resources (SCDNR) as the Broad River Wildlife Management Area (BRWMA). Wetland habitat remaining on the site after development of the proposed units and associated facilities would include a few emergent wetlands on the edge of Parr Reservoir, as well as several forested palustrine wetlands (see EIS Sections 2.4.1 and 4.3.1). None of the wetland habitats on the site or on the nearby BRWMA is likely to be adversely affected by salt deposition or fogging and icing as a result of drift from the mechanical draft cooling towers.

Important Terrestrial Species – Transmission Lines

The transmission lines associated with the proposed project do not travel through any areas designated by the FWS as “critical habitat” for endangered or threatened species (FP&S 2008; MACTEC 2008). However, Federally and State-listed species do inhabit portions of the transmission-line corridors that would be managed to transmit power from the proposed project. A complete list of Federally and State-listed species that are known to occur in counties crossed by transmission lines associated with the project is given in Chapter 2, Table 2-17. The list was compiled from the SCDNR Natural Heritage Database (SCDNR 2010) and the FWS list (FWS 2010). SCE&G and Santee Cooper consulted with FWS and SCDNR and conducted targeted ground surveys in September, October, and November 2010 for Federally listed, threatened, endangered, and candidate species along the proposed transmission-line corridors and no protected species were found (Palmetto 2010; MACTEC 2010). However, there is still a potential that protected species might be discovered in the transmission-line corridors over the operational life of the proposed transmission lines.

Transmission-lines serving the proposed new units would travel through a variety of habitats that support large and small game as well as waterfowl species. Because most of the proposed transmission-line corridors would be constructed within or adjacent to existing corridors for operation of proposed VCSNS Units 2 and 3, no significant additional impacts would be expected to occur on any commercially or recreationally important species as a result of vegetation maintenance activities in the corridors.

No areas designated by the FWS as “critical habitat” for threatened or endangered species occur on or immediately adjacent to the proposed transmission-line corridors associated with proposed VCSNS Units 2 and 3. None of the transmission lines crosses State or Federal parks, wildlife refuges, or preserves or wildlife management areas. The effects of transmission-line corridor maintenance on floodplains and wetlands were evaluated in NUREG-1437 (NRC 1996). The impacts were found to be of small significance at operating nuclear power plants, and these included transmission-line corridors of variable widths. Because SCE&G and Santee Cooper have procedures in place to minimize impacts on important species and habitats, the potential impacts of maintaining existing corridors would be minimal.

5.3.1.4 Terrestrial Monitoring During Operation

SCE&G has stated that there would be no preoperational or operational monitoring of terrestrial ecological resources at the VCSNS site or associated transmission-line corridors (SCE&G 2010a). The review team has not identified any preoperational or operational monitoring of terrestrial ecological resources necessary to prevent impacts on those resources.

5.3.1.5 Potential Mitigation Measures for Operations-Related Terrestrial Impacts

SCE&G has committed to employing mitigation measures for operations-related terrestrial impacts including the implementation of BMPs associated with transmission-line and corridor-maintenance practices. As described in the above sections, these BMPs include the use of properly labeled herbicides in accordance with label instructions regarding the application rates, timing, and setting, as well as compliance with Federal, State, and local regulations.

5.3.1.6 Summary of Operational Impacts on Terrestrial Resources

The potential impacts of operating proposed VCSNS Units 2 and 3 on vegetation, birds, and terrestrial, wetland, and shoreline habitats are likely to be minimal. The potential impacts of transmission-line corridor maintenance and similar impacts on important habitats including floodplains and wetlands, birds, and biota because of EMFs are considered minimal assuming that BMPs and guidance available from State and Federal agencies are followed, as appropriate.

The review team assessed the potential terrestrial ecological impacts of operating two new nuclear power-generation facilities at the VCSNS site, including the associated heat-dissipation system, transmission lines, and associated corridor maintenance. Given the information provided in SCE&G's ER (SCE&G 2010a), the response to RAIs (SCE&G 2009e), interactions with State and Federal agencies, the public scoping process, and the review team's independent assessment, the review team concludes that the impacts from operation of the new facilities and associated transmission-line corridors would be SMALL, and additional mitigation beyond the BMPs mentioned above would not be warranted.

5.3.2 Aquatic Impacts Related to Operation

The following sections discuss potential impacts resulting from the operation of proposed VCSNS Units 2 and 3 on the aquatic ecosystem in the Broad River and Parr Reservoir, Monticello Reservoir, onsite streams, and water courses crossed by transmission lines.

5.3.2.1 Aquatic Resources – Site and Vicinity

For aquatic resources, the primary concerns related to water intake and consumption are the impacts related to the relative amount of water drawn from the cooling-water source (Monticello Reservoir) and the potential for organisms to be impinged on the intake screens or entrained in the cooling-water system. Impingement occurs when organisms are trapped against the raw-water intake screens by the force of the water passing through the intake structure used for cooling water (66 FR 65256). Aquatic biota subjected to impingement can experience starvation and exhaustion, asphyxiation (water velocity forces may prevent proper gill movement or organisms may be removed from the water for prolonged periods of time), and descaling (66 FR 65256). Entrainment occurs when organisms are drawn through the raw-water intake into the proposed VCSNS Units 2 and 3 cooling-water system. Organisms that become entrained are typically small benthic, planktonic, and nektonic (organisms within the water column) forms, including early life stages of fish and shellfish, which often serve as prey for larger organisms (66 FR 65256). As entrained organisms pass through a facility's cooling system, they are subject to pressure, mechanical, thermal, and toxic stresses that are, in most cases, lethal.

A number of factors, such as the type of cooling system, the design and location of the intake structure, and the amount of water withdrawn from the source waterbody, greatly influence the degree to which impingement and entrainment affect the aquatic biota.

SCE&G indicated in its ER that a closed-cycle recirculating cooling system with mechanical draft cooling towers would be used for proposed VCSNS Units 2 and 3 (SCE&G 2010a). Closed-cycle recirculating cooling-water systems can, depending on the quality of the makeup water, reduce water withdrawals by 96 to 98 percent of the amount that the facility would use if it used a once-through cooling system (66 FR 65256). This significant reduction in water-withdrawal rate results in a corresponding reduction in impingement and entrainment.

Monticello Reservoir Intakes

The intake design through-screen velocity greatly influences the rate of impingement of fish and shellfish at a facility. The higher the through-screen velocity, the greater the number of biota impinged. The EPA has established a national standard for the maximum design through-screen velocity of no more than 0.5 fps (66 FR 65256). The EPA determined that species and life stages evaluated in various studies could endure a velocity of 1.0 fps, and subsequently applied a safety factor of two to derive the threshold of 0.5 fps.

SCE&G (2010a) stated that both the CWS raw-water intake and the water-treatment plant intake associated with proposed Units 2 and 3 would be located in Monticello Reservoir, and would have a design through-screen velocity of less than 0.5 fps at a minimum reservoir water elevation of 414.3 ft Northern American Vertical Datum of 1988 (NAVD88) (SCE&G 2010a). Each CWS intake pump would be protected by a debris-exclusion system consisting of a bar screen to trap large debris and a dual-flow traveling screen to filter out fine debris. At the water-treatment plant intake, the end of the intake pipe would be inside a concrete wet well (a chamber used to collect liquid). Screens in the side of the wet well would allow water to pass into the wet well while excluding debris (SCE&G 2009h, 2010a).

Monticello Reservoir is primarily fed by water from the Broad River, which is transferred via the FPSF. The consumptive use of water from the Broad River for VCSNS Units 2 and 3 represents between 1 and 4 percent of the long-term annual mean flow and the lowest annual mean flow, as described in Section 5.2.2.1. These consumptive-use estimates for VCSNS

Units 2 and 3 are less than the conservative withdrawal limit of no more than 5 percent as allowed by the EPA Phase I regulations (66 FR 65256). In the event of low-flow conditions in the Broad River, Monticello Reservoir can supply a total of 45,000 ac-ft of usable storage for cooling water for VCSNS Units 1 through 3. If drought conditions in the Broad River persist and the storage water from Monticello Reservoir is used before hydrologic conditions are restored, "…SCE&G would curtail or cease operation of VCSNS until water is available" (SCE&G 2010a). Due to these operational conditions to maintain a usable volume of water storage in Monticello Reservoir, impacts on aquatic biota during drought conditions are expected to be minor.

Impingement and entrainment of aquatic biota are also influenced by the application and use of design and construction technologies aimed at minimizing impingement mortality and entrainment. The EPA indicated (66 FR 65256) that the optimal design requirement for the intake location is to place the inlet of the cooling-water intake structure (CWIS) in an area of the source waterbody away from areas with the potential for high productivity, where impingement and entrainment of organisms are minimized. Dames and Moore (1985) noted a high diversity and abundance of fish in the southwest portion of Monticello Reservoir and suggested these trends may have been linked to the delivery of nutrient-rich water from the Parr Reservoir via the FPSF. Since those data were collected, large fluctuations in the composition of fishes within the reservoir have been observed (Christie and Stroud 1997). Since the creation of Monticello Reservoir in 1977, the aquatic biota within the reservoir may have adapted to environmental factors (e.g., frequently fluctuating water surface elevation because of FPSF operation), biotic interactions (e.g., predator-prey, invasive species), or a combination of both. Based on the 2006–2009 fishery data collection effort led by SCE&G (e.g., Normandeau 2007, 2008, 2009a) and the aquatic surveys conducted by SCDNR (Christie and Stroud 1998, 1999), the community composition of fish within Monticello Reservoir consists of a diversity of species exhibiting an array of life-history requirements and habitat associations, such as shallow-water nesting for reproduction and benthic scavenging. The recent data documenting changes in fish community composition and the diversity of fish present in the system do not indicate that the southwest portion of Monticello Reservoir is consistently more productive than any other part of the reservoir.

Beginning in October 1983, after VCSNS Unit 1 commenced operations, a study was conducted for VCSNS Unit 1 discharge permitting where ichthyoplankton were collected during a 12-month study at several discrete locations within Monticello Reservoir to determine the types of larvae that would be subjected to entrainment at the VCSNS Unit 1 intake (Dames and Moore 1985). Gizzard shad (*Dorosoma cepedianum*) accounted for 91 percent of the larval samples, followed by white bass (*Morone chrysops*) and perch species (*Perca* spp.), which accounted for 6 and 2 percent of the collective samples, respectively. The remaining taxa encountered during the 1983–1984 ichthyoplankton surveys included minnows (Cyprinidae), suckers (Catostomidae), centrarchids (Centrarchidae), and crappie species (*Pomoxis* spp.) with each accounting for less than 1 percent of the larvae sampled (Dames and Moore 1985).

The results of a 2008–2009 ichthyoplankton study conducted by Normandeau (2009b) indicated a predominance of threadfin shad (*D. petenense*), whereas gizzard shad predominated in the 1983–1984 Dames and Moore (1985) study. In addition, overall densities of larval fish were lower in the 2009 study. Dames and Moore (1985) reported that the highest densities of larvae occurred during May and June, with an average annual estimate of 53.9 larvae/100 m^3 at the surface, and 11.8 larvae/100 m^3 at mid-depth. While there are similarities in the temporal trends of abundance between the two studies, the 2009 ichthyoplankton study results indicate dissimilar trends in that total annual larval densities across depths were only 7.47 larvae/100 m^3 (Normandeau 2009b). Therefore, the overall abundance of fish near the southern portion of Monticello Reservoir appears to be lower than it was over 20 years ago. Differences in ichthyoplankton abundance may be attributed to a shift in the community composition within Monticello Reservoir such that blue catfish (*Ictalurus furcatus*) are now predominant (Christie and Stroud 1996; Normandeau 2009b). Furthermore, Normandeau (2009b) speculated that nutrients within the Monticello Reservoir may be lower than they were during the time period that coincided with the Dames and Moore (1985) study. In assessing VCSNS license renewal for Unit 1, NRC determined that although fish community composition had changed since 1985 with the introduction of white perch (*Morone americana*) and blue catfish, the potential impacts from entrainment on fish populations in Monticello Reservoir would remain small. Survival of larval and juvenile fish is largely compromised by predation and competition and results in low percentages of fish that may survive to become reproducing adults (NRC 2004a).

The projected annual entrainment of larval fish species for the VCSNS Units 2 and 3 CWS is between 15.3 million for a normal pumping rate of 36,214 gpm (81 cfs) and 24.9 million for a maximum pumping rate of 58,800 gpm (131 cfs) with a through-screen velocity of less than 0.5 fps (Normandeau 2009b). It should be noted that no eggs for any species were collected during the 2008–2009 ichthyoplankton surveys. The dominant entrained species is likely to be the threadfin shad, which is a prolific spawner, with females producing over 10,000 eggs per fish and spawning in both spring and fall. Speculation as to the difference in population dynamics include a natural progression of community turnover, stabilization of reservoir water quality or alteration of incoming nutrients into the system, introduction of new species, and density-dependent interactions between predator-prey fish species (Normandeau 2009b).

VCSNS Unit 1 was designed as a once-through cooling plant to withdraw approximately 767 Mgd (1190 cfs) from Monticello Reservoir (Geosyntec 2007). Units 2 and 3 are designed as a closed-cycle recirculating cooling system with mechanical draft cooling towers and would withdraw between 7 and 12 percent of the water needed for Unit 1 operations (SCE&G 2010a). Based on the small percentage of water withdrawn, the planned low through-screen intake velocity, the closed-cycle cooling system design, and the high fecundity of the most likely entrained fish species, the review team concludes that the impacts on the fish populations of the Monticello Reservoir from entrainment would be minor.

Two impingement studies have been conducted at the VCSNS Unit 1 intake structure; the first occurred 10 months after Unit 1 began operation and the second study commenced during 2005. In the first study, Dames and Moore (1985) collected a total of 5140 fish weighing 31 kg sampling at 2-week intervals between October 1983 and September 1984. The abundance of gizzard shad accounted for 82.6 percent of the impinged individuals and 51.8 percent of the overall impinged biomass. Yellow perch (*Perca flavescens*) accounted for 7.6 percent of the abundance and 8.0 percent of the overall biomass. However, numerically dominant taxa detected in the Dames and Moore (1985) study were not necessarily proportional to the biomass of impinged organisms. For example, white catfish (*Ameiurus catus*) accounted for 2.4 percent of the abundance and 17.6 percent of the biomass. Species such as warmouth (*Lepomis gulosus*), white bass, and white crappie (*Pomoxis annularis*) each accounted for less than 1 percent of the impinged taxa, yet these fish species each constituted approximately 3 percent of the overall impinged biomass (Dames and Moore 1985). Assessment of impingement impacts during license renewal for VCSNS Unit 1 noted that non-benthic species such as gizzard shad, threadfin shad, white perch, and white bass are most susceptible to impingement and that overall impingement impacts are small based on the high reproductive and growth rates of these fish, particularly gizzard shad (NRC 2004a).

As a result of EPA regulations stemming from Section 316(b) of the Clean Water Act, SCE&G implemented a 12-month impingement study, with bi-weekly sampling, at existing VCSNS Unit 1 during 2005–2006. A total of 574 organisms weighing 7.9 kg were impinged between July 12, 2005 and June 27, 2006 (Geosyntec 2007). The estimated annual impingement at the VCSNS Unit 1 during the 2005–2006 study period was 8042 organisms (Geosyntec 2007). Similar to the Dames and Moore (1985) impingement study, numerically dominant taxa detected in the Geosyntec study were not necessarily proportional to the biomass of impinged organisms (Table 5-4). Threadfin shad were the most abundant, making up 50 percent of the impinged samples, yet these fish only made up 6.9 percent of the overall biomass. Blue catfish and channel catfish (*Ictalurus punctatus*) accounted for 12.2 and 11.8 percent of impinged samples while accounting for 16.1 and 12.5 percent of the biomass, respectively. White perch represented 9.4 percent of the abundance of impinged samples, and yielded the highest biomass (36.6 percent) of impinged species. Representing less than 5 percent of the impinged catch, gizzard shad and white catfish accounted for 12.9 and 7.4 percent of the impinged biomass, respectively (Geosyntec 2007).

Both the Dames and Moore (1985) and the Geosyntec (2007) impingement studies detected similar patterns with regard to the size class of fish impinged at the VCSNS Unit 1 intake structure. The majority of impinged fish were of small size classes indicative of juvenile to subadult life stages (Dames and Moore 1985; Geosyntec 2007). Dames and Moore (1985) report that the majority of fish, such as gizzard shad, yellow perch, and bluegill (*Lepomis macrochirus*), were impinged as juveniles. However, the size classes of white catfish impinged during their study included juveniles as well as adult stages (Rohde et al. 2009). The overall size-class distribution of fish impinged during the Geosyntec (2007) study suggests the taxa typically subjected to impingement were relegated to small size classes (e.g., less than 140 mm). Impinged fish ranged from 38 to 349 mm in total length (Geosyntec 2007), which, depending on the particular species, can include a range of life stages (Rohde et al. 2009). While the majority of the impinged taxa were representative of juvenile or subadult life stages, an evaluation of the Geosyntec (2007) length frequency distributions indicated that impingement at the Unit 1 intake structure likely included adult threadfin shad, gizzard shad, white perch, and white catfish.

Table 5-4. Abundance and Biomass of Biota Sampled During the 2005-2006 Geosyntec (2007) VCSNS Unit 1 Impingement Study

Common Name	Percent of Total Catch	Percent of Total Biomass
Threadfin shad	50.2	6.9
Blue catfish	12.2	16.1
Channel catfish	11.8	12.5
White perch	9.4	36.6
Yellow perch	6.1	3.4
Gizzard shad	4.4	12.9
White catfish	2.6	7.4
Bluegill	1	1.5
Crayfish	0.7	0.2
Flat bullhead	0.5	1.1
Snail bullhead	0.3	0.6
Flier	0.2	0
Grass shrimp	0.2	0
Hybrid sunfish	0.2	0.7
Warmouth	0.2	0.1

Both impingement studies also noted similar patterns associated with impingement rates linked to seasonal changes. Impingement rates were greatest during winter months. Dames and Moore (1985) and Geosyntec (2007) attributed this pattern to cold water temperatures, which are thought to impose stress on some fish species (e.g., gizzard shad, threadfin shad), making them more susceptible to impingement. Dames and Moore (1985) also postulated that the high rates of occurrence of some species may be linked to schooling and migratory behavior (e.g., gizzard shad, yellow perch), or associations with habitat features near the intake structure (e.g., white catfish).

Neither the Dames and Moore (1985) nor the Geosyntec (2007) study observed correlations between impingement rates and fluctuating elevations of the water surface in Monticello Reservoir resulting from the operation of the FPSF. While impingement rates were not linked to changing water-surface elevations, the size of the hydraulic zone of influence associated with the CWIS at Unit 1 was inversely correlated with the elevation of the reservoir water (Geosyntec 2005). The hydraulic zone of influence was greatest during the lowest reservoir elevations, extending 555 ft from the CWIS and encompassing a surface area equal to 2.9 ac (Geosyntec 2005).

The fish most vulnerable to impingement include small size classes of fish that exhibit weak swimming capabilities, are particularly sensitive to cold water temperatures, demonstrate an affinity for habitats near the intake structure, and/or maintain life-history requirements that increase the likelihood of contact within the CWIS hydraulic zone of influence. Based on these criteria and the results of the Geosyntec (2007) impingement study, the most vulnerable fish include clupeids (gizzard shad, threadfin shad), ictalurids (blue, channel, and white catfish), and white perch. Collectively, these fish are commonly encountered and represent appreciable proportions of the standing stocks of fish in Monticello Reservoir (Christie and Stroud 1997). Furthermore, these fish are typically highly fecund and prolific spawners (Rohde et al. 2009). Of the fish most vulnerable to impingement, blue catfish and white perch are non-native to Monticello Reservoir. Impingement impacts from operation of VCSNS Unit 1 were determined to be small during license renewal assessment (NRC 2004a). Given that the impingement and entrainment rates for Unit 1 are based on a flow rate of 1190 cfs, and the CWS flow rates for Units 2 and 3 would require between 81 and 131 cfs, the reduced flow rates should result in lower impingement rates compared with Unit 1 (SCE&G 2010a). Based on the planned low through-screen intake velocity (less than 0.5 fps), flow rates that are at least 9 times less than those of existing Unit 1, and the high fecundity of the species sampled in the Unit 1 impingement studies the review team concludes that impacts from impingement of fish related to the proposed VCSNS Units 2 and 3 would be minor.

Cooling-Water Discharge

The effluent from proposed VCSNS Units 2 and 3 would be discharged directly to the Parr Reservoir on the Broad River. Section 3.2 discusses the location and design of the discharge and outfall structures; Section 3.4 discusses the effluent discharge rates (Table 3-6). Discharge from VCSNS Units 2 and 3 operations would be 21 cfs for normal operations (68 cfs maximum), which represents about 0.3 percent to 1 percent of the long-term average flow for normal and maximum operating conditions, respectively.

Aquatic Thermal Impacts

Heat Stress

Thermal conditions influence all aspects of aquatic ecology, which includes an array of processes: feeding, metabolic processes, growth, reproduction, development, distribution, and survival (Coutant 1976). In a general sense, biota are often able to persist (e.g., grow, reproduce, survive) under a range of thermal conditions. While many species exhibit similar tolerance for temperature regimes, growth and survival are linked to optimal thermal conditions that are driven by species-specific requirements (Kellog and Gift 1983). The thermal tolerance for aquatic organisms is defined in different ways. Some definitions relate to the temperature that causes fish to avoid the thermal plume, other definitions relate to the temperature that fish prefer for spawning, and others relate to the temperatures (upper and lower) that may cause mortality. The differing life stages of aquatic organisms often have different temperature tolerances and differing abilities to avoid temperature extremes. Spatially, thermal pollution may exist at the site or may include offsite waterbodies. Temporally, conditions that result in water temperatures that exceed ambient levels may be more pronounced during certain times of the year (i.e., winter). Finally, the consequences of thermal pollution within aquatic ecosystems may be confined to individuals or depending on ecosystem conditions, may result in a population-level response (Coutant 1976).

The blowdown discharge from proposed VCSNS Units 2 and 3 into Parr Reservoir would be, in most cases, warmer than the ambient water (Table 5-3). SCE&G, using the CORMIX Version 4.3 model, discusses a mixing zone (where discharge effluent combines with Parr Reservoir water) of less than 25 percent (i.e., 150 ft) of the Parr Reservoir channel width during a maximum heat discharge scenario (winter) to bound the maximum potential for plume temperatures and temperature differentials with the ambient water of Parr Reservoir (SCE&G 2010a). In Section 5.2.3.1, the review team describes its independent assessment of the incremental impacts of proposed VCSNS Units 2 and 3 on the water temperatures in the Parr Reservoir. The review team used a range of mixing zone to channel width ratios (10, 25, and 50 percent) to independently assess thermal changes for comparison with SCE&G's thermal analysis. The following review team analysis was based on the assumption that complete mixing occurs over the portion of the channel width that is specified (10, 25, or 50 percent) over the upper half of channel depth, at 7Q10 flow conditions (Table 5-2 and Table 5-3).

The 7Q10 flow rate during the summer season is used to assess potential extreme drought conditions, with only two cycles of concentration for a maximum discharge of 68 cfs. A mean low flow of 1469 cfs was calculated just for the months from November through April, analogous to a 7Q10 calculation (Toblin 2007) for flows relevant during the lowest ambient water temperatures through the beginning of spawning season. As noted in Table 3-6, blowdown and other liquid effluent would discharge to Parr Reservoir at a normal discharge flow rate of 21 cfs (assuming four cycles of concentration) and at maximum blowdown temperature of 91.8°F

(SCE&G 2010a). Under normal operations with low-flow conditions between November and April, the thermal plume would exceed the 5°F difference between ambient and plume temperature if the mixing zone occurs across 10 percent or less of the Parr Reservoir channel. If the mixing zone was extended to 25 percent, the thermal plume differential with ambient water would be 5°F. Under extreme 7Q10 conditions in the summer, none of the scenarios for mixing zone width violate criteria set by SCDHEC to not exceed 90°F, or be more than 5°F above ambient water temperature for the mixing zone (SCDHEC 2008). The flow reversal by FPSF operation is not expected to exceed the results presented above as representative of extreme flow conditions (see Section 5.2.3.1).

Under the previous extreme assumptions used to assess the extent of the 5°F above ambient isotherm, a mixing zone that would occupy one-half of the Parr Reservoir channel width would still allow motile aquatic biota to avoid the affected mixing zone area during spring conditions. However, fish eggs and larvae would drift with the upstream or downstream current, depending on FPSF operation, and would not be able to avoid the 5°F above ambient isotherm. According to Schubel et al. (1977), some species of fish larvae may tolerate a temperature increase of up to 50°F above ambient for as much as 60 minutes, but no tested fish larval species has been documented to withstand increases of 68°F or more above ambient. Extreme temperature increases of 68°F above ambient are not likely to occur within the mixing zone even under 7Q10 conditions during the spring season. However, based on the review team's analysis, the worst-case conditions occur during maximum operation in the spring with an anticipated maximum temperature change of 23°F above ambient river temperature (Table 5-3). One species present in abundance in Parr Reservoir, gizzard shad, is known to be particularly susceptible to mortality caused by sudden or extreme changes of temperature (Williamson and Nelson 1985). However, increases in temperature are generally more tolerated than decreases for this species as described below.

To evaluate the potential thermal impact on aquatic biota downstream of the Parr Shoals Dam, the review team examined conditions that corresponded to the greatest extent of plume coverage across the river at the multiport diffuser (e.g., 8°F above ambient during spring; Table 5-3). Due to hydraulic mixing from water passing through the turbines it is likely that complete mixing of river and blowdown discharge would occur downstream of Parr Shoals Dam. Extrapolation of data described in Table 5-3 yields no more than a 2°F increase above ambient river temperature below the Parr Shoals Dam during spring months. A less than 5°F change from ambient water temperatures meets State standards (SCDHEC 2008). Based on the minor increase in water temperature below Parr Shoals Dam during the spring months, thermal impacts on aquatic biota below Parr Shoals Dam are likely to be negligible.

Based on the review team's analysis, the thermal plume would not exceed the maximum thermal criterion (>90°F) established by SCDHEC during spring and summer months (Table 5-2). Model simulations also indicate the thermal plume may exceed ambient conditions by 5°F; however, this occurrence would be limited to specific plume width and operating conditions (Table 5-2). These exceedances may be very short in duration (<9 hr/yr), or may never occur (Toblin 2007). The most abundant fish in Parr Reservoir include gizzard shad, threadfin shad, bluegill, and white perch, all of which are prolific spawners (Dames and Moore 1985). Because even under worst-case conditions at least one-quarter of the width of the Parr Reservoir channel would be unaffected by thermal plume impacts, it is not expected that these fish populations would be adversely affected by thermally induced mortality to eggs and larvae. Sufficient habitat for motile species is available in Parr Reservoir under all plume conditions to prevent impacts on the fish populations from the VCSNS Units 2 and 3. Therefore, impacts on aquatic biota from thermal discharges to Parr Reservoir would be minor, and additional mitigation would not be warranted.

Cold Shock

Another factor related to thermal discharges that may affect aquatic biota is cold shock. Cold shock occurs when aquatic organisms that have been acclimated to warm water, such as fish in a power plant's discharge canal, are exposed to a sudden temperature decrease. This sometimes occurs when single-unit power plants shut down suddenly in winter. Cold shock mortalities at U.S. nuclear power plants have typically involved small numbers of fish and did not result in population-level effects (NRC 1996). Cold shock may also occur under extreme weather events and may adversely affect aquatic biota. For example, in January 1984 an extreme cold event resulted in the mortality of a large number of young-of-year gizzard shad within Monticello Reservoir (Dames and Moore 1985).

Impacts on aquatic biota stemming from cold shock most often occur in winter months. Life-history stages that can be particularly sensitive to perturbations in water temperature include larval and juvenile stages as well as spawning and egg development. Fish within the Parr Reservoir do not typically undergo these vulnerable life stages and life-history events during the winter months. Because there would be multiple units that are unlikely to shut down concurrently, the temperature decrease from shutting down one unit would be moderated by the heated discharge from the units that continue to operate. In addition, gradual shutdown of plant operations generally precludes cold shock events (NRC 1996). Based on this analysis, the review team concludes that the thermal impacts on the fish populations due to cold shock would be minor and additional mitigation would not be warranted.

Invasive Organisms

Invasive organisms found on the VCSNS site include two aquatic plant species (alligatorweed [*Alternanthera philoxeroides*] and water primrose [*Ludwigia uruguayensis*]), two fishes (blue catfish, white perch), and one mollusk (Asian clam [*Corbicula fluminea*]) (see Section 2.4.2.3). Neither these invasive organisms nor any other invasive species have been observed to have increased in numbers in the vicinity of the VCSNS Unit 1 thermal plume in Monticello Reservoir.

Therefore, it is assumed that no large growths of invasive organisms are anticipated from the thermal plume for proposed Units 2 and 3 in Parr Reservoir.

Based on this analysis of the potential for thermal impacts on the aquatic ecosystem of the Parr Reservoir, the review team concludes that the impacts on aquatic organisms from thermal discharges from the proposed VCSNS Units 2 and 3 would be minor.

Chemical Impacts

Another discharge-related impact includes the chemical treatment of the cooling water. The ER indicates that chemicals would be added to the circulating-water and service-water systems that would be discharged into the blowdown lines and ultimately into Parr Reservoir. Biofouling would be controlled using metered pumps that inject chemicals into the raw-water pipeline and into the service-water pump discharge (SCE&G 2010a).

Chemical treatments proposed for use during the operation of VCSNS Units 2 and 3 are outlined in Table 3-5 in Section 3.4.4.1 of this EIS. These chemicals are the same that are in use for VCSNS Unit 1 (SCE&G 2010a). The water flow from the Parr Reservoir would further dilute the concentration of these chemicals occurring in the station blowdown discharge.

The use of chemicals in the existing VCSNS Unit 1 is regulated by an NPDES permit, which is granted under permit number SC0030856. The chemical concentrations at the outfall for the existing units meet the NPDES limits (SCE&G 2010a). A new NPDES permit would likely be needed for the new discharge into Parr Reservoir. Sampling efforts in Monticello Reservoir since the operation of Unit 1 have not indicated any impacts associated with chemical toxicity (Christie and Stroud 1996, 1997, 1998, 1999; Normandeau 2007, 2008, 2009a). Therefore, the impacts resulting from chemical discharges from proposed Units 2 and 3 to the Parr Reservoir would likely be minor.

Physical Impacts from Discharge

Physical impacts can occur from discharge in the form of scouring, siltation, sediment transport, increased dissolved oxygen, eutrophication, and increased turbidity. The maximum discharge velocity at the diffuser ports is anticipated to range from 6.9 to 11.3 fps, during periods of two-cycle operation (SCE&G 2010a). Discharge velocities are discussed further in Section 5.2.3.1. The diffuser line would be located near the bottom of the reservoir, approximately 10 ft below the normal minimum water surface (SCE&G 2010a). Riprap placed on the bottom of the reservoir to stabilize the diffuser would also likely reduce localized scouring. The maximum extent of scouring as a result of the discharge system is expected to encompass an area equal to 0.3 ac, or roughly one-sixth of the width of Parr Reservoir at the point of discharge (SCE&G 2010a). Within this localized area, the benthic invertebrate community would likely be altered.

Because this potential scouring is limited to such a small portion of Parr Reservoir, and would likely result in only localized disturbance to benthic invertebrates, the review team concludes that the physical impacts on aquatic biota from thermal discharges from proposed VCSNS Units 2 and 3 would be minor.

Stormwater Drainage

During the period of operation of proposed VCSNS Units 2 and 3, onsite streams (Mayo Creek and intermittent streams) as well as Monticello and Parr reservoirs could be affected by stormwater drainage. SCE&G has an existing SWPPP to manage stormwater prior to its discharge to Monticello Reservoir. SCE&G would revise the existing VCSNS Unit 1 SWPPP to reflect the addition of new paved areas and facilities and changes in drainage patterns (SCE&G 2010a). The review team concludes that based on the use of a stormwater system comparable to the system currently used for the VCSNS Unit 1 site, the impacts on onsite streams (Mayo Creek and intermittent streams) as well as Monticello and Parr reservoirs from operation of proposed VCSNS Units 2 and 3 would be minimal.

5.3.2.2 Aquatic Resources – Transmission Lines

Maintenance activities along the six new 230-kV transmission lines could lead to periodic temporary impacts on the waterways being crossed. However, it is assumed that the same vegetation-management practices currently used by SCE&G and Santee Cooper for their existing transmission-line corridors would be applied to the proposed new and upgraded transmission-line corridors (MACTEC 2009; Pike 2010). SCE&G and Santee Cooper use practices and procedures developed to minimize impacts on aquatic ecosystems from operation and maintenance of transmission lines. Santee Cooper would continue to use its Right-of-Way Management Unit Plan, which addresses vegetation clearing or maintenance for stream buffer zones (MACTEC 2008). Methods include selective application of herbicides aimed at the removal of large woody vegetation that may ultimately interfere with the operation of transmission lines. Herbicides applied in wetlands are EPA-approved and their application would be aimed at controlling woody vegetation while still promoting low-growing, native vegetation. Low-growing vegetation along waterbody shorelines would be maintained as buffer zones (MACTEC 2008). Both SCE&G and Santee Cooper restrict the use of heavy equipment around stream crossings to prevent erosion and sedimentation (SCE&G 2010a).

The review team concludes that the impacts of transmission-line corridor maintenance activities on aquatic resources would not adversely affect aquatic ecosystems, and additional mitigation beyond that described above would not be warranted.

5.3.2.3 Important Aquatic Species and Habitats

As described in Section 2.4.2.3, both Monticello and Parr reservoirs support a recreational fishery that consists mainly of largemouth bass (*Micropterus salmoides*), sunfish (*Lepomis* spp.), and catfish (*Ictalurus* spp.). No Federally listed threatened or endangered aquatic species are known to occur at the VCSNS site; however, seven Federally protected or proposed threatened or endangered aquatic species occur within counties proposed for siting of new transmission lines (Table 2-20). Several aquatic taxa within Fairfield and Newberry Counties are State species of concern (Table 2-20). In addition, some of the aquatic taxa encountered during onsite aquatic inventories have been identified as State conservation priority species, such as the robust redhorse (*Moxostoma robustum*), or are important recreational fish that are stocked to establish a self-sustainable fishery, such as the smallmouth bass (*Micropterus dolomieu*). These taxa (identified in Section 2.4.2.3) demonstrate a range of life-history attributes and habitat requirements. Particularly sensitive life stages include larvae and juveniles that are more sensitive to water quality. The operation of the intakes located on Monticello Reservoir and the multiport diffuser located on Parr Reservoir would likely exclude access by aquatic biota in the vicinity of these localized areas in the southwestern portion of Monticello Reservoir and eastern nearshore area of Parr Reservoir, respectively. However, many aquatic species are motile and would likely move to adjacent habitat and would not be affected by operational activities. Impacts are not anticipated on the Federally and State-listed species identified in Section 2.4.2.3 from maintenance of the transmission-line corridors because of the BMPs that SCE&G and Santee Cooper would use during maintenance activities.

Habitat restoration activities in the Broad River basin may eventually result in the re-introduction of diadromous species, such as sturgeon, in Parr Reservoir (FWS 2001). Changes may be made to water-flow criteria to accommodate spawning activities by diadromous fish if needed, as is stipulated for the striped bass below Parr Shoals Dam (SCE&G 2010). However, impacts to the thermal, chemical, and physical impacts from the discharge are expected to be minimal to reintroduced diadromous fish species, as previously described in Section 5.3.2.1.

Aquatic Threatened and Endangered Species Summary

Although the existing VCSNS-Flat Creek corridor crosses a portion of Flat Creek in Lancaster County, that is listed by FWS as critical habitat for the Carolina heelsplitter (67 FR 44502), maintenance activities for this transmission-line corridor are not likely to affect the protected habitat. The use of BMPs for activities associated with maintenance of transmission-line corridors is expected to limit potential impacts on this species.

Based on threatened and endangered species surveys, historical records, life-history information, known threatened and endangered species locations, possible re-introduction through habitat restoration, and information provided by SCE&G in its ER and in responses to RAIs, the review team concludes that there would be no impacts on aquatic Federally listed species from operational activities on the VCSNS site and associated transmission-line corridors. More detailed analysis can be found in Appendix F in the biological assessments and supplements prepared for the FWS and the National Marine Fisheries Service, respectively, in accordance with the Endangered Species Act of 1973, as amended.

5.3.2.4 Aquatic Monitoring During Operation

SCE&G plans to perform operations-related monitoring for water quality as required by the NPDES permit (SCE&G 2010a). SCE&G will also continue the voluntary monitoring program for water quality in Monticello Reservoir (SCE&G 2010a). Monitoring associated with the SWPPP may also be implemented during operations (SCE&G 2010a), and SCDNR and SCDHEC may require specific monitoring activities as a part of their permitting process to assess potentially affected areas such as onsite waterbodies and transmission-line corridors.

5.3.2.5 Summary of Operational Impacts on Aquatic Resources

With regard to aquatic ecosystems, operational impacts associated with proposed VCSNS Units 2 and 3 are centered on the intake structures and the multiport diffuser, but also include stormwater management as well as maintenance and operation of transmission-line corridors. The aquatic community in the vicinity of the VCSNS site consists of a diversity of biota with a range of life-history requirements. Biota most vulnerable to entrainment and impingement include planktonic and nektonic life forms, respectively. As reviewed in Section 5.3.2.1, the low through-screen intake velocity (less than 0.5 fps), the use of closed-cycle cooling, and the population status and reproductive potential of fish most vulnerable to impingement and entrainment would result in minimal adverse impacts on the aquatic ecosystem in Monticello Reservoir. The blowdown line would deliver effluent with thermal, chemical, and physical inputs to Parr Reservoir, which would be regulated by State and Federal agencies. With regard to thermal influence, a mixing zone that covers approximately 50 percent of the Parr Reservoir channel width would result in a thermal plume that would not exceed the maximum criteria established by SCDHEC. Furthermore, the temporal occurrence of such infrequent events (i.e., exceeding SCDHEC discharge criteria) is not concurrent to critical life-history events of important aquatic biota (e.g., spawning, rearing). Based on the foregoing, the review team concludes that the impacts on the aquatic resources of Monticello and Parr reservoirs and onsite streams from the operation of VCSNS Units 2 and 3 and associated transmission-line corridors would be SMALL.

5.4 Socioeconomic Impacts

Operations activities can affect individual communities, the surrounding region, and minority and low-income populations. This section assesses the impacts of operations-related activities and of the operations workforce on the region. Unless otherwise specified, the primary source of information for this section is the ER (SCE&G 2010a).

Although the review team considered the 50-mi region when assessing socioeconomic impacts, the primary geographic region for physical impacts is the four most local counties (Fairfield, Lexington, Newberry, and Richland). As described in EIS Section 2.5, the review team also uses these counties for the economic impact area when discussing economic impacts such as employment, income, and output impacts from operations.

The socioeconomic impacts of operating two new Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactors at the VCSNS site include the activities and demands of the 800-person operating workforce supplemented by as many as 1000 outage workers onsite for about 45 to 90 days every 18 months (SCE&G 2010a).

Construction at the site is planned to span a total of 123 months or 10.25 years, with 30 months dedicated to site clearing and preparation and 93 months for construction of Units 2 and 3, with Unit 3 construction starting 24 months after the start of Unit 2 operation. According to SCE&G's most recent Integrated Resource Plan (SCE&G 2010a), SCE&G expects to bring Unit 2 online in 2016 and Unit 3 online in 2019.

5.4.1 Physical Impacts

The potential physical impacts of operating the two nuclear units include noise, odors, exhausts, thermal emissions, and visual intrusions. The review team expects these impacts to be mitigated by operating the facility in accordance with all applicable Federal, State, and local environmental regulations without significantly affecting the region surrounding the VCSNS site. The following sections assess the potential operations-related physical impacts of two new units on specific segments of the population, the plant, and nearby communities.

5.4.1.1 Impacts on Workers and the Local Public

This section discusses potential air quality and noise impacts on workers and the local public from operation of VCSNS Units 2 and 3. The VCSNS site is located in western Fairfield County, South Carolina, in an attainment area for ozone and for carbon monoxide. A description of baseline air quality characteristics is included in Section 2.9.2. Once the two new reactors have begun operation, they are not expected to produce any known air pollutants, except for (1) some combustion-related air emissions during the periodic testing and operation of the standby diesel generators and auxiliary power systems, (2) particulate matter created by commuter vehicle dust and exhaust, (3) odors from operations, and (4) operations-based noise. Because certificates to operate diesel generators require that air emissions comply with all applicable regulations, and because the operation of the generators would be intermittent and brief, the review team expects that the impact of the operations of the two units on air quality would be minimal. By enforcing access road maintenance and speed limits, dust generated by commuting workers can be minimized. The review team expects that during normal plant operation, proposed Units 2 and 3 would not use chemicals in amounts that would generate odors exceeding Federal and State limits. If these practices are followed, the review team expects that the addition of two new reactors to the site would have only a minimal impact on air quality.

Most equipment would be located inside structures, thereby reducing the outdoor noise level. In addition, because Unit 1 is already located at the VCSNS site, SCE&G does not expect impacts to be significantly greater than current background levels (SCE&G 2010a). Ambient noise heard by recreational users at local parks under normal conditions typically does not include noise from the operation of Unit 1 because of the distance from the site, and attenuation by vegetation and topography. Units 2 and 3 would be located even farther away from the public than Unit 1. Noise levels below 60 to 65 dB are not considered to be significant (NRC 1996). The maximum sound level generated by the operation of Units 2 and 3 at a distance of 1000 ft would not exceed 60 dB, would not affect residents or the usage of nearby recreational areas, and would not warrant mitigation.

The baseline level of traffic noise on SC-213 and SC-215 is relatively low and includes tractor trailers and other heavy trucking equipment. The annual average daily traffic (AADT) for the routes near the plant is as much as 2400 vehicles. SCE&G estimated the incremental noise from VCSNS-related traffic on these routes would not be significant and would not occur outside of traditional operations shift changes.

5.4.1.2 Impacts on Buildings

Operations activities would not affect offsite buildings. Onsite buildings have been constructed to safely withstand any possible impact, including shock and vibration, from operations activities associated with the generation of electricity at a nuclear power plant (10 CFR Part 50, Appendix A). Except for VCSNS site structures, no other industrial, commercial, or residential structures would be affected.

5.4.1.3 Impacts on Transportation

This EIS assesses the impact of transporting workers and materials to and from the VCSNS site from three perspectives: the socioeconomic impacts, the air quality impacts of dust and particulate matter put into the air by vehicle traffic, and the potential health impacts from additional traffic-related accidents. The socioeconomic impacts are addressed here and in Section 5.4.4.1. The air quality impacts are addressed in Section 5.7.2, and human health impacts from traffic-related accidents are addressed in Section 5.8.6.

Public roads and railways would transport workers, construction materials, and equipment to the site during operations. During plant operations, roads in the vicinity of the site would experience an increase in traffic over baseline levels, but a reduction from the levels at peak construction.

Peak road use would occur at the end of each operations shift and at the beginning and end of each outage support shift. All of the access roads are paved, which reduces both noise and dust. No new public roads would be constructed or be subject to major modifications due to the operation of VCSNS Units 2 and 3. Railroad deliveries during the operation phase would be less frequent than during construction.

5.4.1.4 Impacts on Aesthetics

As discussed in Sections 2.5 and 4.4, the existing 520-ft-tall Unit 1 containment building on the VCSNS site and the transmission line and towers leading into and out of the site are visible from a number of vantage points in the vicinity of the VCSNS site and have already aesthetically altered the area. The additional visual impact from operations compared with the construction phase would result from the steam plumes from the cooling towers, which would resemble cumulus clouds. The plumes would be most visible during cooler weather, and from on and around Monticello Reservoir (see Figure 5-2). The cooling towers and plumes would be most prominent to those using the Monticello Reservoir who could directly view the operation areas. Other recreation areas in the vicinity may also be aesthetically altered during weather conditions that increase plume size. Section 5.7.1 describes the effects of the plume in more detail. Because low-profile cooling towers would be used and weather conditions would vary the visibility of the cooling-tower plumes, the review team concludes that the marginal aesthetic impact of the new reactors and plumes would not be significant, and would be naturally mitigated by topography.

Figure 5-2. Artist Rendering of Proposed VCSNS Unit 2 and Unit 3 Cooling-Tower Plumes as Viewed from Monticello Reservoir (SCE&G 2009h)

5.4.1.5 Summary of Physical Impacts

Based on the information provided by SCE&G, the review team's interviews with local public officials, and the review team's independent assessment of the physical impacts on workers and the local public, buildings, transportation and aesthetics, the review team concludes that the physical impacts of operations at the two new proposed units would be SMALL and additional mitigation would not be warranted.

5.4.2 Demography

This section evaluates the demographic, economic, infrastructure, and community impacts on the region as a result of the operation of VCSNS Units 2 and 3, with a particular focus on the four-county economic impact area and the communities in the vicinity of the VCSNS site.

5.4.2.1 Demographic Impacts

The baseline population of the four most local counties is estimated to increase steadily over the 40 years of operation under the license (see Table 2-23). SCE&G projects a Units 2 and 3 workforce of 800 operations workers, who would start arriving onsite during site development, as discussed in Section 4.4. The operations workforce is projected to increase from 635 workers currently operating Unit 1 to about 1435 workers for all three units. The review team estimates that the majority of the new operations workforce, up to 600 workers (75 percent), would come from within the economic impact area. The review team expects that up to 200 (25 percent) of the new operations workforce would be highly specialized and would relocate to the economic impact area because the needed skill sets would not be readily available in the greater Columbia area. The remainder of the operations workforce would be recruited from within the 50-mi region. Based on these assumptions and because the review team assumes that impacts outside of the economic impact area would be minimal, even if all 800 operations workers migrated into the area, they would constitute less than half a percent increase over the baseline population of the four-county economic impact area. Therefore, the review team concludes that the demographic impact of operations workers on the local area would be minimal.

In addition to the operations workers, each new unit would require an outage workforce of 1000 temporary employees who would be onsite for periods of approximately 30 days for scheduled refueling outages every 18 months. This means there would be an outage at one of the two new units about every 9 months. The review team expects that outage workers would typically migrate to the area from all over the country and stay only during the outage period at temporary lodging as close to the site as possible. Having three units at the VCSNS site would increase the frequency of the refueling outages; however, the temporary nature of the work would generate only a minimal impact on the economic impact area, with little or no effects felt in the larger region.

5.4.2.2 Summary of Demographic Impacts

Based on information provided by SCE&G and the review team's independent review, the review team concludes that operations workers and their families would be expected to have a SMALL beneficial impact on the local communities and governmental entities in Fairfield County and the economic impact area, and a SMALL beneficial impact on the region.

5.4.3 Economic Impacts on the Community

This section evaluates the social and economic impacts on the four-county economic area expected as a result of operating proposed Units 2 and 3 at the VCSNS site. The evaluation assesses the impacts of the jobs, wages, project purchases, and tax payments on the local communities and surrounding region over the estimated 40-year duration of the nuclear power plant operating license.

5.4.3.1 Economy

The primary economic impacts of nuclear power plant operation result from jobs created, wages paid, regional purchases, and tax payments made in the course of operating the power plant. The impacts of plant operation on the local and regional economy depend on the region's economy and population at that time and will be influenced by how the affected communities have responded to the impacts of the construction phase. Although future impacts cannot be predicted with certainty, consideration of historical patterns, projected economic and demographic trends, and consultation with local planners can provide some insight into the qualitative nature of these impacts over the 40-year period of plant operation.

Section 2.5 of this EIS presents a detailed description of local and regional employment trends and workforce characteristics. The economic impact area has a relatively diverse and stable economy, ranging from agricultural and manufacturing on the peripheries to health care and research in Columbia. The 800 new jobs at the VCSNS site during operations are expected to constitute only a very small percentage increase over baseline income in the economic impact area.

The jobs of operations and outage workers would have a multiplier effect in the local and regional economy, similar to that described in Section 4.4 for the construction phase workforce. The applicable Regional Input-Output Modeling System (RIMS II) employment multiplier provided to SCE&G from the U.S. Department of Commerce Bureau of Economic Analysis is 3.13 (SCE&G 2009g). This means that about 1704 indirect jobs would be supported by VCSNS Units 2 and 3 operations in the economic impact area, increasing the total number of jobs supported to about 2504 (not counting outage workers and their temporary effects). The review team expects that only a minimal number of jobs would be created in the wider region. Because the review team expects that 25 percent of the operations workforce would migrate to the economic impact area, only 25 percent of the total employment effects would represent a net impact on the area. Employment effects representing upgraded employment for in-area workers also would count as impacts. However, the review team expects most of the operations workforce and associated indirect and induced employment would come from within the economic impact area. Therefore, the review team concludes that the new jobs would not increase the local baseline employment significantly. Because the indirect jobs typically would be service-related and not highly specialized, the review team expects that they would be filled primarily by residents of the region and would not induce new migration to the region.

Based on additional information supplied by SCE&G, total first-year operations costs for the new units are projected to be $668 million. This represents new spending in the economic impact area. The new expenditures would result in an income multiplier impact felt in the economic impact area. The applicable income multiplier provided from RIMS II is 0.33 (SCE&G 2009g). This means that for each dollar of new expenditure for output from the power generation industry, 33 cents of new income is generated in the economic impact area. Using that number as a basis, the resulting income impact would be $220 million in annual income attributable to the annual expenditures in at VCSNS Units 2 and 3, in addition to incomes received by new operations workers, which are part of the $668 million annual expenditure. Similar to the employment impact, this is not significant in the context of the greater Columbia area.

Based on information provided by SCE&G and the review team's own independent review, the review team concludes that slight beneficial economic impacts would be experienced in the four-county economic impact area. The region also would expect minimal but beneficial impacts.

5.4.3.2 Taxes

The tax structure of the region is discussed in Section 2.5. Several types of taxes would be generated during the operational life of proposed Units 2 and 3 at the VCSNS site. Employees would pay sales, use, personal property, and income taxes; and vendors selling materials and services to the facility would pay a variety of State, Federal, and local taxes. The VCSNS site would be subject to property taxes paid to Fairfield County.

Property, Sales and Use, Income, and Corporate Taxes

To the extent that new operations employees move into the area from outside the state to work at the plant, or currently unemployed persons living in the state become employed at the plant, the States, counties, and communities within the region would experience an increase in sales and use taxes and income tax revenues. This increase in revenue would come from both the taxes paid by VCSNS employees on their personal incomes, sales taxes on goods they purchase within the region, and from SCE&G for property taxes on the VCSNS site.

Upon completion and operation of VCSNS Units 2 and 3, based on additional information provided by SCE&G (SCE&G 2010a), the review team expects that SCE&G would enter an agreement with Fairfield County to pay from $13 to $31 million annually in property taxes over the 40-year operating life of the new units. Taxes in the new units would be in addition to existing taxes being collected by Fairfield County on Unit 1 operations. Table 5-5 provides more detailed information. Santee Cooper also contributes a minor amount of fee-in-lieu-of-property-taxes to Fairfield County, but this amount represents only a negligible source of revenue.

The review team does not expect significant growth in the Fairfield County tax base between now and the start of operations that could otherwise diminish the scale of the VCSNS tax impact on county revenue. The VCSNS-attributable contribution to the total property tax revenue for Fairfield County would increase by 150 percent to an amount that is more in each year than the current overall total property tax revenue of the county. Therefore, the review team concludes that property tax revenue impacts would be substantial and beneficial for Fairfield County.

Table 5-5. Expected Annual Property Tax Payments to Fairfield County from Operation of VCSNS Units 2 and 3

Operation Years	SCE&G Average Annual Fee-in-Lieu-of-Taxes Payments to Fairfield County
2017–2019	$ 18,644,400
2020–2034	$ 31,144,600
2035–2044	$ 20,342,300
2045–2056	$ 13,928,900
Sum over 40 yr	$ 861,265,100

Source: SCE&G 2010a
(a) Dollars are nominal 2007 dollars;
(b) Assumes SCE&G's portion of construction costs amounts to $3404/kW, excluding transmission costs.

In addition to the property taxes paid on the value of the plant itself, the economic impact area would experience an increase in property tax revenues on new homes if the influx of workers results in any new residential construction and/or increases in existing home prices. This overall impact likely would not be noticeable because the operations workforce that is new to the community and their families would make up only a slight proportion of the property tax base in any county in the region.

The current South Carolina sales tax rate is 6 percent for most goods and services and each of the counties in the economic impact area adds a 1-percent use tax to the State sales tax (SCDOR 2009). However, impacts in the state would come from operations workers relocating from out of state or otherwise significantly upgrading their disposable income compared to previous in-state employment. The review team concludes that, when viewed in the context of total sales tax revenue to the State of South Carolina, the net impact on sales tax revenue caused by potential relocations to South Carolina, or from the effect of upgrading disposable income through better employment, would be minimal.

SCE&G would be subject to Federal and State corporate income taxes on income generated from the new units (SCE&G 2010a). Table 5-6 lists the expected revenues from these sources. Santee-Cooper also would pay fee-in-lieu of income tax to Fairfield County. In all cases, when viewed in the context of the all income tax revenues received by Federal, State and County sources, these annual income tax amounts would not be significant at any level of government.

5.4.3.3 Summary of Economic and Tax Impacts

Based on the information provided by SCE&G, the review team interviews with local public officials, and the review team's review of the data on regional economy and taxes, the review team concludes that the economic and fiscal impacts of operations at the two new proposed units would be SMALL and beneficial for the region and LARGE and beneficial for Fairfield County.

Table 5-6. Expected Corporate Income Tax Payments to Affected Jurisdictions from Operation of VCSNS Units 2 and 3

Operations Years	Annual SCE&G Federal Income Tax Liability	Annual SCE&G State Income Tax Liability	Annual Santee-Cooper Portion of Sum-in-Lieu of (Income) Tax Paid to Fairfield County
2017-2030	$ 89,490,000	$ 15,004,500	$ 1,030,000
2031-2040	$ 89,490,000	$ 15,004,500	$ 1,270,000
2041-2050	$ 89,490,000	$ 15,004,500	$ 1,520,000
2051-2056	$ 89,490,000	$ 15,004,500	$ 1,780,000
Sum over 40 yr	$3,579,580,000	$600,180,000	$56,000,000

Source: SCE&G 2010a
(a) Dollars are nominal 2007 dollars.

5.4.4 Infrastructure and Community Services

Infrastructure and community services include transportation, recreation, housing, public services, and education. The operation of two new units at the VCSNS site would affect the transportation network because the additional workforce would use the local roads to commute to and from work and possibly additional truck deliveries would be made to support operation of the new units. These same commuters potentially could affect recreation in the area. As the workforce migrates to and settles in the region, there may be impacts on housing, education, and public sector services. These impacts are discussed further below.

5.4.4.1 Transportation

Based upon the SCE&G traffic analysis, the review team expects that even if there is only one employee per vehicle, traffic would remain within the capacity of the access roadways, as suggested by State management standards (SCE&G 2010a). SCE&G anticipates some congestion, lasting between 10 and 15 minutes, to occur during these shift changes. SCE&G has indicated that it would work to mitigate transportation impacts where they occur with possible alternate routes that can be made available in the future. However, if some employees carpool, the review team expects operations-related traffic to have a lesser impact on traffic congestion at the regional, county, and local levels. In any case, there are few residents along access routes to the site, which further limits the socioeconomic impacts of operations-related traffic.

During refueling and other outages, about 1000 additional workers would be commuting to and from the site for approximately 30 days at a time. SCE&G stated that it would implement measures to stagger road use and reduce the number of vehicles by scheduling shift changes at times other than traditional high-traffic periods and minimizing drive time overlap with operations personnel. Mandatory carpooling, providing buses to transport employees, or other measures also may be warranted, particularly if the work schedule puts workers on these access roads during nighttime hours. Based on information from SCE&G and the review team's independent review, the review team concludes that if the mitigation measures discussed here are implemented, transportation impacts resulting from operation of Units 2 and 3 would not be significant, and additional mitigation would not be warranted.

5.4.4.2 Recreation

Recreational activities in the area include many outdoor activities such as recreational boating and fishing on Monticello Reservoir, as well as hiking, camping, and hunting. Several State and county parks in the region provide facilities and recreational opportunities as do a number of lakes and forests in the area, as discussed in Section 2.5.2.4. The review team expects impacts on area recreation resources to be minimal during operations because the operations would not affect recreational opportunities. The aesthetic impacts of the plant operations from the vantage point of local recreational areas also would not be significant.

5.4.4.3 Housing

Regional housing characteristics and availability are described in Section 2.5.2.5. The proximity of a number of population centers to the VCSNS site, including the City of Columbia, offers a variety of available housing types. The other urban areas in the vicinity include West Columbia, Lexington, Irmo, and Cayce, which are all within reasonable commuting distances of the site. The operations workers who start work during the construction phase would not likely experience housing shortages as a consequence of the increase in demand initially created by the onsite workforce due to the high growth rate of the area. The review team expects the majority of operations workers to come from within the region, and consequently, they would not represent new net demand for housing. The review team also expects Richland and Lexington Counties to receive the greatest number of operations workers and their families, and therefore, the greatest portion of the benefits and costs attributable to operations of Units 2 and 3. Richland and Lexington Counties would also experience the majority of the impacts from outage workers for Units 2 and 3. Outage workers typically find temporary housing as close as possible to the VCSNS site, although SCE&G anticipates that most outage workers would also come from within the region and may commute to the VCSNS site during maintenance.

The review team expects the loss of jobs after construction is completed would result in only a minimal decline in population or housing demand because the majority of construction and operation workers would come from within the area. For workers that do move into the area, a wide selection of housing is available throughout the area. Because, over the long term, the region continues to grow at a steady pace and is constantly developing new housing to meet the increased need, operations workers would have a minimal impact on housing in both the economic impact area and the region.

5.4.4.4 Public Services

This section describes the available public services and discusses the impacts of the operation of proposed VCSNS Units 2 and 3 on water supply and waste treatment; police, fire-protection and medical services; education; and social services in the region.

Water-Supply Facilities

Section 2.5.2.6 describes the water-supply systems and facilities in the vicinity of the VCSNS site. Potable water would be supplied to Units 2 and 3 by the onsite VCSNS water-treatment plant operated by SCE&G. Units 2 and 3 would use the Monticello Reservoir as their source of water. Monticello Reservoir does not supply any industrial, municipal, commercial, or agricultural organizations other than VCSNS Unit 1 and proposed Units 2 and 3. As discussed in Section 4.4.4.4, the local water systems in the four-county area are expected to be able to meet the demand for water from the peak population during construction. Therefore, because the planned operations workforce is less than a quarter of the expected construction workforce, the review team expects local water systems would have no difficulty meeting water demand during the operations phase.

Local water systems have already begun projects to expand capacity or are in the early stages of planning expansions in response to population growth, especially in the area surrounding the VCSNS site. Based on information provided in Section 2.5.2.6, these water systems are generally not operating at or near capacity, and the system managers have been able to provide adequate water to their service territories and expand their systems when necessary. Because the overall population impact from the VCSNS site would not be a significant portion of the projected population growth, the VCSNS site is unlikely to cause water managers to implement their current water-supply plans. Consequently, because demand during the operations phase of the project would be substantially below the demand derived from peak construction levels, the review team expects the impacts of plant operation on municipal water suppliers would be minimal, and mitigation would not be needed. For additional discussion of water-resource impacts, see Section 4.2.

Wastewater-Treatment Facilities

As described in Sections 2.5.2.6 and 3.2.2, the VCSNS site has a wastewater-treatment facility onsite near Unit 1 and SCE&G proposes to construct another one to serve Units 2 and 3 (NRC 2004a; SCE&G 2010a). The five wastewater-treatment systems in the surrounding counties have demonstrated an ability to expand when necessary. Because local planners expect the demand for wastewater treatment to grow during the period of construction as a result of natural regional population growth, any needed facility expansion would already have been put in place when operations begin at Units 2 and 3. Therefore, the local wastewater-treatment systems would have excess capacity sufficient to meet the new demand from in-migrating operations workers.

Police, Fire-Protection, and Medical Facilities

Based on analysis provided in Section 2.5.2, the review team expects that current levels of law enforcement and fire-protection personnel would be adequate to meet the need of the communities throughout the construction phase, as discussed in Section 4.4.2. Therefore, even without adding capacity during the construction phase, the impact on law enforcement and firefighting services from the operation of Units 2 and 3 would be minimal. A similar analysis applies to medical services, where the impact of plant operations on medical services for the region also would be minimal.

Social Services

The review team anticipates that demands placed on social services related to operations would occur in proportion to the settlement pattern of the operations workforce. Based on the expected settlement proportions, no single county would experience greater per capita increases in demand for social services than any other. The review team believes the fact that Fairfield County is the host county of the VCSNS site does not imply that Fairfield County would receive any more impact on its social services infrastructure than any other county in the economic impact area.

Once the transition to operations occurs, the review team expects the demands on social services during the operations phase to be less than during the construction phase.

Consequently, because the construction phase impacts on social services were not significant, the review team expects the operations phase impacts also would be minimal.

5.4.4.5 Education

To meet the growing demands resulting from continued growth in the region, larger local districts already have begun to build and renovate schools. Because there would be relatively few new students coming from operations families, the review team believes the impact of plant operations on public schools would be minimal. The review team expects that school-age children typically would not accompany outage workers commuting temporarily into the area to work at the VCSNS site.

5.4.4.6 Summary of Impacts on Infrastructure and Community Services

The review team has reviewed information provided by SCE&G, visited the site and its environs, and performed its own independent review of potential infrastructure and community services impacts of operations on the local area and region of the VCSNS site. In all cases, the compelling argument in support of the review team's conclusions is that the operations workforce would be less than a quarter of the size of the workforce at VCSNS construction and preconstruction peak employment. Therefore, any impacts derived from operations must necessarily be less than the same impact derived from construction. The review team concludes that expected operations impacts on transportation, recreation, housing, public services, and education would be SMALL and require no mitigation.

5.4.5 Summary of Socioeconomic Impacts

VCSNS Units 2 and 3 operations would have no physical impacts on any non-SCE&G-owned buildings onsite or offsite and would have a SMALL impact on the physical characteristics of public roads and transportation in the vicinity of the nuclear plant. Given the plant's location and the presence of Unit 1, impacts on visual aesthetics would be SMALL at both the local and regional level and, with adherence to BMPs for controlling dust and emissions, impacts on air quality also would be SMALL. Noise from plant operations is expected to be limited to the site. Noise from truck and worker traffic is addressed in Section 5.8.2. Consequently, the review team concludes that the physical impacts of plant operations would be SMALL, and additional mitigation would not be warranted.

The presence of workers and their accompanying family members in the region and the economic impact area for operations would represent a SMALL impact on the economic characteristics of the region. The review team concludes that the social and economic impacts of plant operations would be SMALL at the regional level and SMALL on communities in the vicinity of the plant with the exception of fiscal impacts, which would be LARGE and beneficial to Fairfield County. Community services and infrastructure impacts would be SMALL in the economic impact area and SMALL to those communities closest to the site. Traffic noise and congestion impacts would be SMALL and would not warrant additional mitigation beyond the commitments SCE&G has already made.

5.5 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. The NRC has a policy on the treatment of environmental justice matters in licensing actions (69 FR 52040). Section 2.6 discusses the locations of minority and low-income populations around the VCSNS site, vicinity, and region.

The review team evaluated whether the health or welfare of minority or low-income populations at the census blocks identified in Section 2.6 of this EIS and other communities identified through scoping and outreach could be disproportionately affected by the potential impacts of operating two new reactors at the proposed site. To perform this assessment, the review team used the same process applied in Section 4.5. Figure 2-18 identifies minority populations within the 50-mi region surrounding the VCSNS site. Several minority and low-income census block groups were identified in the vicinity of the VCSNS site. Therefore, the review team concluded that more detailed analysis of these populations, communities, and pathways was warranted.

5.5.1 Health Impacts

The results of normal operation dose assessments (see Section 5.9) indicate that the maximum individual dose was found to be well below the NRC and EPA regulatory guidelines in Appendix I of 10 CFR Part 50 and the regulatory standards of 10 CFR Part 20. Section 5.9 further concludes that radiological health impacts to the operational staff and the public for the proposed Units 2 and 3 would be SMALL. Section 5.8 of this EIS assesses the nonradiological health effects on the public from operation of the cooling system, noise generated by unit operations, EMFs, and transporting operations and outage workers. In Section 5.8, the review team concludes that the potential impacts of nonradiological effects resulting from the operation of two proposed additional units would be SMALL. The review team did not identify evidence of unique characteristics or practices in minority or low-income population that may result in different radiological or non-radiological health impacts compared to the general population. Therefore, there would be no disproportionately high and adverse impact on minority or low-income members of the operational staff or the general public as a result of operations.

5.5.2 Physical Impacts

5.5.2.1 Soil-Related Impacts

The review team does not expect there to be operations-related environmental impacts on soils at the VCSNS site that would affect nearby residents, and there are no populations living on the site. Because soil impacts attenuate rapidly with distance, the review team expects that there would not be soil-related disproportionately high and adverse impact on minority or low-income populations. Land-use impacts in the transmission-line corridors from operation of new units would be minimal and are not expected to have adverse effects on the population. In addition, as discussed in Section 4.5.2 of this EIS, the review team did not identify evidence of unique characteristics or practices that may result in different soil-related impacts compared to the general population. Based on information from SCE&G and the review team's independent review, the review team concludes that the operations-related marginal impact from pathways related to soils from Units 2 and 3 would not impose disproportionately high and adverse impacts on minority or low-income populations.

5.5.2.2 Water-Related Impacts

As discussed in Section 5.2, the review team determined that operating VCSNS Units 2 and 3 would create a volume of cooling-tower blowdown that would not be significant when compared to the river flow and would comply with the existing NPDES permit and applicable State water-quality standards. These impacts would be regulated and monitored, and additional mitigation would not be warranted. As discussed in Section 2.6.3 of this EIS, the review team found evidence of some subsistence fishing in the site vicinity, but did not identify an operational pathway that could result in different water-related impacts compared to the general population. The review team did not identify evidence of unique characteristics or practices in minority or low-income populations that may result in different water-related impacts compared to the general population. Therefore, the review team expects no disproportionately high and adverse impacts on identified minority or low-income populations.

Based on Section 5.2, the review team concludes that Units 2 and 3 water use would have little or no effect on the availability of water for other uses. Based on Section 5.3.2, Units 2 and 3 water use would have minimal impacts on the fish population of Monticello Reservoir or the Broad River. Therefore, the impacts would not warrant mitigation or cause a disproportionately high and adverse impact on identified minority and low-income populations.

Based on information from SCE&G and the review team's independent evaluation, the review team concludes that given the relatively minimal impact on water quantity and quality in Monticello Reservoir, and the small consumptive water use of Units 2 and 3, there would be no operations-related disproportionately high and adverse environmental impacts on minority and low-income populations.

5.5.2.3 Air Quality-Related Impacts

As discussed in Section 5.9, the total liquid and gas effluent doses from the new units would be well within the regulatory limits of the NRC and EPA. The primary air emissions from a nuclear power plant such as VCSNS are water vapor and salt, which do not pose health dangers to the general public. In addition, air quality impacts attenuate rapidly with distance from the source. As described in Section 5.7 the review team concluded that the potential impacts from sources of air emissions would be SMALL. Other than their location within the site vicinity, the review team did not identify any evidence of unique characteristics or practices that may result in different air-related impacts compared to the general population. Given that the total effluent doses from the new units would be well within regulatory limits and given that airborne pollutants released from the new units would rapidly disperse to near background levels, the review team concludes that the potential impacts from operations-related sources of air emissions would not result in disproportionately high and adverse impacts on minority or low-income populations within the site vicinity.

5.5.3 Socioeconomic Impacts

The review team determined that the addition of 800 new operations employees would have minimal impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and schools). In terms of environmental justice, and as discussed in Section 2.6.1, the review team identified several census blocks that meet the criteria for minority populations of interest within the vicinity of the VCSNS site and the site access roads. Further investigation by the review team also revealed a high percentage of low-income families within the same region (NRC 2010). The review team determined these areas may have a greater potential for disproportionately high and adverse operations impacts on minority and low-income populations. Consequently, the review team further analyzed these areas of potential impact to determine whether or not such impacts would be significant.

As discussed in Section 5.4.4.1, based upon the SCE&G traffic analysis, the review team expects operations-related traffic would remain within the capacity of the access roadways. SCE&G anticipates some shift-change congestion, lasting between 10 and 15 minutes and has indicated that it would work to mitigate transportation impacts where possible. Other than their location along access roads that may become congested, the review team did not identify evidence of any other unique characteristics or practices in the affected populations of interest that would result in different impacts compared to the general population. Based on (1) the analysis presented in Sections 2.6.2, 4.5.4, and 5.4.4.1 of this EIS, (2) the intermittent nature of the operations-related traffic impacts, (3) the continued use of mitigation measures implemented by SCE&G to reduce construction-related traffic impacts, and (4) the lower traffic volume of operations in comparison to the volume associated with construction and preconstruction activities (i.e., hundreds of additional workers rather than thousands of workers), the review team determined that the operations-related impact from traffic would be less than the construction- and preconstruction-related impacts of traffic. Therefore, the review team concludes the traffic impacts of operations on minority and low-income populations would be minor, but not disproportionately high and adverse.

5.5.4 Subsistence and Special Conditions

This segment of the review team's environmental justice analysis was performed using the same methodology as described in Section 4.5 of this EIS.

As part of its visits to the site and region, the review team interviewed public officials and community leaders of the local minority populations in relation to subsistence practices (NRC 2010). The review team was also made aware of anecdotal information about local subsistence fishing by the members of the communities of Jenkinsville, Dawkins, and Blair, South Carolina. During scoping, the community submitted informal survey data to the record (see Appendix D). The data give anecdotal evidence of isolated subsistence fishing in the Broad River and Monticello Reservoir. The review team reviewed these accounts and determined that there were no operations-related disproportionately high and adverse impacts on minority or low-income populations related to subsistence. Because adverse health impacts from the operation of the new units are not expected, potential subsistence fishing activity on Monticello Reservoir or in the Broad River would not have either a radiological or nonradiological adverse health effect (see Sections 5.8 and 5.9). The review team also determined that the impacts from chemical discharges to the Broad River would be minimal (see Section 5.3.2), and no additional mitigation would be warranted. Therefore, minority or low-income individuals who may be engaged in subsistence fishing would not experience disproportionately high and adverse impacts.

The review team also identified other subsistence and income-supplementing activities such as hunting and vegetable gardening taking place in the rural areas of the region (NRC 2010). Potential sources of radiological or nonradiological impacts from operations on these activities have been analyzed as part of the air, soil, and water pathways, which have been discussed separately in this EIS section. The review team determined these physical pathways to have no potential for a disproportionately high and adverse impact on minority or low-income populations.

5.5.5 Summary of Environmental Justice Impacts

As discussed in Section 2.6.1, the review team identified several census blocks that meet the criteria for minority populations within the site vicinity. The review team determined these areas may have a greater potential for disproportionately high and adverse operations impacts on minority and low-income populations. Consequently, the review team further analyzed these areas of potential impacts to determine whether or not such impacts would be significant.

Based on information provided by SCE&G, the review team's interviews with local public officials, the team's own independent assessment, and the analyses presented in the preceding sections, the review team did not find environmental pathways that would lead to disproportionately high and adverse impacts on minority and low-income populations. Therefore, the review team concludes environmental justice impacts of operations would be SMALL, and no further mitigation would be warranted beyond commitments made by the applicant.

5.6 Historic and Cultural Resource Impacts from Operation

The National Environmental Policy Act of 1969, as amended (NEPA), requires that Federal agencies 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 (NHPA) of 1966, as amended, also requires Federal agencies to consider impacts on those resources if they are eligible for listing in the National Register of Historic Places (NRHP or National Register) (such resources are referred to as "Historic Properties" in NHPA). As outlined in 36 CFR 800.8, "Coordination with the National Environmental Policy Act of 1969," the NRC is coordinating compliance with Section 106 of the NHPA in fulfilling its responsibilities under NEPA. Operating new power units can affect either known or potential historic properties that may be located at the site. In accordance with the provisions of NHPA and NEPA, the NRC and the USACE are required to make a reasonable and good faith effort to identify historic properties in the areas of potential effect and, if such properties are present, determine whether or not significant impacts are likely to occur. Identification of historic properties 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, then efforts should be made to mitigate them. As part of the NEPA/NHPA integration, even if no historic properties (i.e., places eligible for listing on the National Register of Historic Places) are present or affected, then NRC is still required to notify the SHPO before proceeding. If historic properties are present, then the NRC and the USACE are required to assess and resolve adverse effects of the undertaking.

For a description of the historic and cultural resource information about the VCSNS site, see Section 2.7 of this EIS. As explained in Section 2.7, the applicant conducted several cultural resource identification efforts resulting in the identification of a total of 39 archaeological sites within the VCSNS site Area of Potential Effect (APE), most of which have been recommended as ineligible for listing in the National Register. Four archaeological sites have either been recommended as National Register eligible, 38FA330 (General Pearson Cemetery) and 38FA360; potentially eligible, 38FA366; or recommended for preservation, despite not being considered potentially eligible for inclusion in the National Register, 38FA349.

These four archaeological sites are located within the project APE but outside of the proposed footprint of disturbance identified by SCE&G (2009h). SCE&G currently has protective measures in place for these resources, including fencing at the Pearson Cemetery, temporary fencing at 38FA360, and delineation of all four sites as sensitive areas on management maps and plant layout and design drawings (SCE&G 2009i, j). Proposed signage would read "Environmentally Sensitive Area, Do Not Disturb" (SCE&G 2009j). These protective measures would be identified and added to SCE&G's Environmental Management Plan for VCSNS Units 2 and 3 (SCE&G 2009j). In addition, SCE&G would provide cultural awareness training for all workers including awareness of signage and inadvertent discovery procedures for Unit 1, which would also be applied to Units 2 and 3 and described in SCE&G's Environmental Management Plan (SCE&G 2009i, j, k). These procedures indicate that work would stop and the SHPO would be contacted if inadvertent discovery of cultural resources occurs (SCE&G 2009j, k).

The South Carolina SHPO concurred with a finding of "no adverse effect" on archaeological sites 38FA330 and 38FA360 based on protective and avoidance measures being implemented by SCE&G, but would like to see the protective and avoidance measures formalized in a Programmatic Agreement or a Management Plan (SCE&G 2009e). The SHPO also indicated that if archaeological site 38FA366 cannot be avoided, additional archaeological testing would need to occur to evaluate this site for National Register eligibility. SCE&G would undertake project design and avoidance measures to avoid impacts on site 38FA366 (SCE&G 2009i). The SHPO also concurred with a finding of no historic properties affected for the 35 archaeological sites that are not eligible (SCE&G 2009e). On May 25, 2010, the South Carolina SHPO concurred with both of the NRC's findings based on avoidance measures and development of a management agreement (see Appendix F for a copy of this letter) (SCDAH 2010).

Two separate management agreements between the SHPO, SCE&G, and the USACE and between the SHPO, Santee Cooper, and the USACE have been completed and signed. These agreements formalize how cultural resource investigations and possible mitigations would be carried out in consultation with the SHPO as well as cultural resources awareness training and inadvertent discovery procedures (USACE 2011a, b).

The review team evaluated the activities related to operating the proposed VCSNS Units 2 and 3 and the potential historic and cultural resources impacts. The review team has also considered the management agreements between the SHPO, USACE, and SCE&G and Santee Cooper that formalize the protection and avoidance measures being undertaken by the applicants to ensure protection of the historic and cultural resources (USACE 2011a, b).

For the purposes of NHPA 106 consultation, the NRC and the USACE do not expect any significant impacts on historic and cultural resources during the operation of proposed Units 2 and 3 based on the management agreement between the USACE, SCE&G and the SHPO that formalizes and enforces protective measures and inadvertent discovery procedures. Therefore, the NRC and the USACE conclude a finding of no adverse effect on historic properties. By correspondence dated May 25, 2010, the South Carolina SHPO concurred with the NRC's finding provided that the management agreement is in place (see Appendix F for a copy of this letter) (SCDAH 2010).

For the purpose of the NEPA analysis, the review team does not expect any significant impacts on historic and cultural resources during operation of the proposed VCSNS Units 2 and 3. All proposed onsite operational activities would occur within areas already disturbed by Unit 1 or in areas already surveyed for cultural resources for areas to be disturbed for building activities (SCE&G 2009g). SCE&G would follow the protection and inadvertent discovery procedures described in Section 4.6 (SCE&G 2009l) to confirm that known onsite cultural resources would be protected from operation of VCSNS Units 2 and 3.

Operational impacts associated with maintenance of proposed transmission lines would entail mostly vegetation maintenance with access on maintenance roads (SCE&G 2009j). Any future procedures for avoiding impacts on cultural resources associated with operations, including protective measures and inadvertent discovery procedures, are covered in the management agreements in place between SCE&G, the SHPO, and the USACE, and between Santee Cooper, the SHPO, and the USACE (USACE 2011a, b). With the procedures and management plan in place, the review team concludes that the impacts on cultural resources from operations would be SMALL.

5.7 Meteorological and Air Quality Impacts

The primary impacts of the operation of two new units on local meteorology and air quality would be from releases to the environment of heat and moisture from the primary cooling system, which consists of two mechanical draft cooling towers for each AP1000 unit (SCE&G 2010a), the operation of auxiliary equipment, and emissions from workers' vehicles. The potential impacts of releases from operation of the cooling system are discussed in Section 5.7.1. Section 5.7.2 covers potential air quality impacts from nonradioactive effluent gases releases at the VCSNS site.

5.7.1 Cooling-Tower Impacts

The proposed cooling system for Units 2 and 3 at the VCSNS site consists of mechanical draft cooling towers. A total of four cooling towers would be constructed, two for each unit. Mechanical draft cooling towers remove excess heat by evaporating water. Upon exiting the cooling tower, water vapor mixes with the surrounding air and this process can lead to condensation and the formation of a visible plume. Aesthetic impacts from the visible plume as well as land-use impacts from cloud shadowing, fogging, icing, increased humidity, and drift from dissolved salts and chemicals found in the cooling water can result.

SCE&G used the Seasonal and Annual Cooling Tower Impacts (SACTI) computer code to estimate the impacts from the operation of the cooling towers. Engineering data for the Westinghouse AP1000 reactor design and 3 years (2006–2008) of data from the Columbia Metropolitan Airport were used as input to the SACTI model. The top of each cooling tower would be approximately 70 ft above ground (SCE&G 2009j, SCE&G 2010a).

Results from the SACTI analysis, as reported by SCE&G (SCE&G 2009j), indicate that the longest average plume lengths would occur in the winter and the shortest average plume lengths would occur in the summer. The average summer plume length is 0.34 mi (toward the east-northeast), and the average winter plume length is 0.74 mi (toward the east). Average plume height is also predicted by SACTI, and is found to range from 420 ft in the summer to 630 ft in the winter. No cases of fogging were found in the simulations. Icing can occur when there is ground-level fogging and the ambient temperature is below freezing. No cases of icing were identified in the simulations. Deposition of salts from cooling-tower drift is estimated to be 0.28 lb/ac/mo, which is well below the 8.9-lb/ac/mo threshold described in NUREG-1555 (NRC 2000b). The predicted location of the maximum deposition is 3280 ft east of the towers.

A number of other pollution sources in the vicinity of proposed VCSNS Units 2 and 3 cooling towers include the auxiliary boilers and generators operated at Units 1, 2, and 3 and the combustion turbines located at the Parr Combustion Facility (SCE&G 2010a). The Parr Combustion Facility is operated under an air quality permit issued by SCDHEC. This Part 70 Air Quality (Title V Operating) Permit (SCDHEC permit AIR-1000-0021) indicates that this facility could potentially emit more than 100 T/yr of any air pollutant (SCDHEC 2006b). The turbines are more than 1.25 mi from the proposed cooling towers, and the boilers and generators at Unit 1 are approximately 4500 ft north of the proposed cooling towers. This distance is larger than the distance to the location of maximum salt deposition. The distance is also greater than the average wintertime plume length (which will generally be in an easterly direction). The distance between the VCSNS Units 2 and 3 cooling towers and these other sources, as well as the orientation of the plumes, decrease the likelihood that there would be significant interaction of the cooling towers with plumes from other pollution sources for an extended period of time. Therefore, the NRC staff concludes that the impacts from the operation of the cooling towers, including the interactions of the cooling-tower plumes and plumes from other sources, on air quality would be minimal.

5.7.2 Air Quality Impacts

Standby diesel generators and auxiliary power systems would be used for emergency power and auxiliary steam purposes. A small incinerator would be used periodically to dispose of used oil (SCE&G 2010a). These systems would be used on an infrequent basis and pollutants discharged (e.g., particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides) would be permitted in accordance with the SCDHEC, as described in the South Carolina

Code of Laws 48, Chapter 1, (SC Code Ann. 48-1 2009) and any applicable Federal regulatory requirements. These systems include the following (SCE&G 2010a):

- four standby diesel generators rated at 4000 kW
- four ancillary diesel generators rated at 35 kW
- additional small generators
- small incinerator.

Based on estimates provided by SCE&G, the annual releases of criteria pollutants at the VCSNS site related to the operation of the onsite generators are listed in Table 5-7 (excluding the additional small generators and incinerator operated at various locations) (SCE&G 2010a).

Table 5-7. Regulated Source Emissions (lb/yr)

Source	PM[a]	SO_x[b]	CO[c]	VOC[d]	NO_x[e]
Four standby generators[f]	<1600	<5000	<1000	<1200	<24,000
Four ancillary diesel generators[f]	<20	<10	<60	<22	<280

(a) PM = particulate matter
(b) SO_x = oxides of sulfur
(c) CO = carbon monoxide
(d) VOC = volatile organic compounds
(e) Oxides of nitrogen
(f) Assumes 4 hours of operation per month for each generator and use of No. 2 diesel fuel.

In addition to the generators described above, particulate emissions would be associated with the operation of the cooling towers. These emissions would include particles with a range of different sizes, including particles smaller than 2.5 microns ($PM_{2.5}$) and particles smaller than 10 microns (PM_{10}). As defined in the Clean Air Act, both $PM_{2.5}$ and PM_{10} are considered criteria pollutants. The cooling towers would be required to adhere to the New Source Performance Standards (40 CFR 60.40Da) and a Prevention of Significant Deterioration (PSD) Permit for air emissions would be required before the cooling towers could be operated.

Because these generating systems would be used infrequently (i.e., typically a few hours per month) and the cooling towers would be operated in accordance with relevant State and Federal regulations, the review team concludes that the environmental impact of pollutants from these sources would be minimal.

The transportation of workers to and from the site would also result in both particulate and gaseous emissions associated with their vehicles. It is anticipated that the operations workforce would consist of 800 workers at VCSNS Units 2 and 3 (SCE&G 2010a). Strategies to reduce the emissions of both criteria pollutants and greenhouse gases could include the use of carpools or shuttle services. This workforce is much smaller than the combined preconstruction and construction workforce of up to 3600 workers that were concluded to have a minor impact; therefore, the impact from transportation of operational workers on the air quality would be minimal.

Impacts of existing transmission lines on air quality are addressed in the NUREG-1437 (NRC 1996). Small amounts of ozone and even smaller amounts of oxides of nitrogen are produced by transmission lines. The production of these gases was found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1200-kV transmission line. In addition, it was determined that potential mitigation measures, such as burying transmission lines, would be very costly and would not be warranted.

Six new 230-kV transmission lines would be constructed to accommodate the new power-generating capacity (SCE&G 2010a) from the proposed Units 2 and 3. This size is well within the range of transmission lines discussed in NUREG-1437, and the staff therefore concludes that air quality impacts from transmission lines would not be noticeable.

Finally, the operation of a nuclear power plant involves the emission of some greenhouse gases, primarily carbon dioxide (CO_2). The review team has estimated in Appendix J that the total carbon footprint for actual plant operations of Units 2 and 3 for 40 years would be on the order of 650,000 metric tons (the sum of about 190,000 metric tons for each unit from plant operations and about 130,000 metric tons for each unit from operations workforce transportation) of CO_2 equivalent (an emission rate of about 16,000 metric tons annually, averaged over the period of operation), compared to a total United States annual CO_2 emissions rate of 6,000,000,000 metric tons (EPA 2009). The AP1000 CO_2 emissions estimates are based on carbon footprint estimates in Appendix J and emissions data in the ER (SCE&G 2010a). Based on its assessment of the relatively small plant operations carbon footprint compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would not be noticeable.

5.7.3 Summary of Meteorological and Air Quality Impacts

The review team evaluated the potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions from operating Units 2 and 3 at the VCSNS site. The review team also evaluated the potential impacts of cooling-system emissions and transmission lines. In each case, the review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of operation of Units 2 and 3 on air quality from emissions of criteria pollutants, CO_2 emissions, and cooling-system emissions would be SMALL and that no further mitigation would be warranted.

5.8 Nonradiological Health Impacts

This section addresses the nonradiological health impacts of operating proposed VCSNS Units 2 and 3. Nonradiological health impacts on the public from operation of the cooling system, noise generated by unit operations, EMFs, and transporting operations and outage workers are discussed. Nonradiological health impacts are also evaluated for workers at proposed VCSNS Units 2 and 3. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Etiological (Disease-Causing) Agents

Operation of VCSNS Units 2 and 3 would result in a thermal discharge to Parr Reservoir (SCE&G 2010a). Discharges of warmer water have the potential to increase the growth of thermophilic microorganisms (microorganisms that favor warmer water), including etiological agents, both in the CWS and the Parr Reservoir. Thermophilic microorganisms include enteric (intestinal) pathogens such as *Salmonella* spp., *Pseudomonas aeruginosa*, thermophilic fungi, bacteria such as *Legionella* spp., and free-living amoeba such as *Naegleria fowleri* and *Acanthamoeba* spp. These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels.

Available data assembled by the U.S. Centers for Disease Control and Prevention (CDC) for the years 1996 to 2007 (CDC 1997, 1998, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2007) report only two occurrences of waterborne outbreaks of disease from recreational water in the State of South Carolina. From 1989 to 2000, the CDC surveillance system for waterborne-disease outbreaks documented 24 fatal cases of primary amebic meningoencephalitis (PAM; a disease caused by *Naegleria fowleri*) in the United States, most occurring in southern states during the months of July and September (CDC 2008). Outbreaks of Legionellosis, Salmonellosis, or Shigellosis that occurred in South Carolina were within the range of national trends (CDC 1997, 1998, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2007) in terms of cases per 100,000 population or total cases per year, and the outbreaks were associated with pools, spas, or lakes.

Epidemiological reports from the State of South Carolina indicate a very low risk of outbreaks from thermophilic microorganisms associated with recreational water (CDC 2006). Two SCDHEC water-quality monitoring stations along Parr Reservoir located in or near recreation areas monitor for species that are indicators for the presence of other pathogens that may be present in the water. The main recreational activities associated with Parr Reservoir are fishing and hunting (SCE&G 2010a). There are no public swimming beaches along Parr Reservoir. No reported cases of Legionellosis, Salmonellosis, or Shigellosis occurred in Fairfield County in 2006 (CDC 2006).

Naegleria fowleri is common in freshwater ponds, lakes, and reservoirs throughout the southern states. While it is possible that the thermal discharge from Units 2 and 3 could have an impact on the abundance of this organism, the affected area of Parr Reservoir would be relatively small (Table 5-2 and Table 5-3) under normal operating conditions at most times of the year. In addition, because there are no swimming beaches on Parr Reservoir and limited public access to the outfall area, the likelihood of recreational exposure is expected to be minimal. Based on the historically low risk of diseases from etiological agents in South Carolina, the limited extent of thermal impacts in Parr Reservoir, and the limited opportunities for public exposure, the review team concludes that the nonradiological impacts on human health would be minimal, and mitigation would not be warranted.

5.8.2 Noise Impacts

In NUREG-1437 (NRC 1996), the staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from plant operation include cooling towers, transformers, turbines, and the operation of pumps along with intermittent contributions from loud speakers and auxiliary equipment such as diesel generators. There would also be noise from corona discharge associated with high-voltage transmission lines (SCE&G 2010a). These noise sources are discussed below.

The primary sources for background noise at the proposed VCSNS Units 2 and 3 location are railroad operations (~1 mi to the west) and Unit 1 operations (~1 mi to the north) and occasionally from the Parr Combustion Facility (~1.4 mi to the south-southeast) (SCE&G 2010a). The nearest residence to the site is approximately 5800 ft away (SCE&G 2010a). SCE&G states in its ER that it has never received a complaint about the noise produced by Unit 1 (SCE&G 2010a).

The proposed units at the VCSNS site would use mechanical draft cooling towers. The ER states that noise levels as high as 55 dBA at distances of 1000 ft would be emitted from the cooling towers and intermittently run diesel generators (SCE&G 2010a). The exclusion area boundary is 3390 ft in all directions from the proposed site of VCSNS Units 2 and 3, and 1300 ft from the proposed site of the closest cooling tower (SCE&G 2010a). 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 the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (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.

Noise sources during operation of VCSNS Units 2 and 3 would be sufficiently distant from the plant boundaries so that noise generated by the plant would be attenuated to near ambient levels before reaching critical receptors, such as the nearest residence, outside the plant boundary. Given the postulated noise levels for cooling towers and diesel generators, the review team concludes that the noise impacts would be minimal, and mitigation would not be warranted.

5.8.3 Acute Effects of Electromagnetic Fields

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures are examples of acute effects from EMFs associated with transmission lines (NRC 1999). Such acute effects are controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria and adherence to the standards for transmission systems. The potential impacts from EMFs of the existing transmission lines for Unit 1 at the VCSNS site were evaluated as part of the environmental review for license renewal for operation (NRC 2004a). The reviewers concluded that the potential impacts for electric shock during the renewal term were minimal. SCE&G and Santee Cooper would have to build three new 230-kV transmission lines for Unit 2 and three new 230-kV lines for Unit 3, along with a new switchyard (SCE&G 2010a). All new structures would be designed and built to comply with all NESC provisions that limit the induced current due to electrostatic effects to 5 mA (SCE&G 2010a).

Considering SCE&G's and Santee Cooper's commitment to designing new transmission lines to conform with the present NESC criteria, the review team concludes that the impact on the public from acute effects of EMFs would be negligible, and further mitigation would not be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Operating power transmission lines in the United States produce EMFs of nonionizing radiation at 60 Hz, which is considered to be an extremely low frequency (ELF) EMF. Research on the potential for chronic effects of EMFs from energized transmission lines was reviewed and addressed by the NRC in NUREG-1437 (NRC 1996). At that time, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. An NIEHS report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

The review team reviewed available scientific literature on chronic effects to human health from ELF-EMF published since the NIEHS report, and found that several other organizations reached the same conclusions (AGNIR 2006; WHO 2007). Additional work under the auspices of the

World Health Organization (WHO) updated the assessments of a number of scientific groups reflecting the potential for transmission-line EMF to cause adverse health impacts in humans. The monograph summarized the potential for ELF-EMF to cause disease such as cancers in children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications, and neurological disease. The results of the review by WHO (2007) found that the extent of scientific evidence linking these diseases to EMF exposure is not conclusive.

The review team reviewed available scientific literature on chronic effects of EMF on human health and found that the scientific evidence regarding the chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts.

5.8.5 Occupational Health

In general, occupational health risks for new units are expected to be mostly attributable to occupational injuries (e.g., falls, electric shock, asphyxiation) to workers engaged in activities such as maintenance, testing, and plant modifications. The annual incidence rates (the number of injuries and illnesses per 100 full-time workers) for the State of South Carolina and the United States for electrical power production workers are approximately 1.7 and 1.9, respectively (BLS 2008b). Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates, with a 2007 average incidence rate of approximately 1.5 per 100 workers (BLS 2008a).

Occupational injury and fatality risks are reduced by strict adherence to NRC and Occupational Safety and Health Administration (OSHA) safety standards (29 CFR Part 1910), practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks for new nuclear unit operation. The review team expects SCE&G to adhere to NRC, OSHA, and State safety standards, practices and procedures during operation of the new units.

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, thermophilic microorganisms in the condenser bays, and caustic agents. SCE&G (SCE&G 2010a) reports that it maintains a health and safety program to protect workers from industrial safety risks at existing Unit 1 and would implement the program for the proposed new units. Health impacts on workers from nonradiological emissions, noise, and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations and would be minimal. Additional mitigation would not be warranted.

5.8.6 Impacts of Transporting Operations Personnel to and from the VCSNS Site and Alternative Sites

The general approach used to calculate the nonradiological impacts of fuel and waste shipments is the same as that used to calculate the impacts of transporting operations and outage personnel to and from the VCSNS site and alternative sites. However, preliminary estimates are the only data available to estimate these impacts. The assumptions made to fill in reasonable estimates of the data needed to calculate nonradiological impacts are discussed below.

- The number of workers needed for operations was given in the ER (SCE&G 2010a) as 800 (two units), so each Westinghouse AP1000 reactor at the VCSNS site requires about 400 operating personnel). An additional 1000 temporary workers are estimated to be needed annually for refueling outages (SCE&G 2010a). It was assumed that outages for the two units would not occur simultaneously.
- The average commute distance for operations and outage workers was assumed to be 20 mi one way.
- To develop representative commuter traffic impacts, a source was located that provides South Carolina-specific fatality rates for all traffic for the years 2003 to 2007 (DOT 2009a). The average fatality rate for the 2003 to 2007 period in South Carolina was used as the basis for estimating South Carolina-specific injury and accident rates. Adjustment factors were developed using national-level traffic accident statistics in the U.S. Department of Transportation (DOT) publication *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 South Carolina-specific fatality rate to approximate the injury and accident rates for commuters in the State of South Carolina.

The estimated impacts of transporting operations and outage workers to and from the VCSNS site are listed in Table 5-8. The total annual traffic fatalities during operations, including both operations and outage personnel, represent about a 0.8-percent increase above the 19 traffic fatalities that occurred in Fairfield County, South Carolina, in 2007 (DOT 2009b). This represents a small increase relative to the current traffic fatality risk in the area surrounding the proposed VCSNS site. The impacts of transporting operations workers to and from the alternative sites range from about a 0.3-percent (at the Savannah River alternative site) to a 2-percent (at the Saluda alternative site) increase in traffic fatalities in the counties in which the alternative sites are located (DOT 2009c, d, e, f). These differences are solely because of differences in the average State-specific fatality rates used for operations workers and the county-specific baseline annual fatalities. Because these increases are small relative to the baseline traffic fatalities (that is, before the new units are constructed) in the counties where SCE&G has proposed to build the new units, the review team concludes that the impacts of transporting construction materials and personnel to the proposed VCSNS site and alternative sites would be minimal, and mitigation would not be warranted.

Table 5-8. Nonradiological Impacts of Transporting Operations Workers to and from the VCSNS Site and Alternative Sites for a Single AP1000 Reactor

Worker Type	Accidents per Year per Unit	Injuries per Year per Unit	Fatalities per Year per Unit
Permanent workers	1.2×10^{1}	5.6×10^{0}	8.4×10^{-2}
Outage workers	3.7×10^{0}	1.7×10^{0}	2.5×10^{-2}

5.8.7 Summary of Nonradiological Health Impacts

The review team evaluated health impacts on the public and the workers from the cooling systems, noise generated by unit operations, acute and chronic impacts of EMFs at the higher power levels, and transporting operations and outage workers to and from the two additional units. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts on the public and workers from thermophilic microorganisms, noise generated by operations, and acute impacts of EMFs would be minimal. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the potential impacts of nonradiological effects resulting from the operation of two proposed additional units would be SMALL, and mitigation would not be warranted. The staff is not able to come to conclusions on the chronic impacts of EMFs on public health.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of proposed VCSNS Units 2 and 3, including a discussion of the estimated radiation dose to a member of the public and to the biota inhabiting the area around the VCSNS site. Estimated doses to workers at the proposed units are also discussed. Radiological impacts were determined using the Westinghouse AP1000 reactor design with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation (see discussion in Section 3.4.3).

Revision 15 of the AP1000 design (Westinghouse 2005) is a certified design as set forth in 10 CFR Part 52, Appendix D. Subsequently, Westinghouse submitted Revisions 16 and 17 of the AP1000 design. Revision 2 of SCE&G's ER incorporates Revision 17 of the Design Control Document (DCD); therefore, the COL application and evaluation of radiological impacts of normal operations presented here are based on Revision 17 of the DCD (Westinghouse 2008).

5.9.1 Exposure Pathways

The public and biota would receive radiation dose from a nuclear unit via the liquid effluent, gaseous effluent, and direct radiation pathways. SCE&G estimated the potential exposures to the public and biota by evaluating exposure pathways typical of those surrounding a nuclear unit at the VCSNS site. SCE&G considered pathways that could cause the highest calculated radiological dose based on the use of the environment by the residents located around the site (SCE&G 2010a). For example, factors such as the location of homes in the area, consumption of meat from the area, and consumption of vegetables grown in area gardens were considered.

For the liquid effluent release pathway, SCE&G considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): ingestion of aquatic food (i.e., commercial and sport fish); ingestion of drinking water; ingestion of meats, vegetables, and milk (assuming irrigation downstream of the plant using water from Parr Reservoir or the Broad River); and direct radiation exposure from shoreline activities, swimming, and boating (see Figure 5-3). The analysis for population dose considered the following exposure pathways: ingestion of aquatic food, ingestion of drinking water, and direct radiation exposure from shoreline, swimming, and boating activities. Liquid effluents were assumed to be released via the planned discharge structure into Parr Reservoir, which is part of the Broad River.

As discussed in the FSAR, the design of proposed VCSNS Units 2 and 3 includes a number of features to prevent and mitigate leakage from system components such as pipes and tanks that may contain radioactive material (SCE&G 2010d). In addition, SCE&G committed to use the guidance of NEI 08-08A, "Generic FSAR Template Guidance for Life-Cycle Minimization of Contamination," to the extent practicable in the development of operating programs and procedures (SCE&G 2010d). However, the potential still exists for leaks of radioactive material, such as tritium, into the ground, similar to those that have been reported at currently operating power plants. Based on the discussion above, the NRC staff expects that the impacts from such potential leakage for proposed VCSNS Units 2 and 3 would be small.

For the gaseous effluent release pathway, SCE&G (2010a) considered the following exposure pathways in evaluating the dose to the MEI: immersion in the radioactive plume, direct radiation exposure from deposited radioactivity, inhalation, ingestion of garden fruit and vegetables, ingestion of goat and cow milk, and ingestion of meat animals.

For population doses from the gaseous effluents, SCE&G (2010a) used the same exposure pathways as those used for the individual dose assessment (see Figure 5-3). All agricultural products grown within 50 mi of proposed Unit 3 were assumed to be consumed by the population dose within 50 mi of proposed new units at the VCSNS site.

SCE&G (2010a) stated that direct radiation from the reactor buildings and planned independent spent-fuel storage installation would be the primary sources of direct radiation exposure to the public from the VCSNS site. However, SCE&G assumes that contained sources of radiation at proposed VCSNS Units 2 and 3 would be shielded and would not contribute to the external dose of the MEI or the population. The assumption of negligible contribution from direct radiation beyond the site boundary is supported by the DCD (Westinghouse 2008). The containment and other plant buildings would be shielded and direct radiation from them would be negligible. The AP1000 design also provides for the storage of refueling water inside the

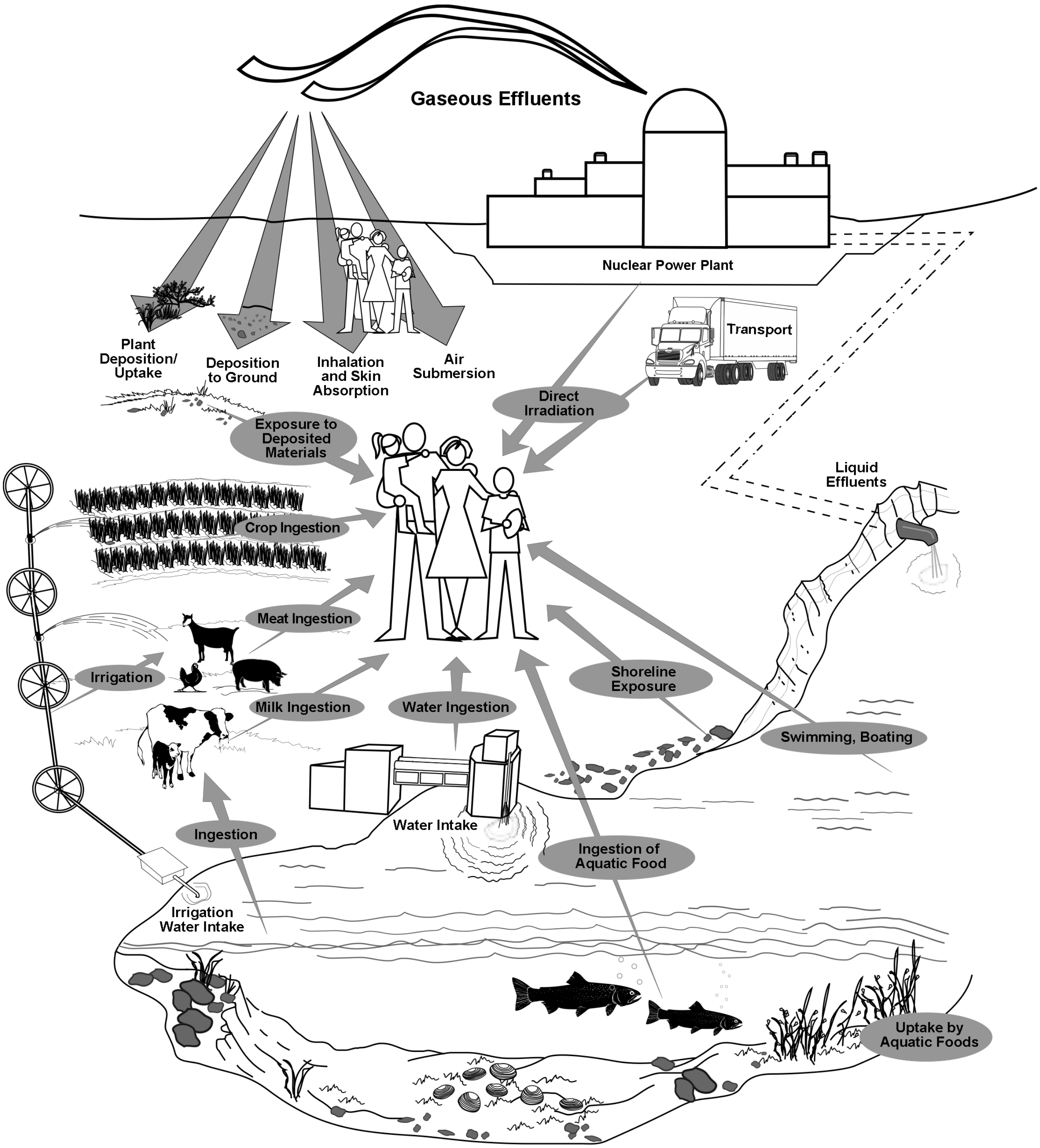


Figure 5-3. Exposure Pathways to Man (adapted from Soldat et al. 1974)

containment building instead of an outside storage tank. Storing refueling water inside the containment building eliminates it as a source of significant direct radiation to offsite receptors.

Exposure pathways considered in evaluating dose to the biota are shown in Figure 5-4 and include the following:

- ingestion of aquatic foods
- ingestion of water
- external exposure from water immersion or surface effect
- inhalation of airborne radionuclides
- external exposure to immersion in gaseous effluent plumes
- surface exposure from deposition of iodine and particulates from gaseous effluents (NRC 1977).

The staff reviewed the exposure pathways for the public and biota identified by SCE&G (2010a) and found them to be appropriate, based on a documentation review, a tour of the environs, and interviews with SCE&G staff and contractors during the site visit in March 2009.

5.9.2 Radiation Doses to Members of the Public

SCE&G calculated the dose to the MEI and the population living within a 50-mi radius of the site from the liquid and gaseous effluent release pathways (SCE&G 2010a). As discussed in Section 5.9.1, direct radiation exposure to the MEI from sources of radiation at proposed VCSNS Units 2 and 3 would be negligible.

5.9.2.1 Liquid Effluent Pathway

Liquid pathway doses were calculated using the LADTAP II computer program (Strenge et al. 1986). The following activities were considered in the dose calculations: (1) consumption of drinking water contaminated by liquid effluents, (2) consumption of fish from water sources contaminated by liquid effluents, (3) consumption of crops, milk, and meat produced on land irrigated with water contaminated by liquid effluents, and (4) direct radiation from waterbodies contaminated by liquid effluents during swimming, boating, and recreation along the shoreline. The liquid effluent releases used in the estimates of dose are found in Table 3.5-1 of the ER (SCE&G 2010a) and listed in Table G-1 of Appendix G of this EIS. Other parameters used as inputs to the LADTAP II program include effluent discharge rate, dilution factor for discharge, transit time to receptor, and liquid pathway consumption and usage factors (i.e., fish consumption and drinking water consumption), and are found in Table 5.4-1 of the ER (SCE&G 2010a).

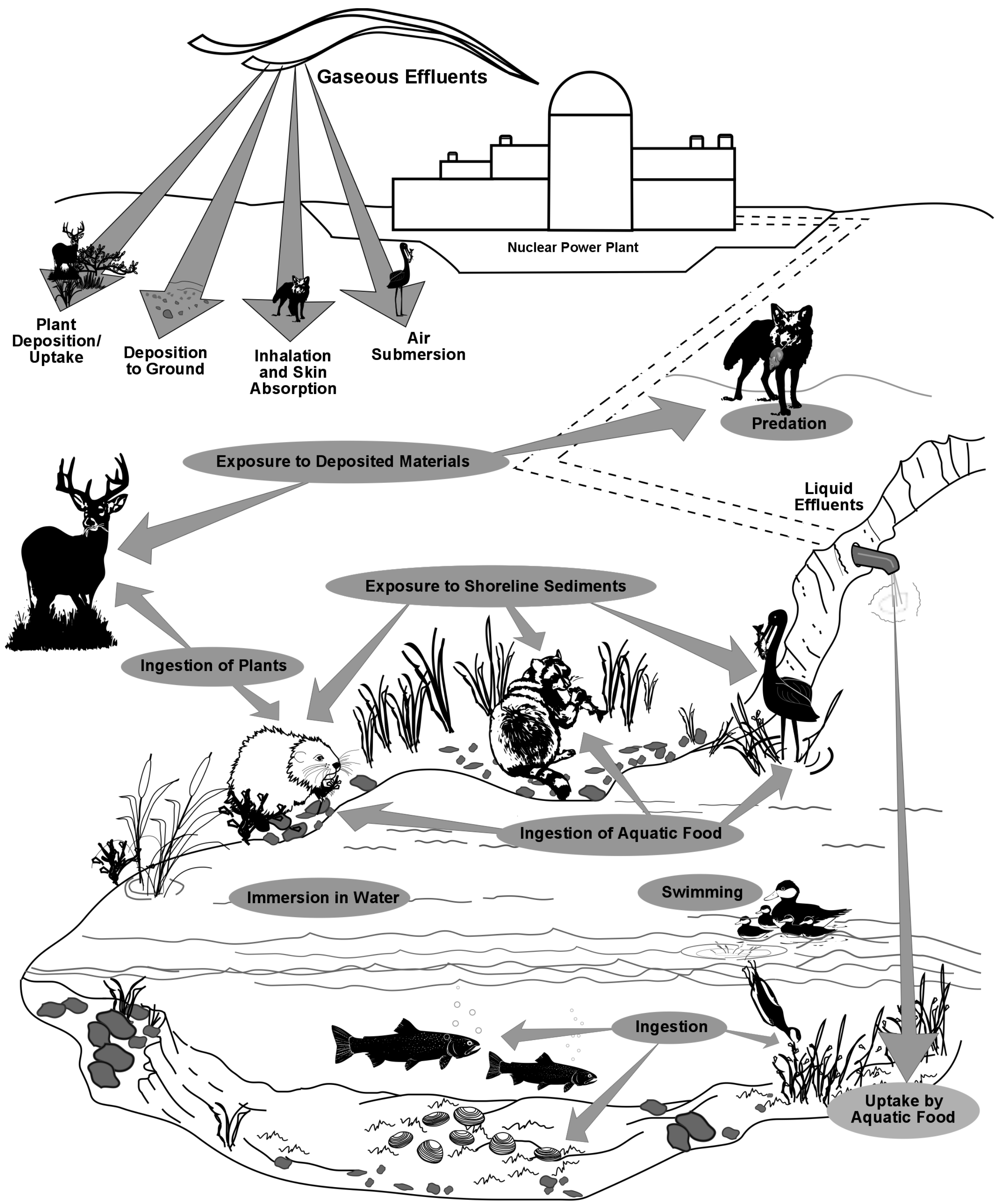


Figure 5-4. Exposure Pathways to Biota Other Than Man (adapted from Soldat et al. 1974)

SCE&G calculated liquid pathway doses to the MEI as shown in Table 5-9 (SCE&G 2009k). The MEI was an adult with the majority of the dose from consumption of fish and other organisms. The maximally exposed organ was the gastrointestinal tract of an adult.

Table 5-9. Annual Doses to the Maximally Exposed Individual for Liquid Effluent Releases from a New Unit

Pathway	Age Group	Total Body (mrem/yr)	Maximum Organ (GI-LLI) (mrem/yr)	Thyroid (mrem/yr)
Drinking water	Adult	0.029	0.035	0.041
	Teen	0.020	0.025	0.031
	Child	0.038	0.042	0.064
Fish and other organisms	Adult	0.058	0.006	0.006
	Teen	0.033	0.005	0.005
	Child	0.013	0.002	0.006
Irrigated land	Adult	0.052	0.456	0.058
	Teen	0.056	0.330	0.071
	Child	0.078	0.252	0.122
Direct radiation	Adult	0.0001	0.0001	0.0001
	Teen	0.0003	0.0003	0.0003
	Child	0.0001	0.0001	0.0001
total	Adult	0.139	0.497	0.104
	Teen	0.110	0.360	0.108
	Child	0.129	0.296	0.192

Source: SCE&G 2009k (LADTAP output attached to NND-09-0203)
GI-LLI = gastrointestinal-lower large intestine

The staff recognizes the LADTAP II computer program as an appropriate method for calculating dose to the MEI for liquid effluent releases. All input parameters used in SCE&G calculations were judged by the NRC staff to be appropriate.

The staff performed an independent evaluation of liquid pathway doses and found similar results. The results of the NRC staff's independent review are found in Appendix G.

5.9.2.2 Gaseous Effluent Pathway

Gaseous pathway doses to the MEI were calculated by SCE&G using the GASPAR II computer program (Strenge et al. 1987) at the nearest residence and the exclusion area boundary. The GASPAR II computer program was also used to calculate annual population doses. The following activities were considered in the dose calculations: (1) direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground, (2) inhalation of gases and particulates, (3) ingestion of meat from animals eating contaminated grass, (4) ingestion of milk from animals eating contaminated grass, and (5) ingestion of garden vegetables contaminated by gases and particulates. The gaseous effluent releases used in the estimate of dose to the MEI and population are found in Table 3.5-2 of the ER (SCE&G 2010a) and Table G-4 of Appendix G. Other parameters used as inputs to the GASPAR II program, including population data, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors, are found in Tables 2.5-1, 2.7-19 through 2.7-25, and 5.4-3 through 5.4-5 of the ER (SCE&G 2010a). Gaseous pathway doses to the MEI calculated by SCE&G are found in Table 5-10. These values are a few percent lower than the doses reported in the draft EIS because Revision 2 of the ER used 2 years of meteorological data, while Revision 1 of the ER used only 1 year of meteorological data.

Table 5-10. Annual Doses to the Maximally Exposed Individual from Gaseous Effluent Releases for a New Unit[(a)]

Pathway	Age Group	Total Body Dose (mrem/yr)	Max Organ (mrem/yr)	Skin Dose (mrem/yr)	Thyroid Dose (mrem/yr)
Plume (1.68 mi. SE)	All	0.058	0.062 (lung)	0.31	0.058
Ground (1.68 mi. SE)	All	0.02930	0.029 (lung)	0.034	0.029
Inhalation (1.68 mi. SE)	Adult	0.0071	0.0091 (lung)	0.0069	0.064
	Teen	0.0072	0.010 (lung)	0.0070	0.080
	Child	0.0064	0.0089 (lung)	0.0062	0.094
	Infant	0.0037	0.0055 (lung)	0.0036	0.084
Vegetable (1.68 mi. SE)	Adult	0.054	0.28 (bone)	0.046	0.64
	Teen	0.080	0.43 (bone)	0.071	0.86
	Child	0.17	1.0 (bone)	0.16	1.7
Meat (1.68 mi. SE)	Adult	0.016	0.069 (bone)	0.015	0.039
	Teen	0.013	0.059 (bone)	0.013	0.029
	Child	0.023	0.11 (bone)	0.023	0.048
Cow milk (1.68 mi. SE)	Adult	0.024	0.083(bone)	0.019	0.67
	Teen	0.038	0.15(bone)	0.033	1.1
	Child	0.082	0.37(bone)	0.076	2.1
	Infant	0.16	0.71(bone)	0.15	5.2
Goat milk (1.68 mi. SE)	Adult	0.036	0.096(bone)	0.023	0.90
	Teen	0.052	0.17(bone)	0.039	1.4
	Child	0.098	0.42(bone)	0.085	2.8
	Infant	0.18	0.78(bone)	0.17	6.8

Source: SCE&G 2010a

(a) Maximally exposed total body individual is the child of resident gardener at 1.68 mi southeast of VCSNS Units 2 and 3. Adult, teen, and infant doses are presented as additional information. Ground-level releases were assumed. Doses are based on 2 years of meteorological data.

The staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the MEI and population from gaseous effluent releases. The staff reviewed the input parameters and values used by SCE&G (SCE&G 2010a) for appropriateness, including references made to the AP1000 DCD (Westinghouse 2008). The staff concluded that the assumed input parameters and values used by SCE&G were appropriate. The staff performed an independent evaluation of the gaseous pathway doses and obtained similar results for the MEI (see Appendix G for details).

5.9.3 Impacts on a Member of the Public

This section describes the staff's evaluation of the estimated impacts from radiological releases and direct radiation of two units at the VCSNS site. The evaluation addresses dose from operations to the MEI located at the VCSNS site and the population dose (collective dose to the population within 50 mi) around the VCSNS site.

5.9.3.1 Maximally Exposed Individual

SCE&G stated that total body and organ dose estimates to the MEI from liquid and gaseous effluents from each new unit would be within the dose design objectives of 10 CFR Part 50, Appendix I (SCE&G 2010a). Doses from liquid effluents from the use of Parr Reservoir to the total body and maximum organ at the nearest residence from liquid effluents would be well within the respective 3-mrem/yr and 10 mrem/yr Appendix I dose design objectives. Doses at the exclusion area boundary from gaseous effluents would be well within the Appendix I dose design objectives of 10 mrad/yr air dose from gamma radiation, 20 mrad/yr air dose from beta radiation, 5 mrem/yr to the total body, and 15 mrem/yr to the skin. In addition, dose to the thyroid from gaseous effluents would be within the 15 mrem/yr Appendix I dose design objective. A comparison of dose estimates for each of two new units to the Appendix I dose design objectives is found in Table 5-11. The staff completed an independent evaluation of compliance with Appendix I dose design objectives and found similar results, as shown in Appendix G.

SCE&G compared the combined dose estimates from direct radiation and gaseous and liquid effluents from existing Unit 1 and proposed Units 2 and 3 with the 40 CFR Part 190 standards (Table 5-12) (SCE&G 2010a). SCE&G stated that the total body and organ dose estimates to the MEI from liquid and gaseous effluents for VCSNS Unit 1 would be less than the estimates from Units 2 and 3 and well within the design objectives of 10 CFR Part 50, Appendix I. Direct radiation doses from the existing VCSNS Unit 1 at the site boundary do not vary significantly from background radiation levels (SCE&G 2009m). As stated in Section 5.9.1, exposure at the site boundary from direct radiation sources at the proposed new Units 2 and 3 would be negligible and would not contribute significantly to the MEI dose. Table 5-12 shows SCE&G's assessment that the total doses to the MEI from liquid and gaseous effluent as well as direct radiation at the VCSNS site would be well below the 40 CFR Part 190 standards. The staff completed an independent evaluation of compliance with 40 CFR Part 190 standards and found similar results, as shown in Appendix G.

Table 5-11. Comparisons of MEI Dose Estimates from Liquid and Gaseous Effluents for a Single New Nuclear Unit to 10 CFR Part 50, Appendix I Dose Design Objectives

Radionuclide Releases/Dose	SCE&G Dose Estimates	Appendix I Design Objectives
Liquid effluents[(a)]		
Total body dose	0.14 mrem	3 mrem
Maximum organ dose	0.50 mrem	10 mrem
Gaseous effluents[(b)] (noble gases only)		
Gamma air dose	0.71 mrad	10 mrad
Beta air dose	3.0 mrad	20 mrad
Total body dose	0.58 mrem	5 mrem
Skin dose	2.4 mrem	15 mrem
Gaseous effluents[(c)] (radioiodines and particulates)		
Maximum organ dose (thyroid)	7.0 mrem[(d)]	15 mrem

Source: SCE&G 2010a
(a) Total body and GI-LLI doses are for an adult using the Parr Reservoir.
(b) Southeast Site Boundary; ground-level releases assumed.
(c) Includes tritium, carbon-14, food chain, and inhalation doses.
(d) Infant drinking home-produced goat milk.

Table 5-12. Comparison of Maximally Exposed Individual Dose Rates with 40 CFR Part 190(a) Criteria

	Unit 1	Units 2 and 3				
Target Organ	Combined Liquid and Gaseous (mrem/yr)	Liquid (mrem/yr)	Gaseous (mrem/yr)	Combined (mrem/yr)	Site Total (mrem/yr)	40 CFR Part 190 Dose Standards (mrem/yr)
Whole body dose	1.2	0.28	0.78	1.1	2.2	25
Thyroid	0.043	0.38 (infant, goat milk)	14 (infant, goat milk)	14	14	75
Other organ	0.043 (bone)	0.23 (child bone)	3.2 (child bone)	3.5	3.5	25

Source: SCE&G 2010a

5.9.3.2 Population Dose

SCE&G estimated the collective total body dose within the 50-mi radius of the proposed VCSNS Units 2 and 3 to be 29 person-rem/yr from liquid effluents and 5.5 person-rem/yr from gaseous effluents (SCE&G 2010a). The staff estimated the collective dose to the same population from background radiation to be 663,000 person-rem/yr (NCRP 2009). The dose from background radiation was calculated by multiplying the 50-mi population estimate for 2060 of 2,131,394 people by the annual background dose rate of 311 mrem/yr (NCRP 2009). SCE&G calculated a higher dose from background because it included radiation from medical practice.

Collective dose from the gaseous and liquid effluent pathways was estimated using the GASPAR II and LADTAP II computer codes, respectively. The staff performed an independent evaluation of population doses and obtained similar results (see Appendix G).

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effect per person-rem. The coefficient is taken from Publication 103 of the International Commission on Radiological Protection (ICRP 2007).

Both the National Council on Radiation Protection and Measurements (NCRP) and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (in other words, less than 1/0.00057, which is less than 1754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995; ICRP 2007). The estimated collective whole body dose to the population living within 50 mi of the proposed new units at the VCSNS site is 29 person-rem/yr (SCE&G 2010a), which is less than the value of 1754 person-rem/yr that ICRP and NCRP suggest would most likely result in zero excess health effects (NCRP 1995; ICRP 2007).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published, “Cancer in Populations Living Near Nuclear Facilities,” in 1990 (Jablon 1990). The NCI report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (Jablon 1990).

5.9.3.3 Summary of Radiological Impacts on Members of the Public

The staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from the new units at the VCSNS site. Based on the information provided by SCE&G and NRC's independent evaluation, the staff concludes there would be no observable health impacts on the public from normal operation of the new units, the health impacts would be SMALL, and additional mitigation would not be warranted.

5.9.4 Occupational Doses to Workers

At the VCSNS site, the annual occupational collective dose for 2005 through 2008 averaged 43 person-rem for the existing VCSNS Unit 1 (SCE&G 2006b, 2007a, 2008a, 2009n). The collective occupational dose for a single AP1000 reactor was estimated at 67.1 person-rem/yr in the DCD (Westinghouse 2008). This collective dose was based on an 18-month fuel cycle and would be bounding for a 24-month fuel cycle.

The licensee of a new plant would be required to maintain individual doses to workers to within 5 rem annually as specified in 10 CFR 20.1201 and incorporate provisions to maintain doses as low as reasonably achievable (ALARA).

The staff concludes that the health impacts from occupational radiation exposure would be SMALL based on individual worker doses being maintained within 10 CFR 20.1201 limits and collective occupational doses being typical of doses found in current operating light water reactors. Additional mitigation would not be warranted because the operating plant would be required to maintain doses ALARA.

5.9.5 Impacts on Biota Other Than Humans

SCE&G estimated doses to biota in the VCSNS site environs using surrogate species. Surrogate species used in the ER are well-defined and provide an acceptable method for evaluating doses to the biota. Surrogate species analysis was performed for aquatic species such as fish, invertebrates, and algae, and for terrestrial species such as muskrats, raccoons, herons, and ducks (SCE&G 2010a). Aquatic species on the VCSNS site are represented by the freshwater fish, invertebrates, and algae surrogates. Although there is no significant harvesting of freshwater invertebrates, Asian clams in Monticello Reservoir have been monitored in the past and found to be free of radioactive contamination (SCE&G 2008b). Terrestrial species are represented by the muskrat and raccoon surrogates; birds are represented by the heron and duck surrogates. SCE&G performed no species-specific dose calculations. Exposure pathways considered in evaluating dose to the biota are discussed in Section 5.9.1 and shown in Figure 5-4. The NRC staff reviewed SCE&G's calculations (SCE&G 2010a) and performed an independent evaluation (see Appendix G) of the fish, invertebrates, algae, muskrat, raccoon, heron, and duck, and found similar results.

5.9.5.1 Liquid Effluent Pathway

SCE&G used the LADTAP II computer code to calculate doses to the biota from the liquid effluent pathway. In estimating the concentration of radioactive effluents in Parr Reservoir (Broad River), SCE&G assumed there would be no additional dilution in the reservoir. The biota dose estimates for the proposed units are also conservative because they do not consider radioactive decay during transit; therefore, actual doses to the biota are likely to be much less than estimated (SCE&G 2010a). All parameters used as input to LADTAP are shown in Table G-1 of Appendix G. Liquid pathway doses were higher for biota compared with man because of considerations for bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, and increased time spent in water and shoreline compared with man. The liquid effluent releases used in estimating biota dose are found in Table 3.5-1 of the ER (SCE&G 2010a). Table 5-13 presents SCE&G's estimates of the doses to biota from the liquid and gaseous pathways from proposed new Units 2 and 3.

Table 5-13. Biota Doses for Proposed VCSNS Units 2 and 3

	SCE&G Biota Dose Estimates		
Biota	**Liquid Pathway (mrad/yr)**	**Gaseous Pathway (mrad/yr)**	**Total Body Biota Dose All Pathways (mrad/yr)**
Fish	0.82	0	0.82
Invertebrate	2.3	0	2.3
Algae	6.66	0	6.7
Muskrat	2.44	5.04	7.5
Raccoon	0.956	7.4	8.4
Heron	11.14	5.04	16
Duck	2.34	7.4	9.7

Source: SCE&G 2010a

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). The exposure pathways include inhalation of airborne radionuclides, external exposure because of immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents. SCE&G used the calculation methods of dose to the MEI from gaseous effluent releases described in Section

5.9.2 to calculate dose to terrestrial surrogate species, with two modifications (SCE&G 2010a). One modification increased the ground deposition factors by a factor of two to account for the closer proximity of terrestrial animals to the ground compared with the MEI. The second modification was to disable the vegetation intake pathway for muskrat and heron because they are not known to consume vegetation. In addition, SCE&G assumed that biota could be inside the exclusion area boundary at a distance of 0.25 mi southeast of the powerblock area circle to estimate these doses (SCE&G 2010a). This assumption is conservative because it results in an overestimation of the doses for almost all of the terrestrial biota. The gaseous effluent releases used in estimating dose are found in Table 3.5-2 of the ER (SCE&G 2010a). Table 5-13 presents SCE&G's estimates of the doses to biota from the liquid and gaseous pathways from proposed VCSNS Units 2 and 3 (SCE&G 2010a).

5.9.5.3 Impact of Estimated Biota Doses

The International Atomic Energy Agency (IAEA 1992) and the NCRP (1991) reported that a chronic dose rate of no greater than 10 mGy/d (1000 mrad/d) to the maximally exposed organism in a population of aquatic organisms would ensure protection of the population. IAEA (1992) also concluded that chronic dose rates of 1 mGy/d (100 mrad/d) or less do not appear to cause observable changes in terrestrial animal populations.

Table 5-14 compares estimated total body dose rates to surrogate biota species that would be produced by releases from Units 2 and 3 to the IAEA/NCRP biota dose guidelines (IAEA 1992; NCRP 1991).

Table 5-14. Comparison of Biota Doses from Proposed VCSNS Units 2 and 3 to IAEA Guidelines for Biota Protection

Biota	SCE&G Estimate of Dose to Biota (mrad/d)[a]	IAEA/NCRP Guidelines for Protection of Biota Populations (mrad/d)[b]
Fish	2.2×10^{-3}	1000
Invertebrate	6.3×10^{-3}	1000
Algae	1.8×10^{-2}	1000
Muskrat	2.0×10^{-2}	100
Raccoon	2.3×10^{-2}	100
Heron	4.4×10^{-2}	100
Duck	2.7×10^{-2}	100

(a) Total dose from liquid and gaseous effluents in Table 5-13 converted to mrad/d.
(b) Guidelines in NCRP and IAEA reports expressed in Gy/d (1 mGy/d equals 100 mrad/d).

The maximum total dose from both liquid and gaseous pathways from the bounding calculation is about 16 mrad/yr, or about 0.044 mrad/d. Thus doses to biota calculated by SCE&G are far below the 100-mrad/d (0.1-rad/d) IAEA guidelines (IAEA 1992) for terrestrial biota and the 1000-mrad/d (1-rad/d) IAEA guideline (IAEA 1992) for aquatic biota. Daily dose rates would not exceed the IAEA guidelines for any surrogate species.

Based on the information provided by SCE&G and the NRC's independent evaluation, the staff concludes that the radiological impact on biota from the routine operation of the proposed VCSNS Units 2 and 3 at the VCSNS site would be SMALL, and additional mitigation would not be warranted.

5.9.6 Radiological Monitoring

A radiological environmental monitoring program (REMP) has been in place for the VCSNS Unit 1 site since its operation began in 1984, with preoperational sample collection activities beginning in 1982 (SCE&G 2010a). The REMP includes monitoring of the airborne-exposure pathway, direct-exposure pathway, water-exposure pathway, aquatic-exposure pathway from Monticello Reservoir, and the ingestion-exposure pathway within a 5-mi radius of the station, with indicator locations near the plant perimeter and control locations at distances greater than 10 mi. An annual survey is conducted for the area surrounding the site to verify the accuracy of assumptions used in the analyses, including the occurrence of milk production (SCE&G 2006c, 2007b, 2008b, 2009q). The preoperational REMP sampled various media in the environment to determine a baseline from which to observe the magnitude and fluctuation of radioactivity in the environment once Unit 1 began operation. The preoperational program included collection and analysis of samples of air particulates, precipitation, crops, soil, well water, surface water, fish, and silt as well as measurement of ambient gamma radiation. After operation of VCSNS Unit 1 began in 1984, the monitoring program continued to assess the radiological impacts on workers, the public, and the environment. Radiological releases are summarized in the two annual reports: the Annual Radiological Environmental Operating Report (SCE&G 2006c, 2007b, 2008b, 2009m, 2010c) and the Annual Radioactive Effluent Release Report (SCE&G 2006d, 2007c, 2008c, 2009o). The limits for all radiological releases are specified in the VCSNS Offsite Dose Calculation Manual (ODCM) (SCE&G 2007d). No additional monitoring program has been established for the proposed units. To the greatest extent practical, the REMP for the VCSNS program would use the procedures and sampling locations used by the existing VCSNS site. The staff reviewed the documentation for the existing REMP, the VCSNS ODCM, and recent monitoring reports from VCSNS, and determined that the current operational monitoring program is adequate to establish the radiological baseline for comparison with the expected impacts on the environment related to the construction and operation of the proposed new units at the VCSNS site.

In 2009, tritium concentrations less than 1000 pCi/L were found in Monticello and Parr Reservoirs, at the Columbia Water Works, and in one groundwater well (SCE&G 2010c). These concentrations are well below the EPA drinking water standard of 20,000 pCi/L (40 CFR Part 141) and would result in doses well below the VCSNS effluent dose limits. In addition, cobalt-60 concentrations ranging from 14-31 pCi/Kg were found in sediments at two locations; these concentrations are right around the minimum detectable level (SCE&G 2010c).

The annual radioactive effluent release reports for, 2007, and 2008 (SCE&G 2008c, 2009o) summarized results of groundwater sampling performed by SCE&G in various onsite locations, which may be a source of groundwater contamination. Tritium concentrations in the range 2000-3000 pCi/L were found in an onsite well located where condensate polisher resins were disposed in 1994; these concentrations are well below the EPA drinking water standard of 20,000 pCi/L (40 CFR Part 141).

5.10 Nonradioactive Waste Impacts

This section describes the potential impacts on the environment that could result from the generation, handling, and disposal of nonradioactive waste and mixed waste during the operation of proposed VCSNS Units 2 and 3. Section 3.4.4 of this EIS describes the nonradioactive waste systems. Types of nonradioactive waste that would be generated, handled, and disposed of during operational activities include solid wastes, liquid effluents, and air emissions. Solid wastes include municipal waste, sewage-treatment sludge, and industrial wastes. Liquid waste includes NPDES-permitted discharges such as effluents containing chemicals or biocides, wastewater effluents, site stormwater runoff, and other liquid wastes such as used oils, paints, and solvents that require offsite disposal. Air emissions would primarily be generated by vehicles and diesel generators. In addition, small quantities of hazardous waste, and mixed waste, which is waste that has both hazardous and radioactive characteristics, may be generated during plant operations. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

5.10.1 Impacts on Land

SCE&G has developed a *Solid Waste Management and Waste Minimization Plan for Virgil C. Summer Nuclear Station* (SCE&G 1996). The current practices for waste-management and waste-minimization practices used at Unit 1 would also be implemented for proposed Units 2 and 3 (SCE&G 2010a). Operational solid wastes such as office waste, cardboard, wood, or metal will be recycled or reused (SCE&G 2010a). SCE&G plans to dispose of municipal solid waste and resins from plant operations in a SCDHEC-approved disposal facility. In addition, a new sanitary wastewater-treatment plant would be installed to serve the operational needs of the new units; plant sludge would be applied at an SCDHEC-approved location onsite or shipped offsite for disposal at a permitted facility (SCE&G 2010a). Debris from trash racks and screens on the water-intake structure would be periodically collected and disposed at an onsite location. SCE&G would follow all applicable Federal, State, and local requirements and standards for handling, transporting, and disposing of solid waste (SCE&G 2010a).

Based on the plans to manage solid and liquid wastes in accordance with all applicable Federal, State, and local requirements and standards, and the effective practices for reusing, recycling, and minimizing waste, the review team expects that impacts on land from nonradioactive wastes generated during the operation of VCSNS Units 2 and 3 would be minimal, and no further mitigation would be warranted.

5.10.2 Impacts on Water

Water withdrawn from the Monticello Reservoir for cooling and other operational purposes for the proposed Units 2 and 3 would be discharged to the Parr Reservoir. These discharges would contain both chemicals and biocides and be controlled by the NPDES permit. Other potential nonradioactive liquid effluent from proposed Units 2 and 3 operations are stormwater runoff and sanitary wastewater discharges (SCE&G 2010a). In all cases, the NPDES permit would limit the volume and constituents concentrations. Sections 5.2.3.1 and 5.2.3.2 of this EIS discuss impacts on surface and groundwater quality from operation of VCSNS Units 2 and 3.

Based on the regulated practices for managing liquid discharges containing chemicals or biocides, wastewater, and the plans for managing stormwater, the review team expects that impacts on water from nonradioactive effluents during the operation of VCSNS Units 2 and 3 would be minimal, and no further mitigation would be warranted.

5.10.3 Impacts on Air

Operation of proposed VCSNS Units 2 and 3 would result in gaseous emission from operation of diesel generators. Impacts on air quality are discussed in Section 5.7.2 of this EIS. In addition, vehicular traffic associated with personnel necessary to operate Units 2 and 3 would increase vehicle emissions in the area. Increases in air emissions from the operation of Units 2 and 3 would require compliance with the Federal and State air quality control laws and regulations (SCE&G 2010a).

Based on the regulated practices for managing air emissions, the review team expects that impacts on air from nonradioactive emissions during the operation of VCSNS Units 2 and 3 would be minimal, and no further mitigation would be warranted.

5.10.4 Mixed-Waste Impacts

Mixed waste contains both low-level radioactive waste and hazardous waste. The generation, storage, treatment, or disposal of mixed waste is regulated by the Atomic Energy Act, the Solid Waste Disposal Act of 1965, as amended by the Resource, Conservation, and Recovery Act (RCRA) in 1976, and the Hazardous and Solid Waste Amendments (which amended RCRA in 1984). Each new reactor at the VCSNS site can be expected to produce approximately 17 ft^3/yr of liquid and 7.5 ft^3/yr of solid mixed waste. In addition, SCE&G has implemented a waste-minimization plan to reduce the amount of mixed waste produced onsite by chemical inventory control, use of less hazardous alternatives, and careful separation of radioactive wastes

(SCE&G 1996, 2010a). SCE&G stated that the treatment, storage, and disposal of mixed wastes generated by the proposed Units 2 and 3 would be managed as the existing Unit 1 mixed wastes is managed (SCE&G 2010a). Mixed waste would be placed in appropriate containers, collected in the radwaste building, and shipped offsite. Mixed waste would be handled by designated personnel trained in proper waste management, including spill prevention and emergency response (SCE&G 2010a).

Based on the practices for minimizing waste currently in place for VCSNS Unit 1 and the plans to manage mixed wastes in accordance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts from the generation of mixed waste at VCSNS Units 2 and 3 would be minimal, and no further mitigation would be warranted.

5.10.5 Summary of Nonradioactive Waste Impacts

Solid, liquid, gaseous, and mixed wastes generated during operation of VCSNS Units 2 and 3 would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid waste would be obtained and implemented. Discharges to the Parr Reservoir of liquid effluents used for operations, including wastewater and stormwater, would be controlled and limited via an NPDES permit. Air emissions from Units 2 and 3 operations would be compliant with local, State, and Federal air quality standards and regulations. Mixed waste generation, storage, and disposal impacts during operation of proposed Units 2 and 3 would be compliant with requirements and standards.

Based on the information provided by SCE&G, the effective practices for recycling, minimizing, managing, and waste disposal planned to be used at the VCSNS site, the expectation that regulatory approvals will be obtained to regulate the additional waste that would be generated from proposed Units 2 and 3, and the independent evaluations as discussed in the referenced sections of this EIS, the review team concludes that the potential impacts from nonradioactive waste resulting from the operation of the proposed additional units at the VCSNS site would be SMALL, and no further mitigation would be warranted.

Cumulative impacts on water and air from nonradiological effluents and emissions are discussed in Sections 7.2 and 7.6, respectively. For the purposes of Chapter 9, the review team expects that there would be no substantive differences between the impacts of nonradiological waste for the proposed Units 2 and 3 and the alternative sites and no substantive cumulative impacts that warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

5.11 Environmental Impacts of Postulated Accidents

The NRC staff considered the radiological consequences on the environment of potential accidents at proposed VCSNS Units 2 and 3. SCE&G based its COL application on the proposed installation of AP1000 reactors for proposed Units 2 and 3. Revision 15 of the AP1000 design (Westinghouse 2005) is a certified design as set forth in the 10 CFR Part 52, Appendix D. Subsequently, Westinghouse submitted Revision 17 of the AP1000 design (Westinghouse 2008). The SCE&G application references Revision 17 of the AP1000 DCD. The NRC staff is reviewing the Westinghouse application to amend the design certification rule for the AP1000.

The term "accident," as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in the release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially in excess of permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2.

Numerous features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, which compose the first line of defense, are intended to prevent the release of radioactive materials from the plant. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas ALARA are specified in 10 CFR Part 50, Appendix I. Additional measures are designed to mitigate the consequences of failures in the first line of defense. These measures include the NRC's reactor siting criteria in 10 CFR Part 100, which require the site to have certain characteristics that reduce the risk to the public and the potential impacts of an accident, and emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47; 10 CFR Part 50, Appendix E; and NUREG-0654/FEMA-REP-1 (NRC 1980). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

This section discusses (1) the types of radioactive materials that may be released, (2) the potential paths for their release to the environment, (3) the relationship between radiation dose and health effects, and (4) the environmental impacts of reactor accidents, both design basis accidents (DBAs) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. Most of the material in the fuel is in the form of nonvolatile solids. However, after operation, a significant fraction of the material is in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities, are volatile. Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and, therefore, have lower tendencies to escape from the fuel than the noble gases and isotopes of iodine.

Radiation exposure to individuals is determined by their proximity to radioactive material, the duration of their exposure, and the extent to which they are shielded from the radiation. Pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in the water, (2) inhalation of radioactive material, and (3) ingestion of food or water containing material initially deposited on the ground and in water.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks.

Physiological effects are clinically detectable if individuals receive radiation exposure resulting in a dose greater than about 25 rem over a short period of time (hours). Untreated doses of about 250 to 500 rem received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.11.1 Design Basis Accidents

SCE&G evaluated the potential consequences of postulated accidents to demonstrate that a AP1000 reactor could be constructed and operated at the VCSNS site without undue risk to the health and safety of the public (SCE&G 2010a). These evaluations used a set of DBAs that are representative for the reactor design being considered for the VCSNS site and site-specific meteorological data. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences.

The DBA review focuses on the AP1000 reactor at the VCSNS site. The bases for analyses of postulated accidents for this design are well established because they have been considered as part of the NRC's reactor design certification process. Potential consequences of DBAs are evaluated by following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions. The source terms for the AP1000 reactor and methods for evaluating potential accidents are based on guidance in Regulatory Guide 1.183 (NRC 2000a).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as relative concentration (χ/Q; units of s/m^3). Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983).

Table 5-15 lists χ/Q values pertinent to the environmental review of DBAs for the proposed VCSNS site. Smaller χ/Q values are associated with greater dilution capability. The first column lists the time periods and boundaries for which χ/Q and dose estimates are needed. For the exclusion area boundary, the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term period (i.e., 2 hours), and for the low-population zone, they are calculated for the course of the accident (i.e., 30 days composed of four time periods). The second column lists the χ/Q values for the SCE&G's site (SCE&G 2010a); these values are calculated at the exclusion area boundary and low-population zone using 2 years of meteorological data (January 1, 2007 through December 31, 2008) for the SCE&G site. A ground-level release was defined to occur at any point on the periphery of a circular area that encompassed the shield buildings for proposed Units 2 and 3 (SCE&G 2009p). Building wake effects were not taken into account (SCE&G 2010a), thereby resulting in more conservative (higher) estimates of χ/Q.

Table 5-15. Atmospheric Dispersion Factors for the VCSNS Site DBA Calculations

Time Period and Boundary	χ/Q (s/m^3)
0 to 2 hr, exclusion area boundary	9.46×10^{-5}
0 to 8 hr, low-population zone	1.07×10^{-5}
8 to 24 hr, low-population zone	8.67×10^{-6}
1 to 4 d, low-population zone	5.52×10^{-6}
4 to 30 d, low-population zone	2.89×10^{-6}

Source: SCE&G 2010a

The NRC staff reviewed the meteorological data used by SCE&G and the method used to calculate the atmospheric dispersion factors. Based on these reviews, the NRC staff concludes that the atmospheric dispersion factors for the VCSNS site are acceptable for use in evaluating potential environmental consequences of postulated DBAs for the AP1000 reactor design at the VCSNS site.

Table 5-16 lists the set of DBAs considered by SCE&G and presents NRC staff estimates of the environmental consequences of each accident in terms of total effective dose equivalent (TEDE). TEDE is estimated by the sum of the committed effective dose equivalent from inhalation and the effective dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988) were used to calculate the committed effective dose equivalent. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993) were used to calculate the effective dose equivalent.

The NRC staff reviewed SCE&G's selection of DBAs by comparing the accidents listed in the COL application with the DBAs considered in Revision 17 of the AP1000 DCD, which is currently in the design-certification process. The DBAs in the ER are the same set as those considered in this design certification, therefore the NRC staff concludes that the set of DBAs is appropriate.

There are no environmental criteria related to the potential consequences of DBAs. Consequently, the review criteria used in the NRC staff's safety review of DBA doses are included in Table 5-16 to illustrate the magnitude of the calculated environmental consequences (TEDE doses). In all cases, the calculated TEDE values are considerably smaller than the TEDE doses used as safety review criteria.

Table 5-16. DBA Doses for an AP1000 Reactor for Proposed VCSNS Units 2 and 3

Accident	Standard Review Plan Section[b]	TEDE in rem[a]		
		EAB[c]	LPZ[d]	Review Criterion
Main steam line break	15.1.5			
Pre-existing iodine spike		9.5×10^{-2}	1.9×10^{-2}	$2.5 \times 10^{+1}$ (e)
Accident-initiated iodine spike		1.0×10^{-1}	5.2×10^{-2}	$2.5 \times 10^{+0}$ (f)
Steam generator tube rupture	15.6.3			
Pre-existing iodine spike		2.1×10^{-1}	2.7×10^{-2}	$2.5 \times 10^{+1}$ (e)
Accident-initiated iodine spike		1.0×10^{-1}	1.8×10^{-2}	$2.5 \times 10^{+0}$ (f)
Loss-of-coolant accident	15.6.5	$4.6 \times 10^{+0}$	$1.1 \times 10^{+0}$	$2.5 \times 10^{+1}$ (e)
Rod ejection	15.4.8	3.4×10^{-1}	1.2×10^{-1}	$6.25 \times 10^{+0}$ (f)
Reactor coolant pump rotor seizure (locked rotor)	15.3.3			
No feedwater		7.6×10^{-2}	8.3×10^{-3}	$2.5 \times 10^{+0}$ (f)
Feedwater available		5.7×10^{-2}	1.7×10^{-2}	$2.5 \times 10^{+0}$ (f)
Failure of small lines carrying primary coolant outside containment	15.6.2	2.0×10^{-1}	2.2×10^{-2}	$2.5 \times 10^{+0}$ (f)
Fuel handling	15.7.4	4.9×10^{-1}	5.5×10^{-2}	$6.25 \times 10^{+0}$ (f)

(a) To convert rem to Sv, divide by 100.
(b) NUREG-0800 (NRC 2007)
(c) EAB = exclusion area boundary.
(d) LPZ = low-population zone.
(e) 10 CFR 52.79(a)(1) and 10 CFR 100.21 criteria.
(f) Standard Review Plan criterion.

Summary of DBA Impacts

The NRC staff reviewed the DBA analysis in the ER, which is based on analyses performed for design certification of the AP1000 reactor design with adjustment for VCSNS site-specific characteristics. The NRC staff also performed its own independent DBA analysis. The results of the SCE&G and the NRC staff analyses indicate that the environmental consequences associated with DBAs, if an AP1000 reactor were to be located at the VCSNS site, would be small. On this basis, the NRC staff concludes that the environmental consequences of DBAs at the VCSNS site would be SMALL for an AP1000 reactor.

5.11.2 Severe Accidents

In its ER, SCE&G considers the potential consequences of severe accidents for an AP1000 reactor at the VCSNS site. Three pathways are considered: (1) the atmospheric pathway, in which radioactive material is released to the air, (2) the surface-water pathway, in which airborne radioactive material falls out on open bodies of water, and (3) the groundwater pathway, in which groundwater is contaminated by a basemat melt-through with subsequent contamination of surface water by the groundwater.

SCE&G's consequence assessment is based on the probabilistic risk assessment (PRA) for Revision 15 of the AP1000 design (Westinghouse 2005), which is certified in 10 CFR Part 52, Appendix D. Westinghouse subsequently upgraded and updated the PRA model; however, Westinghouse reviewed the AP1000 PRA report submitted with Revision 15 of the DCD and concluded that the reported results and insights remain valid for proposed revisions of the DCD (Westinghouse 2010). The NRC staff evaluated the current PRA model and its results using "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications" (DC/COL-ISG-3; NRC 2008a), and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. SCE&G is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects the PRA to be site-specific and that it will no longer use the bounding assumptions of the design-specific PRA.

The SCE&G evaluation (SCE&G 2010a) of the potential environmental consequences for the atmospheric and surface-water pathways incorporates the results of the Melcor Accident Consequence Code System (MACCS2) computer code Version 1.13 (Chanin and Young 1997) using AP1000 reactor source-term information and site-specific meteorological, population, and land-use data. SCE&G provided the NRC with copies of the input and output files for the MACCS2 computer code runs (SCE&G 2009q). The NRC staff reviewed the input and output files, ran confirmatory calculations, and determined that SCE&G's results are reasonable.

The MACCS computer code was developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG-1150 (NRC 1990). The MACCS2 code evaluates the consequences of atmospheric releases of material following a severe accident. The pathways modeled include exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and resuspended from the ground, and ingestion of contaminated food and surface water.

Three types of severe accident consequences were assessed in the MACCS2 analysis: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS2 estimates both early cancer fatalities and latent fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure (Jow et al. 1990).

Latent fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates are based on the population distribution within a 50-mi radius of the site. Economic costs of a severe accident include the costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination following a severe accident. Farmland decontamination is an estimate of the area that has an average whole body dose rate for the 4-year period following the release that would be greater than 0.5 rem/yr if not reduced by decontamination and that would have a dose rate following decontamination of less than 0.5 rem/yr. Decontaminated land is not necessarily suitable for farming.

Risk is the product of the probability and the consequences of an accident. For example, the probability of a severe accident without loss of containment for an AP1000 reactor at the VCSNS site is estimated to be 2.2×10^{-7}/Ryr, and the cumulative population dose associated with a severe accident without loss of containment at the VCSNS site is calculated to be $5.91 \times 10^{+3}$ person-rem. The population dose risk for this class of accidents is the product of 2.2×10^{-7}/Ryr and $5.91 \times 10^{+3}$ person-rem, or 1.30×10^{-3} person-rem/Ryr. The following sections discuss the estimated risks associated with each pathway.

The risks presented in the tables that follow are risks per year of reactor operation. SCE&G plans to build two AP1000 reactors on the VCSNS site. The consequences of a severe accident would be the same regardless of whether one or two AP1000 reactors were built at the VCSNS site. However, if two AP1000 reactors were built, the risks would apply to each reactor, and the total risk for the two new reactors at the site would be double the risk for a single reactor. A discussion of these risks is presented in the following sections.

5.11.2.1 Estimated Risks of Releases to the Air Pathway

The MACCS2 code directly estimates consequences associated with releases to the air pathway. The risks calculated from the results of the MACCS2 runs are presented in Table 5-17 (SCE&G 2010a). The core damage frequencies (CDFs) given in these tables are for internally initiated accident sequences while the plant is at power. Internally initiated accident sequences include sequences that are initiated by human error, equipment failures, loss of offsite power, etc. Estimates of the CDFs for externally initiated events and during shutdown are discussed later.

Table 5-17 shows that the risks of severe accidents for an AP1000 reactor located on the VCSNS site are small for all risk categories considered. For perspective, Table 5-18 and Table 5-19 compare the health risks from severe accidents for an AP1000 reactor at the VCSNS site with the risks for current-generation reactors at various sites and with an AP1000 reactor at the North Anna, Clinton, Grand Gulf, and Vogtle Early Site Permit sites. Table 5-19 also provides the CDFs and population dose risk for the existing Unit 1 reactor at the VCSNS site.

In Table 5-18, the health risks estimated for an AP1000 reactor at the VCSNS site are compared with health-risk estimates for the five reactors considered in NUREG-1150 (NRC 1990). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG-1150, only risks associated with internally initiated events are presented in Table 5-18. Table 5-18 also compares health risks of an AP1000 reactor at the VCSNS site with health risks for an AP1000 reactor at four Early Site Permit sites (NRC 2006a, b, c, 2008b).

The last two columns of Table 5-18 provide average individual fatality risk estimates. To put these estimates into context for the environmental analysis, the NRC staff compares these estimates to the safety goals. The Commission has set safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents in the Safety Goal Policy Statement (51 FR 30028). These goals are presented here solely to provide a point of reference for the environmental analysis and do not serve the purpose of a safety analysis. The Policy Statement expressed the Commission's policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows (51 FR 30028):

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.
- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

Table 5-17. Mean Environmental Risks from an AP1000 Reactor Severe Accident at the VCSNS Site

			Environmental Risk					
				Fatalities (per Ryr)				
Release Category Description (Accident Class)		Core Damage Frequency (per Ryr)	Population Dose (person-rem/Ryr)(a)	Early(b)	Latent(c)	Cost(d) ($/Ryr)	Farm Land Decontamination(e) (ac/Ryr)	Population Dose from Water Ingestion (person-rem/Ryr)(a)
IC	Intact containment	2.2×10^{-7}	1.3×10^{-3}	$0.0 \times 10^{+0}$	7.8×10^{-7}	1.5×10^{-1}	2.5×10^{-6}	1.0×10^{-5}
BP	Containment bypass, fission products released directly to environment	1.1×10^{-8}	8.1×10^{-2}	2.2×10^{-8}	5.0×10^{-5}	$2.2 \times 10^{+2}$	2.5×10^{-3}	5.4×10^{-3}
CI	Containment isolation failure occurs prior to onset of core damage	1.3×10^{-9}	3.0×10^{-3}	1.7×10^{-10}	1.8×10^{-6}	$7.1 \times 10^{+0}$	1.1×10^{-4}	1.1×10^{-4}
CFE	Early containment failure, after onset of core damage but before core relocation	7.5×10^{-9}	1.8×10^{-2}	1.4×10^{-9}	1.1×10^{-5}	$4.4 \times 10^{+1}$	6.1×10^{-4}	8.2×10^{-4}
CFI	Intermediate containment failure, after core relocation but before 24 hours	1.9×10^{-10}	6.1×10^{-4}	1.0×10^{-11}	3.7×10^{-7}	$1.7 \times 10^{+0}$	3.1×10^{-5}	1.1×10^{-5}
CFL	Late containment failure occurring after 24 hours	3.5×10^{-13}	1.6×10^{-6}	$0.0 \times 10^{+0}$	9.7×10^{-10}	5.6×10^{-3}	7.4×10^{-8}	2.3×10^{-9}
Total		2.4×10^{-7}	1.0×10^{-1}	2.4×10^{-8}	6.4×10^{-5}	$2.7 \times 10^{+2}$	3.2×10^{-3}	6.4×10^{-3}

Source: SCE&G 2010a

(a) To convert person-rem to person-Sv, divide by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).
(c) Latent fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990).
(e) Land risk is the area where the average whole body dose rate for the 4-year period following the accident exceeds 0.5 rem/yr but can be reduced to less than 0.5 rem/yr by decontamination.

Table 5-18. Comparison of Environmental Risks for an AP1000 Reactor at the VCSNS Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG-1150[(a)] and the AP1000 at Four Early Site Permit Sites

Site	Core Damage Frequency (per Ryr)	50-mi Population Dose Risk (person-rem/Ryr)[(b)]	Fatalities (per Ryr)		Average Individual Fatality Risk (per Ryr)	
			Early	Latent	Early	Latent Cancer
Grand Gulf[(c)]	4.0×10^{-6}	$5 \times 10^{+1}$	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom[(c)]	4.5×10^{-6}	$7 \times 10^{+2}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah[(c)]	5.7×10^{-5}	$1 \times 10^{+3}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry[(c)]	4.0×10^{-5}	$5 \times 10^{+2}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion[(c)]	3.4×10^{-4}	$5 \times 10^{+3}$	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
AP1000[(d)] Reactor at the VCSNS site	2.4×10^{-7}	1.0×10^{-1}	2.4×10^{-8}	6.4×10^{-5}	1.4×10^{-10}	3.5×10^{-12}
AP1000[(e)] Reactor at North Anna	2.4×10^{-7}	8.3×10^{-2}	1.2×10^{-10}	4.0×10^{-5}	2.6×10^{-13}	4.9×10^{-11}
AP1000[(f)] Reactor at Clinton	2.4×10^{-7}	2.2×10^{-2}	1.4×10^{-8}	1.2×10^{-5}	6.4×10^{-13}	5.5×10^{-11}
AP1000[(g)] Reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-2}	$< 1.0 \times 10^{-12}$	6.9×10^{-6}	$<1.0 \times 10^{-14}$	2.0×10^{-11}
AP1000[(h)] Reactor at Vogtle	2.4×10^{-7}	2.8×10^{-2}	1.9×10^{-10}	1.9×10^{-5}	1.6×10^{-12}	1.1×10^{-11}

(a) NRC (1990)
(b) To convert person-rem to person-Sv, divide by 100.
(c) Risks were calculated using the MACCS code and presented in NUREG-1150 (NRC 1990).
(d) ER (SCE&G 2010a)
(e) NUREG-1811 (NRC 2006a)
(f) NUREG-1815 (NRC 2006b)
(g) NUREG-1817 (NRC 2006c)
(h) NUREG-1872 (NRC 2008b)

Table 5-19. Comparison of Environmental Risks from Severe Accidents Initiated by Internal Events for an AP1000 Reactor at the VCSNS Site with Risks Initiated by Internal Events for Current Plants Undergoing Operating License Renewal Review and Environmental Risks of the AP1000 Reactor at Other Sites

	Core Damage Frequency (per year)	**50-mi Population Dose Risk (person-rem/Ryr)[(a)]**
Current reactor maximum[(b)]	2.4×10^{-4}	$6.9 \times 10^{+1}$
Current reactor mean[(b)]	2.7×10^{-5}	$1.6 \times 10^{+1}$
Current reactor median[(b)]	1.6×10^{-5}	$1.3 \times 10^{+1}$
Current reactor minimum[(b)]	1.9×10^{-6}	3.4×10^{-1}
VCSNS Unit 1 (Existing Reactor)[(c)]	5.6×10^{-5}	$1.0 \times 10^{+0}$
AP1000[(d)] reactor at VCSNS	2.4×10^{-7}	1.0×10^{-1}
AP1000[(e)] reactor at North Anna	2.4×10^{-7}	8.3×10^{-2}
AP1000[(f)] reactor at Clinton	2.4×10^{-7}	2.2×10^{-2}
AP1000[(g)] reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-2}
AP1000[(h)] reactor at Vogtle	2.4×10^{-7}	2.8×10^{-2}

(a) To convert person-rem to person-Sv, divide by 100.
(b) Based on MACCS and MACCS2 calculations for 76 current-generation plants at 44 sites.
(c) NUREG-1437 Supplement 15 (NRC 2004a)
(d) Calculated with MACCS2 code using VCSNS site-specific input.
(e) NUREG-1811 (NRC 2006a)
(f) NUREG-1815 (NRC 2006b)
(g) NUREG-1817 (NRC 2006c)
(h) NUREG-1872 (NRC 2008b)

The following quantitative health objectives are used when determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.
- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all “other accidents to which members of the U.S. population are generally exposed” is about 4.0×10^{-4}/yr, including a 1.6×10^{-4}/yr risk associated with transportation accidents (NSC 2006). One-tenth of 1 percent of these figures implies that the individual risk of prompt fatality from a reactor accident should be less than 4×10^{-7}/Ryr.

- "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the United States, which is about 1 in 500 or 2×10^{-3}/yr (Reed 2007). One-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant because of its operation should be limited to 2×10^{-6}/Ryr.

MACCS2 calculates average individual early and latent cancer fatality risks. The average individual early fatality risk is calculated using the population distribution within 1 mi of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 10 mi of the plant. For the plants considered in NUREG-1150, these risks were well below the Commission's safety goals. Risks calculated by SCE&G for the AP1000 reactor design at the VCSNS site are also well below the Commission's safety goals.

The NRC staff compared the CDF and population dose risk estimate for an AP1000 reactor at the VCSNS site with statistics summarizing the results of severe accident analyses performed for 76 current-generation reactors at 44 sites. The results of these analyses are included in the final site-specific Supplements 1 through 30 to the NUREG-1437 (NRC 1996), and in the ERs included with license renewal applications for the plants for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150 (NRC 1990) and the analyses for 72 of the reactors used MACCS2, which was released in 1997. Table 5-17 shows that the CDF estimated for the AP1000 reactor is significantly lower than those of current-generation reactors. Similarly, the population doses estimated for a Westinghouse AP1000 reactor at the VCSNS site are well below the mean and median values for current-generation reactors undergoing license renewal and an order of magnitude lower than the existing VCSNS Unit 1 reactor.

Finally, the population dose risk from a severe accident for an AP1000 reactor at the VCSNS site, 1.0×10^{-1} person-rem/Ryr, may be compared with the dose risk for normal operation of a single AP1000 reactor at the VCSNS site, 5.8×10^{0} person-rem/Ryr (SCE&G 2010a); comparatively, the population dose risk for a severe accident is small.

5.11.2.2 Estimated Risks of Releases to Surface-Water Pathways

Surface-water dose pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water and include ingestion of water and aquatic foods as well as water submersion and activities occurring near the water. Of these surface-water pathways, the MACCS2 code evaluates the ingestion of contaminated water. The risks associated with this pathway were calculated for the VCSNS site and are included in the last column of Table 5-17. The water-ingestion dose risk of about 6.4×10^{-3} person-rem/Ryr is small compared with the total dose risk of 1.0×10^{-1} person-rem/Ryr.

The Broad River and Monticello Reservoir are used for fishing as well as other general recreational activities, such as swimming and boating. Doses from these surface-water pathways are not modeled in MACCS2. Population exposure risk from aquatic food ingestion was considered in NUREG-1437 for license renewals of current-generation reactors (NRC 1996). In the analysis, nuclear plants were categorized as being sited on an estuary, one of the Great Lakes, a small river, or a large river. Exposure risk was then compared with that of the Fermi plant, located on Lake Erie, for which an analysis of an uninterdicted dose had been completed (NRC 1981). For the purpose of evaluating the surface-water pathway, the existing VCSNS site was classified as being on a small river (NRC 1996). For small river sites, the population dose from the aquatic food pathway was well below the population dose from the air pathway. Analysis of water-related exposure pathways at the Fermi reactor (NRC 1981) suggests that population exposures from swimming are significantly lower than exposures from the aquatic food pathway. If a severe accident occurred at an AP1000 reactor located at the VCSNS site, Federal, State, and local officials would likely restrict access to affected water areas. These interdiction actions would further reduce potential surface-water pathway exposures. Therefore, the NRC staff concludes that the population dose risk from surface-water pathways at the VCSNS site likely would be a small fraction of the air pathway risk.

5.11.2.3 Estimated Risks of Releases to the Groundwater Pathway

The groundwater pathway involves a reactor core melt, reactor vessel failure, and penetration of the floor (basemat) below the reactor vessel. Ultimately, core debris reaches groundwater where soluble radionuclides are transported with the groundwater. In the NUREG-1437 (NRC 1996), the NRC staff assumed that the probability of a severe accident with basemat penetration was 1×10^{-4}/Ryr and concluded that the groundwater contribution to risk is generally a small fraction of the risk attributable to the atmospheric pathway. The SCE&G ER (SCE&G 2010a) summarizes the discussion in NUREG-1437 and reaches the same conclusion.

The NRC staff has re-evaluated its assumption of a 1×10^{-4} Ryr^{-1} probability of a basemat melt-through. The NRC staff believes that the 1×10^{-4} probability is too large for new power stations. Design elements have been included in the AP1000 design to minimize the potential for reactor core debris to reach groundwater. These elements include external reactor vessel cooling and ex-vessel core debris cooling. Furthermore, the probability of core melt with basemat melt-through should be no larger than the total CDF estimate for the reactor. Table 5-17 gives a total CDF estimate of 2.4×10^{-7} Ryr^{-1} for an AP1000 reactor. NUREG-1150 indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. If the CDF for AP1000 severe accidents in which containment remains intact are subtracted from the total AP1000 CDF to get the CDF for severe accidents in which basemat melt-through is a possibility, the CDF is on the order of 2×10^{-8}/Ryr. On this basis, the NRC staff believes that a basemat melt-through probability of 2×10^{-8}/Ryr is reasonable and still conservative.

The groundwater pathway is more tortuous and affords more time for implementing protective actions than the atmospheric pathway and, therefore, results in a lower risk to the public. As a result, the NRC staff concludes that the risks associated with releases to groundwater are low and that they would not have a significant effect on the overall plant risk.

5.11.2.4 Estimated Risks of Releases Related to External Events

The analyses described above are specifically for internally initiated events. The AP1000 reactor vendor and the NRC staff have addressed three externally initiated events during design certification of the AP1000 reactor: seismic, internal fire, and internal flooding events. The analyses are described Section 19.1.5 of the Final Safety Evaluation Report (FSER) for the AP1000 reactor (NRC 2004b).

With respect to seismic events, the AP1000 reactor vendor performed a PRA-based seismic margin analysis. This analysis indicated that there is a high confidence (95 percent) that safety systems and components would survive a 0.5-g peak acceleration during a seismic event. The safe-shutdown earthquake for the AP1000 reactor design is 0.3 g. Consequently, the NRC staff concluded in the FSER that the AP1000 reactor design is acceptable (NRC 2004b).

With respect to internal fires, the AP1000 reactor vendor estimated the fire-induced CDFs to be about 5.6×10^{-8}/yr during power operation and about 8×10^{-8}/yr during shutdown, and the vendor considers these estimates to be conservative. While the staff believes that such a conclusion is not possible without a detailed PRA, the NRC staff, in its safety review, did conclude that the AP1000 reactor design is capable of withstanding severe accident challenges from internal fires in a manner superior to most, if not all, operating plant designs (NRC 2004b).

With respect to internal flooding, the AP1000 reactor vendor did not perform a detailed PRA to assess the risk from internal flooding. Instead, the vendor performed an internal flooding PRA commensurate with the level of detail available and, where detailed information was not available, made conservative assumptions to bound the flooding analysis. In its safety review, the NRC staff found that this analysis was adequate to identify potential vulnerabilities and to provide insight into the design that could be used to support design certification requirements. Quantification of potential scenarios with the plant at power resulted in a total CDF from internal floods of about 1×10^{-9}/yr. The CDF from internal floods when the plant is shutdown is estimated to be about 3.2×10^{-9}/yr. The vendor considers these estimates to be conservative. While the staff believes that such a conclusion is not possible without a detailed PRA, the NRC staff, in its safety review, did conclude that the AP1000 reactor design is capable of withstanding severe accident challenges from internal floods in a manner superior to operating plants and is consistent with the conclusions from the vendor's internal flood risk analysis (NRC 2004b).

5.11.3 Summary of Severe Accident Impacts

The SCE&G application refers to proposed Revision 17 of the AP1000 reactor certified design (10 CFR Part 52, Appendix D). The consequence assessment is based on the PRA for Revision 15 of the AP1000 design (Westinghouse 2005), which is certified in 10 CFR Part 52, Appendix D. Westinghouse subsequently upgraded and updated the PRA; however, Westinghouse reviewed the AP1000 PRA report submitted with Revision 15 of the DCD and concluded that the reported results and insights remain valid for proposed revisions of the DCD (Westinghouse 2010). The NRC staff evaluated the current PRA model and its results using DC/COL-ISG-3 (NRC 2008a), "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications," and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. SCE&G is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects the PRA to be site-specific and that it will no longer use the bounding assumptions of the design-specific PRA. The NRC staff concludes it is unlikely that the PRA would change sufficiently to cause the staff to materially change its conclusions related to severe accident risks.

The NRC staff reviewed the risk analysis in the ER and conducted a confirmatory analysis of the probability-weighted consequences of severe accidents for the proposed VCSNS Units 2 and 3 using the MACCS2 code. The results of both the SCE&G analysis and the NRC analysis indicate that the environmental risks associated with severe accidents if an AP1000 reactor were to be located at the VCSNS site would be small compared with risks associated with operation of the current-generation reactors at the VCSNS site and other sites. These risks are within the Commission's safety goals. On these bases, the NRC staff concludes that the probability-weighted consequences of severe accidents at the VCSNS site would be SMALL for an AP1000 reactor.

5.11.4 Severe Accident Mitigation Alternatives

The purpose of the evaluation of severe accident mitigation alternatives (SAMAs) is to determine whether there are severe accident mitigation design alternatives (SAMDAs), procedural modifications, or training activities that can be justified to further reduce the risks of severe accidents (NRC 2000a). SCE&G based its COL application on the AP1000 reactor design (see Appendix D of 10 CFR Part 52, Design Certification Rule for the AP1000 Design), which incorporates many features intended to reduce severe accident CDFs and the risks associated with severe accidents. The effectiveness of the AP1000 reactor design features is evident in Table 5-18 and Table 5-19, which compare CDFs and severe-accident risks for the AP1000 reactor with CDFs and risks for current-generation reactors. The CDFs and risks have been reduced considerably when compared with current-generation reactors.

Consistent with the direction from the Commission to consider the SAMDAs at the time of certification, the AP1000 reactor vendor (Westinghouse 2005) and the NRC staff (NRC 2004b, 2005a) considered a number of design alternatives for an AP1000 reactor at a generic site. The conclusion of the NRC staff's review was

> …that none of the potential design modifications evaluated are justified on the basis of benefit-cost considerations. The NRC further concludes that it is unlikely that any other design changes would be justified in the future on the basis of person–rem exposure because the estimated CDFs are very low on an absolute scale.

Westinghouse reviewed the AP1000 PRA for Revision 15 and concluded that the PRA remains valid for a proposed revision of the DCD (Westinghouse 2010); this is unchanged for Revision 17. Furthermore, the NRC staff evaluated the current PRA using DC/COL-ISG-3 (NRC 2008a), "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications," and concluded that the PRA submitted with Revision 15 is a conservative and acceptable basis for evaluating severe accidents and strategies for mitigating them. Therefore, the NRC staff considers the PRA for DCD Revision 15 to be an adequate basis for a SAMDA analysis for an application referencing DCD Revision 17. Consequently, the NRC staff incorporates by reference the environmental assessment accompanying the design certification rulemaking for Appendix D to 10 CFR Part 52 (NRC 2005b).

Section 5.11.2 of this chapter presents the environmental risks from various classes of severe accidents for the VCSNS site. Site-specific information appears in SAMDA evaluations as population dose risk (person-rem/Ryr) and offsite economic costs ($/Ryr). The NRC staff considers these two elements to be the appropriate metrics to use to determine if the site characteristics are bounded by the site parameters in the DCD because they are calculated from site-specific meteorology, population distribution, and land-use data. Appendix 1B of the AP1000 DCD lists the population dose risk (person-rem/Ryr) used in the DCD generic SAMDA review. While it does not specifically list the offsite economic costs, it does include a maximum attainable benefit that considers offsite economic costs, onsite exposure costs, onsite cleanup costs, and replacement power costs in addition to the cost associated with the offsite population dose risk. To perform a like-kind comparison, the NRC staff used the maximum attainable benefit cost for the VCSNS site characteristic. The probability-weighted, mean population dose risks derived from Table 1B-1 and the base case maximum attainable benefit listed in Table 1B-4 are the metrics used by the NRC staff to determine whether the VCSNS site characteristics are within the site parameters specified in Appendix 1B of the AP1000 DCD.

Table 5-20 presents the comparison of the VCSNS site-specific values (SCE&G 2010a) with the generic values from Appendix 1B of the AP1000 DCD (Westinghouse 2008). Table 5-20 shows that the population dose risk for the proposed VCSNS site is about 2.3 times larger than that listed in DCD Appendix 1B, while the maximum attainable benefit for the VCSNS site is roughly

1.5 times greater than the DCD Appendix 1B value. Potential design modifications were examined further to determine if they would be cost beneficial in reducing risk at the VCSNS site.

Table 5-20. Comparison of VCSNS SAMDA Site Characteristics with Site Parameters Specified in AP1000 DCD, Appendix 1B

	Population Dose Risk, person-rem/Ryr	Maximum Attainable Benefit
DCD Appendix 1B (internal events)[(a)]	4.3×10^{-2}	$21,000
VCSNS site (internal events)[(b)]	1.0×10^{-1}	$32,000
Ratio of VCSNS site-specific value to DCD value	2.3	1.52

(a) AP1000 DCD Appendix 1B (Westinghouse 2008)
(b) ER (SCE&G 2010a)

The generic AP1000 SAMDA analysis is presented in Appendix 1B of the DCD (Westinghouse 2008, Appendix 1B). Design alternatives considered by Westinghouse and their estimated implementation costs are presented in Table 5-21 (Westinghouse 2008). In the base-case analysis, the benefit-cost methodology of NUREG/BR-0184 (NRC 1997) is used to calculate the maximum attainable benefit. The analysis assumes that the implementation of the design alternative completely eliminates all potential for core damage. For the AP1000, the maximum attainable benefit was valued at $21,000 (Westinghouse 2008). Only one design alternative in Table 5-21 – the self-actuating containment isolation valves – has a cost ($33,000) that is comparable to the maximum attainable benefit. To evaluate the benefit of this SAMDA, the design change was assumed to eliminate the Containment Isolation severe accident release category, which is only a small contributor to the total CDF. Therefore, this design alternative provides almost no benefit in reducing the AP1000 CDF.

The SCE&G ER (SCE&G 2010a) updates the SAMDA analysis conducted for AP1000 design certification using the results of the VCSNS site-specific consequence analysis (MACCS2) that are discussed in Section 5.11.2. The results of the SCE&G analysis indicate that the maximum attainable benefit, if the total risk for internal events for the VCSNS site could be reduced to zero, has a value of approximately $32,000 (SCE&G 2010a). Similar to the finding in the AP1000 DCD SAMDA analysis, only the self-actuating containment isolation valves design alternative (Table 5-21) has a value comparable to the maximum attainable benefit for the VCSNS site.

Table 5-21. Design Alternatives Considered for SAMDA in the AP1000 DCD

No.	Design Alternative	Cost ($)
1	Upgrade chemical, volume, and control system for small loss-of-coolant accident (LOCA)	1,500,000
2	Containment filtered vent	5,000,000
3	Self-actuating containment isolation valves	33,000
4	Safety grade passive containment spray	3,900,000
6	Steam generator shell-side heat removal	1,300,000
7	Steam generator relief flow to in-containment refueling water storage tank (IRWST)	620,000
8	Increased steam generator pressure capability	8,200,000
9	Secondary containment ventilation with filtration	2,200,000
10	Diverse IRWST injection valves	570,000
12	Ex-vessel core catcher	1,660,000
13	High-pressure containment design	50,000,000
14	More reliable diverse actuation system	470,000

Source: Westinghouse 2008

Table 5-17, which lists the mean environmental risks from an AP1000 reactor severe accident at the VCSNS site, shows that the containment isolation severe accident category only contributes a small fraction to the total population dose and cost risk (approximately 3 percent each) at the VCSNS site. Assuming that implementation of the self-actuating containment isolation valves completely eliminates the risks associated with this release category, then the value of the reduction in risk would only be about $960. Thus, the site-specific SAMDA review conducted by SCE&G confirms the results of the design certification SAMDA review. Although the dose risk for the VCSNS site exceeds the DCD value, the site-specific SAMDA analysis for the VCSNS site shows that the resulting design alternative (self-actuating containment isolation valves) would only reduce this total risk by a small fraction. The next lowest cost design alternative has more than an order-of-magnitude higher cost than the self-actuating containment isolation valves. On this basis, the NRC staff concludes that, in fact, there are no potential design modifications that are justified on the basis of benefit-cost considerations, and it is unlikely that any other design changes would be justified in the future on the basis of person-rem exposure because the estimated CDFs are very low on an absolute scale.

The PRA upon which the AP1000 and SCE&G severe accident reviews are based was conducted for Revision 15 of the AP1000 design. Westinghouse subsequently upgraded and updated the PRA; however, Westinghouse reviewed the AP1000 PRA report submitted with Revision 15 of the DCD and concluded that the reported results and insights remain valid for proposed revisions of the DCD (Westinghouse 2010). The NRC staff evaluated the current

PRA model and its results using DC/COL-ISG-3 (NRC 2008a), "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications," and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. SCE&G is required by regulation to update the PRA prior to fuel loading. The NRC staff expects the PRA to be site-specific rather than use the bounding assumptions used for the design-specific PRA. The NRC staff considers it unlikely that the PRA would change sufficiently to cause the NRC staff to conclude that any SAMDA considered in the design-certification process would become cost beneficial.

The SAMDA issue is a subset of the SAMA review. The other attributes of the SAMA review, namely procedural modifications and training activities, have not yet been addressed by SCE&G. However, SCE&G has stated (SCE&G 2010a) that risk insights would be considered in the development of plant procedures and training. Because the maximum attainable benefit is so low, a SAMA based on procedures or training for an AP1000 reactor at the VCSNS site would have to reduce the CDF or risk to near zero to become cost beneficial. Based on its evaluation, the staff concludes that it is unlikely that any of the SAMAs based on procedures or training would reduce the CDF or risk that much. Therefore, the staff further concludes it is unlikely that these SAMAs would be cost effective. Additionally, based on statements by SCE&G in the ER (SCE&G 2010a), the staff expects that SCE&G will consider risk insights in the development of procedures and training. However, this expectation is not crucial to the staff's conclusions because the staff already concluded procedural and training SAMAs would be unlikely to be cost effective. Therefore, the NRC staff concludes that SAMAs have been appropriately considered.

5.11.5 Summary of Postulated Accident Impacts

The NRC staff evaluated the environmental impacts from DBAs and severe accidents for an AP1000 reactor at the VCSNS site. Based on the information provided by SCE&G and the NRC's own independent review, the NRC staff concludes that the potential environmental impacts (risks) from a postulated accident from the operation of the proposed VCSNS Units 2 and 3 would be SMALL, and no further mitigation would be warranted.

5.12 Measures and Controls to Limit Adverse Impacts During Operation

In its evaluation of environmental impacts during operation of proposed Units 2 and 3 at the VCSNS site, the review team relied on SCE&G's compliance with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (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 permits or licenses required for operation of the new unit (e.g., USACE's Section 404 Permit, NPDES)
- compliance with existing VCSNS Unit 1 processes and/or procedures applicable to proposed Units 2 and 3 environmental compliance activities for the VCSNS site (e.g., solid waste management, hazardous waste management, and spill prevention and response)
- incorporation of environmental requirements into construction contracts
- implementation of BMPs.

The review team considered these measures and controls in its evaluation of the impacts of plant operation. Table 5-22 lists a summary of measures and controls to limit adverse impacts during operation proposed by SCE&G.

Table 5-22. Summary of Measures and Controls Proposed by SCE&G to Limit Adverse Impacts During Operation of Proposed Units 2 and 3 at the VCSNS Site

Impact Category	Specific Measures and Control
Land-Use Impacts	
The site and vicinity	SCE&G did not propose any additional measures or controls
Transmission-line corridors and offsite areas	• Vegetation maintenance practices within affected corridors would protect sensitive habitats and protected species, including wetlands and water crossings.
Historic properties and cultural resources	• Before site disturbance, conduct archaeological surveys. • Continue to have a fence barrier around Pearson Cemetery. • Continue any applicable mitigation measures for any National Register-eligible sites • USACE management agreement with SHPO and applicants. • Conduct earth-disturbing activities under existing procedures that prescribe actions to be taken in the event that significant archaeological or paleontological artifacts are encountered. • Conduct awareness training for procedures associated with inadvertent discoveries.
Water-related impacts	
Water-use impacts	• Monitor hydrologic impacts as required by NPDES permit.

Table 5-22. (contd)

Impact Category	Specific Measures and Control
Water-quality impacts	• Monitor constituent emissions as required by NPDES permit. • Implement SCE&G's Spill Prevention, Control, and Countermeasure Plan. • Conduct stormwater monitoring as required by stormwater permit.
Future water use	SCE&G did not propose any additional measures or controls
Cooling system impacts	
Intake system:	
Hydrodynamic descriptions and physical impacts	• Design and operate intake structures based on best available technology.
Aquatic ecosystems	• Continue voluntary monitoring program for water quality in Monticello Reservoir.
Discharge system:	
Thermal description and other physical impacts	• Implement planned design that alternates discharge orientation.
Aquatic ecosystems	SCE&G did not propose any additional measures or controls
Terrestrial ecosystems	SCE&G did not propose any additional measures or controls
Impacts on members of the public	• No mitigation for noise will be required. • Control personnel and public access to the cooling towers by administrative controls and security patrols. Implement procedure to reduce the risk associated with exposure to thermophilic microorganisms by providing work practices and personal protective equipment to eliminate routes of exposure to thermophilic microorganisms that may produce illnesses.
Radiological impacts of normal operation	
Exposure pathways	• Implement radiological monitoring program as required.
Radiation doses to members of the public	• Conduct radiological monitoring program as required.
Impacts on members of the public	• Conduct meteorological monitoring.
Impacts on biota other than members of the public	• Conduct radiological monitoring program as required.
Environmental impact of waste	
Nonradioactive waste system impacts	• All discharges would comply with NPDES permit and applicable water-quality standards. • Implement existing VCSNS waste-minimization program at new units.
Mixed waste impacts	• Implement existing VCSNS waste-minimization program at new units.

Table 5-22. (contd)

Impact Category	Specific Measures and Control
Waste minimization	• Implement existing VCSNS waste-minimization program at new units.
Radioactive waste	• Implement existing VCSNS waste-minimization program at new units.
Terrestrial ecosystems	• Train personnel in the handling of fuel and lubricants and the cleanup and reporting of any incidental spills. • Have adequate spill response equipment on hand during maintenance activities in the corridors. • Maintenance practices would protect sensitive habitats and protected species, including wetland and water crossings.
Aquatic ecosystems	• Implement existing SCE&G and Santee Cooper procedures intended to prevent impacts on water quality and be protective of wetlands and stream crossings, including restriction of heavy equipment to prevent erosion, use of approved herbicides only, and spill-prevention practices when fueling or lubricating equipment.
Impacts on members of the public	• Build new transmission lines to national electrical standards to limit shock from induced currents.
Socioeconomic impacts	
Physical impacts of proposed units	• Pave access roads and set speed limits for vehicle traffic to minimize noise impacts.
Social and economic impacts of proposed units	• Stagger outage schedules to minimize traffic congestion. • Before the start of Unit 2 operation, develop an operations management traffic plan. • Minimize the visual impact of the structures through use of topography, design, materials, and color.
Environmental justice	• No mitigation would be required.
Decommissioning	
Decommissioning	• Continue applicable mitigation measures used during the operations period for decommissioning activities or for transportation of waste and materials to disposal sites. • SCE&G would assure that adequate funding for decommissioning would be available.
Transportation of radioactive waste	
Transportation of radioactive waste	• No mitigation would be required.
Nonradiological health impacts	
Nonradiological health impacts	• Implement existing SCE&G industrial safety program at Units 2 and 3.

5.13 Summary of Operational Impacts

The review team's evaluation of the environment impacts of operations is summarized in Table 5-23. Impact level categories are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts, if any. With the socioeconomic issues for which the impacts are likely to be beneficially MODERATE or LARGE, this is noted in the Comments column.

Table 5-23. Characterization of Operational Impacts at the VCSNS Site

Category	Comments	Impact Level
Land-use impacts		SMALL
The site and vicinity	Operational activities would have minimal impact on land use on the site.	SMALL
Transmission-line corridors	Operational activities would have minimal impact on land use on or along transmission-line corridors.	SMALL
Water-related impacts		SMALL
Water use	Operational activities would have negligible impacts on groundwater availability and small impacts on surface-water availability.	SMALL
Water quality	Operational activities would have negligible impacts on surface and groundwater quality.	SMALL
Ecological impacts		SMALL
Terrestrial and wetland ecosystems	Operational activities would have minimal impact on terrestrial and wetland ecological resources and habitat.	SMALL
Aquatic ecosystems	Operational activities would have minimal impact on aquatic ecological resources and habitat.	SMALL
Socioeconomic impacts		SMALL to LARGE (beneficial)
Physical impacts	Operational activities would have negligible physical impacts.	SMALL
Demography	Operational activities would have minimal demographic characteristics of the vicinity and region.	SMALL
Economic impacts on the community	Operational activities would have substantial tax revenue impacts in Fairfield County.	LARGE (beneficial)

Table 5-23. (contd)

Category	Comments	Impact Level
Infrastructure and community service	Operational activities would have negligible impacts on local and regional transportation networks, recreation resources, housing, public services, or education.	SMALL
Environmental justice		SMALL
Health and physical impacts	No disproportionate and adverse health or physical impacts to low-income and minority populations would be expected from operations	SMALL
Socioeconomic	No disproportionate and adverse impacts on any minority or low-income population would be expected from operations	SMALL
Subsistence and special conditions	No disproportionate and adverse impacts on any minority or low-income population would be expected from operations	SMALL
Historic and cultural resources	Operational activities would have minimal impact on historic and cultural resources.	SMALL.
Meteorological and Air-Quality Impacts		SMALL
Cooling towers	Operational activities would not have a significant meteorological or air quality impacts	SMALL
Air quality	Operational activities would not have a significant meteorological or air quality impacts	SMALL
Transmission lines	Operational activities would not have a significant meteorological or air quality impacts	SMALL
Nonradiological health impacts	Operational activities would not have significant nonradiological health impacts to the public	SMALL
Radiological health impacts		SMALL
Members of public	Operational activities would result in no observable radiological health impacts to the public	SMALL
VCSNS workers	Occupational doses to workers would be within regulatory limits	SMALL
Biota other than humans	Doses to terrestrial and aquatic biota would be far below IAEA guidelines	SMALL
Nonradioactive waste impacts	Solid, liquid, gaseous, and mixed wastes generated during operations would be handled according to county, State, and Federal regulations.	SMALL

Table 5-23. (contd)

Category	Comments	Impact Level
Impacts of postulated accidents		SMALL
Design basis accidents	The environmental consequences of DBAs would not be significant	SMALL
Severe accidents	The environmental risks of severe accidents are well below the NRC safety criteria	SMALL

5.14 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection against Radiation."

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

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

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6.0 Fuel Cycle, Transportation, and Decommissioning

This chapter addresses the environmental impacts from (1) the uranium fuel cycle and solid-waste management, (2) the transportation of radioactive material, and (3) the decommissioning of two new nuclear units at the Virgil C. Summer Nuclear Station (VCSNS) site. In its evaluation of uranium fuel-cycle impacts from two new units at the VCSNS site, South Carolina Electric and Gas (SCE&G) used the Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactor design. SCE&G's assessment of fuel-cycle impacts is based on values in Table S–3 in Title 10 of the Code of Federal Regulations (CFR) 51.51(b), which in turn assumes an 80-percent annual capacity factor referenced to a 1000-MW(e) light water reactor (LWR), resulting in 800 MW of electrical output. SCE&G then assumed a 93-percent capacity factor for each of the two new 1200-MW(e) AP1000 reactors and scaled the impact values from Table S–3 by 34 percent (SCE&G 2010). The results reported here apply to the impacts from two AP1000 units, each with the capacity factor of 93 percent assumed by SCE&G.

6.1 Fuel-Cycle Impacts and Solid-Waste Management

This section discusses the environmental impacts from the uranium fuel-cycle and solid-waste management for the AP1000 reactor design. The environmental impacts of this design are evaluated against specific criteria for LWR designs at 10 CFR 51.51.

The regulations in 10 CFR 51.51(a) state the following:

> Under § 51.50, every environmental report prepared for the construction permit stage or Early Site Permit stage or combined license stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S–3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level wastes and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S–3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The AP1000 reactors proposed for Units 2 and 3 at the VCSNS site are light-water-cooled reactors that use uranium dioxide fuel; therefore, Table S–3 (10 CFR 51.51(b)) can be used to assess the environmental impacts of the uranium fuel cycle. Table S–3 values are normalized for a reference 1000-MW(e) LWR at an 80-percent capacity factor. The 10 CFR 51.51(a) Table S–3 values are reproduced in Table 6-1.

Each AP1000 reactor unit is rated at 3400 MW(t) (Westinghouse 2008). Assuming that two AP1000 reactors would be located on the VCSNS site (SCE&G 2010), the power rating for the new units at the VCSNS site would be 6800 MW(t). Each AP1000 reactor unit is rated at 1200 MW(e), of which 93 MW(e) are used for station and auxiliary loads, leaving 1107 MW(e) net electric output when the reactor is operating (Westinghouse 2008). With a capacity factor of 93 percent (SCE&G 2010), each AP1000 unit produces an average of 1070 MW(e). For two AP1000 units, this corresponds to 2140 MW(e).

Specific categories of environmental considerations are included in Table S–3 (see Table 6-1). These categories relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic, high-level waste (HLW) and low-level waste (LLW), and radiation doses from transportation and occupational exposures. In developing Table S–3, the staff considered two fuel-cycle options that differed in the treatment of irradiated (spent) fuel removed from a reactor. The “no-recycle” option treats all spent fuel as waste to be stored at a Federal waste repository, whereas the “uranium-only recycle” option involves reprocessing spent fuel to recover unused uranium and return it for use in new fuel. Neither cycle involves the recovery of plutonium. The contributions in Table S–3 resulting from reprocessing, waste management, and transportation of wastes are maximized for both of the two fuel cycles (uranium-only and no-recycle); that is, the identified environmental impacts are based on the cycle that results in the greater impact. The uranium fuel cycle is defined as the total of the operations and processes associated with provision, use, and ultimate disposition of fuel for nuclear power reactors.

Table 6-1. Table of Uranium Fuel Cycle Environmental Data[(a)]

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
Natural resource use		
Land (ac)		
Temporarily committed[(b)]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 100-MW(e) coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to a 95-MW(e) coal-fired power plant.

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
Water (millions of gallons)		
Discharged to air	160	=2 percent of model 1000-MW(e) LWR with cooling tower.
Discharged to waterbodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1000 MW(e) with once-through cooling.
Fossil Fuel		
Electrical energy (thousands of MW-hr)	323	<5 percent of model 1000-MW(e) LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45-MW(e) coal-fired power plant.
Natural Gas (millions of standard cubic feet)	135	<0.4 percent of model 1000 MW(e) energy output.
Effluents – chemical (MT)		
Gases (including entrainment)[(c)]		
SO_x^{-1}	4400	
NO_x^{-1}[(d)]	1190	Equivalent to emissions from 45-MW(e) coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1154	
Other Gases		
F	0.67	Principally from uranium hexafluoride (UF_6) production, enrichment, and reprocessing. The concentration is within the range of state standards – below level that has effects on human health.
HCl	0.014	
Liquids		
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3 – 600 cfs, NO_3 – 20 cfs, Fluoride – 70 cfs.
NO_3^-	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10	
Fe	0.4	
Tailings solutions (thousands of MT)	240	From mills only – no significant effluents to environment.
Solids	91,000	Principally from mills – no significant effluents to environment.

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
Effluents – radiological (curies)		
Gases (including entrainment)		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	0.14	Principally from fuel-reprocessing plants.
I-129	1.3	
I-131	0.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranic	0.203	
Liquids		
Uranium and daughters	2.1	Principally from milling – included tailings liquor and returned to ground – no effluents; therefore, no effect on environment.
Ra-226	0.0034	From UF_6 production.
Th-230	0.0015	
Th-234	0.01	From fuel fabrication plants – concentration 10 percent of 10 CFR Part 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried onsite)		
Other than high level (shallow)	11,300	9100 Ci comes from low-level reactor wastes and 1500 Ci comes from reactor decontamination and decommissioning – buried at land burial facilities. 600 Ci comes from mills – included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent-fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository.
Effluents – thermal (billions of British thermal units)	4063	<5 percent of model1000-MW(e) LWR.
Transportation (person-rem)		
Exposure of workers and general public	2.5	
Occupational Exposure (person-rem)	22.6	From reprocessing and waste management.

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR

Source: Table S–3 from 10 CFR 51.51(b),

(a) In some cases where no entry appears, it is clear from the background documents that the matter was addressed and that, in effect, the table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the table. Table S–3 does not include health effects from the effluents described in the table, or estimates of releases of radon-222 from the uranium fuel cycle or estimates of technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.
Data supporting this table are given in *Environmental Survey of the Uranium Fuel Cycle*, WASH-1248 (AEC 1974); *Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle*, NUREG-0116 (Supp.1 to WASH-1248) (NRC 1976); NUREG-0216 (Supp. 2 to WASH-1248) (NRC 1977a); and in the record of the final rulemaking pertaining to *Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management*, Docket RM-50-3. The contributions from reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium-only and no-recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor, which are considered in Table S–4 of Sec. 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

(b) The contributions to temporarily committed land from reprocessing are not prorated over 30 years, because the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

(c) Estimated effluents based upon combustion of equivalent coal for power generation.

(d) 1.2 percent from natural gas use and process.

HLW = high-level waste; LWR = light water reactor; TRU = transuranic elements

The Nuclear Nonproliferation Act of 1978 (22 USC 3201, et seq.) significantly affected the disposition of spent nuclear fuel by deferring indefinitely the commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power program. While the ban on the reprocessing of spent fuel was lifted during the Reagan administration, economic circumstances changed, reserves of uranium ore increased, and the stagnation of the nuclear power industry in the United States provided little incentive for industry to resume reprocessing. During the 109th Congress, the Energy Policy Act of 2005 (119 Statute 594) was enacted. It authorized the U.S. Department of Energy (DOE) to conduct an advanced fuel-recycling technology research and development program to evaluate proliferation-resistant fuel-recycling and transmutation technologies that minimize environmental or public health and safety impacts. Consequently, while Federal policy does not prohibit reprocessing, additional DOE efforts would be necessary before commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power plants could commence.

The no-recycle option is presented schematically in Figure 6-1. Natural uranium is mined in either open-pit or underground mines or by an in situ leach-solution mining process. In situ leach mining, presently the primary form of mining in the United States, involves injecting a lixiviant solution into the uranium ore body to dissolve uranium and then pumping the solution to the surface for further processing. The ore or in situ leach solution is transferred to mills where it is processed to produce “yellowcake” (U_3O_8). A conversion facility prepares the uranium oxide by converting it to uranium hexafluoride, which is then processed by an enrichment facility to increase the percentage of the more fissile isotope uranium-235 and decrease the percentage of the nonfissile isotope uranium-238. At a fuel-fabrication facility, the enriched uranium, which

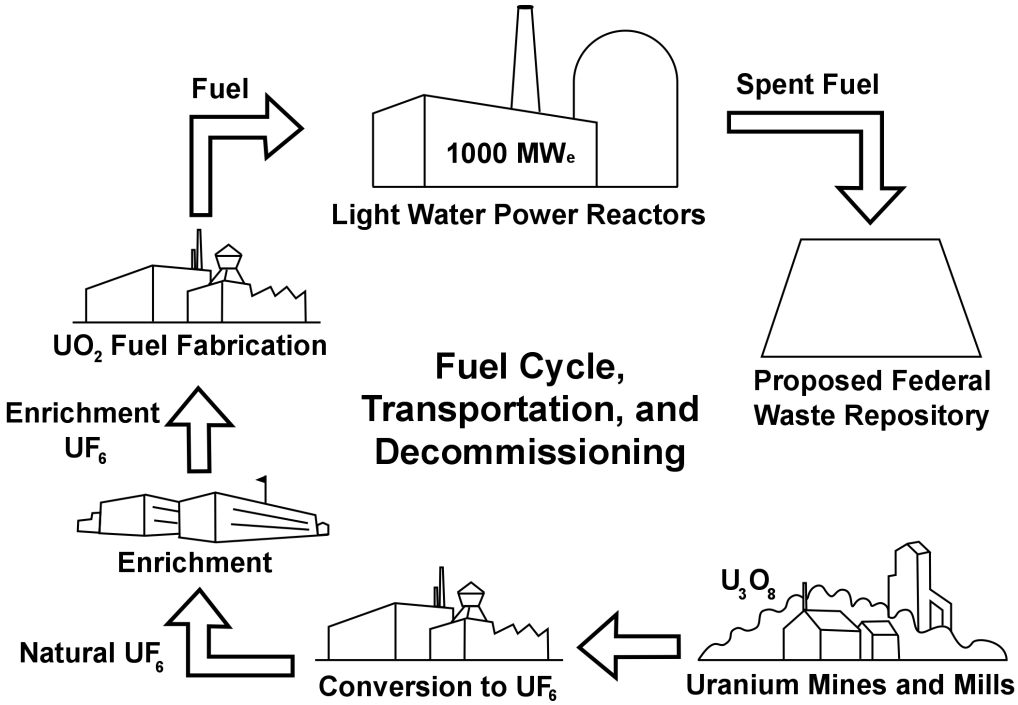

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (derived from NRC 1996)

is approximately 5 percent uranium-235, is then converted to uranium dioxide (UO_2). The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies, which are placed in a reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reactor has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor. After onsite storage for sufficient time to allow for short-lived fission-product decay and to reduce the heat-generation rate, the fuel assemblies are transferred to a waste repository for interment. Disposal of spent-fuel elements in a repository constitutes the final step in the no-recycle option.

The following assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project is based on the values given in Table S–3 (Table 6-1) and the staff's analysis of the radiological impact from radon-222 and technetium-99. In NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996, 1999),[a] the staff provides a detailed analysis of the environmental impacts from the uranium fuel cycle. Although NUREG-1437 is specific to the impacts related to license renewal, the information is relevant to this review because the advanced LWR design

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

considered here uses the same type of fuel as considered in the staff's evaluation in NUREG-1437. The staff's analyses in Section 6.2.3 of NUREG-1437 are summarized and set forth here.

The fuel-cycle impacts in Table S–3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). As explained above, the total net electric output for the proposed two new units at the VCSNS site is 2140 MW(e), which is about 2.68 times (i.e., 2140 MW(e) divided by 800 MW(e) yields 2.68) the output value in Table S–3 (see Table 6-1). For added conservatism in its review and evaluation of the environmental impacts of the nuclear fuel cycle, the staff multiplied the values in Table S–3 by a factor of 3, rather than a factor of 2.68, scaling the impacts upward to account for the increased electric generation of the two proposed AP1000 units. Scaling up by a factor of 3 is referred to as using the 1000-MW(e) LWR-scaled model.

Recent changes in the fuel cycle may have some bearing on environmental impacts; however, as discussed below, the staff is confident that the contemporary fuel-cycle impacts are below those identified in Table S–3. This is especially true in light of the following recent fuel cycle trends in the United States:

- Increasing use of in situ leach uranium mining, which does not produce mine tailings.
- Transitioning of U.S. uranium enrichment technology from gaseous diffusion to gas centrifuge. The centrifuge process uses only a small fraction of the electrical energy per separation unit compared to gaseous diffusion. (U.S. gaseous diffusion plants relied on electricity derived mainly from the burning of coal.)
- Current LWRs use nuclear fuel more efficiently due to higher fuel burnup. Therefore, less uranium fuel per year of reactor operation is required than in the past to generate the same amount of electricity.
- Fewer spent-fuel assemblies per reactor-year are discharged, hence the waste storage/repository impact is lessened.

The values in Table S–3 were calculated from industry averages for the performance of each type of facility or operation within the fuel cycle. Recognizing that this approach meant that there would be a range of reasonable values for each estimate, the staff followed the policy of choosing the assumptions or factors to be applied so that the calculated values would not be underestimated. This approach was intended to make sure that the actual environmental impacts would be less than the quantities shown in Table S–3 for all LWR nuclear power plants within the widest range of operating conditions. Many subtle fuel-cycle parameters and interactions were recognized by the staff as being less precise than the estimates and were not considered or were considered but had no effect on the Table S–3 calculations. For example, to determine the quantity of fuel required for a year's operation of a nuclear power plant in

Table S–3, the staff defined the model reactor as a 1000-MW(e) LWR operating at 80-percent capacity with a 12-month fuel-reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a “reactor reference year” or “reference reactor year” depending on the source (either Table S–3 or NUREG-1437), but it has the same meaning.

If approved, the combined construction permits and operating licenses (COLs) for the proposed two units would allow 40 years of operation. In NUREG-1437, the sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor was divided by a 60-year lifetime (40-year initial license term and 20-year license renewal term) to obtain an average annual fuel requirement. This approach was followed in NUREG-1437 for both boiling water reactors and pressurized water reactors; the higher annual requirement, 35 MT of uranium made into fuel for a boiling water reactor, was chosen in NUREG-1437 as the basis for the reference reactor year (NRC 1996). The average annual fuel requirement presented in NUREG-1437 would only be increased by 2 percent if a 40-year lifetime was evaluated. However, a number of fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative-work (enrichment) requirements. Since the time when Table S–3 was promulgated, these improvements have reduced the annual fuel requirement, which means the Table S–3 assumptions remain bounding as applied to the proposed two units.

Another change supporting the bounding nature of the S–3 assumptions with respect to Units 2 and 3 impacts is the elimination of the U.S. restrictions on the importation of foreign uranium. Until recently, the economic conditions of the uranium market favored use of foreign uranium at the expense of the domestic uranium industry. From the mid-1980s to 2004, the price of U_3O_8 remained below $20/lb. These market conditions resulted in the closing of most U.S. uranium mines and mills, thereby substantially reducing the environmental impacts in the United States from these activities. However, more recently the spot price of uranium has increased dramatically from $24/lb in April 2005 to $135/lb in July 2007 and has decreased to near $44/lb as of April 2009 (UxC 2009). As a result, there is a renewed interest in uranium mining and milling in the United States and the U.S. Nuclear Regulatory Commission (NRC) anticipates receiving multiple license applications for uranium mining and milling in the next several years. The majority of these applications are expected to be for in situ leach solution mining that does not produce tailings. Factoring in changes to the fuel cycle suggests that the environmental impacts of mining and tail millings could drop to levels below those given in Table S–3; however, Table S–3 estimates remain bounding as applied to the proposed two units.

In summation, these reasons highlight why Table S–3 is likely to overestimate impacts from the proposed two units and therefore remains a bounding approach for this analysis.

Section 6.2 of NUREG-1437 discusses in greater detail the sensitivity to changes in the fuel cycle since issuance of Table S–3 on the environmental impacts.

6.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1000-MW(e) LWR-scaled model is about 339 ac. Approximately 39 ac are permanently committed land, and 300 ac are temporarily committed. A "temporary" land commitment is a commitment for the life of the specific fuel-cycle plant (e.g., a mill, enrichment plant, or succeeding plants). After decommissioning, such land can be released for unrestricted use. "Permanent" commitments represent land that may not be released for use after plant shutdown and decommissioning because decommissioning activities do not result in the removal of sufficient radioactive material to meet the limits in 10 CFR Part 20, Subpart E, for release of that area for unrestricted use. Of the 300 ac of temporarily committed land, 66 ac are assumed to be disturbed. In comparison, a coal-fired power plant using the same megawatt electric output as the LWR-scaled model and using strip-mined coal requires the disturbance of about 528 ac/yr for fuel alone. The staff concludes that the impacts on land use to support the 1000-MW(e) LWR-scaled model would be SMALL.

6.1.2 Water Use

The principal water use for the fuel cycle supporting a 1000-MW(e) LWR-scaled model is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Scaling from Table S–3, of the total annual water use of 3.41×10^{10} gal, about 3.33×10^{10} gal are required for the removal of waste heat. Also, scaling from Table S–3, other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 4.80×10^{8} gal/yr and discharge to the ground (e.g., mine drainage) of about 3.81×10^{8} gal/yr.

On a thermal-effluent basis, annual discharges from the nuclear fuel cycle are about 4 percent of the 1000-MW(e) LWR-scaled model using once-through cooling. The consumptive water use is about 2 percent of the 1000-MW(e) LWR-scaled model using cooling towers. The maximum consumptive water use (assuming that all plants supplying electrical energy to the nuclear fuel cycle use cooling towers) would be about 4 percent of the 1000-MW(e) LWR-scaled model using cooling towers. Under this condition, thermal effluents would be negligible. The staff concludes that the impacts on water use for these combinations of thermal loadings and water consumption would be SMALL.

6.1.3 Fossil Fuel

Electric energy and process heat are required during various phases of the fuel-cycle process. The electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy use associated with the fuel cycle represents about 5 percent of the annual electric power production of the 1000-MW(e) LWR-scaled model. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the model plant. The staff concludes that the fossil fuel impacts from the direct and indirect consumption of electric energy for fuel-cycle operations would be SMALL relative to the net power production of the proposed project.

The largest source of carbon dioxide (CO_2) emissions in the fuel cycle is production of electric energy from combustion of fossil fuel in conventional power plants. This energy is used to power components of the fuel cycle such as enrichment. The CO_2 emissions from the fuel cycle are about 5 percent of the CO_2 emissions from an equivalent fossil fuel-fired plant.

The largest use of electricity in the fuel cycle comes from the enrichment process. It appears that gas centrifuge (GC) technology is likely to eventually replace gaseous diffusion (GD) technology for uranium enrichment in the United States. The same amount of enrichment from a GC facility uses less electricity and therefore results in lower amounts of air emissions such as carbon dioxide than a GD facility. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S–3 continue to be appropriately bounding values.

In Appendix J, the staff estimates that the carbon footprint of the fuel cycle to support a reference 1000-MW(e) LWR for a 40-year plant life is on the order of 17,000,000 metric tons of CO_2, including a very small contribution from other greenhouse gases. Scaling this footprint to the power level of the AP1000 reactor and two proposed units using the scaling factor of 3 discussed earlier, the NRC staff estimates the carbon footprint for 40 years of fuel-cycle emissions to be approximately 51,000,000 metric tons (an emissions rate of about 1,300,000 metric tons annually, averaged over the period of operation) of CO_2, as compared to a total United States annual emissions rate of 6,000,000,000 metric tons (EPA 2010).

On this basis, the NRC staff concludes that the fossil fuel impacts including greenhouse gas emissions from the direct and indirect consumption of electric energy for fuel cycle operations would be SMALL.

6.1.4 Chemical Effluents

The quantities of gaseous and particulate chemical effluents produced in fuel-cycle processes are given in Table S–3 (Table 6-1) for the reference 1000-MW(e) LWR and, according to WASH-1248 (AEC 1974), result from the generation of electricity for fuel-cycle operations. The principal effluents are sulfur oxides, nitrogen oxides, and particulates. Table S–3 states that the fuel cycle for the reference 1000-MW(e) LWR requires 323,000 MWh of electricity. The fuel cycle for the 1000-MW(e) LWR-scaled model would therefore require 969,000 MWh of electricity, or less than 0.024 percent of the 4.1 billion MWh of electricity generated in the United States in 2008 (DOE 2009a). Therefore, the gaseous and particulate chemical effluents from fuel-cycle processes to support the operation of the 1000-MW(e) LWR-scaled model would add less than 0.024 percent to the national gaseous and particulate chemical effluents for electricity generation.

Liquid chemical effluents produced in fuel-cycle processes are related to fuel enrichment and fabrication and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table S–3 (Table 6-1) specifies the amount of dilution water required for specific constituents. In addition, all liquid discharges into the navigable waters of the United States from facilities associated with the fuel-cycle operations would be subject to requirements and limitations set by appropriate Federal, State, Tribal, and local agencies.

Tailings solutions and solids are generated during the milling process, but as Table S–3 indicates, effluents are not released in quantities sufficient to have a significant impact on the environment.

Based on the above analysis, the NRC staff concludes that the impacts of these chemical effluents (gaseous, particulate and liquid) would be SMALL.

6.1.5 Radiological Effluents

Radioactive effluents estimated to be released to the environment from waste management activities and certain other phases of the fuel-cycle process are listed in Table S–3 (Table 6-1). NUREG-1437 (NRC 1996) provides the 100-year environmental dose commitment to the U.S. population from fuel cycle activities for 1 year of operation of the model 1000-MW(e) LWR using the radioactive effluents in Table S–3. Excluding reactor releases and dose commitments because of exposure to radon-222 and technetium-99, the total overall whole body gaseous dose commitment and whole body liquid dose commitment from the fuel cycle were calculated to be approximately 400 person-rem and 200 person-rem, respectively. Scaling these dose commitments by a factor of about 3 for the 1000-MW(e) LWR-scaled model results in whole body dose commitment estimates of 1200 person-rem for gaseous releases and 600 person-rem for liquid releases. Therefore, for both pathways, the estimated 100-year environmental dose commitment to the U.S. population would be approximately 1800 person-rem for the 1000-MW(e) LWR-scaled model.

Currently, the radiological impacts associated with radon-222 and technetium-99 releases are not addressed in Table S–3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from gaseous-diffusion enrichment facilities. SCE&G provided an assessment of radon-222 and technetium-99 in its Environmental Report (ER) (SCE&G 2010). SCE&G's evaluation relied on the information discussed in NUREG-1437 (NRC 1996).

In Section 6.2 of NUREG-1437 (NRC 1996), the staff estimated the radon-222 releases from mining and milling operations and from mill tailings for each year of operation of the reference 1000-MW(e) LWR. The estimated release of radon-222 for the 1000-MW(e) LWR-scaled model is approximately 16,000 Ci. Of this total, about 78 percent would be from mining, 15 percent from milling operations, and 7 percent from inactive tailings before stabilization. For radon releases from stabilized tailings, the staff assumed that the LWR-scaled model would result in an emission of 3 Ci/Ryr, (i.e., about three times the NUREG-1437 [NRC 1996] estimate for the reference reactor year). The major risks from radon-222 are from exposure to the bone and the lung, although there is a small risk from exposure to the whole body. The organ-specific dose-weighting factors from 10 CFR Part 20 were applied to the bone and lung doses to estimate the 100-year dose commitment from radon-222 to the whole body. The estimated 100-year environmental dose commitment from mining, milling, and tailings before stabilization for each reactor year (assuming the 1000-MW(e) LWR-scaled model) would be approximately 2800 person-rem to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 53 person-rem to the whole body. Additional insights regarding Federal policy/resource perspectives concerning institutional controls comparisons with routine radon-222 exposure and risk and long-term releases from stabilized tailing piles are discussed in NUREG-1437 (NRC 1996).

Also as discussed in NUREG-1437, the staff considered the potential doses associated with the releases of technetium-99. The estimated releases of technetium-99 for the reference reactor year for the 1000-MW(e) LWR-scaled model are 0.021 Ci from chemical processing of recycled uranium hexafluoride before it enters the isotope-enrichment cascade and 0.015 Ci into the groundwater from a HLW repository. The major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney, although there is a small risk from exposure to the whole body. Applying the organ-specific dose-weighting factors from 10 CFR Part 20 to the gastrointestinal tract and kidney doses, the total-body 100-year dose commitment from technetium-99 to the whole body was estimated to be 300 person-rem for the 1000-MW(e) LWR-scaled model.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per

1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effect per person-rem. The coefficient is taken from Publication 103 of the International Commission on Radiological Protection (ICRP 2007).

The nominal probability coefficient was multiplied by the sum of the estimated whole body population doses from gaseous effluents, liquid effluents, radon-222, and technetium-99 discussed above (approximately 5000 person-rem/yr) to calculate that the U.S. population would incur a total of approximately 3 fatal cancers, nonfatal cancers, and severe hereditary effects annually.

Radon-222 releases from tailings are indistinguishable from background radiation levels at a few miles from the tailings pile (at less than 0.6 mi in some cases) (NRC 1996). The public dose limit in the U.S. Environmental Protection Agency's (EPA's) regulation, 40 CFR Part 190, is 25 mrem/yr to the whole body from the entire fuel cycle, but most NRC licensees have airborne effluents resulting in doses of less than 1 mrem/yr (61 FR 65120).

In addition, at the request of the U.S. Congress, the National Cancer Institute conducted a study and published *Cancer in Populations Living Near Nuclear Facilities* in 1990 (Jablon et al. 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel-cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (Jablon et al.1990). The contribution to the annual average dose received by an individual from fuel-cycle-related radiation and other sources as reported in a publication of the National Council on Radiation Protection and Measurements (NCRP 2009) is listed in Table 6-2. The contribution from the nuclear fuel cycle to an individual's annual average radiation dose is extremely small (less than 0.01 mrem/yr) compared to the annual average background radiation dose (about 311 mrem/yr).

Based on the analyses presented above, the staff concludes that the environmental impacts of radioactive effluents from the fuel cycle, including gaseous and liquid releases, are SMALL.

6.1.6 Radiological Wastes

The estimated quantities of buried radioactive waste material (LLW, HLW, and transuranic wastes) generated by the reference 1000-MW(e) LWR are specified in Table S–3 (Table 6-1). For LLW disposal at land burial facilities, the Commission[(a)] notes in Table S–3 that there would be no significant radioactive releases to the environment. The VCSNS site is in the State of

(a) The Commission is the body of up to five NRC commissioners that formulates policies, develops regulations governing nuclear reactor and nuclear material safety, issues orders to licensees, and adjudicates legal matters.

South Carolina, and thus has continuing access to the LLW disposal facility at Barnwell, South Carolina, as long as it remains open.

Table 6-2. Comparison of Annual Average Dose Received by a U.S. Resident from All Sources

	Source	Dose (mrem/yr)[a]	Percent of Total
Ubiquitous background	Radon & thoron	228	37
	Space	33	5
	Terrestrial	21	3
	Internal (body)	29	5
	Total background sources	311	50
Medical	Computed tomography	147	24
	Medical x-ray	76	12
	Nuclear medicine	77	12
	Total medical sources	300	48
Consumer	Construction materials, smoking, air travel, mining, agriculture, fossil fuel combustion	13	2
Other	Occupational	0.5[b]	0.1
	Nuclear fuel cycle	0.05[c]	0.01
Total		624	100

Source: NCRP 2009
(a) NCRP Report 160 table expressed doses in mSv/yr (1 mSv/yr equals 100 mrem/yr).
(b) Occupational dose is regulated separately from public dose and is provided here for informational purposes.
(c) Calculated using 153 person-Sv/yr from Table 6-1 of NCRP 160 and a 2006 U.S. population of 300 million.

The Barnwell facility is expected to be closed to LLW in 2038, including LLW generated in South Carolina (Chem-Nuclear Systems 2005). At that time, SCE&G could enter into an agreement with another NRC-licensed facility that would accept LLW from VCSNS Units 2 and 3. Alternatively, SCE&G could implement measures to reduce or eliminate the generation of Class B and C wastes, extending the capacity of the onsite solid waste storage system. SCE&G could also construct additional temporary storage facilities onsite. Finally, SCE&G could enter into an agreement with a third-party contractor to process, store, own, and ultimately dispose of LLW from VCSNS Units 2 and 3. Because SCE&G would likely have to choose one or a combination of these options, the staff considered the environmental impacts of each of these options.

Table S–3 addresses the environmental impacts if SCE&G enters into an agreement with an NRC-licensed facility for disposal of LLW, and Table S–4 addresses the environmental impacts from transportation of LLW as discussed in Section 6.2. The use of third-party contractors was not explicitly addressed in Tables S–3 and S–4; however, such third-party contractors are already licensed by the NRC and currently operate in the United States. Experience from the operation of these facilities shows that the additional environmental impacts are not significant compared to the impacts described in Tables S–3 and S–4.

Measures to reduce the generation of Class B and C wastes, such as reducing the service run length of resin beds, could increase the volume of LLW, but would not increase the total activity (in curies) of radioactive material in the waste. The volume of waste would still be bounded by or very similar to the estimates in Table S–3, and the environmental impacts would not be significantly different.

In most circumstances, the NRC's regulations (10 CFR 50.59) allow licensees operating nuclear power plants to construct and operate additional onsite LLW storage facilities without seeking approval from the NRC. Licensees are required to evaluate the safety and environmental impacts before constructing the facility and make those evaluations available to NRC inspectors. A number of nuclear power plant licensees have constructed and operate such facilities in the United States. Typically, these additional facilities are constructed near the powerblock inside the security fence on land that has already been disturbed during initial plant construction. Therefore, the impacts on environmental resources (e.g., land use and aquatic and terrestrial biota) would be very small. All of the NRC (10 CFR Part 20) and EPA (40 CFR Part 190) dose limitations would apply both for public and occupational radiation exposure. The radiological environmental monitoring programs around nuclear power plants that operate such facilities show that the increase in radiation dose at the site boundary is not significant; the radiation doses continue to be below 25 mrem/yr, the dose limit of 40 CFR Part 190. The NRC staff concludes that doses to members of the public within the NRC and EPA regulations are a small impact. Therefore, the impacts from radiation would be SMALL.

In addition, NUREG-1437 assessed the impacts of LLW storage onsite at currently operating nuclear power plants and concluded that the radiation doses to offsite individuals from interim LLW storage are insignificant (NRC 1996). The types and amounts of LLW generated by the proposed reactors at VCSNS Units 2 and 3 would be very similar to those generated by currently operating nuclear power plants and the construction and operation of these interim LLW storage facilities would be very similar to the construction and operation of the currently operating facilities.

Current national policy, as found in the Nuclear Waste Policy Act (42 USC 10101, *et seq.*) mandates that high-level and transuranic wastes are to be buried at a deep geologic repository, such as the proposed repository at Yucca Mountain, Nevada. No release to the environment is expected to be associated with deep geologic disposal because it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG-0116 (NRC 1976), which provides background and context for the Table S–3 values established by the Commission, the staff indicates that these high-level and transuranic wastes will be buried and will not be released to the environment.

As part of the Table S–3 rulemaking, the staff evaluated, along with more conservative assumptions, this zero-release assumption associated with waste burial in a repository, and the

NRC reached an overall generic determination that fuel-cycle impacts would not be significant. In 1983, the Supreme Court affirmed the NRC's position that the zero-release assumption was reasonable in the context of the Table S–3 rulemaking to address generically the impacts of the uranium fuel cycle in individual reactor licensing proceedings (Baltimore Gas & Electric v. National Resources Defense Council, 462 U.S. 87(1983)).

Further, in the Commission's Waste Confidence Decision and rule (10 CFR 51.23(a)) (75 FR 81032), the Commission has made the generic determination that "if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and at either onsite or offsite independent spent fuel storage installations. Further, the Commission believes there is reasonable assurance that sufficient mined geologic repository capacity will be available to dispose of the commercial high-level radioactive waste and spent fuel generated in any reactor when necessary." In addition, 10 CFR 51.23(b) applies the generic determination in Section 51.23(a) to provide that "no discussion of any environmental impact of spent fuel storage in reactor facility storage pools or independent spent fuel storage installations (ISFSI) for the period following the term of the . . . reactor combined license or amendment . . . is required in any . . . environmental impact statement . . . prepared in connection with . . . the issuance or amendment of a combined license for a nuclear power reactors under parts 52 or 54 of this chapter."

In the context of operating license renewal, Sections 6.2 and 6.4 of NUREG-1437 (NRC 1996) provide additional description of the generation, storage, and ultimate disposal of LLW, mixed waste, and HLW including spent fuel from power reactors, concluding that environmental impacts from these activities are small. For the reasons stated above, the staff concludes that the environmental impacts of radioactive waste storage and disposal associated with proposed Units 2 and 3 would be SMALL.

6.1.7 Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the 1000-MW(e) LWR-scaled model is about 1800 person-rem. This is based on the NUREG-1437 occupational dose estimate of 600 person-rem attributable to all phases of the fuel cycle for the model 1000-MW(e) LWR (NRC 1996). The environmental impact from this occupational dose is considered SMALL because the dose to any individual worker would be maintained within the limits of 10 CFR Part 20, which is 5 rem/yr.

6.1.8 Transportation

The transportation dose to workers and the public related to the uranium fuel cycle is approximately 2.5 person-rem annually for the reference 1000-MW(e) LWR in accordance with

Table S–3 (Table 6-1). This corresponds to a dose of 7.5 person-rem for the 1000-MW(e) LWR-scaled model. For purposes of comparison, in the year 2010 the population within 50 mi of the VCSNS site is estimated to be 1.15 million people (SCE&G 2010). Using 0.311 rem/yr as the average dose to a U.S. resident from natural background radiation (NCRP 2009), the collective dose to that population is estimated to be 358,000 person-rem/yr. On the basis of this comparison, the staff concludes that the environmental impacts of transportation would be SMALL.

6.1.9 Conclusions

The staff evaluated the environmental impacts of the uranium fuel cycle, as given in Table S–3 (Table 6-1), considered the effects of radon-222 and technetium-99, and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. Based on this evaluation, the staff concludes that the impacts of the uranium fuel cycle would be SMALL.

6.2 Transportation Impacts

This section addresses both the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to the VCSNS site and alternative sites, (2) shipment of irradiated (spent) fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of low-level radioactive waste and mixed waste to offsite disposal facilities. Alternative sites evaluated in this environmental impact statement (EIS) include the existing VCSNS site (proposed), Cope Generating Station (CGS) site, Saluda County site, and the Savannah River (SR) project site. Note that the transportation impacts for the Fairfield 1 (FA-1) site are not explicitly analyzed in this EIS. This is because the FA-1 site is less than 10 mi from the existing VCSNS site and the transportation impacts would be approximately equal to those for the VCSNS site.

The NRC performed a generic analysis of the environmental effects of transportation of fuel and waste to and from LWRs in the *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants*, WASH-1238 (AEC 1972) and in a supplement to WASH-1238, NUREG-75/038 (NRC 1975), and found the impact to be SMALL. These documents provided the basis for Table S–4 in 10 CFR 51.52 that summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 MW(t) (1000 to 1500 MW(e)). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR. The transportation impacts associated with the VCSNS site and alternative sites were normalized for a reference 1100-MW(e) LWR at an 80-percent capacity factor for comparison with Table S–4.[a] Dose to transportation

(a) Note that the basis for Table S–4 is an 1100-MW(e) LWR at an 80-percent capacity factor (AEC 1972; NRC 1975). The basis for Table S–3 in 10 CFR 51.51(b) that was discussed in Section 6.1 of this EIS is an 1000-MW(e) LWR with an 80-percent capacity factor (NRC 1976). However, because workers during normal transportation operations was estimated to result in a collective dose of 4 person-rem per reference reactor year. The combined dose to the public along the route and dose to onlookers were estimated to result in a collective dose of 3 person-rem per reference reactor year.

Environmental risks of radiological effects during accident conditions, as stated in Table S–4, are small. Nonradiological impacts from postulated accidents were estimated as one fatal injury in 100 reactor years and one nonfatal injury in 10 reference reactor years. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977b) and by Sprung et al. (2000) concluded that impacts were bounded by Table S–4 in 10 CFR 51.52.

In accordance with 10 CFR 51.52(a), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (i.e., impacts are assumed to be bounded by Table S–4) if the reactor meets the following criteria:

- The reactor has a core thermal power level not exceeding 3800 MW(t).
- Fuel is in the form of sintered UO_2 pellets having a uranium-235 enrichment not exceeding 4 percent by weight; and pellets are encapsulated in zircaloy-clad fuel rods.
- The average level of irradiation of the fuel from the reactor does not exceed 33,000 MWd/MTU, and no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor.
- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.
- Unirradiated fuel is shipped to the reactor by truck; irradiated (spent) fuel is shipped from the reactor by truck, railroad, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or railroad.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities were resolved generically in 10 CFR 51.52, provided that the specific conditions in the rule (see above) are met; if not, then a full description and detailed analysis is required for initial licensing. The NRC may consider requests for licensed plants to operate at conditions beyond those in the facility's licensing basis; for example, higher burnups (above 33,000 MWd/MTU), enrichments (above 4 percent uranium-235), or thermal power levels (above 3800 MW(t)). Departures from the conditions itemized in 10 CFR 51.52(a) must be supported by a full description and detailed analysis of the environmental effects, as specified in 10 CFR 51.52(b). Departures found to be acceptable for licensed facilities cannot serve as the basis for initial licensing for new reactors.

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fuel cycle and transportation impacts are evaluated separately, this difference does not affect the results and conclusions in this EIS.

In its application, SCE&G requested COLs for two additional reactors at its VCSNS site in Fairfield County, South Carolina. Each proposed new reactor would be an AP1000 unit, which has a thermal power rating of 3400 MW(t) and a net electrical output of 1107 MW(e). The thermal power rating is less than the 3800-MW(t) condition given in 10 CFR 51.52(a). Westinghouse AP1000 reactors are expected to operate with a 93-percent capacity factor, so the net electrical output (annualized) is about 1030 MW(e) (SCE&G 2010). Fuel for the reactors would be enriched up to about 4.54 weight percent uranium-235, which exceeds the 10 CFR 51.52(a) condition. In addition, the expected irradiation level of about 50,533 MWd/MTU (SCE&G 2010) exceeds the 10 CFR 51.52(a) condition. Therefore, a full description and detailed analysis of transportation impacts is required.

In its ER (SCE&G 2010), SCE&G provided a full description and detailed analysis of transportation impacts. In the analysis, the radiological impacts of transporting fuel and waste to and from the VCSNS site were calculated using the RADTRAN 5.6 computer code (Weiner et al. 2008). RADTRAN 5.6 was used in this EIS and is the most commonly used transportation impact analysis software in the nuclear industry.

6.2.1 Transportation of Unirradiated Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting unirradiated (i.e., fresh) fuel to the VCSNS site and alternative sites. The radiological impacts of normal operating conditions and transportation accidents as well as nonradiological impacts are discussed in this section. Radiological impacts to populations and maximally exposed individuals (MEIs) are presented. Because the specific fuel fabrication plant for VCSNS unirradiated fuel is not known at this time, the staff's analysis assumes a "representative" route between the fuel fabrication facility and the VCSNS site or alternative sites. This means that one analysis was done using a "representative" route with one set of route characteristics (distances and population distributions), and that analysis was used to conclude that the impact from radiation dose would be small for the VCSNS site and each of the alternative sites. Once the location of the fuel fabrication site is known, there would likely be small differences in the route and dose estimates for the VCSNS site and the alternative sites. However, the radiation doses from transporting unirradiated fuel to the VCSNS site and alternative sites would still be small.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destinations without releasing any radioactive material to the environment. The impacts of these shipments would be from the low levels of radiation that penetrate the shipping containers of unirradiated fuel. Radiation exposures at some level would occur to the following populations: (1) persons residing along the transportation corridors between the fuel fabrication facility and the VCSNS site; (2) persons in vehicles traveling on the same route as a shipment of unirradiated fuel; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) the transportation crew (including drivers).

Truck Shipments

Table 6-3 provides the NRC staff's estimate of the number of truck shipments of unirradiated fuel for the Westinghouse AP1000 reactor design compared to those of the reference 1100-MW(e) reactor specified in WASH-1238 (AEC 1972) operating at 80-percent capacity (880 MW(e)). After normalization to electric generation capacity, the number of truck shipments of unirradiated fuel to the VCSNS site and alternative sites is fewer than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238.

Table 6-3. Number of Truck Shipments of Unirradiated Fuel for the Reference LWR and the Westinghouse AP1000 Reactor

Reactor Type	Number of Shipments per Reactor: Total[a]	Unit Electric Generation, MW(e)[b]	Capacity Factor[b]	Normalized, Shipments per 1100 MW(e)[c]
Reference LWR (WASH-1238)	252	1100	0.8	252
VCSNS Westinghouse AP1000	233	1107	0.93	199

(a) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(b) Unit capacities and capacity factors were taken from WASH-1238 for the reference light water reactor (LWR) and the ER (SCE&G 2010) for the Westinghouse AP1000 reactor.
(c) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100-MW(e) plant at 80 percent or net electrical output of 880 MW(e)).

Shipping Mode and Weight Limits

In 10 CFR 51.52, one identified condition is that all unirradiated fuel is to be shipped to the reactor by truck; SCE&G specifies that unirradiated fuel would be shipped to the proposed reactor site by truck (SCE&G 2010). Table S–4 in 10 CFR 51.52 includes a condition that the truck shipments not exceed 73,000 lb as governed by Federal or State gross vehicle-weight restrictions; SCE&G states in its ER that the unirradiated fuel shipments to the proposed VCSNS site and alternative sites would comply with applicable weight restrictions (SCE&G 2010).

Radiological Doses to Transport Workers and the Public

10 CFR 51.52, Table S–4, includes conditions related to radiological dose to transport workers and members of the public along transport routes. These doses are a function of many variables, including the radiation dose rate emitted from the unirradiated fuel shipments, the number of individuals exposed and their locations relative to the shipment, the time in transit (including travel and stop times), and the number of shipments to which the individuals are

exposed. For this EIS, the NRC staff independently calculated the radiological dose impacts to transport workers and the public from the transportation of unirradiated fuel using the RADTRAN 5.6 computer code (Weiner et al. 2008).

One of the key assumptions in WASH-1238 (AEC 1972) for the reference-LWR unirradiated fuel shipments is that the radiation dose rate at 1 m (3.3 ft) from the transport vehicle is about 0.1 mrem/hr, which is one percent of the regulatory limit. This assumption was also used in the NRC staff's analysis of the Westinghouse AP1000 reactor unirradiated fuel shipments. This assumption is reasonable because the AP1000 reactor fuel material would be low-dose-rate uranium radionuclides and would be packaged similarly to the practice described in WASH-1238 (i.e., inside a metal container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table 6-3 by 40 years of reactor operation. Other key input parameters used in the radiation-dose analysis for unirradiated fuel are shown in Table 6-4.

The RADTRAN 5.6 results for this "generic" unirradiated fuel shipment are as follows:

- worker dose: 1.71×10^{-3} person-rem/shipment
- general public dose (onlookers/persons at stops and sharing the highway): 3.62×10^{-3} person-rem/shipment)
- general public dose (along route/persons living near a highway or truck stop): 5.12×10^{-5} person-rem/shipment.

These values were combined with the average annual shipments of unirradiated fuel for the Westinghouse AP1000 reactor to calculate annual doses to the public and workers. Table 6-5 presents the annual radiological doses calculated by the NRC staff to workers, public onlookers (persons at stops and sharing the road), and members of the public along the route (i.e., residents within 0.5 mi of the highway) for transportation of unirradiated fuel to the VCSNS site and alternative sites. The cumulative annual dose estimates in Table 6-5 were normalized to 1100 MW(e) (880 MW(e) of net electrical output). The NRC staff performed an independent review and determined that all dose estimates calculated by the staff are bounded by the Table S–4 conditions of 4 person-rem/yr to transportation workers, 3 person-rem/yr to onlookers, and 3 person-rem/yr to members of the public along the route.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A report by the National Research Council (2006), the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effect per person-rem. The coefficient is taken from ICRP Publication 103 (ICRP 2007).

Table 6-4. RADTRAN 5.6 Input Parameters for Unirradiated Fuel Shipments

Parameter	RADTRAN 5.6 Input Value	Source
Shipping distance, km	3200	AEC (1972)[(a)]
Travel fraction – rural	0.90	NRC (1977b)
Travel fraction – suburban	0.05	
Travel fraction – urban	0.05	
Population density – rural, persons/km^2	10	DOE (2002a)
Population density – suburban, persons/km^2	349	
Population density – urban, persons/km^2	2260	
Vehicle speed – km/hr	88.5	Conservative in-transit speed of 88.5 km/hr (55 mph) assumed; predominantly interstate highways used.
Traffic count – rural, vehicles/hr	530	DOE (2002a)
Traffic count – suburban, vehicles/hr	760	
Traffic count – urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	AEC (1972)
Packaging length, m	9.1	Approximate length of two AP1000 fuel assemblies placed end to end (Westinghouse 2007).
Number of truck crew	2	AEC (1972), NRC (1977b), and DOE (2002a)
Stop time, hr/trip	4	Based on one 30-minute stop per 400 km (Johnson and Michelhaugh 2003).
Population density at stops, persons/km^2	See Table 6-8 for truck stop parameters	

(a) AEC (1972) provides a range of shipping distances between 25 mi and 3000 mi for shipments of fresh fuel. A 3200-km (2000-mi) “representative” shipping distance was assumed here.

Table 6-5. Radiological Impacts Under Normal Conditions of Transporting Unirradiated Fuel to the VCSNS Site and Alternative Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose, person-rem/yr per 1100 MW(e)[(a)] (880 MW(e) net)		
		Transportation Workers	Public – Onlookers	Public – Along Route
Reference LWR (WASH-1238)	6.3	1.1×10^{-2}	2.3×10^{-2}	3.2×10^{-4}
VCSNS and alternative sites AP1000	5.0	8.5×10^{-3}	1.8×10^{-2}	2.5×10^{-4}
10 CFR 51.52, Table S–4 condition	<1 per day	4	3	3

(a) Multiply person-rem/yr times 0.01 to obtain doses in person-Sv/yr.
LWR = light water reactor

Both the NCRP and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (in other words, less than 1/0.00057, which is less than 1754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995; ICRP 2007). The largest annual collective dose estimate for transporting unirradiated fuel to the VCSNS site and alternative sites was 0.018 person-rem, which is less than the value of 1754 person-rem that NCRP and ICRP suggest would most likely result in zero excess health effects.

To place these impacts in perspective, the average U.S. resident receives about 311 mrem/yr effective dose equivalent from natural background radiation (i.e., exposures from cosmic radiation, naturally occurring radioactive materials such as radon, and global fallout from testing of nuclear explosive devices (NCRP 2009). Using this average effective dose, the collective population dose from natural background radiation to the population along this representative route would be about 2.2×10^5 person-rem. Therefore, the radiation doses from transporting unirradiated fuel to the VCSNS site and alternative sites are small compared to the collective population dose to the same population from exposure to natural sources of radiation.

MEIs Under Normal Transport Conditions

The NRC staff conducted a scenario-based analysis to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the VCSNS site and alternative sites. An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the VCSNS site and alternative sites. The following discussion applies to shipments of unirradiated fuel to, and spent fuel and radioactive waste shipments from, any of the alternative sites. The analysis is based on data in the Yucca Mountain Final EIS (DOE 2002b) and incorporates data about exposure times, dose rates, and the number of times an individual may be exposed to an offsite shipment. Adjustments were made where necessary to reflect the normalized fuel and waste shipments addressed in this EIS. In all cases, the NRC staff assumed that the dose rate emitted from the shipping containers is 10 mrem/hr at 2 m

(6.6 ft) from the side of the transport vehicle. This is conservative in that the assumed dose rate is the maximum dose rate allowed by U.S. Department of Transportation (DOT) regulations (see 49 CFR 173.441). Most unirradiated fuel and radioactive waste shipments would have much lower dose rates than the regulations allow (AEC 1972; DOE 2002a). The analysis is described below.

Truck crew member. Truck crew members would receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period. The NRC staff's analysis assumed that crew-member doses are limited to 2 rem/yr, which is the DOE administrative control level presented in DOE-STD-1098-99, *DOE Standard, Radiological Control*, Chapter 2, Article 211 (DOE 2009b). This limit is anticipated to apply to shipments of spent nuclear fuel to a disposal facility, because DOE would take title to the spent fuel at the reactor site. There would be more shipments of spent nuclear fuel from the VCSNS site (or alternative sites) than there would be shipments of unirradiated fuel to, and radioactive waste other than spent fuel from, these sites. This is because the capacities of spent-fuel shipping casks are limited due to their substantial radiation shielding and accident resistance requirements. Spent-fuel shipments would also have significantly higher radiation dose rates than unirradiated fuel and radioactive waste (DOE 2002a). As a result, crew doses from shipments of unirradiated fuel and radioactive waste would be lower than the doses from shipments of spent nuclear fuel. The DOE administrative limit of 2 rem/yr (see DOE 2009b) is less than the NRC limit for occupational exposures of 5 rem/yr (see 10 CFR Part 20).

The DOT does not regulate annual occupational exposures. It does recognize that air crews are exposed to elevated cosmic radiation levels and recommends dose limits to air-crew members from cosmic radiation (DOT 2003). Air passengers are less of a concern because they do not fly as frequently as air crews. The recommended limits are a 5-year effective dose of 2 rem/yr with no more than 5 rem in a single year (DOT 2003). As a result, a 2-rem/yr MEI dose to truck crews is a reasonable estimate to apply to shipments of fuel and waste from the VCSNS site and alternative sites.

Inspectors. Radioactive shipments are inspected by Federal or State vehicle inspectors, for example, at State ports of entry. The Yucca Mountain Final EIS (DOE 2002b) assumed that inspectors would be exposed for 1 hour at a distance of 1 m (3.3 ft) from the shipping containers. The dose rate at 1 m (3.3 ft) is conservatively assumed to be at the regulatory limit, or equivalent to about 14 mrem/hr; therefore, the dose per shipment is about 14 mrem. This is independent of the location of the reactor site. Based on this conservative value and the assumption that the same person inspects all shipments of fuel and waste to and from the VCSNS site and alternative sites, the NRC staff calculated the annual doses to vehicle inspectors to be about 0.9 rem/yr, based on a combined total of 66 shipments of unirradiated fuel, spent fuel, and radioactive waste per year. This value is less than one-half of the 2-rem/yr DOE administrative control level on individual doses (DOE 2009b) and one-fifth of the 5-rem/yr NRC occupational dose limit.

Resident. The analysis assumed that residents living adjacent to a highway where a shipment would pass would be exposed to all shipments along that particular route. Exposures to residents on a per-shipment basis were obtained from the NRC staff's RADTRAN 5.6 output files developed for this EIS. These dose estimates are based on an individual located 100 ft from shipments that are traveling 15 mph. The potential radiation dose to the maximally exposed resident is about 0.04 mrem/yr for shipments of fuel and waste to and from the site.

Individual stuck in traffic. This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for 1 hour at a distance of 4 ft. The NRC staff's analysis assumed that this exposure scenario would occur only one time to any individual, and that the dose rate was at the regulatory limit of 10 mrem/hr at 6.6 ft from the shipment, so the dose rate will be higher at the assumed exposure distance of 4 ft. The dose to the MEI was calculated to be 16 mrem in DOE's Yucca Mountain EIS (DOE 2002b).

Person at a truck service station. This scenario estimates doses to an employee at a service station where all truck shipments to and from the VCSNS site and alternative sites are assumed to stop. The NRC staff's analysis assumed that this person is exposed for 49 minutes at a distance of 52 ft from the loaded shipping container (DOE 2002b). The exposure time and distance were based on the observations discussed by Griego et al. (1996). This results in a dose of about 0.34 mrem/shipment and an annual dose of about 22 mrem/yr for the VCSNS site and alternative sites, assuming that a single individual services all shipments of unirradiated fuel, spent fuel, and radioactive waste to and from the VCSNS site and alternative sites.

6.2.1.2 Radiological Impacts of Transportation Accidents

Accident risks are a combination of accident frequency and consequence. Accident frequencies for transportation of unirradiated fuel to the VCSNS site and alternative sites are expected to be lower than those used in the analysis in WASH-1238 (AEC 1972), which forms the basis for Table S–4 of 10 CFR 51.52, because of improvements in highway safety and security, and an overall reduction in traffic accident, injury, and fatality rates since WASH-1238 was published. There is no significant difference between the Westinghouse AP1000 and current-generation LWRs in consequences of transportation accidents severe enough to result in a release of unirradiated fuel particles to the environment because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, consistent with the conclusions of WASH-1238 (AEC 1972), the impacts of accidents during transport of unirradiated fuel for the Westinghouse AP1000 at the VCSNS site and alternative sites are expected to be negligible.

6.2.1.3 Nonradiological Impacts of Transportation Accidents

Nonradiological impacts are the human-health impacts projected to result from traffic accidents involving shipments of unirradiated fuel to the VCSNS site and alternative sites; that is, the analysis does not consider the radiological or hazardous characteristics of the cargo.

Nonradiological impacts include the projected number of traffic accidents, injuries, and fatalities that could result from shipments of unirradiated fuel to the site and return shipments of empty containers from the site.

Nonradiological impacts are calculated using accident, injury, and fatality rates from published sources; the rates (i.e., impacts per vehicle-km traveled) are then multiplied by estimated travel distances for workers and materials. The general formula for calculating nonradiological impacts is as follows:

Impacts = (unit rate) × (round-trip shipping distance) × (annual number of shipments)

In this formula, impacts are presented in terms of the number of accidents, number of injuries, and number of fatalities per year. Corresponding unit rates (i.e., impacts per vehicle-km traveled) are used in the calculations.

Accident, injury, and fatality rates were taken from Table 4 in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Nationwide median rates were used for shipments of unirradiated fuel to the site. The data are representative of traffic-accident, injury, and fatality rates for heavy truck shipments similar to those to be used to transport unirradiated fuel to the VCSNS site and proposed alternative sites. In addition, the DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) rates, which were taken from the Motor Carrier Management Information System, and determined that the rates were under-reported. Therefore, the accident, injury, and fatality rates reported by Saricks and Tompkins (1999) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI 2003). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 and 36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively, to account for the under-reporting.

The nonradiological accident impacts calculated by the NRC staff for transporting unirradiated fuel to (and empty shipping containers from) the VCSNS site and alternative sites are shown in Table 6-6. The nonradiological impacts associated with the WASH-1238 reference LWR are also shown for comparison purposes. Note that there are only small differences between the impacts calculated for a Westinghouse AP1000 at the VCSNS site and alternative sites and the reference LWR in WASH-1238 due entirely to the smaller number of shipments.

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the VCSNS Site and Alternative Sites, Normalized to the Reference LWR

Plant Type	Annual Shipments Normalized to Reference LWR	One-Way Shipping Distance, km	Round-trip Distance, km per Year	Annual Impacts		
				Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (WASH-1238)	6.3	3200	4.0×10^{4}	1.9×10^{-2}	9.3×10^{-3}	5.8×10^{-4}
VCSNS and alternative sites AP1000 reactors	5.0	3200	3.2×10^{4}	1.5×10^{-2}	7.4×10^{-3}	4.6×10^{-4}

LWR = light water reactor

6.2.2 Transportation of Spent Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting spent fuel from the proposed VCSNS site and alternative sites to a spent-fuel disposal repository. For the purposes of these analyses, the staff considered the proposed geologic HLW repository at Yucca Mountain in Nevada as a surrogate destination. Currently, the NRC has not made a decision about the DOE application for the proposed geologic repository at Yucca Mountain. However, the NRC staff considers an estimate of the impacts of the transportation of spent fuel to a possible repository in Nevada to be a reasonable bounding estimate of the transportation impacts on a storage or disposal facility because of the distances involved and the representativeness of the distribution of members of the public in urban, suburban, and rural areas (i.e., population distributions) along the shipping routes. Radiological impacts of normal operating conditions and transportation accidents, as well as nonradiological impacts of accidents, are discussed in this section.

The NRC staff's analysis is based on shipment of spent fuel by legal-weight trucks in shipping casks with characteristics similar to currently available casks (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Due to the large size and weight of spent-fuel shipping casks, each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with those made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG-1437 (NRC 1996). Because the alternative transportation methods involve railroad transportation or heavy-haul trucks, which would reduce the overall number of spent-fuel shipments (NRC 1996), thereby reducing impacts, these assumptions are conservative. Also, the use of current shipping-cask designs for this analysis results in conservative impact estimates because the current designs are based on transporting short-cooled spent fuel (approximately 120 days out of reactor). Future shipping casks would be designed to transport longer-cooled fuel (greater than 5 years out of reactor) and would require much less shielding to meet external dose limitations. Therefore, future shipping casks are expected to have higher cargo capacities, thereby reducing the numbers of shipments and associated impacts.

The NRC staff calculated the radiological impacts of transportation of spent fuel using the RADTRAN 5.6 computer code (Weiner et al. 2008). Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the Transportation Routing Analysis Geographic Information System (TRAGIS) code (Johnson and Michelhaugh 2003). The population data in the TRAGIS code are based on the 2000 census. Nonradiological impacts were calculated using published traffic accident, injury, and fatality data (Saricks and Tompkins 1999) in addition to route information from TRAGIS (Johnson and Michelhaugh 2003). Traffic accident rates used the RADTRAN 5.6 and nonradiological impact calculations were adjusted to account for under-reporting, as discussed in Section 4.8.3.

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as “incident-free” conditions, are transportation activities in which shipments reach their destination without an accident occurring en route. Impacts from these shipments would be from the low levels of radiation that penetrate the heavily shielded spent-fuel shipping cask. Radiation exposures would occur to the following populations: (1) persons residing along the transportation corridors between the VCSNS site (or alternative sites) and the proposed repository location; (2) persons in vehicles traveling on the same route as a spent-fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) the transportation crew (drivers). For the purposes of this analysis, the NRC staff assumed that the destination for the spent-fuel shipments is the proposed geologic HLW repository at Yucca Mountain in Nevada. This assumption is conservative because it tends to maximize the shipping distance from the VCSNS site and alternative sites.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the Westinghouse AP1000. Information in *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003) indicated that advanced LWR fuel designs would not be significantly different from existing LWR designs; therefore, current shipping-cask designs were used for the analysis of Westinghouse AP1000 reactor spent-fuel shipments. The NRC staff assumed that the capacity of a truck shipment of Westinghouse AP1000 reactor spent fuel was 0.5 MTU/shipment, the same capacity as that used in WASH-1238 (AEC 1972). In its ER (SCE&G 2010), SCE&G assumed a shipping-cask capacity of 1.8 MTU/shipment, representative of future shipping-cask designs.

Input to RADTRAN 5.6 includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code (Johnson and Michelhaugh 2003) for highway routes from the proposed VCSNS site and alternative sites to the proposed geologic HLW repository at Yucca Mountain. The resulting route-characteristics information, generated by the NRC staff, is listed in Table 6-7. Note that for truck shipments, all of the spent fuel is assumed to be shipped to the proposed geologic HLW repository at Yucca Mountain over designated highway- route controlled-quantity routes. In addition, TRAGIS data were loaded into RADTRAN 5.6 on a state-by-state basis, which increases precision and allows the results to be presented for each state along the route between the VCSNS site and alternative sites and the proposed geologic HLW repository at Yucca Mountain, if desired.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate, packaging dimensions, number in the truck crew, stop time, and population density at stops. The values for these and other parameters that were used in the NRC staff's analysis and the sources of the information are listed in Table 6-8.

Table 6-7. Transportation-Route Information for Shipments from the VCSNS Site and Alternative Sites to the Proposed Geologic HLW Repository at Yucca Mountain, Nevada

Advanced Reactor Site[a]	One-Way Shipping Distance, km				Population Density, persons/km^2			Stop Time per Trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
VCSNS Site	4096	3284	735	77	9.5	311.4	2209.8	5
CGS	4202	3331	790	81	9.6	315.5	2213.1	5
Saluda	4077	3271	729	77	9.4	312.8	2209.8	5
SR	4094	3232	754	107	9.3	335.0	2272.1	5

Source: Johnson and Michelhaugh (2003)

Note: This table presents aggregated route characteristics generated by TRAGIS (Johnson and Michelhaugh 2003), including estimated distances from the alternative sites to the nearest TRAGIS highway node. Input to the RADTRAN 5.6 computer code was disaggregated to a state-by-state level.

(a) The transportation impacts for the FA-1 site are not explicitly analyzed in this EIS. Shipping distances and population distributions are approximately the same as those for the VCSNS Site.

Table 6-8. RADTRAN 5.6 Normal (Incident-Free) Exposure Parameters

Parameter	RADTRAN 5.6 Input Value	Source
Vehicle speed, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a). Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – rural, vehicles/hr Traffic count – suburban, vehicles/hr Traffic count – urban, vehicles/hr	State-specific	State-specific rural, suburban, and urban traffic counts are taken from Weiner et al. (2008).

Table 6-8. (contd)

Parameter	RADTRAN 5.6 Input Value	Source
Vehicle occupancy, persons/vehicle	1.5	DOE (2002a)
Dose rate at 1 m from vehicle, mrem/hr	14	DOE (2002a, b) – approximate dose rate at 1 m that is equivalent to maximum dose rate allowed by Federal regulations (i.e., 10 mrem/hr at 2 m from the side of a transport vehicle).
Packaging dimensions, m	Length – 5.2 Diameter – 1.0	DOE (2002b)
Number of truck crew	2	AEC (1972), NRC (1977b), and DOE (2002a, b)
Stop time, hr/trip	Route-specific	See Table 6-4
Population density at stops, persons/km^2	30,000	Sprung et al. (2000). Equivalent to nine persons within 10 m of vehicle. See Figure 6-2
Min/max radii of annular area around vehicle at stops, m	1 to 10	Sprung et al. (2000)
Dimensionless shielding factor applied to annular area surrounding vehicle at stops	1 (no shielding)	Sprung et al. (2000)
Population density surrounding truck stops, persons/km^2	340	Sprung et al. (2000)
Min/max radius of annular area surrounding truck stop, m	10 to 800	Sprung et al. (2000)
Dimensionless shielding factor applied to annular area surrounding truck stop	0.2	Sprung et al. (2000)

For the purposes of this analysis, the transportation crew for spent-fuel shipments delivered by truck is assumed to consist of two drivers. Escort vehicles and drivers were considered, but they were not included in the analysis because their distance from the shipping cask would reduce the dose rates to levels well below the dose rates experienced by the drivers and would be negligible. Stop times for refueling and rest were assumed to accrue at the rate of 30 minutes per 4 hours of driving time. TRAGIS outputs were used to estimate the number of stops. For this analysis, doses to the public at refueling and rest stops ("stop doses") are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure 6-2. The inner ring represents persons who may be at the truck stop at the same time as a spent-fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and extends from 10 to 800 m from the vehicle. This scheme is similar to that used by Sprung et al. (2000). Population densities and shielding factors were also taken from Sprung et al. (2000), which were based on the observations of Griego et al. (1996).

The results calculated by the NRC staff for these normal (incident-free) exposure conditions are shown in Table 6-9 for the proposed VCSNS site and alternative sites. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at stops and persons on highways exposed to the spent-fuel shipment), and persons along the route (persons living near the highway). Shipping schedules for spent fuel generated by the proposed new unit have not been determined. The NRC staff concluded it is reasonable to calculate annual doses assuming that the annual number of spent-fuel shipments is equivalent to the annual refueling requirements. Population doses were normalized to the reference LWR in WASH-1238 (880 net MW(e)). This corresponds to an 1100-MW(e) LWR operating at 80-percent capacity.

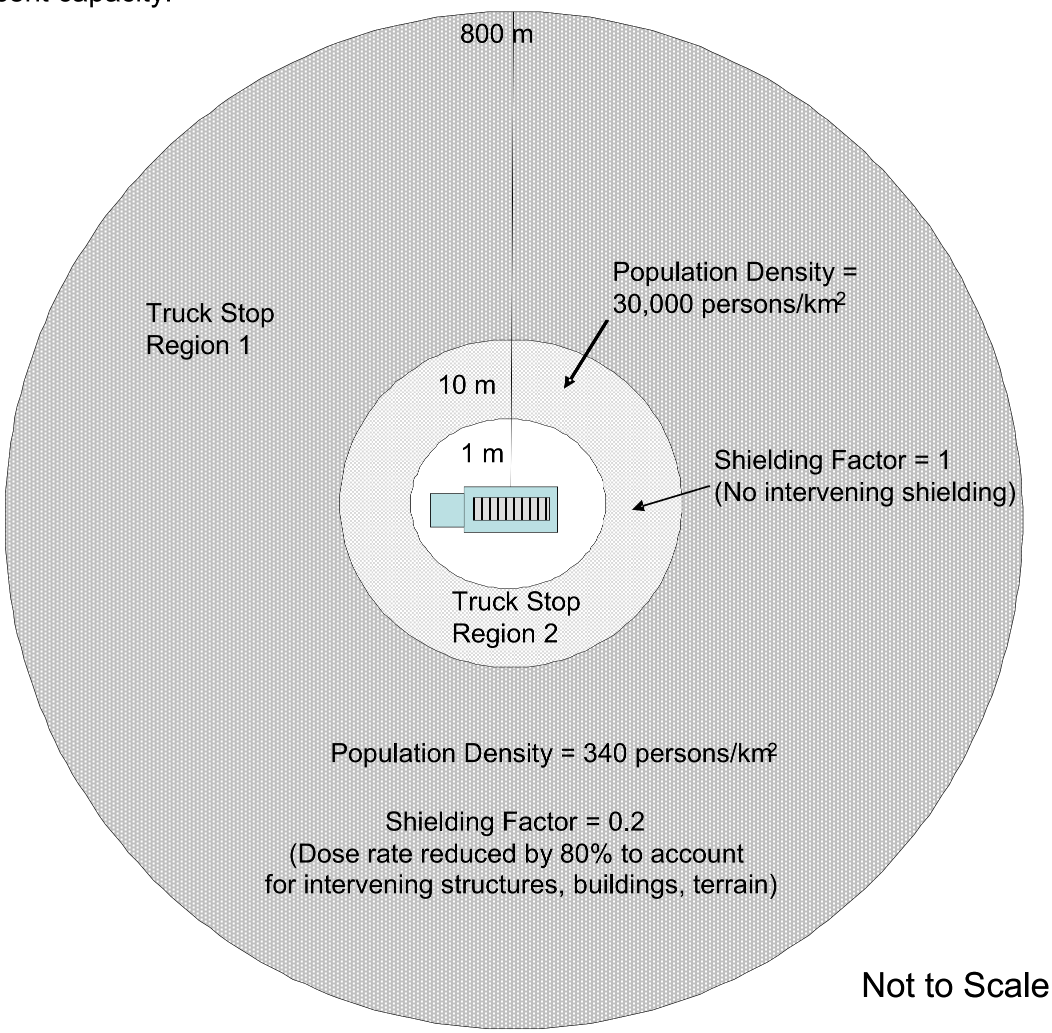

Figure 6-2. Illustration of Truck Stop Model

There are only small differences in transportation impacts among the VCSNS site and the alternative sites evaluated. The differences are due to the route characteristics (distance, population density) for shipments from the VCSNS site and alternative sites to the proposed geologic HLW repository at Yucca Mountain.

The bounding cumulative doses to the exposed population given in Table S–4 are

- 4 person-rem/reactor-year to transport workers
- 3 person-rem/reactor-year to general public (onlookers) and to members of the public along the route.

Table 6-9. Normal (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the VCSNS Site and Alternative Sites to the Proposed Geologic HLW Repository at Yucca Mountain

	Normalized Impacts (person-rem/yr)[a]		
	Worker (Crew)	**Along Route**	**Onlookers**
Reference LWR (WASH-1238)	$1.1 \times 10^{+1}$	5.3×10^{-1}	$2.4 \times 10^{+1}$
VCSNS COL normalized impacts[b]	7.4×10^{0}	3.5×10^{-1}	$1.5 \times 10^{+1}$
CGS	7.5×10^{0}	3.9×10^{-1}	$1.6 \times 10^{+1}$
Saluda	7.3×10^{0}	3.6×10^{-1}	$1.5 \times 10^{+1}$
SR	7.3×10^{0}	3.9×10^{-1}	$1.6 \times 10^{+1}$
Table S–4 condition	4×10^{0}	3×10^{0}	3×10^{-0}

(a) To convert person-rem to person-Sv, divide by 100.
(b) The transportation impacts for the FA-1 site are not explicitly analyzed in this EIS. Shipping distances, population distributions, and transportation impacts are approximately the same as those for the VCSNS Site.
LWR = light water reactor

The calculated population doses to the crew and onlookers for the reference LWR and the VCSNS and alternative site shipments exceed Table S–4 values. A key reason for the higher population doses relative to Table S–4 is the longer shipping distances assumed for this COL analysis (i.e., to a proposed repository in Nevada) than the distance used in WASH-1238. WASH-1238 assumed that each spent-fuel shipment would travel a distance of 1000 mi, whereas the shipping distances used in this assessment were about 2500 to 2600 mi. If the shorter distance were used to calculate the impacts for the VCSNS spent-fuel shipments, the doses in Table 6-9 could be reduced by half or more. Other important differences are the model related to vehicle stops described above and the additional precision that results from incorporating state-specific route characteristics and vehicle densities on highways (vehicles per hour).

Where necessary, the NRC staff made conservative assumptions to calculate impacts associated with transportation of spent fuel. Some of the key conservative assumptions are as follows:

- Use of the regulatory maximum dose rate (10 mrem/hr at 2 m) in the RADTRAN 5.6 calculations. The shipping casks assumed in the EIS prepared by DOE in support of the application for the proposed geologic HLW repository at Yucca Mountain (DOE 2002b) were designed to transport spent fuel that has cooled for a minimum of 5 years (see 10 CFR Part 961, Subpart B). Most spent fuel would have cooled for much longer than 5 years before being shipped to a possible geologic repository. For this reason, shipments from the VCSNS site and alternative sites are also expected to be cooled for longer than 5 years. Consequently, the estimated population doses in Table 6-9 could be further reduced if more realistic dose-rate projections and shipping-cask capacities are used.
- Use of 30 minutes as the average time at a truck stop in the calculations. Many stops made for actual spent-fuel shipments are of short duration (i.e., 10 minutes) for brief visual inspections of the cargo (e.g., checking the cask tie-downs). These stops typically occur in minimally populated areas, such as an overpass or freeway ramp in an unpopulated area. Furthermore, empirical data provided by Griego et al. (1996) indicate that a 30-minute duration is toward the high end of the stop-time distribution. Average stop times observed by Griego et al. (1996) are on the order of 18 minutes.

A sensitivity study was performed to demonstrate the effects of using more realistic dose rates and stop times on the incident-free population dose calculations. For this sensitivity study, the dose rate was reduced to 5 mrem/hr, the approximate 50-percent confidence interval of the dose rate distribution estimated by Sprung et al. (2000) for future spent-fuel shipments. The stop time was reduced to 18 minutes per stop. All other RADTRAN 5.6 input values were unchanged. The result is that the annual crew doses were reduced to 2.6 person-rem/yr or about 35 percent of the annual dose shown in Table 6-9. The annual onlooker doses were reduced to 4.0 person-rem/yr (26 percent) and the annual doses to persons along the route were reduced to 0.13 person-rem/yr (38 percent). The NRC concluded that using more realistic parameters for shipment capacities, stop times, and dose rates would reduce the annual doses in Table 6-9 to below the Table S–4 values.

In the ER, SCE&G described the results of a RADTRAN 5.6 analysis of the impacts of incident-free transport of spent fuel to the proposed geologic HLW repository at Yucca Mountain (SCE&G 2010). Although the overall approaches are the same (e.g., use of TRAGIS and RADTRAN 5.6), there are some differences in the modeling details. For example, the NRC staff's analysis used state-by-state route characteristics and a shipment capacity of 0.5 MTU, whereas SCE&G elected to use aggregated route information and a shipment capacity of 1.8 MTU. After adjusting for these key differences, the results are similar to those calculated by the NRC staff in this EIS.

Using the linear no-threshold dose-response relationship discussed in Section 6.2.1.1, the annual public dose impacts for transporting spent fuel from the VCSNS site and alternative sites to the proposed geologic HLW repository at Yucca Mountain are less than the value of 1754 person-rem that ICRP (ICRP 2007) and NCRP (NCRP 1995) suggest would most likely result in zero excess health effects. This risk is very small compared to the estimated 2.1×10^5 person-rem that the same population along the route from the proposed VCSNS site to Yucca Mountain would incur annually from exposure to natural background radiation. Note that the estimated dose to persons along the Summer-to-Yucca-Mountain route from natural background radiation is different than the natural background dose calculated by the NRC staff for unirradiated fuel shipments in Section 6.2.1.1 of this EIS because the route characteristics are different. A generic route was used in Section 6.2.1.1 for unirradiated fuel shipments and an actual highway route was used in this section for spent-fuel shipments.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and wastes under normal conditions are presented in Section 6.2.1.1.

6.2.2.2 Radiological Impacts of Accidents

As discussed previously, the NRC staff used the RADTRAN 5.6 computer code to estimate the impacts of transportation accidents involving spent-fuel shipments. RADTRAN 5.6 considers a spectrum of postulated transportation accidents, ranging from those with high frequencies and low consequences (e.g., “fender benders”) to those with low frequencies and high consequences (i.e., accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were taken from SCE&G’s ER (SCE&G 2010). Spent-fuel radionuclide inventories used in the NRC staff analysis are presented in Table 6-10. The radionuclides listed in the table include all of the radionuclides that were included in the analysis conducted by Sprung et al. (2000). The staff’s analysis also included the estimated inventory of “crud,” or radioactive material deposited on the external surfaces of LWR spent-fuel rods. Because crud is deposited from corrosion products generated elsewhere in the reactor cooling system and the complete reactor design and operating parameters are uncertain, the quantities and characteristics of crud deposited on Westinghouse AP1000 reactor spent fuel are not available at this time. The VCSNS Westinghouse AP1000 spent-fuel transportation accident impacts were calculated in this EIS and in SCE&G’s ER assuming that the cobalt-60 inventory in the form of crud is 4.09 Ci/MTU, based on information provided in the ER (SCE&G 2010).Robust shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71. Spent-fuel shipping casks must be certified Type-B packaging systems, meaning they must be designed to withstand a series of severe postulated hypothetical accident conditions with essentially no loss of containment or shielding capability. These casks are also designed with fissile-material controls to verify that the spent fuel remains subcritical under normal and accident conditions. According to Sprung et al. (2000), the probability of encountering accident conditions during transport that would lead to shipping-cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). The NRC staff assumed that shipping casks approved for transportation of spent fuel from an AP1000 reactor would provide equivalent mechanical and thermal protection of the spent-fuel cargo.

Table 6-10. Radionuclide Inventories Used in Transportation-Accident Risk Calculations for the Westinghouse AP1000 Reactor[(a)(b)]

Radionuclide	Ci/MTU	Bq/MTU	Physical-Chemical Group
Am-241	7.27E+02	2.7E+13	Particulate
Am-242m	1.31E+01	4.9E+11	Particulate
Am-243	3.34E+01	1.2E+12	Particulate
Ce-144	8.87E+03	3.3E+14	Particulate
Cm-242	2.83E+01	1.0E+12	Particulate
Cm-243	3.07E+01	1.1E+12	Particulate
Cm-244	7.75E+03	2.9E+14	Particulate
Cm-245	1.21E+00	4.5E+10	Particulate
Co-60	4.09E+00	2.9E+12	Crud
Cs-134	4.80E+04	1.8E+15	Cesium
Cs-137	9.31E+04	3.4E+15	Cesium
Eu-154	9.13E+03	3.4E+14	Particulate
Eu-155	4.62E+03	1.7E+14	Particulate
I-129	4.65E-02	1.7E+09	Gas
Kr-85	8.90E+03	3.3E+14	Gas
Pm-147	1.76E+04	6.5E+14	Particulate
Pu-238	6.07E+03	2.2E+14	Particulate
Pu-239	2.55E+02	9.4E+12	Particulate
Pu-240	5.43E+02	2.0E+13	Particulate
Pu-241	6.96E+04	2.6E+15	Particulate
Pu-242	1.82E+00	6.7E+10	Particulate
Ru-106	1.55E+04	5.7E+14	Ruthenium
Sb-125	3.83E+03	1.4E+14	Particulate
Sr-90	6.19E+04	2.3E+15	Particulate
Y-90	6.19E+04	2.3E+15	Particulate

(a) Divide becquerel per metric ton uranium (Bq/MTU) by 3.7×10^{10} to obtain curies per MTU (Ci/MTU)
(b) The source of the spent-fuel inventories is SCE&G (2010).

Accident frequencies are calculated in RADTRAN 5.6 using user-specified accident rates and conditional shipping-cask failure probabilities. State-specific accident rates were taken from Saricks and Tompkins (1999) and used in the RADTRAN 5.6 calculations. The state-specific accident rates were then adjusted to account for under-reporting, as described in Section 6.2.1.3. Conditional shipping-cask failure probabilities (i.e., the probability of cask failure as a function of the mechanical and thermal conditions applied in an accident) were taken from Sprung et al. (2000).

The RADTRAN 5.6 accident-risk calculations were performed using the radionuclide inventories given in Table 6-10. The resulting risk estimates were then multiplied by the assumed annual spent-fuel shipments to derive estimates of the annual accident risks associated with spent-fuel shipments from the VCSNS site and alternative sites to the proposed geologic HLW repository at Yucca Mountain in Nevada. As was done for normal transport exposures, the NRC staff assumed that the number of shipments of spent fuel per year is equivalent to the annual discharge quantities.

For this assessment, release fractions for current-generation LWR fuel designs (Sprung et al. 2000) were used to approximate the impacts of the Westinghouse AP1000 reactor spent-fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions.

The NRC staff used RADTRAN 5.6 to calculate the population dose from the released radioactive material from four of five possible exposure pathways.[a] These pathways are as follows:

- external dose from exposure to the passing cloud of radioactive material (cloudshine)
- external dose from the radionuclides deposited on the ground by the passing plume (groundshine). The NRC staff's analysis included the radiation exposure from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.
- internal dose from inhalation of airborne radioactive contaminants (inhalation)
- internal dose from resuspension of radioactive materials that were deposited on the ground (resuspension). The staff's analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

(a) Internal dose from ingestion of contaminated food was not considered because the staff assumed evacuation and subsequent interdiction of foodstuffs following a postulated transportation accident.

Table 6-11 presents the environmental consequences calculated by the NRC staff for transportation accidents when shipping spent fuel from the VCSNS site and alternative sites to the proposed geologic HLW repository at Yucca Mountain. The shipping distances and population-distribution information for the routes were the same as those used for the normal “incident-free” conditions (see Section 6.2.2.1). The results are normalized to the WASH-1238 reference reactor (880-MW(e) net electrical generation, 1100-MW(e) reactor operating at 80-percent capacity) to provide a common basis for comparison to the impacts listed in Table S–4. Note that the impacts for all site alternatives are less than the reference LWR impacts. Also, although there are slight differences in impacts among the alternative sites, none of the alternative sites would be clearly favored over the VCSNS site.

Table 6-11. Annual Spent-Fuel Transportation Accident Impacts for a Westinghouse AP1000 Reactor at the VCSNS Site and Alternative Sites, Normalized to the Reference 1100-MW(e) LWR Net Electrical Generation

	Normalized Population Impacts, person-rem/yr[(a)]
Reference LWR (WASH-1238)	2.7×10^{-5}
VCSNS Site[(b)]	1.8×10^{-5}
CGS	2.0×10^{-5}
Saluda	1.7×10^{-5}
SR	3.9×10^{-5}

(a) Multiply person-rem/yr times 0.01 to obtain person-Sv/yr.
(b) The transportation impacts for the FA-1 site are not explicitly analyzed in this EIS. Shipping distances, population distributions, and transportation impacts are approximately the same as those for the VCSNS Site.
LWR = light water reactor

Using the linear no-threshold dose-response relationship discussed in Section 6.2.1.1, the annual risk to the public from accidents during transportation of spent fuel from the VCSNS site and alternative sites to the proposed geologic HLW repository at Yucca Mountain is lower than the value of 1754 person-rem that ICRP (2007) and NCRP (1995) suggest would most likely result in zero excess health effects. This risk is very small compared to the estimated 2.1×10^5 person-rem that the same population along the route from the proposed VCSNS site to the proposed geologic HLW repository at Yucca Mountain would incur annually from exposure to natural sources of radiation. Note that the estimated population dose to persons along the VCSNS-to-Yucca-Mountain route is different than the population dose calculated by the NRC staff for unirradiated fuel shipments in Section 6.2.1.1 because the route characteristics are different.

The NRC staff performed a confirmatory evaluation of SCE&G’s spent-fuel transportation accident risk analysis. It was noted that SCE&G used a different, though valid, methodology for the ER calculations. The primary difference was that SCE&G assumed aggregated route parameters, whereas in this EIS the NRC staff used state-by-state shipping distances and population densities. The staff concluded that SCE&G's analysis was reasonable and comprehensive and thus was considered to meet the intent of 10 CFR 51.52(b).

6.2.2.3 Nonradiological Impact of Spent-Fuel Shipments

The general approach used to calculate nonradiological impacts of spent-fuel shipments is the same as that used for unirradiated fuel shipments. The main difference is that the spent-fuel shipping route characteristics are better defined so the State-level accident statistics from Saricks and Tompkins (1999) may be used. State-by-state shipping distances were obtained from the TRAGIS output file and combined with the annual number of shipments and accident, injury, and fatality rates by state from Saricks and Tompkins (1999) to calculate nonradiological impacts. In addition, the accident, injury, and fatality rates from Saricks and Tompkins (1999) were adjusted to account for under-reporting (see Section 6.2.1.3). The results calculated by the NRC staff are shown in Table 6-12.

Table 6-12. Nonradiological Impacts of Transporting Spent Fuel from the VCSNS Site and Alternative Sites to the Proposed Geologic Repository at Yucca Mountain, Nevada, Normalized to the Reference LWR

Site	One-Way Shipping Distance, km	Nonradiological Impacts, per year		
		Accidents/yr	Injuries/yr	Fatalities/yr
VCSNS (preferred site)[a]	4096	1.1×10^{-1}	7.1×10^{-2}	5.6×10^{-3}
CGS	4202	1.2×10^{-1}	7.4×10^{-2}	5.9×10^{-3}
Saluda	4077	1.1×10^{-1}	7.0×10^{-2}	5.5×10^{-3}
SR	4094	1.3×10^{-1}	8.0×10^{-2}	5.7×10^{-3}

Note: The number of shipments of spent fuel assumed in the calculations is 46 shipments/yr after normalizing to the reference light water reactor.
(a) The transportation impacts for the FA-1 site are not explicitly analyzed in this EIS. Shipping distances, population distributions, and transportation impacts are approximately the same as those for the VCSNS Site.

6.2.3 Transportation of Radioactive Waste Other Than Spent Fuel

This section discusses the environmental effects of transporting radioactive waste other than spent fuel from the VCSNS site and alternative sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- Radioactive waste (except spent fuel) would be packaged and in solid form.
- Radioactive waste (except spent fuel) would be shipped from the reactor by truck or railroad.
- The weight limitation of 73,000 lb per truck and 100 tons per cask per railcar would be met.

- Traffic density would be less than the one truck shipment per day or three railcars per month condition.

Radioactive waste other than spent fuel from the Westinghouse AP1000 reactor is expected to be capable of being shipped in compliance with Federal or State weight restrictions. Table 6-13 presents the NRC staff's estimates of annual waste volumes and annual waste-shipment numbers for a Westinghouse AP1000 reactor normalized to the reference 1100-MW(e) LWR defined in WASH-1238 (AEC 1972). The expected annual radioactive waste volumes for the Westinghouse AP1000 reactor, except for spent fuel, was estimated at 1964 ft^3/yr per unit, and the annual number of waste shipments was estimated at 21 shipments per year (SCE&G 2010). The expected annual waste volume is less than that for the 1100-MW(e) reference reactor that was the basis for Table S–4. Therefore, the number of radioactive waste shipments for the

Table 6-13. Summary of Radioactive Waste Shipments from the VCSNS Site and Alternative Sites

Reactor Type	**Waste Generation Information**	**Annual Waste Volume, m^3/yr per Unit**	**Electrical Output, MW(e) per Unit**	**Normalized Rate, m^3/1100-MW(e) Unit (880 MW(e) Net)**[(a)]	**Shipments/ 1100-MW(e) (880 MW(e) Net) Electrical Output**[(b)]
Reference LWR (WASH-1238)	3800 ft^3/yr per unit	108	1100	108	46[(b)]
VCSNS and alternative sites Westinghouse AP1000 reactor (expected)	1964 ft^3/yr per unit[(c)]	56	1107	48	21[(d)]
VCSNS and alternative sites Westinghouse AP1000 reactor (maximum)	5717 ft^3/yr per unit[(c)]	162	1107	138	60[(d)]

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 L (0.21 m^3).

(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are 80 percent for the reference LWR (AEC 1972) and 93 percent for the Westinghouse AP1000 (SCE&G 2010). Waste generation for the Westinghouse AP1000 is normalized to 880 MW(e) net electrical output (1100-MW(e) unit with an 80-percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste-shipment capacity of 2.34 m^3 (82.6 ft^3) per shipment.

(c) These values were taken from the ER (SCE&G 2010) and are the same as the waste-generation estimates in the AP1000 Design Control Document (Westinghouse 2007).

(d) This value was obtained by normalizing the SCE&G (2010) estimate (15 shipments/yr) to the reference-LWR electrical generation output. If the WASH-1238 shipment capacity is used (2.34 m^3 per shipment) in lieu of the SCE&G (2010) annual shipment estimate, the normalized shipments from the Westinghouse AP1000 would be about 53 shipments per year.

Westinghouse AP1000 is smaller than the reference LWR. The NRC staff reviewed the radioactive waste generation and shipment data in the ER (SCE&G 2010) and concluded that the information is consistent with current LWR operating experience. Therefore, the number of shipments of radioactive waste, other than spent fuel, to disposal facilities is expected to be smaller than the reference LWR in WASH-1238.

The sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste for a Westinghouse AP1000 reactor located at the VCSNS site and alternative sites is less than the one-truck-shipment-per-day condition given in 10 CFR 51.52, Table S–4.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and waste under normal conditions are presented in Section 6.2.1.1.

Nonradiological impacts of radioactive waste shipments were calculated using the same general approach used for unirradiated and spent-fuel shipments. For this EIS, the shipping distance was assumed to be 500 mi one way (AEC 1972). Because the actual destination is uncertain, national median accident, injury, and fatality rates were used in the calculations (Saricks and Tompkins 1999). These rates were adjusted to account for under-reporting, as described in Section 6.2.1.3. The results calculated by the NRC staff are presented in Table 6-14. As shown, the calculated nonradiological impacts for transportation of radioactive waste other than spent fuel from the VCSNS site and alternative sites to waste disposal facilities are less than the impacts calculated for the reference LWR in WASH-1238.

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from the VCSNS Site

	Normalized Shipments per Year	One-Way Distance, km	Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (WASH-1238)	46	800	3.4×10^{-2}	1.7×10^{-2}	1.1×10^{-3}
VCSNS Westinghouse AP1000 reactor (expected waste volume)	21	800	1.6×10^{-2}	7.8×10^{-3}	4.9×10^{-4}

Note: The shipments and impacts have been normalized to the reference light water reactor (LWR); the expected waste volumes and shipments from the Westinghouse AP1000 (SCE&G 2010) were used.

6.2.4 Conclusions

The NRC staff conducted a confirmatory analysis and performed independent calculations of potential impacts under normal and accident conditions of transporting fuel and wastes to and from a Westinghouse AP1000 reactor proposed to be located at the VCSNS site and alternative sites. To make comparisons with Table S–4, the environmental impacts were adjusted (that is, normalized) to the environmental impacts associated with the reference LWR in WASH-1238

(AEC 1972) by multiplying the Westinghouse AP1000 impact estimates by the ratio of the total electric output for the reference reactor to the electric output of the proposed reactor.

Because of the conservative approaches and data used to calculate impacts, the actual environmental effects are not likely to exceed those calculated in this EIS. Thus, the NRC staff concludes that the environmental impacts of transportation of fuel and radioactive wastes to and from the VCSNS site and alternative sites would be SMALL, and would be consistent with the environmental impacts associated with transportation of materials, personnel, fuel, and radioactive wastes from current-generation reactors presented in Table S–4 of 10 CFR 51.52.

The NRC staff notes that on March 3, 2010, DOE submitted a motion to the Atomic Safety and Licensing Board to withdraw with prejudice its application for a permanent geologic repository at Yucca Mountain, Nevada (DOE 2010). Regardless of the outcome of this motion, the NRC staff concludes that transportation impacts are roughly proportional to the distance from the reactor site to the repository site, in this case South Carolina to Nevada. The distance from the VCSNS site or any of the alternate sites to any new planned repository in the contiguous United States would be no more than double the distance from the VCSNS site to Yucca Mountain. Doubling the environmental impact estimates from the transportation of spent reactor fuel, as presented in this section, would provide a reasonable bounding estimate for the impacts for NEPA purposes. The NRC staff concludes that the environmental impacts of these doubled estimates would still be SMALL.

6.3 Decommissioning Impacts

At the end of the operating life of a power reactor, NRC regulations require that the facility be decommissioned. The NRC defines decommissioning as the safe removal of a facility from service and the reduction of residual radioactivity to a level that permits termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75 and 10 CFR 50.82. The radiological criteria for termination of the NRC license are in 10 CFR Part 20, Subpart E.

An applicant for a COL is required to certify that sufficient funds will be available for radiological decommissioning at the end of power-generation operations. As part of its COL application for the proposed Units 2 and 3 on the VCSNS site, SCE&G included a Decommissioning Funding Assurance Report (SCE&G 2008). SCE&G and Santee Cooper (the State-owned electric and water utility, formally called the South Carolina Public Service Authority) would establish an external sinking-funds account to accumulate funds for decommissioning.

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement I, Regarding the Decommissioning of Nuclear Power Reactors* (GEIS-DECOM), NUREG-0586 Supplement 1

(NRC 2002). Environmental impacts of the DECON, SAFSTOR, and ENTOMB decommissioning methods are evaluated in the GEIS-DECOM. A COL applicant is not required to identify a decommissioning method at the time of the COL application. The staff's evaluation of the environmental impacts of decommissioning presented in the GEIS-DECOM identifies a range of impacts for each environmental issue for a range of different reactor designs. The NRC staff concludes that the construction methods that would be used for the AP1000 are not sufficiently different from the construction methods used for the current plants to significantly affect the impacts evaluated in the GEIS-DECOM. Therefore, the NRC staff concludes that the impacts discussed in the GEIS-DECOM remain bounding for reactors deployed after 2002, including the AP1000.

The GEIS-DECOM does not specifically address the carbon footprint of decommissioning activities. However, it does list the decommissioning activities and states that the decommissioning workforce would be expected to be smaller than the operational workforce and that the decontamination and demolition activities could take up to 10 years to complete. Finally, it discusses SAFSTOR, in which decontamination and dismantlement are delayed for a number of years. Given this information, the NRC staff estimated the CO_2 footprint of decommissioning to be of the order of 70,000 MT without SAFSTOR. This footprint is about equally split between decommissioning workforce transportation and equipment usage. The details of the NRC staff's estimate are presented in Appendix J. A 40-year SAFSTOR period would increase the footprint of decommissioning by about 40 percent. These CO_2 footprints are roughly three orders of magnitude lower than the CO_2 footprint presented in Section 6.1.3 for the uranium fuel cycle.

Therefore, the staff relies upon the bases established in the GEIS-DECOM, and concludes the following:

1. Doses to the public would be well below applicable regulatory standards, regardless of which decommissioning method considered in the GEIS-DECOM is used.
2. Occupational doses would be well below applicable regulatory standards during the license term.
3. The quantities of Class C or greater-than Class C wastes generated would be comparable to or smaller than the amounts of solid waste generated by reactors licensed before 2002.
4. The air quality impacts of decommissioning are expected to be negligible at the end of the operating term.
5. Measures are readily available to avoid potential significant water-quality impacts from erosion or spills. The liquid radioactive-waste system design includes features to limit release of radioactive material to the environment, such as pipe chases and tank collection basins. These features will minimize the amount of radioactive material in spills and leakage that would have to be addressed at decommissioning.

6. The ecological impacts of decommissioning are expected to be negligible.
7. The socioeconomic impacts would be short-term and could be offset by decreases in population and economic diversification.

On the basis of the GEIS-DECOM, and the evaluation of air quality impacts from greenhouse gas emissions above, the NRC staff concludes that, as long as the regulatory requirements on decommissioning activities to limit the impacts of decommissioning are met, the decommissioning activities would result in a SMALL impact.

6.4 References

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 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

10 CFR Part 961. Code of Federal Regulations, Title 10, *Energy*, Part 961, "Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

49 CFR Part 173. Code of Federal Regulations, Title 49, *Protection of Environment*, Part 173, "Shippers-General Requirements for Shipments and Packagings."

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7.0 Cumulative Impacts

The National Environmental Policy Act of 1969, as amended (NEPA), requires Federal agencies to consider the cumulative impacts of proposals under its review. Cumulative impacts may result when the environmental effects associated with the proposed action are overlaid or added to temporary or permanent effects associated with past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. When evaluating the potential impacts of two new units at the Virgil C. Summer Nuclear Station (VCSNS) site proposed by South Carolina Electric and Gas (SCE&G) in its application for combined construction permits and operating licenses (COLs) (SCE&G 2008), U.S. Nuclear Regulatory Commission (NRC) staff and U.S. Army Corps of Engineers (USACE) staff considered potential cumulative impacts on resources that could be affected by the construction, preconstruction, and operation of two Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactors at the VCSNS site. Cumulative impacts result when the effects of an action are added to or interact with other past, present, and reasonably foreseeable future effects on the same resources. For the purposes of this analysis, past actions are those prior to the receipt of the COL application. Present actions are those related to resources from the time of the COL application until the start of NRC-authorized construction of the proposed new units. Future actions are those that are reasonably foreseeable through building and operating proposed VCSNS Units 2 and 3, including decommissioning. The geographic area over which past, present, and reasonably foreseeable future actions could contribute to cumulative impacts is dependent on the type of resource considered and is described below for each resource area. The review team considered, among other things, cumulative effects of proposed Units 2 and 3 with current operations at VCSNS Unit 1.

The approach for evaluating cumulative impacts in this environmental impact statement (EIS) is outlined in the following discussion. To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on guidance developed by the Council on Environmental Quality (CEQ) (Title 40 of the Code of Federal Regulations [CFR] 1508.27). The three significance levels established by the NRC – SMALL, MODERATE, or LARGE – are defined 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.

The impacts of the proposed action, as described in Chapters 4 and 5, are combined with other past, present, and reasonably foreseeable future actions near the VCSNS site that would affect the same resources affected by proposed VCSNS Units 2 and 3, regardless of what agency (Federal or non-Federal) or person undertakes such actions. These combined impacts are defined by CEQ as “cumulative” in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE cumulative impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

The description of the affected environment in Chapter 2 serves as the baseline for the cumulative impacts analysis, including the effects of past actions. The incremental impacts related to the construction activities requiring NRC authorization (10 CFR 50.10(a)) are described and characterized in Chapter 4 and those related to operations are described in Chapter 5. These impacts are summarized for each resource area in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area. This chapter includes an overall cumulative impact assessment for each resource area, following guidance provided in NRC Staff Memorandum “Addressing Construction and Preconstruction Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues In Environmental Impact Statements” (NRC 2010).

The specific resources and components that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were assessed. This assessment includes the impacts of construction and operation of the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning as described in Chapter 6; and impacts from past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could affect the same resources affected by the proposed actions.

The review team visited the VCSNS site from March 8 through 13, 2009. The team then used the information provided in the Environmental Report, responses to Requests for Additional Information, information from other Federal and State agencies, and information gathered during the visits to the VCSNS site to evaluate the cumulative impacts of building and operating two new nuclear power plants at the site. To inform the cumulative analysis, the review team researched U.S. Environmental Protection Agency (EPA) databases for recent EISs, used an EPA database for permits for water discharges in the geographic area to identify water-use projects, and used the www.recovery.gov website to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Other actions and projects that were identified during this review and considered in the review team's independent analysis of the potential cumulative effects are described in Table 7-1.

Table 7-1. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Analysis

Project Name	Summary of Project	Location	Status
Energy Projects			
VCSNS Unit 1	VCSNS Unit 1 consists of one 996-MW(e) nuclear power generating plant.	<1 mi north of proposed VCSNS Units 2 and 3	VCSNS Unit 1 is currently operational and is licensed to continue operations through August 6, 2042[(a)]
Independent Spent Fuel Storage Installation	Dry spent-fuel storage	Same general location as VCSNS Units 2 and 3	Proposed[(b)]
Old Steam Generator Recycle Facility	Decommissioned steam generator storage	Same general location as VCSNS Unit 2 and 3	Operational[(c)]
Carolinas-Virginia Tube Reactor (CVTR)	Experimental pressurized tube heavy water nuclear power reactor	About 2 miles south of VCSNS Unit 1	Decommissioned[(v)]
SCE&G Parr Hydroelectric Generating Station (Parr Hydroelectric Plant)	14-MW(e) hydroelectric plant	<1 mi south of VCSNS on Broad River	Operational[(d)]
SCE&G Fairfield Pumped Storage Facility (FPSF)	511.2-MW(e) hydroelectric plant. VCSNS Units 2 and 3 would use water supply from this facility	<2 mi northwest of VCSNS on Parr Reservoir (Broad River)	Operational[(b)]
SCE&G Parr Combustion Facility	71-MW(e) natural gas electric generating plant	About 2 mi south of VCSNS	Operational[(v)]
Lee Nuclear Station	Two 1199.5-MW(e) Westinghouse AP1000 pressurized water reactors	About 52 mi north	Proposed new nuclear plant. Operation would begin in 2021[(e)]
Catawba Nuclear Station, Units 1 and 2	Two 1129-MW(e) Westinghouse reactors	About 54 mi north-northeast	Operational[(f)]
H.B. Robinson Steam Electric Plant, Unit 2	Nuclear power generating plant with one 710-MW(e) unit	About 66 mi east	Operational[(g)]
McGuire Nuclear Station, Units 1 and 2	Two 1100-MW(e) Westinghouse reactors	About 80 mi north-northeast	Operational[(h)]

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Vogtle Electric Generating Plant (VEGP)	Nuclear power generating plant with 2 units, VEGP 1 (1109 MW(e)) and VEGP 2 (1127 MW(e))	Approx 80 mi south-southwest	Operational[i]
VEGP Units 3 and 4	Nuclear power generating plant with two 1117-MW(e) Westinghouse AP1000 pressurized water reactors	Approx 80 mi south-southwest	Proposed[j] Pre-construction activities have commenced. NRC Limited Work Authorization has been issued. Commercial operations are estimated to begin in 2016 for Unit 3 and 2017 for Unit 4.
Oconee Nuclear Station, Units 1, 2, and 3	Three 846-MW(e) Babcock and Wilcox reactors	About 96 mi west-northwest	Operational[b]
Buzzard Roost Combustion Turbine Station	196-MW oil/gas-fired peaking facility	Approx 35 mi west-southwest	Operational[k]
Buzzard's Roost Dam	15-MW hydroelectric facility	Approx 35 mi west-southwest	Operational[l]
Westinghouse Fuel Fabrication Plant in Columbia, South Carolina	Design and fabricate completed nuclear fuel assemblies and fuel-related products, such as top and bottom nozzles, control rods, and Zirconium Diboride and Erbia integral fuel burnable absorbers for pressurized water reactors and Vodo-Vodyanoi Energetichesky Reactors.	About 26 mi southwest	Operational[m]
Six Broad River Hydroelectric Projects	Hydroelectric facilities	5 upstream on the Broad River and 1 downstream on the Broad River	Operational[b]
Mining Projects			
Vulcan Materials Company/ Blair Quarry	Products include asphalt aggregate, base material, concrete, aggregate, and manufactured sand	Approximately 10 mi north of VCSNS	Operational[n]
Transportation Projects			
South Carolina Strategic Corridor System Plan	Strategic system of corridors forming the backbone of the state's transportation system.	State-wide	Planning document with no explicit schedules for projects, however, many strategic corridors coincide with routes which would/could be used for development at the VCSNS site[o]

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Parks and Aquaculture Facilities			
Sumter National Forest	371,000-ac National Forest.	Located about 9 mi northwest of VCSNS boundary	Currently managed by U.S. Forest Service[p]
Parr Hydro Wildlife Management Area	4400-ac wildlife management area	Adjacent to VCSNS	Currently managed by the South Carolina Department of Natural Resources[b]
Other Actions/Projects			
City of Columbia	Municipal water withdrawals from the Broad River	About 26 mi southeast	Ongoing[b]
Various hospitals and industrial facilities that use radioactive materials	Medical isotopes	Within 50 mi	Operational in Columbia, Lexington, Newberry, Rock Hill, Lancaster, Laurens, Greenwood, and Camden
Cone Mills Carlisle Finishing Co.	Fabric finisher	About 22 mi. north of VCSNS on Broad River	Operational[q]
Chemtrade Performance Chemicals, LLC	Industrial Inorganic Chemicals	About 23 mi north of VCSNS on Broad River	Operational[r]
Newberry County Water and Sewer Authority (NCW&SA)/Cannons Creek Waste Water Treatment Plant (WWTP)	Waste water treatment	About 8 mi west of VCSNS	Operational[s]
NCW&SA Broad River Wastewater Treatment Facility (WWTF) Phase 1	Waste water treatment	About 12 mi west of VCSNS	Deactivated, discharge permit expired[t]
SCE&G Combined Site Emergency Operations Facility	A new combined site emergency operations facility	10 mi from VCSNS	Operational[u]
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroad; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents. There is a low-to-moderate potential for increase urbanization within the	Throughout region	Construction would occur in the future, as described in State and local land-use planning documents.

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
	Broad River watershed in Newberry and Fairfield Counties, South Carolina. The highest potential for development would be associated with residential development around the reservoirs, the Towns of Prosperity and Pomaria, and the City of Newberry. Sumter National Forest would limit urbanization north of VCSNS.		

(a) Source: NRC 2004
(b) Source: SCE&G 2010a
(c) Source: NRC GEIS (NRC 1996)
(d) Source: EPA 2009a
(e) Source: NRC 2009a
(f) Source: NRC 2009b
(g) Source: NRC 2009c
(h) Source: NRC 2009d
(i) Source: NRC 2009e
(j) Source: NRC 2009f
(k) Source: Duke 2009a
(l) Source: Greenwood County 2008
(m) Source: Westinghouse 2009
(n) Source: SCDHEC 2007a
(o) Source: SCDOT 2009
(p) Source: USFS 2004
(q) Source: EPA 2009b
(r) Source: EPA 2009c
(s) Source: EPA 2009d
(t) Source: EPA 2009e,g
(u) Source: SCE&G 2010c
(v) Source: SCE&G 2011

7.1 Land Use

The description of the affected environment in Section 2.2 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.1, the impacts of NRC-authorized construction activities on land use would be SMALL, and no further mitigation would be warranted. As described in Section 5.1 of this EIS, the review team concludes that the impacts of operations on land use would also be SMALL, and no further mitigation would be warranted.

The combined impacts from construction and preconstruction were described in Section 4.1 and were determined to be MODERATE locally where new transmission lines would be installed and SMALL at the site. Overall, the combined impacts of preconstruction, construction, and operation of all of the proposed VCSNS facilities can be described as MODERATE. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could affect land use. For this cumulative analysis, the geographic area of interest is considered to be the 50-mi region described in Section 2.2.3, plus any transmission-line corridors that extend beyond that range. Most but not all of the transmission-line corridor length falls within a 50-mi radius of the site. Although Fairfield County has adopted a zoning ordinance and developed a comprehensive plan specific to the county, land-use planning for transmission-line routing over wide areas must consider land-use plans of adjoining counties and other land-managing agencies, rather than considering one county in isolation. Further, in predominately rural settings such as that surrounding the VCSNS site, land-use changes occurring substantial distances away from a project site can substantially influence land-planning decisions close to the site. Roads and other public facilities and services in rural areas tend to serve people who are spread thinly but broadly over large portions of the landscape. Therefore, land-use changes can affect roads and other facilities at greater distances than similar changes in more densely populated areas.

The VCSNS site is located in a sparsely populated, largely rural area, with forests and small farms composing the dominant land use. This Piedmont terrain varies from gently rolling to hilly and is punctuated by relatively narrow stream valleys. Historically, most upland areas have been used for crop production, but presently they are used for silviculture. Jenkinsville and Peak are the closest communities. Monticello Reservoir was created by impounding Frees Creek as part of the Unit 1 development, and since then portions of the shoreline have experienced private residential and public recreational development. Several electric transmission lines, State routes, and interstate highways currently traverse the region. Industries and facilities that have historically affected the land use near VCSNS are described in Table 7-1. The proposed project would result in land conversions to residential areas, roads, and businesses to accommodate growth, new workers, and services related to the proposed nuclear facility. Other reasonably foreseeable projects in the area that could contribute to an increase in urbanization include potential residences along the Monticello Reservoir. This would result in a conversion of open areas, forests, and wetlands to residential areas. There are no specific plans to build new or widen existing roads in the area, other than those described for proposed VCSNS Units 2 and 3. The amount of land to be converted to residences, roads, or businesses would be minimal compared to the amount of land available in the area.

Because the other projects described in Table 7-1 do not include any reasonably foreseeable changes in types of land use within 50 mi of the VCSNS, other than the Monticello Reservoir shoreline development discussed above, there would not be any significant additional cumulative impacts on land use from those activities.

As described in Section 4.1, approximately 6.5 mi of new transmission-line corridors would be built in areas not adjacent to existing transmission-line corridors. In addition, approximately

39 mi of transmission lines would be built in widened rights-of-way adjacent to existing transmission-line rights-of-way. These corridor impacts would amount to the conversion of existing land uses, especially forest cover and silviculture, on about 426 ac of which 204 ac are currently forested. These corridor impacts would noticeably alter land-use patterns within the geographic area of interest.

Cumulative land-use impacts within the geographic area of interest would be consistent with existing land-use plans and zoning. However, due to the potential clearing of forested acreage caused by transmission-line development, especially for the 45 mi that would not be built within existing transmission-line rights-of-way, the review team concludes that the cumulative land-use impacts associated with the proposed Units 2 and 3, related transmission-line corridors, and other projects in the geographic area of interest would be MODERATE.

Construction of transmission lines does not require NRC authorization; therefore, the NRC staff concludes that the incremental impacts from NRC-authorized activities for proposed Units 2 and 3, which are limited to the proposed VCSNS site, would be SMALL and would not noticeably alter land-use patterns within the geographic area of interest. The incremental impacts associated with developing the proposed transmission lines, especially those not routed within or adjacent to existing transmission-line corridors, are the principal contributor to the MODERATE rating of cumulative impacts.

7.2 Water Use and Quality

This section addresses the cumulative impacts of the proposed new units, the existing VCSNS units, and other past, present, and reasonably foreseeable future projects on water use and quality.

7.2.1 Water-Use Impacts

This section describes the cumulative water-use impacts from construction, preconstruction, and operation of proposed Units 2 and 3 and other past, present, and reasonably foreseeable projects.

7.2.1.1 Surface-Water-Use Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for surface-water use. As described in Section 4.2.2.1, the impacts from NRC-authorized construction on surface-water use would be SMALL, and no further mitigation would be warranted. As described in Section 5.2.2.1, the review team concludes that the impacts of operations on surface-water use would also be SMALL, and no further mitigation would be warranted.

The combined surface-water-use impacts from construction and preconstruction are described in Section 4.2.2.1 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for surface-water use also considers other past, present, and reasonably foreseeable future actions that could potentially affect this resource. For the cumulative analysis of impacts of surface water, the geographic area of interest is considered to be the drainage basin of the Broad River upstream and downstream of the VCSNS site because other actions within this region could result in a cumulative impact. The Broad River has provided water for agricultural, industrial, and municipal use since colonial times. Dams have been installed on the river to provide flood control, increase the reliability of water supply to the region, and to provide power. Key actions that have current and reasonably foreseeable future potential impacts on surface-water supply in the Broad River basin include operation of VCSNS Unit 1, operation of the Fairfield Pumped Storage Facility (FPSF) that connects Monticello Reservoir with Parr Reservoir, the SCE&G Parr Hydroelectric Generating Station (or Plant), and the proposed William States Lee III Nuclear Station in Cherokee County, South Carolina (Lee Nuclear Station).

Peak water needs during construction and preconstruction, as described in Section 4.2.2.1, are estimated to be 420 gpm (approximately 1 cfs) (SCE&G 2010a). This represents less than 1 percent of the 7Q10 (lowest flow for 7 consecutive days expected to occur once per decade) estimated for Broad River (SCE&G 2010a) and the impact of its use would not be noticeable. The surface-water-use impacts of construction, preconstruction, and operation are dominated by the higher demands that would occur under normal operation. The projected consumptive water use of proposed Units 2 and 3 is expected to be about 62 cfs or 1 percent of the average river discharge of6300 cfs near the site, as described in Section 5.2.2.1. This average river flow reflects upstream cumulative consumptive uses of current users including the consumptive use associated with VCSNS Unit 1. Increases in consumptive use of water in the Broad River drainage is anticipated in the future. For example, Duke Energy is proposing to build two nuclear reactors at the Lee Nuclear Station (Duke 2009b). Duke has prepared an assessment of water availability and projected use for the Broad River to determine the availability of water to support expansions of Duke's generating capability (Duke 2007). Duke considered future agriculture and irrigation projects, power projections, public water supplies and wastewater projections, and future industrial use. Duke also considered future trends in water use such as water reuse, water conservation, and changes in regulations and the regional economy. The Duke study does not consider the impact of climate change. The study indicates that consumptive water use would increase in the Broad River drainage from the 241.5 cfs (0.33 ac-ft/yr) in 2006 to 412.9 cfs (0.57 ac-ft/yr) by 2070. Duke asserts in the document that the study will enable it to plan for water needs and develop water-storage facilities necessary to support the operation of its proposed facilities. Similarly, SCE&G asserts that the impact of consumptive use by VCSNS Units 1, 2, and 3 during low flows can be mitigated by using water from Monticello Reservoir. Because both the Lee Nuclear Station and VCSNS Units 1, 2, and 3 would rely on water from reservoirs during period of low flow, impacts would not likely noticeably alter surface-water resources in the Broad River. The impacts of other projects listed in Table 7-1 are considered in the analysis included in Sections 4.2 and 5.2 or would have little or no impact on surface-water use.

The review team is also aware of the potential climate changes that could affect the water resources available for cooling and the impacts of reactor operations on water resources for other users. A recent compilation of the state of the knowledge in this area (Karl et al. 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region during the life of proposed VCSNS Units 2 and 3 site include an increase in average temperature of 2 to 3°F and a decrease in precipitation in the winter, spring, and summer and a small increase in the fall (Karl et al. 2009, figures on pp. 28, 29, 31). Changes in climate during the life of proposed Units 2 and 3 could result in either an increase or decrease in the amount of runoff; the divergence in model projections for the southeastern United States precludes a definitive estimate (Karl et al. 2009, figures on p. 45). While the changes that are attributed to climate change in these studies are not insignificant, the review team did not identify anything that suggests the cumulative impacts would noticeably alter this resource.

The review team has examined the cumulative consumptive use of surface water from the operation of VCSNS Unit 1 and proposed Units 2 and 3 and other consumptive uses (existing or reasonably foreseeable user) and potential impacts from climate change. Although the cumulative effects on surface-water use may be detectable, they would not noticeably alter the resource. Based on its evaluation, the review team concludes that the cumulative impacts on surface-water use would be SMALL, and no mitigation would be warranted.

7.2.1.2 Groundwater-Use Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for groundwater use. As described in Section 4.2.2.2, the impacts from NRC-authorized construction on groundwater use would be SMALL, and no further mitigation would be warranted. As described in Section 5.2.2.2, the review team concludes that the impacts of operations on groundwater use would also be SMALL, and no further mitigation would be warranted.

The combined groundwater-use impacts from construction and preconstruction are described in Section 4.2.2.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for groundwater use also considers other past, present, and reasonably foreseeable future actions that could potentially affect this resource. For the cumulative analysis of impacts on groundwater two geographic areas of interest have been identified – the VCSNS site and Fairfield County, South Carolina. The geographic area of interest affected by dewatering activities for construction and preconstruction activities is limited to the VCSNS site because local bodies of surface water along the project boundaries (Mayo Creek, Broad River, Parr Reservoir, and Monticello

Reservoir) limit the influence of dewatering beyond those features. Fairfield County is considered a region of interest for groundwater production because water from the Jenkinsville water-supply system would be used for construction and preconstruction of proposed Units 2 and 3 until SCE&G completes the proposed water-treatment plant. The Jenkinsville water-supply system obtains a portion of its water from groundwater wells and is located in Fairfield County.

Impacts on groundwater use on the VCSNS site would be localized and temporary during both construction and preconstruction, as discussed in Section 4.2.2.2. As mentioned above, the groundwater withdrawals on the VCSNS site would not contribute to a cumulative impact offsite because local bodies of surface water along the project boundaries (Mayo Creek, Broad River, Parr Reservoir, and Monticello Reservoir) limit the influence of onsite withdrawals beyond those features.

Impacts on groundwater use in Fairfield County would be minimal. As described in Section 4.2, SCE&G has indicated that a portion of the water needed for construction and preconstruction would be supplied by the Jenkinsville Water District. The Jenkinsville Water District obtains a portion of its water from groundwater wells but also has an excess capacity of 1 Mgd through its agreements with other nearby water districts (SCE&G 2010a). As mentioned in Section 4.2.2.2, the excess capacity is from surface-water sources.

Groundwater supplies less than 10 percent of the water used for public water supplies in Fairfield County (SCDHEC 2007b). South Carolina requires that any user withdrawing more than 3 million gallons per month in any given month from surface water or groundwater report its withdrawal to the State. The 2006 water-use summary report for South Carolina reports no groundwater use for industrial, agricultural, or power generation for Fairfield County (SCDHEC 2007b).

As discussed in Section 5.2.2.2, impacts on groundwater use during operations are anticipated to be localized because there is no plan to use groundwater or to discharge waste to groundwater during operations. No other projects listed in Table 7-1 would affect groundwater at the VCSNS site. As mentioned in Section 3.4.2.1, impacts on groundwater use in Fairfield County during operations are not anticipated because VCSNS would obtain all water for operations from Monticello Reservoir. Given that the potable water needed for Units 2 and 3 represents less than 2 percent of the excess capacity available, the potable water demand on ground water resources would be temporary until the VCSNS water-treatment plant is completed, and no industrial, agricultural or power generation uses are identified for groundwater, the NRC staff concludes that the cumulative impact on groundwater use in Fairfield County would be minimal.

The review team has examined the cumulative consumptive use of groundwater including the operation of Unit 1 and the proposed Units 2 and 3, and other consumptive uses (existing and reasonably foreseeable users). Based on its evaluation, the review team concludes that the cumulative impacts on groundwater use would be SMALL, and no mitigation would be warranted.

7.2.2 Water-Quality Impacts

This section describes cumulative water-quality impacts resulting from construction, preconstruction, and operation of the proposed VCSNS Units 2 and 3 and impacts from other past, present, and reasonably foreseeable projects.

7.2.2.1 Surface-Water-Quality Impacts

The description of the affected environment in Section 2.3 serves as a baseline for this resource area. As described in Section 4.2.3.1, the impacts from NRC-authorized construction on surface-water quality would be SMALL, and no further mitigation would be warranted. As described in Section 5.2.3.1, the review team concludes that the impacts of operations on surface-water quality would also be SMALL, and no further mitigation would be warranted.

The combined surface-water-quality impacts from construction and preconstruction are described in Section 4.2.3.1 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for surface-water quality also considers other past, present, and reasonably foreseeable future actions that could potentially affect this resource. The geographic area of interest is the same as that described for surface-water use (see Section 7.2.1.1).

The impacts from building and operating proposed Units 2 and 3 were determined to be minimal, and were evaluated using the current conditions in the Broad River. The current conditions include the impact of operations of the VCSNS Unit 1, the FPSF, and the Parr Hydroelectric Plant. The hydrological conditions described in Sections 4.2 and 5.2 also include the impact of the activities listed as currently operational in Table 7-1 that are distinct from the activities at the VCSNS site. Those activities include facilities with National Pollutant Discharge Elimination System (NPDES) permits to discharge water to the river and its tributaries, including the Newberry County Water and Sewer Authority (NCW&SA) Broad River Waste-Water Treatment Plant (WWTP) and NCW&SA Cannons Creek WWTP. The NCW&SA Broad River WWTP has an active NPDES permit for discharge of 34.7 gpm (0.078 cfs) to Cannons Creek, which ultimately flowed into Parr Reservoir up until the permit expired in September of 2007 (EPA 2009e, g). Currently, only the NCW&SA Cannons Creek WWTP has a current NPDES permit (SC0048313) with a discharge of 65,972 gpm (147 cfs) to Cannons Creek (EPA 2009d). Discharge from this WWTP is monitored for compliance with NPDES permitting regulations.

The review team performed an independent assessment of the primary water-quality impacts on the Parr Reservoir and the Broad River in its analysis of the estimated blowdown discharge of Units 2 and 3 (see Section 5.2.3). The review team determined that both the thermal impacts and the impact of discharging solutes and solids concentrated through evaporation in the cooling towers would be minimal and localized to the zone defined by the thermal plume. Table 7-1 identifies the proposed construction of two nuclear reactors at the Lee Nuclear Station. The review team anticipates that operation of this facility would result in a thermal discharge to the Broad River. However, given that it is located more than 50 mi upstream of the discharge for the proposed VCSNS Units 2 and 3, any thermal impact of the proposed Lee station would be undetectable by the time the water reaches Parr Reservoir. The impacts of other projects listed in Table 7-1 are either considered in the analysis included in Sections 4.2 and 5.2 or would have little or no impact on surface-water quality.

Although the cumulative effects on surface-water quality may be detectable, they would not noticeably alter the resource; therefore, the review team concludes that cumulative impacts of surface-water quality would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted.

7.2.2.2 Groundwater-Quality Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for this resource area. The groundwater-quality impacts from NRC-authorized construction are described in Section 4.2.3.2 and were determined to be SMALL. As described in Section 5.2.3.2, the review team concludes that groundwater quality impacts from operation of the two proposed units would be SMALL

The combined groundwater-quality impacts from construction and preconstruction are described in Section 4.2.3.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for groundwater quality also considers other past, present, and reasonably foreseeable future actions that could potentially impact this resource. The geographic area of interest is the same as that described for groundwater use (see Section 7.2.1.2).

As discussed in Section 4.2.3.2, impacts on groundwater quality would be localized and temporary during construction. Impacts on groundwater quality during operations, as discussed in Section 5.2.3.2, are anticipated to be localized because there is no plan to use groundwater or to discharge waste to groundwater during operations. No other projects listed in Table 7-1 would affect groundwater at the VCSNS site.

Although the cumulative effects on groundwater quality may be detectable, they would not noticeably alter the resource; therefore, the review team concludes that cumulative impacts of groundwater quality would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted.

7.3 Ecology

This section addresses the cumulative impacts on terrestrial, wetlands, and aquatic ecological resources as a result of activities associated with the proposed new units at the proposed VCSNS site and past, present, and reasonably foreseeable future activities within the geographic area of interest of each resource.

7.3.1 Terrestrial Ecology and Wetlands

The description of the affected environment in Section 2.4.1 provides the baseline for the cumulative impacts assessments for terrestrial ecological resources. As described in Section 4.3.1, the impacts from NRC-authorized construction on terrestrial and wetlands ecology would be SMALL, and no further mitigation would be warranted. As described in Section 5.3.1, the review team concludes that the impacts of operations on terrestrial and wetlands ecology would also be SMALL, and no further mitigation would be warranted.

The combined impacts from construction and preconstruction were described in Section 4.3.1 and determined to be SMALL for the site and MODERATE for the transmission-line corridors. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could affect terrestrial resources. For the cumulative analysis of terrestrial ecology, the geographic area of interest is considered to be the 6-mi vicinity of the VCSNS site plus the proposed transmission-line corridors and adjacent properties extending 1 mi outward from the center line on each side of each corridor (as defined in Chapter 4). This area is expected to encompass the ecologically relevant landscape features and species potentially affected by proposed Units 2 and 3, including the associated proposed transmission lines. The 1-mi distance from each proposed transmission-line corridor was chosen to include distances used by SCDNR for its elemental occurrence analysis. Current projects within the geographic area of interest include operation of VCSNS Unit 1, the SCE&G Parr Hydroelectric Plant, the FPSF and urbanization. There are no other major current projects in the geographic area of interest that would contribute to cumulative impacts on terrestrial ecological resources. Reasonably foreseeable projects within the geographic area of interest that could affect terrestrial resources include continued regional commercial and residential development, such as new residences along Monticello Reservoir.

The geographic area of interest is located primarily in the South Carolina Southern Outer Piedmont ecoregion (which includes the site) and portions of the transmission-line routes cross the Sandhills and Coastal Plain ecoregions. These ecoregions have been altered considerably since European settlement primarily due to farming, agriculture, and forestry (Godfrey 1980). During the time of early settlement, the forests were primarily a mixture of oaks, hickories, and pines (Kirkman et al. 2007). Currently, most forests in the geographic area of interest are dominated by planted and naturally vegetated pine. The area around the site has also changed dramatically since the damming of the Broad River and of Frees Creek to create the Parr and Monticello reservoirs (SCE&G 2010a; FPC 1974; SCE&G 1977; see historical photos in Chapter 2 [Figure 2-13]). Prior to impoundment, the land currently inundated was primarily forest land, riparian land, and farmland (SCE&G 1977; FPC 1974). There also has been ongoing residential and commercial urbanization within the geographic area of interest.

Most of the geographic area of interest includes open water and rural forested land with scattered small farms. The habitats and wildlife that would be disturbed are common in the region, and are not considered to be unique or critical for the survival of Federally listed threatened or endangered species or for the other important species identified in Section 2.4.1. In addition, the percentage of wetlands and riparian habitats that would be lost due to the preconstruction, construction, and operations of VCSNS Units 2 and 3 represents only a small fraction of the wetlands in the area.

7.3.1.1 Site-Preparation and Site-Development Impacts

The impacts on terrestrial habitats, wetlands, and important species from site preparation and development of the proposed VCSNS Units 2 and 3 and associated transmission lines are described in Section 4.3.1. Proposed future actions that have the potential to result in cumulative impacts on terrestrial resources in the geographic area of interest include the regional urbanization that is expected to continue. The nearby Parr Hydro Wildlife Management Area, however, would continue to be managed for the benefit of wildlife, helping offset habitat losses in the future.

Activities from the projects mentioned above that could contribute to cumulative impacts for terrestrial ecological resources include land clearing and grading (temporary and permanent), filling and/or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabit affected areas. Some wildlife, including some individuals of important species, would perish or be displaced during land clearing for any of the above projects as a consequence of habitat loss, fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities. Undisturbed land adjacent to areas of activity could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from each noise-generating activity is expected to be temporary and minor. The clearing of new transmission-line corridors, as well as other linear features such as roadways and other utility lines, could be beneficial for some species, including those that inhabit early successional habitat or use forest edge environments, such as white-tailed deer (*Odocoileus virginianus*), bobwhite quail (*Colinus virginianus*), eastern meadowlark (*Sturnella magna*), and the gopher tortoise (*Gopherus polyphemus*). Birds of prey, such as red-tailed hawks (*Buteo jamaicensis*) would likely exploit newly created hunting grounds. Forested wetlands within transmission-line and other utility corridors would be converted to, and maintained in, a herbaceous or scrub-shrub condition that could provide improved foraging habitat for some waterfowl and wading birds. However, fragmentation of forests could adversely affect species that are dependent on large tracts of continuous forested habitat. Fragmentation would result in noticeable, but not destabilizing, impacts on continuously forested habitats.

7.3.1.2 Operational Impacts

As described in Section 5.3.1, potential operational impacts would include cooling-tower noise, salt drift from vapor plumes, and avian collisions with tall structures, and transmission-line operation. Although increased urbanization would lead to greater noise and human presence on the landscape, the incremental contribution from operation of the proposed new VCSNS facilities would be minimal. During the review of the VCSNS COL application, no other past, present, or reasonably foreseeable actions in the region were identified that would substantially affect terrestrial ecological resources that would be affected by the operation of the VCSNS Units 2 and 3.

7.3.1.3 Summary of Terrestrial Impacts

Cumulative impacts on terrestrial ecology and wetland resources from construction, preconstruction, and operation of the VCSNS and other past, present, and reasonably foreseeable projects are estimated based on the information provided by SCE&G and the review team's independent review. Due to the extent of habitat loss and fragmentation caused by the proposed new transmission lines and the additional forest fragmentation expected from new roads and utilities serving increased urban development, the review team concludes that the cumulative impacts on terrestrial and wetland resources would be MODERATE. Such fragmentation would result in noticeable, but not destabilizing, impacts on species that are highly dependent on large tracts of continuous forest.

Because most of the terrestrial ecology impacts associated with the project result from the transmission lines, which do not require NRC authorization, the NRC staff concludes that the incremental impacts from NRC-authorized activities (which are limited to the proposed VCSNS site and immediately adjacent lands), would be SMALL and would not noticeably alter the ecology within the geographic area of interest. The incremental impacts associated with developing the proposed transmission lines, especially those not routed within or adjacent to existing transmission-line corridors, are the principal contributor to the MODERATE rating of cumulative impacts.

7.3.2 Aquatic Ecosystem Impacts

The description of the affected environment in Section 2.4.2 serves as a baseline for the cumulative impacts assessment for aquatic ecological resources. As described in Section 4.3.2, the impacts of NRC-authorized construction on aquatic biota would be SMALL, and no further mitigation would be warranted. As described in Section 5.3.2, the review team concludes that impacts of VCSNS Units 2 and 3 operations on aquatic resources inhabiting onsite waterbodies, Monticello Reservoir, and Parr Reservoir, and along the six new offsite transmission lines would be SMALL, and no further mitigation would be warranted.

The combined impacts on aquatic resources from construction and preconstruction were described in Section 4.3.2 and determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable actions that could affect aquatic ecology. For this analysis, the geographic area of interest is considered to be the Broad River drainage basin upstream and downstream of the VCSNS site, Monticello Reservoir, and corresponding intermittent and seasonal streams on the VCSNS site, as the most likely to show the impact of water-use and water-quality criteria for aquatic biota. In addition, waterbodies crossed by the transmission-line corridors (as defined in Table 4-1) include the Santee River basin, Broad River basin, Catawba River basin, Ashepoo-Combahee-Edisto basin, and Pee Dee River basins. Other actions listed in Table 7-1 within the geographic area of interest that have present and reasonably foreseeable future potential impacts on Monticello and Parr reservoirs include operation of VCSNS Unit 1; operation of the FPSF that connects Monticello Reservoir with Parr Reservoir; the NCW&SA Broad River WWTP; the NCW&SA Cannons Creek WWTP; Blair Quarry; SCE&G's Parr Hydroelectric Plant located on the Broad River less than 1 mi southwest of proposed Units 2 and 3; five licensed hydropower facilities upstream of VCSNS on the Broad River; the proposed William States Lee III Nuclear Station in Cherokee County, South Carolina (Lee Nuclear Station); the implementation of the Santee Cooper River Basin Diadromous Fish Passage Restoration Plan (FWS 2001); and the Santee River Basin Accord (SRBA 2008) The evaluation of cumulative impacts from these actions on aquatic biota is described below.

Monticello Reservoir was formed in 1977 by impounding Frees Creek, a tributary to Parr Reservoir. Monticello Reservoir was designed to serve as a source of cooling water for VCSNS Unit 1, to receive thermal and chemical discharge from the VCSNS Unit 1, and to serve as the upper pool for the FPSF located on Parr Reservoir (SCE&G 2010a). Water elevations within Monticello Reservoir are maintained via operation of the FPSF, which pumps water between the Monticello and Parr reservoirs. The increased consumption of water from the Monticello

Reservoir for cooling purposes for VCSNS Units 2 and 3 is expected to be about 1 percent of the average annual Broad River flow at Alston (SCE&G 2010a). Parr Reservoir was created in 1914 by impounding a segment of the Broad River to provide a pool for the original Parr Hydroelectric Plant. In 1977, the size of Parr Reservoir increased to approximately 4400 ac when the height of the dam was increased to accommodate operation of the FPSF (SCE&G 2010a).

Operation of proposed VCSNS Units 2 and 3 would increase the level of impingement and entrainment of aquatic biota in Monticello Reservoir and introduce discharge of effluent to Parr Reservoir. The Unit 1 intake structure impingement and entrainment estimates are discussed in Section 5.3.2. The new circulating-water system (CWS) proposed for VCSNS Units 2 and 3 would operate at a reduced intake velocity (< 0.5 fps versus 0.72 fps for VCSNS Unit 1), with water withdrawal rates varying between 81 cfs for normal operations and 131 cfs for maximum use operations. In addition, the new water-treatment plant (for plant service, potable, demineralized, and fire protection systems) would withdraw 2.2 cfs during normal operations and 6.7 cfs during maximum operations (SCE&G 2010a). Given that the impingement and entrainment rates for Unit 1 are based on a cooling-water withdrawal rate of 1190 cfs, the planned cooling-water withdrawal rate for VCSNS Units 2 and 3 should result in at least a ninefold less potential for impingement and entrainment when compared to Unit 1 impingement and entrainment rates, which were found to result in minimal impacts (NRC 2004). Organisms most vulnerable to impingement and entrainment (see Section 5.3.2.1) at the VCSNS Unit 1 intake structure include taxa that are common and represent appreciable proportions of the standing stocks of fish in Monticello Reservoir (Christie and Stroud 1997). Further, many of these fish, such as gizzard shad (*Dorosoma cepedianum*) and bluegill (*Lepomis macrochirus*), are typically highly fecund and prolific spawners (Rohde et al. 2009).

Blowdown from proposed VCSNS Units 2 and 3 would enter the Parr Reservoir. Because the discharge structure for VCSNS Unit 1 is located on Monticello Reservoir, there would be no direct interaction between the thermal plume from Unit 1 and the plume associated with proposed Units 2 and 3. The proposed blowdown discharge to Parr Reservoir is not likely to noticeably affect the biota, water quality, or consumptive use of the Parr Hydroelectric Plant, and is described in more detail in Section 5.3.2.1. The proposed water-treatment plant associated with VCSNS Units 2 and 3 would discharge effluent into an existing Unit 1 discharge canal in Monticello Reservoir (SCE&G 2010a). Effluent from the water-treatment plant has the potential to affect aquatic biota in Monticello Reservoir; however, the impacts on aquatic biota are expected to be minimal because the discharge waste stream is quite small (from 0.1 to 0.3 fps) and chemical constituents would be regulated by an NPDES permit.

Cumulative impacts on aquatic resources within Monticello and Parr reservoirs may also include activities or events that are distinct from the VCSNS site. Water quality may be affected by discharges from other plants or facilities that maintain hydrologic connectivity to the Monticello and Parr reservoirs, such as wastewater treated discharge that enters Parr Reservoir through Cannons Creek with the current discharge point approximately 8 mi to the west of the VCSNS site. The NCW&SA Broad River WWTP had an active NPDES permit (SC0048020) for discharge of 0.05 Mgd to Cannons Creek. This discharge ultimately flowed into Parr Reservoir until cessation of permitted discharge in January 2008 (EPA 2009g). Currently only the NCW&SA Cannons Creek WWTP has a current NPDES permit (SC0048313) with a discharge of 0.95 Mgd to Cannons Creek (EPA 2009d). Discharge from this operating WWTP is monitored for compliance with NPDES permitting regulations to ensure water-quality metrics do not exceed allowable levels. Given that current discharges do not exceed allowable levels, operation of the NCW&SA Cannons Creek WWTP has minor impacts on aquatic biota. The Blair Quarry, approximately 10 mi north of the VCSNS site in the vicinity of Neal Shoals Dam, has an active permit for granite mining. The Blair Quarry operates under an NPDES permit for minor industrial effluent to Rocky Creek, which feeds into the Broad River (SCDHEC 2007a). Impacts on aquatic biota are considered minor due to the NPDES compliance and minimal effluent discharge.

Parr Shoals Dam is located approximately 1 mi from the proposed discharge location for VCSNS Units 2 and 3. The Parr Hydroelectric Plant at the Parr Shoals Dam generates up to 15 MW through operation of six turbine units (SCE&G 2010a). A minimum daily average flow of 800 cfs results in the transport of aquatic biota within the influence of the turbine intake systems downriver below Parr Shoals. The operation of the hydroelectric plant influences aquatic communities within Parr Reservoir by preventing any organisms that pass through the hydropower facility from returning upstream of the facility. In addition, the operation of the FPSF, which can produce over 511 MW of electricity, results in a daily average fluctuation of 4 ft in water elevation in Parr Reservoir as water is pumped from the Parr Reservoir into Monticello Reservoir and then flows back to Parr Reservoir through the hydroelectric turbines (NRC 2004). This daily pump-and-discharge operation may result in injury or mortality for some aquatic biota, thus contributing to the overall impact on aquatic populations. However, the overall impact is minor with no noticeable changes in local aquatic populations as a result of continuous operations.

Another potential cumulative impact may come from the continued operation of the FPSF that maintains the water elevation within Monticello Reservoir. SCDNR has active fish-stocking programs in the Broad River for smallmouth bass (*Micropterus dolomieu*) and robust redhorse (*Moxostoma robustum*). Both species were recently collected by SCDNR in Monticello Reservoir and may have been transferred via FPSF intake operation from Parr Reservoir to Monticello Reservoir (SCDNR 2009). The intake withdrawal rate from Monticello Reservoir for operation of VCSNS Units 2 and 3 composes a very small fraction of the FPSF pumping rate and would have little to no impact on water use. The combined VCSNS Units 2 and 3 intake rates are approximately 83 (normal) and 138 (max) cfs from Monticello Reservoir (SCE&G 2010a). Toblin (2007) estimates the hourly pumping rate at FPSF to be 19,255 cfs during power generation. Comparison of the VCSNS Units 2 and 3 intake rates (e.g., 83 and 138 cfs) to the FPSF pumping rate of 19,255 cfs shows that VCSNS Units 2 and 3 operations represent less than 1 percent of the flow of the FPSF during pumping operations from Parr Reservoir. It is therefore anticipated that operation of VCSNS Units 2 and 3 would not result in significant cumulative impacts with the current operation of the FPSF.

As described in Section 7.2.1.1, Duke Energy is proposing to build two nuclear reactors at the Lee Nuclear Station (Duke 2009b) that will result in an increase of water use upstream of the VCSNS site. Duke Energy is evaluating the use of an onsite reservoir and a proposed offsite reservoir to supply cooling water during periods of drought at the proposed Lee Nuclear Station. The cumulative effect on water use for VCSNS Units 2 and 3 and any resulting impacts on habitat in the Broad River is expected to be minimal. Thermal effluent from the proposed Lee Nuclear Station is not likely to contribute to cumulative effects downstream because the sites are more than 50 river miles apart and segregated by a series of impoundments.

The cumulative impact of existing water uses on aquatic biota in Parr Reservoir, Monticello Reservoir, and the Broad River during drought conditions has also been considered. The Federal Energy Regulatory Commission (FERC) license for operation of the Parr Shoals Dam requires that "…the flow shall be maintained at 1,000 cfs or at the average daily natural inflow into Parr Reservoir…during the striped bass spawning season in March, April, and May in order to protect the fishery of the Broad River" (SCE&G 2010a). The FERC license further stipulates that minimum flow below the dam will be 800 cfs for the remainder of the year. During low-flow conditions in the Broad River, Monticello Reservoir can supply a total of 45,000 ac-ft of usable storage for cooling water for VCSNS Units 1 through 3. If drought conditions in the Broad River persist and the storage water from Monticello Reservoir is used before hydrologic conditions are restored, "…SCE&G would curtail or cease operation of VCSNS until water is available" (SCE&G 2010a). Due to the combination of FERC licensing stipulations at the Parr Shoals Dam and the usable volume of water storage in Monticello Reservoir, cumulative impacts on aquatic biota during drought conditions are expected to be minor. Five hydropower facilities upstream of VCSNS on the Broad River are not expected to result in cumulative effects on water use because these facilities are run-of-river dams. However, due to the absence of fish-passage facilities, these dams prohibit upstream migration of aquatic biota. Planned diadromous fish restoration activities in the Broad River basin may improve fish passage in the future, which would result in minimal cumulative impacts.

As described in Section 2.4.2.1, the Santee-Cooper Basin Diadromous Fish Passage Restoration Plan (Plan) (FWS 2001) and the Santee River Basin Accord (SRBA 2008) focus on restoring habitat connectivity for diadromous fish that were historically present within the basin. Within the Santee-Cooper basin, the Plan identified the Broad River sub-basin as a high priority for restoration due to the amount of potential habitat available as well as the quality of existing habitat. There is currently no evidence that the Plan's targeted diadromous fish species reside within the vicinity of the VCSNS site; but there are documented historical accounts that these fish migrated to the upper reaches of the Broad River. Future restoration efforts may result in the reestablishment of migratory fish populations upstream of the Parr Shoals Dam.

Potential impacts on aquatic biota resulting from the operation of VCSNS Units 2 and 3 are evaluated in Section 5.3.2. With respect to future populations of migratory fish that may become established in the Broad River, impacts stemming from impingement and entrainment are unlikely because the intake structures associated with plant operation are located in Monticello Reservoir. The multiport diffuser, proposed to be located on Parr Reservoir, presents the greatest opportunity for direct interaction with future populations of migratory fishes in the Broad River. The discharge effluent may result in thermal impacts, but, as discussed in Section 5.3.2.1, impacts on populations of aquatic biota, including diadromous fish species, would likely be minimal.

No Federally listed threatened or endangered aquatic species are known to occur at the VCSNS site, but seven Federally protected or proposed Federally protected aquatic species are known to occur within counties proposed for siting the six new transmission lines (Table 2-20). In particular, an existing segment of the VCSNS-Flat Creek corridor crosses a portion of Flat Creek in Lancaster County that is listed by FWS as critical habitat, and supports the Lynches River / Flat Creek population of the Federally endangered Carolina heelsplitter (*Lasmigona decorata*) (67 FR 44502). In addition, some of the aquatic taxa encountered during onsite aquatic inventories have been identified as State conservation priority species (e.g., robust redhorse, seagreen darter (*Etheostoma thalassinum*) eastern floater (*Pyganodon cataracta*). Largemouth bass (*Micropterus salmoides*), sunfish (*Lepomis spp.*), and catfish (*Ictalurus spp.*) are important recreational species in both Parr Reservoir and Monticello Reservoir.

The construction of six new transmission lines for VCSNS Units 2 and 3 would have a minor effect on these and other aquatic species because best management practices (BMPs) would be employed during construction and environmentally responsible practices would be followed during transmission-line corridor maintenance activities once the lines are completed and energized. Impact on populations of Federally threatened or endangered, State-listed, or recreationally important species and on the critical habitat for Carolina heelsplitter in Flat Creek is expected to be minimal.

Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility can present additional constraints on aquatic resources. Future activities may include shoreline development (i.e., removal of habitat), increased water needs, and increased discharge of effluents into the Broad River, Parr Reservoir, and/or Monticello Reservoir. There is a low-to-moderate potential for additional residential development within the geographic area of interest, and one new residential area is under construction along the Monticello Reservoir. In addition to direct anthropogenic activities, physical disturbance and climatic events may impose external stressors on aquatic communities. Aquatic ecosystem responses to these events are difficult to predict. At certain times of the year, VCSNS operation, other anthropogenic stressors, and climatic events could combine to adversely affect the aquatic populations of Parr and Monticello reservoirs. The level of impact resulting from these activities or events would depend on the intensity of the perturbation and the resiliency of the aquatic communities.

7.3.2.1 Summary of Aquatic Ecology Impacts

Cumulative impacts on aquatic ecology resources are estimated based on the information provided by SCE&G and the review team's independent review. Given the minimal levels of impingement and entrainment found at VCSNS Unit 1, which uses a once-through cooling system, the impacts for impingement and entrainment at proposed VCSNS Units 2 and 3, which will use a closed-cycle cooling system, would be negligible. VCSNS Unit 1 requires at least nine times more water for cooling operations compared to proposed VCSNS Units 2 and 3. Therefore due to the minimal impingement and entrainment from VCSNS Units 1, 2, and 3, the high fecundity and prolific spawning habits of many of the potentially affected fish species, and other water-use impacts from current and reasonably foreseeable projects, anticipated impacts on aquatic resources would be minor. Cumulative impacts from thermal or chemical discharges are also expected to have minimal impacts on aquatic species because dischargers are operating within allowable levels that prevent water-quality degradation. The installation of six new transmission lines for VCSNS Units 2 and 3 would have a minor effect on Federally listed threatened or endangered species, other aquatic species, and on the critical habitat for Carolina heelsplitter because BMPs would be used during installation and environmentally responsible practices would be followed during transmission-line corridor maintenance activities once the lines are completed and energized. Other direct and indirect anthropogenic stressors in the geographic area of interest, such as additional residential development and other changes in land use and global climate change, would cumulatively lead to some adverse effects on the aquatic communities, but they likely would be minor during the time period encompassing the building, operating, and decommissioning of proposed VCSNS Units 2 and 3. Therefore, the review team concludes that cumulative impacts on aquatic biota related to proposed VCSNS Units 2 and 3 and other past, present, and reasonably foreseeable projects would be SMALL.

7.4 Socioeconomics and Environmental Justice

The evaluation of cumulative impacts on socioeconomics and environmental justice is described in the following sections.

7.4.1 Socioeconomics

The description of the affected environment in Section 2.5 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.4, the NRC staff concludes that any negative impacts of the NRC-authorized construction activities on all socioeconomics categories would be SMALL, with one exception. The NRC staff determined there would be a MODERATE and adverse traffic impact on Fairfield County in the vicinity of Jenkinsville for NRC-authorized construction. As described in Section 5.4, the review team concludes that all elements of socioeconomics would be SMALL and adverse, with the following exception. Operations would result in SMALL and beneficial tax revenue impacts in the region, and LARGE and beneficial impacts on Fairfield County.

The combined impacts from construction and preconstruction were described in Section 4.4 and determined to be SMALL with one exception. The review team determined that traffic impacts in the vicinity of the site would be MODERATE and adverse. The cumulative analysis also considers past, present, and reasonably foreseeable future actions that could affect socioeconomics. For this cumulative analysis, the geographic area of interest is considered to be Fairfield, Lexington, Newberry, and Richard Counties, as that is where the review team expects the socioeconomic impacts to be the greatest. The geographic area of interest was modified as appropriate for specific impact analyses. For example, for some analyses the review team considered the entire 50-mi region surrounding the proposed VCSNS site, and for other analyses or specific taxation jurisdictions were considered. As the economic hub of the Central Midlands, the City of Columbia is the center of government and industry for a wide area in central South Carolina. Relatively recently, the Interstate-26 corridor has seen significant commercial and residential development in the areas of West Columbia and Irmo. The University of South Carolina and several regional medical facilities have attracted a well-educated workforce to this area. Fort Jackson, a large military installation in Columbia, is supported by nearly 4000 civilian employees.

The construction of Unit 1 provides context for what the potential cumulative impacts of building the new units would be. The NRC was completing its Final Environmental Statement (FES) for the Operating License (OL) for VCSNS Unit 1 just as final construction of that unit was winding down over the 1979–1981 period. As such, the OL FES provides a glimpse at the observed socioeconomic impacts from that construction project. At that time, the review team noted that the construction contractor commissioned a workforce survey to ascertain information such as the residence pattern of the construction workers. Of the approximately 2400 workers surveyed, 1913, or about 80 percent came from within the VCSNS region, and 927, or nearly 50 percent came from either Lexington or Richland Counties (NRC 1981). The review team also observed that more than 70 percent of the workers came from the Central Midlands area, with the remainder coming from outside the region.

The impact analyses in Chapters 4 and 5 are cumulative by nature. Economic impacts associated with activities listed in Table 7-1 already have been considered as part of the socioeconomic baseline presented in Section 2.5. For example, the economic impacts of existing enterprises such as mining, other electrical utilities, etc., are part of the base used for establishing the Regional Input-Output Modeling System (RIMS) II multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team's assessment of reasonably foreseeable future impacts. Thus, there are no cumulative impacts associated with building and operating VCSNS Units 2 and 3 beyond those already evaluated in Chapters 4 and 5.

The review team considered the impacts of the NRC-authorized activities plus past, present, and reasonably foreseeable future activities over the life of the two new units. Based on the above considerations, information provided by SCE&G, and the review team's independent review, the review team concludes that NRC-authorized construction of proposed VCSNS Units 2 and 3 could make a temporary detectable adverse contribution to the cumulative effects associated with some socioeconomic issues. Adverse cumulative impacts would include physical impacts (workers and the local public, buildings, transportation, and visual aesthetics) and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and schools).

The review team concludes there would be a LARGE and beneficial cumulative impact associated with tax revenues in Fairfield County. The incremental impact from NRC-authorized activities would be LARGE and beneficial. The review team also identified a MODERATE and adverse cumulative traffic impact in the Jenkinsville area that would be localized and temporary (limited to only "rush hour" traffic and the peak building employment period). The incremental impact from NRC-authorized activities would be MODERATE. The review team concludes that cumulative impacts on other socioeconomic impact categories would be SMALL and adverse.

7.4.2 Environmental Justice

The description of the affected environment in Section 2.6 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.5, the NRC staff concludes that the NRC-authorized construction traffic-related activities may create disproportionately high and adverse impacts on minority or low-income populations and, therefore, the environmental justice can be characterized as MODERATE for traffic impacts in the vicinity for the building period. Because traffic is so much less for operations, the review team determined there would be no disproportionately high and adverse impacts on minorities or low-income populations due to traffic-related activities during operations and, therefore, the impact would be SMALL. As described in Sections 4.5 and 5.5 for all other environmental justice impacts, the review team determined there would be no disproportionately high or adverse impacts on minority or low-income populations, and therefore the impact would be SMALL.

The combined impacts from construction and preconstruction were described in Section 4.5 and determined to impose no disproportionately high and adverse impacts on minority or low-income populations and, therefore the impact can be considered SMALL, with one exception. The review team determined traffic-related activities may create disproportionately high and adverse impacts on minority or low-income populations and, therefore, the environmental justice impact would be MODERATE. The cumulative analysis also considers past, present, and reasonably foreseeable future actions that would cause environmental justice impacts on minority and low-income populations. For this cumulative analysis, the geographic area of interest is considered to be the entire 50-mi region surrounding the proposed VCSNS site.

From an environmental justice perspective, there is a potential for minority and low-income populations to be disproportionately affected by environmental impacts. Although the Columbia metropolitan area is an urban population center, the wider region is largely rural and agricultural. Throughout the area of interest, the review team found low-income, African American, and aggregated minority populations that met the Census identification criteria established in Section 2.6.1 in the vicinity of the VCSNS site. The impact analyses in Chapters 4 and 5 are cumulative by nature. Any environmental justice impacts associated with activities listed in Table 7-1 already have been considered as part of the environmental justice baseline presented in Sections 2.6 and 7.4.1. The transmission-line routing and installation process typically attempts to avoid residential areas and minimize right-of-way acquisition costs to the extent practicable. Therefore the review team expects only minor impacts, if any, would be expected in any residential areas because of transmission-line installation, and thus would not be expected to noticeably affect any minority and low-income populations. Thus, there are no environmental justice cumulative impacts associated with building and operating of VCSNS Units 2 and 3 beyond those already evaluated in Chapters 4 and 5.

Based on the above considerations, information provided by SCE&G, and the staff's independent review, the NRC staff concludes that NRC-authorized construction of proposed VCSNS Units 2 and 3 would not contribute additional environmental justice cumulative impacts beyond those described in Chapters 4 and 5. The impacts would include physical impacts (workers and the local public, noise, air quality, buildings, transportation, and visual aesthetics) and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and schools). The NRC staff concludes that the environmental justice impacts of the NRC-authorized activities plus past, present, and reasonably foreseeable future activities over the life of the two new units depends on the impact category being considered. For example, the review team concludes there may be disproportionately high and adverse cumulative impacts on minority and low-income populations from traffic during limited periods of time during the peak building period in the Jenkinsville area, and that those impacts could be considered MODERATE. The incremental impacts from NRC-authorized activities would be MODERATE. Impacts from building and operating Units 2 and 3 in combination with other projects described in Table 7-1 would have minimal disproportionately high and adverse cumulative impacts on minority and low-income populations from all other environmental justice impact categories can be considered SMALL.

7.5 Historic and Cultural Resources

The description of the affected environment in Section 2.7 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.6, impacts on cultural resources from NRC-authorized construction activities would be SMALL. As described in Section 5.6, the review team concludes that the impacts on cultural resources from operations are SMALL. Mitigative actions may be warranted only in the event of an unanticipated discovery during any ground-disturbing activities associated with construction or maintenance of the operating facility; these actions would be determined by SCE&G in consultation with the South Carolina State Historic Preservation Office (SHPO). To address the SHPO's request for a Programmatic Agreement, SCE&G and Santee Cooper have management agreements with the SHPO to formalize avoidance and protective measures listed above as well as any updates made to the Environmental Management Plan regarding cultural resources awareness training and inadvertent discovery procedures (USACE 2011a, b).

The combined impacts from construction and preconstruction were described in Section 4.6 and determined to be MODERATE. If preconstruction activities associated with the transmission lines result in significant alterations to the cultural environment, then the impact could be greater. Chapter 2 defines the direct effects and viewshed Area of Potential Effect (APE) for cultural resources as the SCE&G property boundary, which is the geographic area of interest for this cumulative impacts assessment. The cumulative impacts assessment considers the eligibility of historical properties for listing on the National Register of Historic Places. Discussions with the SHPO provides information on cultural resources and potential impacts on cultural resources with respect to other past, present, and reasonably foreseeable future actions in the geographic area of interest.

Historically, several groups of American Indians lived in South Carolina, many of which became extinct or merged with other groups due to non-American Indian encroachment by Spanish, French, and British explorers and settlers by the mid-1700s. The largest groups were the

Catawba and the Cherokee who likely used the Broad River region for resource gathering. Several Tribal groups and descendants of earlier groups are present today in South Carolina (descendants of the Cherokee, Catawba, Pee Dee, Chicora, Edisto, Santee, and Chicora-Waccamaw Tribes). In 1838, the Cherokee were forced to leave the eastern United States and resettle in Oklahoma. European settlement and colonization of South Carolina began in the early 1600s with more permanent settlement occurring along the Broad River in the early 1740s. Cotton production and plantations began flourishing during the 1800s, but were later affected by social and economic upheavals during the Civil War and later by the Great Depression of the 1930s.

Table 7-1 identifies other past, present, and reasonably foreseeable projects and other actions considered in the cumulative analysis of the VCSNS site. Projects within the geographic area of interest that may have a potential cumulative impact on cultural resources include continued operation and decommissioning for VCSNS Unit 1 and future urbanization. Such projects could affect cultural resources if ground-disturbing activities occur that affect cultural resources. As described in Section 4.6, there are no significant cultural resources that would be adversely affected by building activities or operation of Units 2 and 3 because the four significant cultural resources located within the APE of the VCSNS site would be protected by SCE&G, in accordance with the signed management agreement between SCE&G, the South Carolina SHPO, and the USACE (USACE 2011a).

Table 3-1 describes the transmission lines supporting the new VCSNS units. As described in Sections 4.6 and 5.6, the incremental impacts from installation of transmission lines would be minimal if there are no significant alterations (either physical alteration or visual intrusion) to the cultural environment. If these activities result in significant alterations to the cultural environment, then the impact could be greater. For impacts greater than small, mitigation would occur as described in Section 4.6.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on its evaluation, the review team concludes that the cumulative cultural resources impact from preconstruction, construction, operation and other projects would be MODERATE. However, activities related to transmission lines and urbanization have the potential to affect cultural resources within the APEs. If these activities result in alterations to the cultural environment, then the impact could be greater. The review team further concludes that the incremental impacts associated with the NRC-authorized activities would be SMALL because no significant cultural resources would be affected by these activities. The incremental impacts associated with onsite preconstruction activities are the principal contributor to the MODERATE rating of cumulative impacts.

7.6 Air Quality

The description of the affected environment in Section 2.9 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.7, the impacts of NRC-authorized construction on air quality would be SMALL, and no further mitigation would be warranted. As described in Section 5.7, the review team concludes that the impacts on air quality from operations would be SMALL, and no further mitigation would be warranted.

7.6.1 Criteria Pollutants

The combined impacts from construction and preconstruction were described in Section 4.7 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts on air quality. The geographic area of interest defined for this evaluation is Fairfield County, South Carolina. The single county was selected because designations of attainment or nonattainment by the EPA are made on a county-by-county basis.

The VCSNS site is located in an area that is in attainment for all criteria pollutants for which National Ambient Air Quality Standards (NAAQSs) have been established (40 CFR 81.341). Emissions from building proposed Units 2 and 3 are expected to be temporary and limited in magnitude, as described in Section 4.7. During operations of proposed Units 2 and 3, emissions of water vapor and some salt drift would be associated with the operation of the mechanical draft cooling towers, as described in Section 5.7. Air emissions from operations would be primarily from cooling towers, diesel generators, and auxiliary power supplies. These systems would be permitted and operated in accordance with State and Federal regulatory requirements and emissions would be infrequent and negligible compared to other sources within the Columbia Intrastate Air Quality Control Region.

Other sources of permitted air emission sources within Fairfield County include the SCE&G VCSNS Unit 1 and the SCE&G Parr Combustion Facility. Gaseous emissions from Unit 1 include sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides associated with the intermittent operation of diesel generators (NRC 2004). The SCE&G Parr Combustion Facility, located approximately 2 mi south of the VCSNS, uses four natural gas turbines to generate electricity. Gaseous emissions from the Parr Combustion Facility include sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides. This facility has a Part 70 Air Quality (Title V Operating) Permit (SCDHEC permit AIR-1000-0021), indicating that it could potentially emit more than 100 T/yr of any air pollutant (SCDHEC 2006). VCSNS Unit 1 is operated under a regulated air quality permit. In addition, Fairfield County, South Carolina, is in attainment, indicating that the total level of regulated pollutants within the county are within NAAQSs set by EPA.

Future development of the region around the VCSNS site could lead to increases in gaseous emissions related to transportation. Table 7-1 lists low-to-moderate potential for growth within Fairfield County.

Given the intermittent operation of the diesel generators at both the existing VCSNS Unit 1 and proposed Units 2 and 3, the current attainment status of Fairfield County, and the low-to-moderate potential for growth in the county, and limited gaseous emissions from other projects identified in Table 7-1, the review team concludes the cumulative impacts on air quality would be minimal, and mitigation would not be warranted.

7.6.2 Greenhouse Gas Emissions

As discussed in the state of the science report issued by the U.S. Global Change Research Program (GCRP), it is the "… production and use of energy that is the primary cause of global warming, and in turn, climate change will eventually affect our production and use of energy. The vast majority of U.S. greenhouse gas emissions, about 87 percent, come from energy production and use…" Approximately one-third of the greenhouse gas emissions are the result of generating electricity and heat (Karl et al. 2009). This assessment is focused on greenhouse gas emissions. Other elements of climate change are discussed in the EIS sections on hydrology and ecology.

Greenhouse gas emissions associated with building, operating, and decommissioning a nuclear power plant are addressed in Sections 4.7, 5.7.2, 6.1.3, and 6.3. The review team concludes that the atmospheric impacts of the emissions associated with each aspect of building, operating, and decommissioning a single plant are minimal. The review team also concludes that the impacts of the combined emissions for the full plant life cycle are minimal.

The cumulative impacts of a single or combination of greenhouse gas emission sources must be placed in geographic context:

- The environmental impact is global rather than local or regional.
- The effect is not particularly sensitive to location of the release point.
- The magnitudes of individual greenhouse gas sources related to human activity, no matter how large compared to other sources, are small when compared to the total mass of greenhouse gases in the atmosphere.
- The total number and variety of greenhouse gas sources is extremely large and the sources are ubiquitous.

These points are illustrated by the following comparison of annual carbon dioxide emission rates (Table 7-2).

Table 7-2. Comparison of Annual Carbon Dioxide Emission Rates

Source	Metric Tons per Year
Global emissions	28,000,000,000[a]
United States	6,000,000,000[a]
1000-MW nuclear power plant (including fuel cycle, 80-percent capacity factor)	400,000[b]
1000-MW nuclear power plant (operations only, 80-percent capacity factor)	5000[b]
Average U.S. passenger vehicle	5[c]

(a) EPA 2009f
(b) Appendix J of this EIS
(c) FHWA 2006

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The Karl et al. (2009) report referenced above provides a synthesis of the results of numerous climate modeling studies. The review team concludes that the cumulative impacts of greenhouse emissions around the world as presented in the report are the appropriate basis for its evaluation of cumulative impacts. Based on the impacts set forth in the Karl et al. (2009) report, and the CO_2 emissions criteria in the final EPA CO_2 Tailoring Rule (75 FR 31514), the review team concludes that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team further concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emission of the proposed project.

Consequently, the review team has determined an appropriate approach to addressing the cumulative impacts of greenhouse gases emissions, including carbon dioxide, is to recognize that the emissions contribute to climate change and that the carbon footprint is a relevant factor in evaluating energy alternatives. Section 9.2.5 contains a comparison of carbon footprints of the viable energy alternatives.

7.6.3 Summary

Cumulative impacts on air quality resources are estimated based on the information provided by SCE&G and the review team's independent evaluation. Other past, present, and reasonably foreseeable activities exist in the geographic areas of interest (local for criteria pollutants and global for greenhouse gas emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the VCSNS site and other projects would be minimal. The national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emissions from the VCSNS site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be SMALL to MODERATE. The incremental contribution of impacts on air quality resources from building and operating proposed Units 2 and 3 would be SMALL. The incremental contribution of impacts on air quality resources from the NRC-authorized activities would also be SMALL.

7.7 Nonradiological Health

The description of the affected environmental in Section 2.10 serves as a baseline for the nonradiological health cumulative impact assessment. As described in Section 4.8, the impacts from NRC-authorized construction on nonradiological health would be SMALL, and no further mitigation would be warranted. As described in Section 5.8, the review team concludes that the impacts of operations on nonradiological health would also be SMALL, and no further mitigation would be warranted.

As described in Section 4.8, the combined nonradiological health impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted beyond what is described in SCE&G's Environmental Report. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts to nonradiological health (see Table 7-1). Based on the localized nature of nonradiological health impacts, the geographic area of interest for this cumulative impacts analysis includes projects within the 10-km (6-mi) radius of the VCSNS site plus the proposed transmission-line rights-of-way and immediately adjacent properties extending outward from the 6-mi vicinity. This area is expected to encompass areas where public and worker health could be influenced by the proposed project and associated transmission lines, in combination with any past, present, or reasonably foreseeable future actions.

Other than the continued operation of VCSNS Unit 1, there are no major current projects in the geographic area of interest that would contribute to the cumulative impacts for nonradiological health. Future non-major projects expected to occur within the geographic area of interest are limited to non-specified urbanization.

There are no known existing or future projects that could contribute to cumulative nonradiological health impacts of occupational injuries. Existing and potential development of new transmission lines could increase nonradiological health impacts from exposure to acute electromagnetic fields (EMFs). However, as stated in Section 5.8.3, adherence to Federal criteria and State utility codes would create minimal cumulative nonradiological health impacts. With regard to chronic effects of EMFs, the scientific evidence on human health does not conclusively link extremely low frequency EMFs to adverse health impacts (although potential chronic health risks cannot be completely ruled out). Cumulative impacts from noise and vehicle emissions associated with current and future urbanization, current operations of VCSNS

Unit 1, Parr Hydroelectric Station, the Parr Combustion Facility, and FPSF, along with further removed hydroelectric stations along the Broad River could occur. However, as discussed in Sections 4.8 and 5.8, the VCSNS Units 2 and 3 contribution to these impacts would be temporary and minimal, and existing facilities would likely comply with local, State, and Federal regulations governing noise and emissions. Section 7.10.2 discusses cumulative nonradiological health impacts related to additional traffic on the regional and local highway networks leading to and from the VCSNS site, and the review team determines that these impacts would be minimal.

The cumulative health impacts of operating cooling systems associated with the existing unit (Unit 1) and proposed two new units (Units 2 and 3) at the VCSNS site were evaluated relative to the ambient temperature of Monticello Reservoir and Parr Reservoir and the potential propagation of thermophilic or other etiological microorganisms. The proposed William States Lee III Nuclear Station near Gaffney, South Carolina, also on the Broad River (on which Parr Reservoir is located), is sufficiently remote from the Monticello and Parr reservoirs that thermal discharges to the Broad River would not interact with those from the existing and proposed units at VCSNS. The review team's independent evaluation indicated that because the thermal discharge from Unit 1 goes into Monticello Reservoir and proposed Units 2 and 3 would discharge to Parr Reservoir, the addition of two proposed new units is not likely to increase populations of thermophilic or other etiological microorganisms in either reservoir.

Furthermore, the low incidence of waterborne diseases in the geographic area of interest indicates that the public uses these waters for recreation in a manner that minimizes their potential exposure to waterborne etiological organisms.

The review team is aware of the potential climate changes that could affect human health; a recent compilation of the state of the knowledge in this area (Karl et al. 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region during the life of proposed VCSNS Units 2 and 3 include an increase in average temperature and a decrease in precipitation. This may result in an increase in water temperature and frequency of downpours, which may alter the presence of microorganisms and parasites. While the changes that are attributed to climate change in these studies are not inconsequential, the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change the incidence of waterborne diseases.

Cumulative impacts on nonradiological health are based on information provided by SCE&G and the review team's independent evaluation of impacts resulting from proposed Units 2 and 3, along with a review of potential impacts from other past, present, and reasonably foreseeable projects and urbanization located in the geographic areas of interest. The review team concludes that cumulative impacts on public and worker nonradiological health would be SMALL, and that mitigation beyond what is discussed in Sections 4.8 and 5.8 would not be warranted. The review team acknowledges, however, that there is still uncertainty associated with chronic effects of EMFs.

7.8 Radiological Impacts

The description of the affected environment in Section 2.11 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.9, the NRC staff concludes that the radiological impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted. As described in Section 5.9, the NRC staff concludes that the radiological impacts from operations would be SMALL, and no further mitigation would be warranted.

The combined impacts from construction and preconstruction were described in Section 4.9 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative radiological impacts. For the purposes of this analysis, the geographic area of interest is the area within the 50-mi radius of the VCSNS site. Historically, the NRC has used the 50-mi radius as a standard bounding geographic area to evaluate population doses from routine releases from nuclear power plants. Located on the VCSNS site are the existing VCSNS Unit 1 reactor, the decommissioned Carolinas-Virginia Tube Reactor, and decommissioned steam generators at the steam-generator recycle-facility vault. SCE&G plans to construct an independent spent-fuel storage installation (ISFSI) on the VCSNS site. Offsite, but within the 50-mi radius area, are the Westinghouse nuclear fuel fabrication facility (south of Columbia, South Carolina) and hospitals using medical isotopes (in Columbia, Lexington, Newberry, Rock Hill, Lancaster, Laurens, Greenwood, and Camden, South Carolina).

As stated in Section 2.11, SCE&G has conducted a radiological environmental monitoring program (REMP) around the VCSNS site since 1982. The REMP measures radiation and radioactive materials from all sources, including the existing Unit 1 at the VCSNS site. In 2009, tritium concentrations less than 1000 pCi/L were found in Monticello and Parr Reservoirs, at the Columbia Water Works, and in one groundwater well (SCE&G 2010b). These concentrations are well below the EPA drinking water standard of 20,000 pCi/L (40 CFR Part 141) and would result in doses well below the VCSNS effluent dose limits. In addition, cobalt-60 concentrations ranging from 14-31 pCi/Kg were found in sediments at two locations; these concentrations are right around the minimum detectable level (SCE&G 2010b).

As described in Section 4.9, the estimate of dose to construction workers during the building of proposed Units 2 and 3 is well within NRC annual exposure limits (i.e., 100 mrem/year), which are designed to protect the public health. For workers at Units 2 and 3, the estimate includes exposure from Unit 1, the steam generator recycle facility, and the proposed ISFSI. After Unit 2 begins operation, this estimate also includes exposure to workers at Unit 3 from operation of Unit 2. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of two new units at the VCSNS site are well below regulatory limits and standards. In addition, the site-boundary dose to the maximally exposed individual (MEI) from existing Unit 1 and proposed Units 2 and 3 at the VCSNS site would be well within the regulatory standard in 40 CFR Part 190. The decommissioned tube reactor, the steam-generator recycle facility, and the planned ISFSI do not contribute significantly to the dose offsite. Also, based on results of the REMP and the estimates of doses to biota given in Section 5.9, the staff concludes that the cumulative radiological impact on biota would not be significant. The results of the REMP indicate that effluents and direct radiation from the distant nuclear fuel fabrication plant, area hospitals, and industrial facilities that use radioactive materials, do not contribute measurably to the cumulative dose.

Currently, there are no other nuclear facilities planned within 50 mi of the VCSNS site. The NRC, the U.S. Department of Energy, and the State of South Carolina would regulate or control any reasonably foreseeable future actions in the region that could contribute to cumulative radiological impacts.

Therefore, the NRC staff concludes that the cumulative radiological impacts of operating two new units, along with the existing unit at VCSNS and the influence of other man-made sources of radiation nearby would be SMALL.

7.9 Postulated Accidents

As described in Section 5.11.5, the staff concludes that the potential environmental impacts (risk) from a postulated accident from the operation of proposed VCSNS Units 2 and 3 would be SMALL. Section 5.11 considers both design basis accidents (DBAs) and severe accidents.

As described in Section 5.11, the staff concludes that the environmental consequences of DBAs at the VCSNS site would be SMALL for an AP1000 reactor. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The consequences of DBAs are bounded by the consequences of severe accidents.

As described in Section 5.11.2, the NRC staff concludes that the severe-accident probability-weighted consequences (i.e., risks) of an AP1000 reactor at the VCSNS site are SMALL compared to risks to which the population is generally exposed, and no further mitigation would be warranted. The cumulative analysis considers risk from potential severe accidents at all other existing and proposed nuclear power plants that have the potential to increase risks at any location within 50 mi of proposed VCSNS Units 2 and 3. Existing reactors within the geographic area include VCSNS Unit 1, H.B. Robinson Unit 1, Oconee Units 1, 2, and 3, Catawba Units 1 and 2, McGuire Units 1 and 2, and Vogtle Electric Generating Plant (VEGP) Units 1 and 2 nuclear generating stations. Also, within the geographic area of interest, new reactors have been proposed for the existing Vogtle site and the new Lee site in South Carolina.

Tables 5-18 and 5-19 in Section 5.11.2.1 provide comparisons of estimated risk for the proposed AP1000 units at the VCSNS site and current-generation reactors. The estimated population dose risk for the proposed AP1000 units at the VCSNS site is well below the mean and median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's[(a)] safety goals (51 FR 30028). For existing plants within the geographic area of interest, namely VCSNS Unit 1, H.B. Robinson Unit 1, Oconee Units 1, 2, and 3, Catawba Units 1 and 2, McGuire Units 1 and 2, and Vogtle Units 1 and 2 nuclear generating stations, the Commission has determined that the probability-weighted consequences of severe accidents are SMALL (10 CFR 51, Appendix B, Table B-1). Finally, according to the Lee Nuclear Station Environmental Report (Duke 2009b) and the Final Environmental Impact Statement for the Vogtle Early Site Permit (NRC 2008), the risks from these proposed reactors would also be well below risks for current-generation reactors and would meet the Commission's safety goals. The severe accident risk due to any particular nuclear power plant gets smaller as the distance from that plant increases. However, the combined risk at any location within 50 mi of the VCSNS site would be bounded by the sum of risks for all of these operating and proposed nuclear power plants. Even though there would be potentially several plants included in the combination, this combined risk would still be low. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the VCSNS likely would be SMALL, and no further mitigation would be warranted.

7.10 Fuel Cycle, Transportation, and Decommissioning

The cumulative impacts related to the fuel cycle, transportation of radioactive materials (fuel and waste), and facility decommissioning for the proposed site are described below.

7.10.1 Fuel Cycle

As described in Section 6.1, the NRC staff concludes that the environmental impacts of the fuel cycle due to operation of proposed Units 2 and 3 would be SMALL. Fuel-cycle impacts would occur not only at the VCSNS site but would also be scattered through other locations in the United States or, in the case of foreign-purchased uranium, in other countries as described in Section 6.1.

In addition to fuel-cycle impacts from proposed Units 2 and 3, this cumulative analysis also considers fuel-cycle impacts from existing Unit 1. There are no other nuclear power plants

(a) The Commission is the body of up to five NRC commissioners that formulates policies, develops regulations governing nuclear reactor and nuclear material safety, issues orders to licensees, and adjudicates legal matters.

within 50 mi of the VCSNS site. The fuel-cycle impact of Unit 1 would be similar to that of proposed Unit 2 or Unit 3. In accordance with 10 CFR 51.51(a), the NRC staff considers the impacts to be acceptable for a 1000-MW(e) reference reactor. The impacts of producing and disposing of nuclear fuel include mining of the uranium ore, milling of the ore, conversion of the uranium oxide to uranium hexafluoride, enrichment of the uranium hexafluoride, fuel fabrication (where the uranium hexafluoride is converted into uranium oxide fuel pellets), and disposition of the spent fuel in a proposed Federal waste repository. As discussed in Section 6.1, advances in reactors since the development of Table S–3 in 10 CFR 51.51 reduce environmental impacts relative to the operating reference reactor. For example, a number of fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. The Westinghouse nuclear fuel fabrication facility near Columbia, South Carolina, is an impact of the fuel-cycle, and is implicitly included in the discussion in Section 6.1. In Section 6.1, the NRC staff multiplied the values in Table S–3 by a factor of three to scale the impacts up from the 1000-MW(e) LWR model to address the fuel-cycle impacts of proposed Units 2 and 3. Adding the fuel-cycle impacts from Unit 1 would increase the scaling to no more than a factor of four. Therefore, the staff considers the cumulative fuel-cycle impacts of operating the VCSNS site to be SMALL.

7.10.2 Transportation

The description of the affected environment in Section 2.5.2 serves as the baseline for the cumulative impacts assessment in this resource area. As described in Sections 4.8.3 and 5.8.6, the review team concludes that impacts of transporting personnel and nonradiological materials to and from the VCSNS site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the VCSNS site.

Nonradiological transportation impacts are related to the additional traffic on the regional and local highway networks leading to and from the VCSNS site. Additional traffic would result from shipments of construction materials and movements of construction personnel to and from the sites. However, the additional traffic increases the risk of traffic accidents, injuries, and fatalities. A review of the projects listed in Table 7-1 indicates that other projects in the region could potentially increase nonradiological impacts. The most significant cumulative nonradiological impacts in the vicinity of the VCSNS site would result from major construction projects. However, there are no planned major construction projects in the region surrounding the VCSNS site. Operation of existing facilities could also result in cumulative nonradiological impacts if traffic to and from the VCSNS site would interact with traffic traveling to and from operating facilities in the region. For the VCSNS site, nearby operating facilities that could contribute to traffic hazards include the existing VCSNS Unit 1, Parr Hydroelectric Plant, FPSF, and the Blair Quarry facility. There are also a number of recreation projects, such as park improvements, identified in Table 7-1. These types of improvements are generally of much smaller scope and have much lower resource and personnel requirements than constructing a new nuclear power plant or highway, and are therefore less likely to result in a measurable addition to cumulative impacts. In this EIS, it was shown that the impacts of transporting construction material and personnel to and from the VCSNS site and alternative sites is a small fraction of the existing nonradiological accidents, injuries, and fatalities in the counties in which the alternative sites are located. Mitigation measures designed to improve traffic flow at the VCSNS have been proposed by SCE&G (2010a). Based on this conclusion and the magnitude of nonradiological transportation impacts of nuclear power plant construction and operations relative to the other construction and operating activities listed above, the review team considers the cumulative nonradiological transportation impacts associated with constructing and operating the proposed new reactor at the VCSNS site to be minimal, and no further mitigation would be warranted.

As described in Section 6.2, the NRC staff concludes that impacts of transporting unirradiated fuel to the VCSNS site and spent fuel and radioactive waste from the VCSNS site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the VCSNS site.

Historically, the radiological impacts on the public and environment associated with transportation of radioactive materials in the 50-mi region surrounding the VCSNS site are dominated by shipments of fuel and waste to and from the existing VCSNS Unit 1. The Westinghouse Fuel Fabrication Plant in Columbia, South Carolina, may also contribute to the cumulative radiological impacts of transportation due to sharing highway links with some VCSNS shipments. Radiological impacts of transporting radioactive materials would occur along the routes leading to and from the VCSNS site and would also be scattered throughout the United States. For all these historical, current, and potential future projects, the radiological transportation impacts are a small fraction of the impacts from natural background radiation. The impacts of transporting this fuel and radioactive waste to and from the VCSNS site would be consistent with the environmental impacts associated with transportation of fuel and radioactive wastes from current-generation reactors presented in Table S–4 of 10 CFR 51.52. In accordance with 10 CFR 51.52, the NRC staff considers the impacts to be acceptable for the 1000-MW(e) reference reactor. Advances in reactors since the development of Table S–4 of 10 CFR 51.52 will have the effect of reducing environmental impacts relative to the operating reference reactor. For example, fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel requirements. This leads to fewer unirradiated and spent-fuel shipments than for the 1000-MW(e) reference reactor in 10 CFR 51.52. In addition, advances in shipping cask designs to increase their capacities will result in fewer shipments of spent fuel to offsite storage or disposal facilities.

Therefore, the NRC staff considers the cumulative radiological and nonradiological transportation impacts of operating the proposed new reactors at the VCSNS site to be SMALL, and no further mitigation would be warranted.

7.10.3 Decommissioning

As discussed in Section 6.3 of this EIS, the environmental impacts of decommissioning proposed Units 2 and 3 are expected to be SMALL.

In this cumulative analysis, the geographic area of interest is within a 50-mi radius of the VCSNS site. In addition to the proposed Units 2 and 3, the only other nuclear power plant within this area is the existing VCSNS Unit 1. The impacts of decommissioning nuclear power plants are bounded by the assessment in Supplement 1 to NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*. In that document, the NRC found the impacts on radiation dose to workers and the public, waste management, water quality, air quality, ecological resources, and socioeconomics to be small (NRC 2002). In addition, in Section 6.3 the review team concluded that the impact of greenhouse gas emissions on air quality during decommissioning would be small. Therefore, the cumulative impacts for the VCSNS site would be SMALL, and further mitigation would not be warranted.

7.11 Staff Conclusions

The review team considered the potential cumulative impacts resulting from construction, preconstruction, and operation of two additional nuclear units at the VCSNS site together with past, present, and reasonably foreseeable future actions. The specific resources that could be affected by the incremental effects of the proposed action and the other actions listed in Table 7-1 in the same geographic area were assessed. This assessment included the impacts of construction and operations for the proposed new units as described in Chapters 4 and 5: impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning described in Chapter 6; and impacts of past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could affect the same resources affected by the proposed action.

Table 7-3 summarizes the cumulative impacts by resource area. The cumulative impacts for the majority of resource areas would be SMALL, although there could be MODERATE or LARGE impacts for some resources, as discussed below. For example, the cumulative impacts for land use and terrestrial ecology would be MODERATE, primarily due to new transmission lines. The incremental impact from NRC-authorized activities on land use would be SMALL because the effects to land use, and terrestrial ecology from constructing and operating Unit 2 and 3 would be minimal and because construction of transmission lines does not require NRC authorization.

Table 7-3. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Units 2 and 3

Resource Category	Impact Level
Land use	MODERATE
Water-related	
Surface-water use	SMALL
Groundwater use	SMALL
Surface-water quality	SMALL
Groundwater quality	SMALL
Ecology	
Terrestrial ecosystems	MODERATE
Aquatic ecosystems	SMALL
Socioeconomic	
Physical impacts	SMALL
Demography	SMALL
Economic impacts on the community	SMALL to LARGE (beneficial)
Infrastructure and community services	SMALL to MODERATE
Aesthetics and recreation	SMALL
Environmental justice	SMALL to MODERATE
Historic and cultural resources	MODERATE
Air quality	SMALL to MODERATE
Nonradiological health	SMALL
Radiological health	SMALL
Severe accidents	SMALL
Fuel cycle, transportation, and decommissioning	SMALL

For socioeconomics, most categories would have SMALL cumulative impacts. However, the review team concludes there would be a LARGE and beneficial cumulative impact associated with tax revenues in Fairfield County, and the incremental impact from NRC-authorized activities would be LARGE and beneficial. The review team also identified a MODERATE and adverse cumulative traffic impact in the Jenkinsville area that would be localized and temporary (limited to only "rush hour" traffic and the peak building activity period), and the incremental impact from NRC-authorized activities would be MODERATE. Cumulative impacts to other socioeconomic impact categories would be SMALL.

For environmental justice, most categories would have SMALL cumulative impacts. However, there may be intermittent disproportionately high and adverse cumulative impacts on minority and low income populations from traffic during the peak construction employment period in the Jenkinsville area and those impacts could be considered MODERATE. These incremental traffic impacts from NRC-authorized activities would be MODERATE. Cumulative impacts to other environmental justice impact categories would be SMALL.

There would be a MODERATE cumulative impact on historic and cultural resources, primarily due to preconstruction activities. The incremental impact from NRC-authorized activities would be SMALL.

For air quality, the cumulative impacts would be MODERATE primarily due to national and world-wide impacts of greenhouse gases emissions. The incremental impacts from NRC-authorized activities would be SMALL since such impacts would be minimal.

7.12 References

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

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 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

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8.0 Need for Power

Chapter 8 of the U.S. Nuclear Regulatory Commission's (NRC's) Environmental Standard Review Plan (ESRP) (NRC 2000) with additional clarification provided in NRC Staff Memorandum (NRC 2010) guides the staff's review and analysis of the need for power for a proposed nuclear power plant. The guidance states:

> Affected states or regions continue to prepare need-for-power evaluations for proposed energy facilities. The NRC will review the evaluation for the proposed facility and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. If the State's or region's need-for-power evaluation is found acceptable, no additional independent review by NRC is needed, and the State's analysis can be the basis for ESRPs 8.2 through 8.4 (NRC 2000).

In a 2003 response to a petition for rulemaking, the NRC reviewed whether the need for power should be considered in NRC environmental impact statements (EISs) prepared in conjunction with applications that could result in new plant construction (68 FR 55905). The NRC concluded that "…need for power must be addressed in connection with new power plant construction so that the NRC may weigh the likely benefits (e.g., electrical power) against the environmental impacts of constructing and operating a nuclear power reactor." The NRC also stated in its response to the petition discussed above that (1) the NRC does not supplant the States, which have traditionally been responsible for assessing the need for power-generating facilities, for their economic feasibility, and for regulating rates and services; and (2) the NRC has acknowledged the primacy of State regulatory decisions regarding future energy options (68 FR 55905).

As identified in Section 1.3 of this EIS, the purpose and need for the project is to provide for additional baseload electric generating capacity. Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3 would provide a combined net electrical output of approximately 2214 MW(e) of baseload electric generating capacity. Unit 2 is projected to enter commercial service in mid-2016, while Unit 3 is projected to enter commercial service in 2019. As a joint venture, SCE&G would be a 55-percent owner of VCSNS Units 2 and 3 and receive the commensurate power output, and Santee Cooper (the State-owned public utility, formally called the South Carolina Public Service Authority [SCPSA]) would own 45 percent of VCSNS Units 2 and 3 and receive the commensurate power output. The State of South Carolina frames the term "base load plant" by offering the following: "units or facility that is designed to be operated at a capacity factor exceeding seventy percent annually, has a gross initial generation capacity of 350 MW(e) or more, and is intended in whole or in part to serve retail customers of a utility of South Carolina"

(South Carolina [SC] Code Ann. 58-33-220). The purpose of the proposed project is consistent with the definition as offered by the State.

The proposed action is subject to the regulatory review and approval by the State of South Carolina through the Public Service Commission of South Carolina (PSCSC), as well as the Board of Directors of the SCPSA. Both the PSCSC and the Board of Directors of the SCPSA evaluated the proposed need for power. Finding that the State's evaluations and ensuing directions from these regulatory bodies conformed to the NRC's four criteria as previously discussed, the NRC staff relied on their analysis to provide the basis for its conclusion that there is a need for power from proposed VCSNS Units 2 and 3. Specific information regarding the application of the criteria is addressed in Section 8.1.5.

The following sections describe the need for baseload electric generating capacity. Section 8.1 reviews the current power system, including geographic considerations, and describes the regional characteristics. Section 8.1 also reviews and discusses the State's regulatory guidance characterizing both the determination of the need for power and the approval of the proposed project through the PSCSC and SCPSA processes. Section 8.2 provides a review of pertinent details describing the demand for power, including an assessment of aspects that can impact the demand for power such as regional, State and Federal policies, energy efficiency (EE) and demand-side management (DSM), and econometric indicators. Section 8.3 is a discussion of power supply, including a review of past, present, and future generating capacity, power purchasing, and policies that may impact supply-side resources. Section 8.4 provides the staff's conclusions regarding the determination of the need for power as proposed by the applicant and verified by the PSCSC and SCPSA evaluation processes, and concludes with a description of how the need-for-power evaluation performed by the State of South Carolina meets the four required criteria provided by the NRC.

Where necessary, data and details may be supplemented by information from other resources such as State Energy Offices, regional reliability and power planning entities such as the Southeastern Electric Reliability Council (SERC), Energy Information Administration (EIA) estimates, and neighboring electric generating utilities.

8.1 Description of the Power System

The following sections describe the SCE&G and Santee Cooper relevant service areas, the regional reliability of the bulk power-supply system infrastructure related to the South Carolina power system, and the regulatory framework of the State of South Carolina under which the need for power has been evaluated and validated.

8.1.1 SCE&G Relevant Service Area

SCE&G is an investor-owned utility in the Southeast United States operating wholly within the State of South Carolina with a franchised service territory. The utility maintains a summer peak-generating capacity of approximately 5745 MW(e) including power purchases, and provides electrical service to approximately 640,000 customers in 24 counties across central and southern South Carolina (PSCSC 2008a) as shown in Figure 8-1.

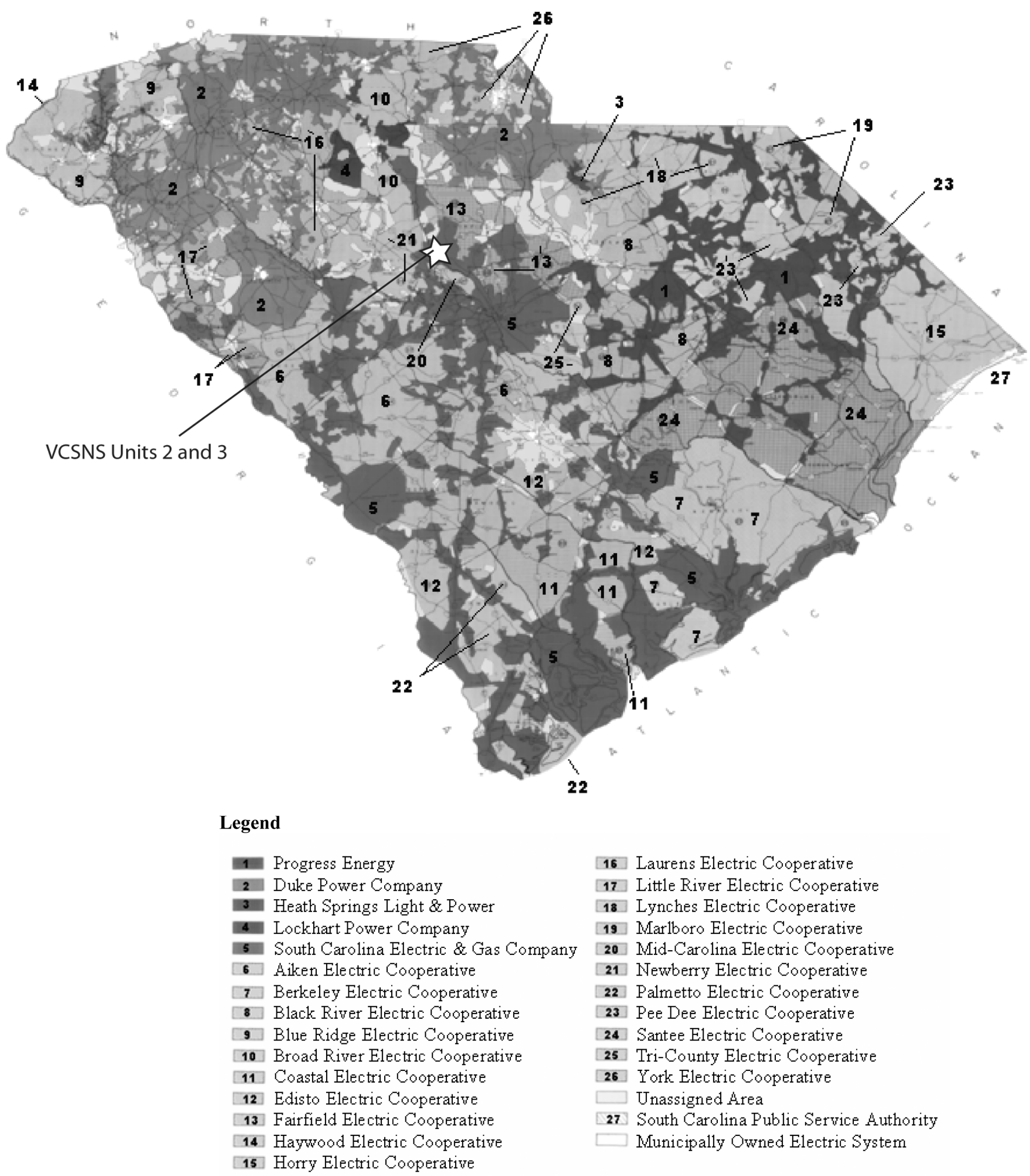

Figure 8-1. The Combined Service Territory of SCE&G and Santee Cooper (including State electric cooperatives) (SCE&G 2009a)

The major native load centers within SCE&G's relevant service territory include municipal areas in South Carolina such as Columbia, Aiken, and the coastal regions up to and including the Charleston area. The territory includes portions of the quickly growing Interstate 95 and southern coastal corridors, with municipalities in that area continuing to show consistent growth in residential population and associated light commercial supporting industries.

8.1.2 Santee Cooper Relevant Service Area

The SCPSA, operating as Santee Cooper, is a 100-percent State-owned electric and water utility, supplying electricity to more than 163,000 retail customers in Berkeley, Georgetown, and Horry Counties, as well as to 29 large industrial facilities, the cities of Bamberg and Georgetown, and the Charleston Air Force Base. Santee Cooper also generates the power distributed by the State's 20 electric cooperatives to more than 700,000 customers in all 46 counties of South Carolina. Santee Cooper maintains 6091 MW(e) of total summer peak-generating capacity (SCE&G 2009b).

Santee Cooper provides transmission and electrical services to a geographic area that is considerably larger than the franchised service territory of SCE&G. For the purposes of this EIS, the geographic boundary under consideration for the determination of the need for power is the SCE&G franchised service territory in addition to the retail and wholesale customer base of Santee Cooper as described above. The combined service territory of SCE&G and Santee Cooper (including State electric cooperatives) is illustrated in Figure 8-1.

8.1.3 Regional Reliability

SCE&G and Santee Cooper transmission systems operate entirely within the Virginia-Carolinas (VACAR) subregion of the SERC region, and are interconnected with both privately owned and State-owned utility systems. SERC serves as a regional entity with delegated authority from the North American Electric Reliability Corporation (NERC) for the purpose of proposing and enforcing reliability standards within the SERC region. SERC is a nonprofit corporation responsible for promoting and improving the reliability, adequacy, and critical infrastructure of the bulk power-supply systems in all or portions of 16 central and southeastern states. Owners, operators, and users of the bulk power-supply system in these states cover the SERC region, which, as shown in Figure 8-2, is an area of approximately 560,000 mi^2 (NERC 2008).

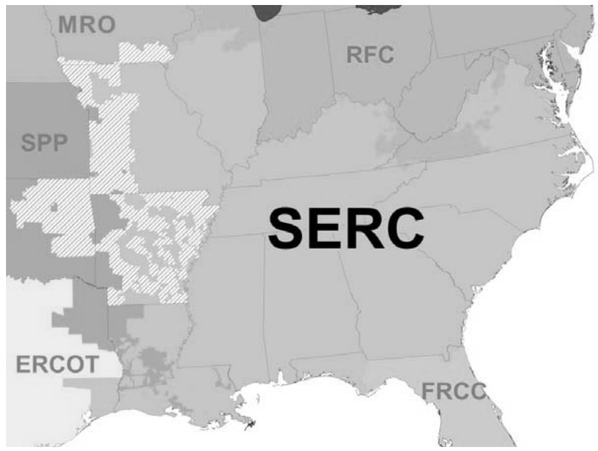

Figure 8-2. The SERC Service Territory (NERC 2008)

As participants in the regional production and distribution of energy, SCE&G and Santee Cooper, in conjunction with other members of the VACAR subregion, develop current and future power-flow and stability models of the integrated transmission system to assess the reliability of the system and to ensure compliance with regional and Federal reliability standards. The models are routinely adjusted to accommodate variations in power-generation capacity, seasonal changes or regional impacts such as drought, and planning margins, and include both long-term and short-term reliability and power-flow assessments (SCE&G 2009c).

SCE&G and Santee Cooper's annual demand forecasts and electrical growth estimates are generally consistent with the most recent SERC forecasts. SCE&G stated for the PSCSC hearing record that it forecasted firm territorial demand growth of 1.7 percent per year for the next 15 years (PSCSC 2008a). Santee Cooper is forecasting average demand to increase 1.2 percent per year for the next 15 years (SCE&G 2010a-). This is reasonable when compared with the SERC region forecast of approximately 1.7 percent annual growth for the next 10 years (NERC 2010), and the VACAR subregion of SERC forecast of approximately 1.7 percent annual growth for the next 10 years (NERC 2010).

Nonregulated (merchant) capacity exists in neighboring, balancing authority areas with direct interconnection to the SCE&G and Santee Cooper balancing authority areas. This capacity is primarily natural-gas-fired generation. Due to the unknown commitment status of this capacity, transmission access limitations, and physical transmission constraints, the reliable deliverability of this capacity cannot be guaranteed. Therefore, conclusions cannot be drawn regarding the purchase and distribution of merchant capacity within the service territory or in neighboring areas and the capacity can neither be considered nor modeled as a viable supply of baseload capacity. This premise is consistent with a review of nonregulated power capacity within the South Carolina service territories, which indicates a limited amount of total available capacity (EPA 2007).

8.1.4 South Carolina Regulatory Framework

The proposed VCSNS Units 2 and 3 project was reviewed and evaluated by the PSCSC, which issued the final findings of fact, conclusions of law, and the Certificate of Environmental Compatibility and Public Convenience and Necessity (CPCN) giving legal authority to SCE&G to proceed with construction and operation of a two-unit nuclear power plant, after SCE&G met the State of South Carolina's statutory requirements for the commencement of the project. The granting of the CPCN is a process that is independent from the approval of the combined construction permit and operating licenses (COLs). Therefore, the authority granted by the PSCSC in the approval of the CPCN does not influence the NRC in its approval of a COL. SCE&G was the sole applicant petitioning the PSCSC to grant the CPCN; however, SCE&G and the SCPSA (the latter operating as Santee Cooper) would be co-owners of the two-unit nuclear power plant and the power output. As such, both SCE&G and Santee Cooper have had to effectively demonstrate a need for power in their respective operating territories that is commensurate with the power output of the proposed project. They have done so through separate, yet analogous, proceedings, each of which is governed and controlled ultimately by the General Assembly of the State of South Carolina.

Broadly, the South Carolina General Assembly has numerous responsibilities directed toward the effective control and oversight of both public and private utilities operating within the State. The General Assembly directly contributes legislative membership and appoints public participants to the State Regulation of Public Utilities Review Committee. The committee is then tasked with evaluating and nominating leaders to each of the following entities (SC Code Ann. 58-3 Article 5):

- PSCSC, which controls regulated utilities such as SCE&G
- SCPSA Board of Directors, which represents the State of South Carolina operating as Santee Cooper
- South Carolina Office of Regulatory Staff, which serves as a public interest advocate and provides independent overview of the PSCSC.

8.1.4.1 SCE&G's Certificate of Public Convenience and Necessity

A provision in South Carolina State law, the Utility Facility Siting and Environmental Protection Act, requires all persons desiring to construct major utility facilities to obtain a CPCN from the PSCSC prior to the commencement of any construction activities. This process is governed by Chapter 103, Article 3, Subarticle 1 of the South Carolina Code of Regulations and by Title 58, Chapter 33 of the South Carolina Code of Laws.

Pursuant to the Utility Facility Siting and Environmental Protection Act, the PSCSC may not grant a certificate for the construction, operation, and maintenance of a major utility facility, either as proposed or as modified, unless it shall find and determine the basis of the need for the facility; the nature of probable environmental impact; that the impact of the facility upon the environment is justified considering the alternatives; that the facilities serve in the interests of system economy and reliability; that there is reasonable conformance to applicable State and local laws and regulations; and that public convenience and necessity require the construction of the facility (PSCSC 2009). It is important to note that while the CPCN authorizes the construction of two units, the PSCSC does not have jurisdiction over Santee Cooper (PSCSC 2009). Therefore, no ruling by the PSCSC through the CPCN evaluation is extended to the 45 percent of the project that would be owned by Santee Cooper. However, as a joint owner in the proposed project, Santee Cooper's need for power is discussed in the following sections.

The PSCSC reviewed and evaluated SCE&G's petition for a determination of the need for power in the proceedings governing the Combined Application for the CPCN and Base Load Review Order (PSCSC 2008b) pursuant to provisions in South Carolina's Utility Facility Siting and Environmental Protection Act. Consistent with the preceding discussion, SCE&G submitted the *Combined Application of South Carolina Electric and Gas Company for a Certificate of Environmental Compatibility and Public Convenience and Necessity and for a Base Load Review Order for the Construction and Operation of a Nuclear Facility in Jenkinsville, South Carolina*, to the PSCSC on May 30, 2008.

The final order provided by the PSCSC approving the combined application and CPCN was issued to SCE&G on March 2, 2009, granting SCE&G approval for the construction and operation of two Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactors at the VCSNS site (PSCSC 2008a). The PSCSC further ruled that the impact of the proposed project would be justified based on the demonstrated need for additional baseload capacity (PSCSC 2008a). The CPCN application review proceedings provided full disclosure of expert and independent testimony provided by representative parties to the certification proceedings including the applicant, the South Carolina Office of Regulatory Staff, the Department of Health and Environmental Control, Department of Natural Resources, Department of Parks and Tourism, as well as public hearing and testimony.

Because the formal State process has been completed and the need for power has been demonstrated and documented by order of the PSCSC, the staff, in accordance with NUREG-1555 criteria, relies on the State's evaluation of the need for power for its own independent analysis of the applicant's determination of need. A discussion of the four NUREG-1555 reliability criteria can be found in Section 8.1.5 of this EIS (NRC 2000).

8.1.4.2 South Carolina Public Service Authority (Santee Cooper)

Santee Cooper is the State-owned public utility operating under direct authorization of the SCPSA Board of Directors to produce, distribute, and sell electric power in accordance with good business practices and the requirements of applicable licenses, laws, and regulations (SC Code Ann. 58-31-30(A) and 58-31-55(A)(3)(c)). Because Santee Cooper is a State-owned utility, the State prepares, or designates the preparation of, all analyses as required by statute such as Integrated Resource Plans (IRPs) and rate cases. The analyses are provided to the South Carolina State Energy Office for review and comment, and must be consistent with the processes imposed on regulated utilities by the PSCSC (SC Code Ann. 58-37-40). The IRP, which includes a review of the load forecast, energy efficiency and conservation programs, and options to meet expected load growth and reserve requirements, is also submitted to the Board of Directors of the SCPSA. The Board of Directors authorizes auditing of the resource plan by both independent parties as well as affected parties, and upon final consideration provides final adoption of the plan through a formal SCPSA Board of Directors resolution (SCE&G 2009d).

The SCPSA Board of Directors adopted several board resolutions that provide a coordinated framework directly aligning Santee Cooper with the VCSNS Units 2 and 3 project. Individually, the resolutions address the following: (1) company-wide resource planning through IRPs that have been substantiated through independent reviews; (2) the need for South Carolina to aggressively pursue goals toward expanding the deployment of power-generating resources that do not emit greenhouse gases, and improving energy efficiency and conservation; and (3) the need to provide the authority and mechanisms by which Santee Cooper as the State public utility may partner with SCE&G for the construction, operation, and rate-recovery of the proposed two-unit nuclear power plant at the VCSNS site located in Fairfield County.

In successive review and in support of the preceding discussion detailing Santee Cooper's ability to become a joint owner of a power plant in Fairfield Country, the Board of Directors representing the State of South Carolina, fully adopted the following resolutions (SCE&G 2009d):

- Mar. 27, 2006 (MB06-09): Adoption of the 2005/2006 Generation Resource Plan, which detailed the need for additional capacity as independently reviewed and corroborated by the R.W. Beck consulting company based on current data and acceptable forecasting methods. The resolution further authorized management to take actions deemed necessary or appropriate to obtain a construction and operating permit for an ownership share not to exceed 50 percent of a two-unit nuclear power plant at the VCSNS site.
- Oct. 20, 2006 (MB06-25): Santee Cooper management was authorized to continue to take actions necessary to design, permit, procure, construct, and install two nuclear units at the VCSNS site.
- Oct. 19, 2007 (MB07-14): The Board of Directors established a goal of generating 40 percent of the gross electrical generation needs by non-greenhouse-gas-emitting resources, biomass fuels, energy efficiency, and conservation by 2020.

- Apr. 25, 2008 (MB08-06): Adoption of the 2008 Generation Resource Plan that reflected the necessary addition of new generating resources to meet projected load growth. The plan was independently reviewed and corroborated by the R.W. Beck consulting company, which concluded that the processes and assumptions were reasonable and accurate. Management was further authorized to take actions deemed necessary or appropriate to obtain a construction and operating permit for an ownership share not to exceed 50 percent of a two-unit nuclear power plant at the VCSNS site.
- May 22, 2008 (MB08-07): The resolution appointed SCE&G to act as the SCPSA's agent in connection with the execution and performance of the Engineer, Procure, Construct contract for the VCSNS Units 2 and 3 project. The resolution further authorized management to continue taking actions necessary to permit, design, procure, and install two nuclear units at the VCSNS site and allowed an expenditure of an additional sum of money through December 31, 2011.

With authority granted by the South Carolina General Assembly, the above resolutions constitute the State's evaluation and direct assessment of the need for power-generating facilities, their economic feasibility, and the regulation of rates and services. These resolutions, as reviewed and approved by the SCPSA Board of Directors, established both precedence and further guidance for Santee Cooper's commitment to the VCSNS Units 2 and 3 project.

The following sections characterize the basis provided by the State via issuance of the CPCN. Further, because Santee Cooper is a participant in the project, the following review includes relevant sections and conclusions from its 2008 and 2009 IRP, as well as responses to Requests for Additional Information (RAIs) as issued by the NRC staff, which describes the need for power for Santee Cooper.

8.1.5 Description of the South Carolina Analytical Process

In accordance with NUREG-1555, the staff reviewed the analytical process and need for power evaluation performed by the State of South Carolina. The staff found that this evaluation process met the four NRC criteria for being (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. The following details how the four NRC criteria were met.

Systematic: Regulatory provisions in South Carolina as previously described, state that on an annual basis SCE&G and Santee Cooper must provide the most up-to-date forecast and expected resource portfolio, respective of all known current conditions. SCE&G and Santee Cooper have a systematic and iterative process for load forecasting, which is updated and reviewed annually, as directed by the State either through the PSCSC or through the Board of Directors of the SCPSA. The load forecasts use utility industry best practices and methodological approaches to determine the utility's need for power and the most cost-effective strategies to meet its regulatory obligations. In the PSCSC hearings regarding the applicant's request for a CPCN the South Carolina Office of Regulatory Staff and other witnesses indicated that SCE&G's forecasts were reasonable for planning purposes, with the PSCSC finding that SCE&G had provided a reliable and appropriate basis for assessing the need for Units 2 and 3 (PSCSC 2008a). The Board of Directors of the SCPSA approved the 2008 Santee Cooper IRP through Resolution MB-08-06 (April 25, 2008). For these reasons, the staff determined the SCE&G and Santee Cooper processes are sufficiently systematic for the purposes of this analysis.

Comprehensive: Peak and energy forecasts for both SCE&G and Santee Cooper incorporate key influencing factors such as economic and demographic trends, weather, and implemented load-reduction programs such as new energy-efficiency/demand-side management (EE/DSM) programs. Forecasts generated included each sector of the economy, and separate forecasts are developed to determine both short- and long-term demand. Power-supply forecasts include a comprehensive evaluation of present and planned generating capabilities as well as present and planned power purchases and sales in the service territory. All analyses are performed with forecasting, statistical modeling, and methodological approaches appropriate for the power industry. The peak and energy forecasts were evaluated and ruled upon by the PSCSC via the CPCN hearing process, and by the Board of Directors of the SCPSA via approval of the IRP. Therefore, the staff determined the SCE&G and Santee Cooper forecasting process coupled with the State's evaluation process were sufficiently comprehensive for the purposes of this analysis.

Subject to Confirmation: The process, models, and estimations used in SCE&G's petition to the PSCSC for review and issuance of the CPCN are documented and subject to evidentiary review by the PSCSC, the South Carolina Office of Regulatory Staff, and the general public. The CPCN proceedings and relevant findings are all documented in the final order issued by the PSCSC (PSCSC 2008a). Santee Cooper's resource planning process includes an independent third-party review, and is subject to the State's approval as confirmed through issuance of a resolution by the SCPSA Board of Directors. The resolution provides details specific to the presented annual resource plan such as interactions with relevant parties (Customer Advisory Council, SCPSA Executive Council, industrial customers, etc.); instructions for future actions including those related to permitting, additional capacity requirements and development; and other directives regarding the implementation of stated goals such as obtaining 40 percent of gross electrical generation from non-greenhouse-gas-emitting resources, renewable energy sources, and EE/DSM. Therefore, the staff determined the SCE&G and Santee Cooper processes are sufficiently subject to confirmation for the purposes of this analysis.

Responsive to Forecasting Uncertainty: SCE&G and Santee Cooper test the validity of their overall forecast by analyzing the impact of alternative load forecasts (high, medium, and low). In addition, uncertainty in the load forecast is quantified by evaluating the resource portfolios against variations in future sensitivities, such as fuel and construction costs, load forecasts, environmental laws and regulations, and risk. In doing so, SCE&G and Santee Cooper developed resource portfolios that quantify the long-term cost to customers under varying potential sensitivities, while understanding the fundamental strengths and weaknesses of various resource configurations. The PSCSC hearing record indicated that the forecast presented by SCE&G was comparatively analyzed against the previous 7 years as well as against the forecasts of other utilities within the region, and SCE&G's forecast was found to be not only accurate, but conservative as well (PSCSC 2008a). Santee Cooper's IRP, which contains the load forecast developed by GDS Associates, was independently verified by R.W. Beck, an independent consulting company specializing in the objective assessment of utility operations and management, who concluded that the assumptions and processes used were reasonable. Further, the generating plan, assumptions, and results were provided to affected parties for review, including the Central Electric Power Cooperative, Central Executive Committee, Customer Advisory Council, industrial customers, and the SCPSA Board of Directors. The most recent IRP was adopted via SCPSA Board of Directors Resolution MB 08-06 (SCE&G 2009d). For the reasons discussed here, the staff determined the SCE&G and Santee Cooper processes are sufficiently responsive to forecasting uncertainty for the purposes of this analysis.

8.2 Power Demand

In Section 8.2.1, the demand for power is discussed for SCE&G as described through the State's PSCSC process that culminated in the issuance of the CPCN. In Section 8.2.2, the demand for power is discussed for Santee Cooper as provided by its most recent IRP, and updated via RAI and Comment responses.

8.2.1 SCE&G

SCE&G is an investor-owned utility operating in South Carolina with a well-defined franchised service territory. As such, SCE&G is subject to the regulatory purview and jurisdiction of the PSCSC as granted by the General Assembly of the State of South Carolina, which charges the PSCSC with the broad supervision and regulation of the rates and services of every public utility in the State (SC Code Ann. 58-3-140).

8.2.1.1 Factors Affecting Demand

Pursuant to the Siting Act as previously described, SCE&G must provide for and justify the basis of need for the proposed facility (PSCSC 2008a). The following sections describe relevant information from the PSCSC proceedings regarding SCE&G's CPCN filing, and the basis for final issuance of the CPCN.

Reliability of Load Forecasting and Margin

The PSCSC reviewed the assertion that SCE&G energy forecasts incorporate extensive economic, population, and weather-based analysis, and that the forecasting accuracy compares favorably to actual growth rates on the SCE&G electrical system. Expert witnesses audited and corroborated the forecasting methodology and conclusions, and provided direct testimony supporting the forecasted growth in energy sales (1.3 percent per year) and growth in territorial peak demand (1.7 percent per year). It was also noted in the final order that current forecasts are 35 percent lower than historical growth rates for the prior 15-year period, and that the conservative nature of the assumptions would tend to understate the need for the proposed project rather than overstate the need. The South Carolina Office of Regulatory Staff expert witness also compared the SCE&G forecast to other utility forecasts and concluded that the forecast was consistent with others' forecasts within the region (PSCSC 2008a).

Testimony was provided during the PSCSC CPCN application hearing regarding reserve and capacity margin analysis that demonstrated the need for additional capacity within the time frame under consideration. SCE&G has established a minimum of 12-percent and a maximum of 18-percent reserve margin of the firm peak forecasted demand for planning purposes. This reserve margin was corroborated as being appropriate by the South Carolina Office of Regulatory Staff, and is included in the CPCN hearing record (PSCSC 2008a). The CPCN application hearings were based on the SCE&G 2008 IRP forecast, which showed reserve margin declining to 2 percent in 2016 (which corresponds to the planned commencement of commercial operation of Unit 2) if no additional capacity was added prior to that time (PSCSC 2008a). This is below the accepted range of generating reserves, and would likely render the utility in breach of its service obligations to the reserve sharing group in which SCE&G participates.

Responsiveness to Forecast Uncertainty

As an industry-accepted standard, SCE&G develops its forecast incorporating relevant variables as they pertain to its service territory. The forecasts are heavily data driven including but not limited to aspects of weather-related variability, such as heating degree days and cooling degree days; historic consumption; integration of new efficiency standards; and numerous others. The hearing record showed that as part of the audit of SCE&G's application filing, the forecasts offered were not only reasonable, but conservative as well (PSCSC 2008a).

The PSCSC reviewed the assertion that VCSNS Units 2 and 3 would likely not be needed when collective variations in supply and demand variables such as the implementation of new demand-side management and energy-efficiency programs, or adverse economic conditions are considered. Expert witness testimony was provided and the hearing record demonstrated that even if persistent adverse economic conditions significantly reduced SCE&G load capacity requirements in the future, VCSNS Units 2 and 3 would still be quite valuable (PSCSC 2008a).

Further testimony demonstrated that the most recent economic data were contained in the load forecast used to evaluate the combined application up to the time of the hearing, and that SCE&G regularly receives and updates load forecasts with data from national economic consulting firms (PSCSC 2008a). The data indicated that the impact of the current economic downturn on load forecasting, while potentially significant in the near term, would have only a minor impact on load forecasts in the 2016 and 2019 time frame (coinciding with commercial operation of VCSNS Units 2 and 3), and that the impacts did not change the forecasted need for VCSNS Units 2 and 3. The PSCSC concurred with the position that long-term decisions related to energy capacity should be based on the long-range needs of the system, and not on short-term considerations (PSCSC 2008a).

Demand-Side Management and Energy Efficiency

SCE&G demand-side management (DSM) programs depend heavily on supply-side generation resources such as the Fairfield Pumped Storage Facility and Saluda Hydro to reduce peak demand. When combined with additional DSM resources, SCE&G maintains the capability to reduce demand by approximately 4 percent, which is well above industry standards for utilities in the region (PSCSC 2008a).

Based on the hearing record, the PSCSC found that SCE&G had accurately reflected DSM efforts and the proposed impacts of energy-efficiency measures in its resource planning, and that they were not a viable substitute for the baseload capacity that SCE&G was seeking in the application (PSCSC 2008a). The PSCSC further found that SCE&G had included substantial reductions in demand due to current and forecasted DSM contributions and that the resource plans provided room for increased DSM contributions even with the addition of VCSNS Units 2 and 3 to the system (PSCSC 2008a).

The PSCSC considered expert testimony on the impact of current and projected energy-efficiency programs in the resource plan and determined, though accurate, SCE&G could have done more in general with its energy-efficiency programs in the past, particularly in regard to the expansion of residential energy-efficiency programs (PSCSC 2008a). In response to these specific concerns and previous feedback from PSCSC findings, SCE&G has performed a comprehensive study of potential new DSM programs. The suite of programs was submitted on June 30, 2009, for PSCSC review and approval and is currently undergoing the PSCSC and public vetting process (PSCSC 2009). The staff reviewed the information available regarding the nine proposed new DSM programs and determined that the targeted 131 MW(e) demand reduction expected by the end of the third year of implementation does not materially affect the need for power (PSCSC 2009). This is consistent with the PSCSC finding in the hearing record (PSCSC 2008a) that stated “DSM is a useful supplement to the generation capacity needed on SCE&G’s system. It is not a substitution for it.”

System Economy and Reliability

The Utility Facility Siting and Environmental Protection Act requires that the proposed project "serve the interests of system economy and reliability" (SC Code Ann. 58-33-160 (1)(d)). The PSCSC heard expert witness testimony from SCE&G staff, the South Carolina Office of Regulatory Staff, and independent outside experts, and found that the projections and comparative analysis on which the selection of VCSNS Units 2 and 3 was based were reasonable and appropriate. The PSCSC further found that SCE&G properly concluded that the construction and operation of VCSNS Units 2 and 3 would provide the greatest and most dependable contribution to system economy of all reasonable competitive alternatives (PSCSC 2008a).

The PSCSC assessed the ability of VCSNS Units 2 and 3 to provide reliable electricity to SCE&G customers. Although primarily limited to concerns regarding water availability and transmission planning, the PSCSC found that neither water supply nor transmission issues were likely to compromise the reliability of the plant to deliver power to SCE&G customers, and further found that the proposed location in Jenkinsville, South Carolina, provides a site that is appropriately located close to load centers in the central part of the State, thereby minimizing the impact on transmission issues (PSCSC 2008a).

SCE&G maintains a 12- to 18-percent reserve margin as discussed above. The reserve margin must also include SCE&G's pro-rata share of approximately 200 MW(e) (SCE&G 2009c) as part of its VACAR Reserve Sharing Agreement.

8.2.2 Santee Cooper

The following sections describe Santee Cooper's demand for power based on the adopted resource plan of 2008, the updated resource plan of 2009, applicant responses to RAIs as issued by the NRC, and applicant updates and revisions to the ER. After independent review by outside consultants and affected parties, the 2008 resource plan was adopted by the full Board of Directors of the SCPSA via Resolution MB 08-06 (April 25, 2008). This resolution constitutes the State of South Carolina's approval of the resource plan and the findings therein and provides the basis for the following analysis. As necessary, changes to that resource plan are reflected and noted by the most recent forecast in RAI Response NND-09-0320 (SCE&G 2009b) and in ER update information in NND-10-0334 (SCE&G 2010a).

8.2.2.1 Factors Affecting Demand

There are several contingencies currently impacting the future demand for power in the Santee Cooper service territory. Key among those that will affect the forecast estimates are the recent economic downturn, proposed Federal legislation that may increase the operating costs from fossil-fired generation, and the expected transition of a portion of wholesale power sales to the

Central Electric Power Cooperative (SCE&G 2010a). These impacts are modeled using industry accepted standards and incorporated into the most current forecast to reflect the best known and currently available information.

Reliability in Load Forecasting

The Santee Cooper service territory is somewhat unique in that it provides energy to three electric systems that have widely varying characteristics. Accordingly, Santee Cooper prepares separate forecasts for each area, and then combines them for a total territorial energy and peak demand prediction (SCE&G 2009b). The forecasts are independently updated and validated by GDS Associates, Inc. (Santee Cooper 2008); the forecast and generation plan is further evaluated by R.W. Beck as a condition of acceptance by the Board of Directors of the SCPSA. The 2008 IRP, which was reviewed and approved the Board of Directors of the SCPSA (MB 08-06), projected energy growth at 1.8 percent.

In its most recent energy forecast, Santee Cooper indicates that energy sales are expected to grow at 1.2 percent for the next 15 years (SCE&G 2010a). The forecast includes future energy projections based on econometric modeling for weather, temperatures, non-weather-related components, and historical trends. The model also accounts for the potential loss of energy sales to the Central Electric Cooperative as indicated in NND-10-0334 (SCE&G 2010a).

Energy Efficiency and Demand-Side Management

Santee Cooper actively pursues cost-effective EE/DSM programs. Formalized in 2007, the Santee Cooper Conservation and Renewable Energy Department has been tasked with developing and implementing new energy-efficiency and conservation programs, in addition to evaluating and acquiring renewable generating capacity to serve load. Discussion regarding Santee Cooper's effort to expand on renewable energy can be found in Section 8.3.2.

Currently, EE/DSM programs collectively account for almost 300 MW(e) of peak demand reduction and are effectively embedded in the system peak demand forecast (Santee Cooper 2008). Santee Cooper also maintains an additional 300 MW of load-taking service, which is governed primarily through interruptible power rate structures.

To the extent that these programs are accurately reflected in the current and projected load forecasts, have been independently verified through third-party analysis, and have been judged to be acceptable projections based on known information through Board of Directors approval, the staff finds that the EE/DSM programs proposed by Santee Cooper reasonably reflect the utility's effort to reduce energy and peak demand in the service territory. However, these programs, though effective, do not represent a viable substitute for the baseload capacity that Santee Cooper would receive as a partner in the proposed project.

System Economy and Reliability

Santee Cooper maintains a planning reserve margin from 10 to 13 percent to meet firm load requirements, and to assess the adequacy of its resources for long-term power planning. The total load-requiring reserve that Santee Cooper is responsible for does not include power requirements that are served by other resources, such as the power supplied by the Southeastern Power Administration (SEPA) (Santee Cooper 2008). Much like SCE&G, Santee Cooper is a participant in the VACAR reliability group, which requires maintenance of a pro-rata daily reserve margin. This additional capacity is factored into Santee Cooper's reserve-margin analysis and directly contributes to the minimum acceptable capacity that must be available to service peak load(s). If existing company generating resources are not able to service the peak power demand, firm capacity purchases of additional power must be used to meet the shortfall (SCE&G 2009b). Additional information regarding the reserve-margin analysis can be found in the Santee Cooper IRP (Santee Cooper 2008).

Purchase of long-term wholesale power in the region is challenging. The reasons for this include the lack of excess baseload capacity available, excessive costs when compared to self-build options, limited transmission paths that can effectively bring power into the service territory, and risk. An example of this is Santee Cooper's 2005 Request for Proposal for additional capacity that received no bids (SCE&G 2009b).

8.2.3 Demand Forecast

The following is a summary of the forecasted cumulative demand for the combined SCE&G and Santee Cooper service territories. Table 8-1 lists the 2022 forecasted demand. The forecasted cumulative demand is evaluated for 2022, which would represent 3 years of commercial operation of both proposed units. The analysis accounts for all known demand-side influencing resources as provided through utility IRPs, ER revisions, and from information contained in the CPCN proceedings.

The following analysis provides the projected demand for capacity and does not make assumptions regarding generating alternatives. The final demand and supply analysis is provided in Section 8.4.

Table 8-1. 2022 Forecasted Demand

	IRP and CPCN-Related Forecasted Demand (MW(e))
SCE&G firm peak demand[(a)]	6076
SCE&G reserve[(b)]	729
Santee Cooper firm peak demand[(c)]	5928
Santee Cooper reserve[(d)]	771
Final electricity demand for the service territory	13,504

IRP = Integrated Resource Plan; CPCN = Certificate of Environmental Compatibility and Public Convenience and Necessity
(a) From SCE&G 2009c
(b) 12-percent reserve margin
(c) From SCE&G 2010a
(d) 13-percent reserve margin

Based on preceding information, the staff determined that the conclusions are acceptable as reviewed, verified, and approved by respective State regulatory bodies. Electricity demand for the combined utilities, including the minimum acceptable reserve margin, is forecast to be approximately 13,504 MW(e) in 2022.

8.3 Power Supply

This section discusses the expected supply of electricity in the relevant service area that would be available three years after full operation of both proposed units. In Section 8.3.1, the supply of power is discussed for SCE&G as described through the State's PSCSC process that culminated in the issuance of the CPCN. In Section 8.3.2, the supply of power is discussed for Santee Cooper as provided in its most recent IRP, and the revised forecast provided via ER Revision response NND-10-0334 (SCE&G 2010a).

8.3.1 SCE&G

The reliable supply of power is inherent to SCE&G's legal obligations in South Carolina. Accordingly, the PSCSC annually reviews the proposed forecasts and/or annual updates in addition to supporting documentation that may materially affect forecasting accuracy and power-supply requirements. For the proposed project, which requires a full public vetting process, the energy forecast and its distinct components were also subject to independent third-party review and testimony addressing the accuracy and completeness of the forecast.

In the comprehensive energy forecast submitted to the PSCSC as part of the proceedings that led to issuance of the CPCN, SCE&G factored in its full resource portfolio, including present and planned generating capabilities, present and planned purchases and sales of power, and the impact from EE/DSM programs.

8.3.1.1 Present and Planned Generating Capacity

By annually reviewing and adjusting capacity resources over a rolling 15-year planning period, SCE&G is able to account for new capacity, proposed unit retirements, capacity uprates and derates, policy drivers such as improved energy standards or Federal legislation regarding emissions, and their impact on the generating resource portfolio. In doing so, the forecasted variable (e.g., customer class) is modeled against multiple sensitivities of a broad range of possible indicators such as economic environment, weather, conservation, and price (SCE&G 2009c). From this, multiple resource portfolios are generated and tested against cumulative capacity requirement projections and the likely combinations of forecast sensitivities. The resource portfolios do not specify preference or partiality for capacity type; rather, they provide a systematic analysis of a range of potential capacity resources necessary for the development of a balanced and cost-effective resource portfolio and include both purchased alternatives and self-build options.

As part of the PSCSC CPCN application hearing record, SCE&G indicated that it maintained 5687 MW(e) of generating capacity broken out by capacity type as the following: coal-fired (2484), co-generation (90), natural-gas/oil fired combined cycle (1319), peaking combustion turbine (347), hydropower (227), pumped storage (576), and nuclear (644). SCE&G also has two long-term power purchase agreements that bring its total supply capacity to 5745 MW(e) (PSCSC 2008a). In servicing a 2007 peak power demand of 5248 MW(e), SCE&G's existing capacity provided for a 9-percent online reserve margin,[a] which is below its established reserve margin target of 12 percent as previously indicated. To meet its reserve margin target, SCE&G has been required to purchase short-term, off-system capacity to supplement and satisfy the growing demand for power.

8.3.1.2 Need for Baseload Capacity

The PSCSC heard testimony from SCE&G company witnesses regarding the need to add baseload capacity to the power-generation mix. The record shows that the last baseload capacity addition to the fleet was completed in 1996. From 1996 to the present, only peaking and intermediate capacity additions have been made to meet the 31-percent growth in demand over the same time period. By 2020, at the time when both Units 2 and 3 would be in commercial operation, the growth in energy demand is forecasted to have grown by 44 percent since 1996 (PSCSC 2008a).

(a) (Capacity – Peak) / Peak

Review of SCE&G current operating practices demonstrates the value of baseload “preferred” capacity. Baseload capacity currently represents approximately 56 percent of total capacity in the SCE&G system, while providing over 80 percent of the energy used by SCE&G customers (PSCSC 2008a). Without the capacity additions represented by the proposed operation of VCSNS Units 2 and 3, baseload capacity as a percentage of total capacity would shrink to 45 percent by 2020, indicating a significantly higher reliance on intermediate duty cycle technologies (such as natural-gas-fired combined-cycle power plants) to make up the need for more energy. With the additional capacity of the proposed nuclear project, both fossil-fired technologies listed in Table 8-2 (coal and gas) would likely experience lower demands for their capacity than are currently observed. The table outlines the potential impact the proposed project would have on baseload capacity resources and fuel diversity. Table 8-2 is not a final power supply portfolio, rather it serves to demonstrate how in the absence of the proposed project, SCE&G would likely observe a substantial increase in its reliance on natural-gas-fired capacity.

The PSCSC hearing record further demonstrated that even with the addition of the baseload capacity resources as proposed in the project, at no time does SCE&G actually exceed its reserve planning target. In 2016, at the time Unit 2 is proposed to be in commercial operation, the reserve margin in that year would go from 2 percent (if no capacity additions are made in the interim), up to 13 percent. Likewise, in 2019, at the time Unit 3 is proposed to be in commercial operation, the reserve margin in that year would increase to 17 percent; this is still below the targeted maximum reserve margin of 18 percent (PSCSC 2008a).

Table 8-2. Potential Impact the Proposed Project Would Have on SCE&G Baseload Capacity Resources and Fuel Diversity

SCE&G	Percent of Capacity in Baseload	Total Capacity (MW(e))	Percent Capacity of Total		
			Coal	Nuclear	Gas
Current	56	5687	43	11	30
2020 with nuclear	63	6888	37	27	24
2020 without nuclear[(a)]	45	6888	36	9.4	41

Sources: SCE&G 2009c and PSCSC 2008a
(a) Calculated using existing nuclear and coal capacity and forecasted capacity requirements for 2020.

8.3.1.3 Fuel Diversity

The PSCSC heard relevant testimony from the SCE&G resource planning experts, as well independent review and auditing from the South Carolina Office of Regulatory Staff demonstrating the appropriate selection and mix of power-generating resources that would function to minimize exposure to future fuel costs and environmental compliance costs. The assessed SCE&G generation plans provided analysis comparing the “base case” scenario (two nuclear units) to combinations of various fossil-fired alternatives, such as coal-fired and natural-gas-fired plants either in simple cycle or combined cycle, including sensitivity analysis based on factors such as uranium pricing, lower gas prices, reduced reliability of aging fossil plants, and associated emissions considerations.

SCE&G is heavily dependent on fossil-fired capacity at 73 percent of existing resources. The utility's exposure to future variations in fuel costs, environmental compliance, and operational risks were qualitatively assessed against the strengths and weaknesses of the current power-generation fleet, and what the proposed generating alternatives might entail. The PSCSC CPCN application hearing record states that company leaders determined that the nuclear option would serve to strengthen SCE&G's aging baseload capacity portfolio, diversify the company's fuel mix, and reduce customer exposure to the risks and volatility of fossil fuel markets and supply (PSCSC 2008a). As discussed in Section 8.2.1, this was further validated by the PSCSC in its conclusion indicating that VCSNS Units 2 and 3 would provide the "greatest and most dependable contribution to system economy of all reasonably competitive alternatives" (PSCSC 2008a).

SCE&G company witnesses also confirmed the useful flexibility of adding VCSNS Units 2 and 3 to the capacity supply mix by providing testimony addressing the potential benefit to reducing company reliance on an aging coal-fired fleet. Allowing older fossil-fired plants to be retired or used less intensively in the future could benefit the electrical system in terms of reliability, compliance, and fuel efficiency (PSCSC 2008a).

8.3.2 Santee Cooper

In developing the power-supply and capacity forecasts for its service territory, Santee Cooper factored in its present and planned generating capabilities, present and planned purchases and sales of power, distributed and self-generation power sources, and demand-side reduction. The power-supply analysis is bound by the description of Santee Cooper's current customer base, and any known proposals or conditions that may materially affect forecasting accuracy and power-supply requirements. An example of such is the recent decision by the SCPSA to suspend all efforts to further permit and expand generating capacity at the Pee Dee site due to the expected transition of wholesale energy sales to the Central Electric Power Cooperative (SCE&G 2010a).

The reliable supply of power is inherent to Santee Cooper's legal obligation to the constituents of the State of South Carolina as reviewed in Section 8.2.2. Accordingly, the Board of Directors of the SCPSA reviews the IRP, and formally issues a resolution indicating its approval of the IRP and ensuing instructions or authorizations regarding future directions such as the continued investment in the VCSNS Units 2 and 3 project.

8.3.2.1 Present and Planned Generating Capacity

As a power generator, Santee Cooper is engaged in the operation of baseload, intermediate and peaking duty cycle power plants. Santee Cooper owns and maintains a summer peak generating capacity of approximately 6091 MW(e), which also includes long-term purchased power contracts. The capacity mix currently includes very high exposure to fossil-based generating resources, such as coal at 70 percent of all capacity, and gas-oil fired at 22 percent of all capacity (SCE&G 2009b). These fossil-based generating resources produce and supply approximately 81 percent of the energy required by Santee Cooper; the remainder being supplied by hydropower (1 percent), nuclear (9 percent), and power purchases (9 percent). Santee Cooper also indicates that approximately 70 percent of all its generation resources operate in baseload (SCE&G 2009b).

By periodically reviewing and adjusting capacity resources over a rolling 20-year planning period, Santee Cooper is able to account for new capacity, unit retirements, capacity uprates and derates, policy drivers such as Renewable Energy Portfolio Standards and potential Federal greenhouse gas legislation, and their impact on the resource mix. From this, multiple resource portfolios are generated and tested against cumulative capacity requirement projections and combinations of forecast sensitivities. The resource portfolios do not specify preference or partiality for capacity type; rather, they provide a systematic analysis of a range of potential capacity resources necessary for the development of a balanced and cost-effective resource portfolio.

Santee Cooper is currently engaged in several activities that may provide additional capacity within the timeline of consideration. These activities include the potential development of fossil-fired capacity; integration of alternative or renewable based capacity; and upgrading, relicensing, or developing hydropower-based power plants. The activities are also modeled periodically on a rolling 20-year planning horizon enabling the incorporation of the most recent and updated information, such as receiving the final ruling on the VCSNS CPCN or a sensitivity analysis regarding the cost and risk for potential capacity additions. Collectively, all of these activities are subject to the review and approval by applicable regulatory bodies such as the Board of Directors of the SCPSA and Federal Energy Regulatory Commission.

8.3.2.2 Purchased Power

Santee Cooper satisfies a portion of the resource portfolio by routinely purchasing intermediate and peaking power capacity through firm power purchase agreements. This practice has historically included contracted power purchase agreements from conventional non-utility (merchant) units, such as natural-gas-fired combustion turbines and combined cycle plants in addition to the known purchase and distribution of hydropower based power from SEPA and U.S. Army Corps of Engineers. In its 2008 IRP, Santee Cooper indicates that it currently has firm wholesale power purchase commitments for over 570 MW(e) from such facilities. Of this, approximately 28 percent represents mid-term firm power purchases expiring in 2014 that are intended to provide adequate reserve margin; with the remainder representing long-term power purchases (Santee Cooper 2008). Further, in the 2009 IRP, Santee Cooper indicates that in order to maintain an adequate reserve margin prior to commercial operation of VCSNS Unit 2 in 2016, increased short-term power purchases would be required starting in 2014 (SCE&G 2010b). In deciding to add any new power resource, including purchased power, Santee Cooper evaluates and screens all viable supply-side options against the load forecast, assumptions of cost and risk, and the possible generation mix (SCE&G 2010b).

8.3.2.3 Renewable Resources

Enabling legislation passed by the South Carolina General Assembly in 1934 chartered Santee Cooper with the development of renewable resources in the form of hydropower-based power generation. Hydropower continues to supply customers of Santee Cooper with clean energy. Although with limited developable resources, what was once the sole source of power generation, hydropower currently supplies only 2 percent of the summer-time peak generating capacity at 130 MW(e) (SCE&G 2009b). This still represents the single largest contribution to Santee Cooper's renewable energy portfolio.

Although renewable energy resources do not individually provide a significant amount of increased capacity, Santee Cooper continues to pursue developments in biomass, solar, and wind generation as the region and resources permit. Further, Santee Cooper indicates in long-term load forecasts (15 years) as reflected in the IRP and RAI responses, that renewable resources in combination are forecast to supply up to 250 MW(e) during the timeline of consideration. To date, approximately 50 MW(e) of the proposed renewable resources have been contractually negotiated, and are included in the most recent forecast (SCE&G 2010a). One example includes the expansion of landfill-based methane gas collection and combustion, currently at 13 MW(e), which is expected to double by the end of 2010 (Santee Cooper 2008). In addition, Santee Cooper has partnered with universities and others to either expand on existing programs such as solar development, or to continue investigating alternatives such as coastal wind power (Santee Cooper 2008).

Additional information regarding specific renewable energy alternatives is discussed in Section 9.2.3.

8.3.2.4 Need for Baseload Capacity

As previously discussed, Santee Cooper operates 70 percent of its existing fleet of generating resources at baseload. As a percentage of available generating resources, this represents a significant commitment of resources, and is indicative of the utility's current need to develop additional baseload resources. This premise has been corroborated by several entities including the SERC's Reliability Review Subcommittee (RRS); the State of South Carolina through the State Regulation of Public Utilities Review Committee, and Board of Directors of the SCPSA.

The SERC RRS reported in its 2009 Annual Report that while near-term[a] planning horizons appear to indicate sufficient capacity resources, adequate long-term[b] planning reserves would be dependent on future business decisions, including the use of uncommitted generation and construction of new baseload capacity (SERC 2009). The RRS also recognizes that based on the percentage of planned net capacity additions, utilities are preparing to meet long-term demand growth with a significant commitment to base-load generation rather than relying on natural-gas-fired generation or purchases (SERC 2009). As previously discussed in Section 8.1.3, there is both a shortage of available uncommitted capacity for Santee Cooper to pursue for long-term baseload capacity requirements, and the capacity that is available is largely natural-gas-fired generation. Typically, plants fueled by natural gas are used to supply intermediate generation (20−60 percent capacity factor), and peaking generation (20 percent capacity factor) (PURC 2009, Appendix B, Glossary). Accordingly, the staff finds that Santee Cooper's commitment to the proposed project aligns its need for baseload capacity with a SERC RRS recognized baseload generating alternative. The staff considers additional generating alternatives, including natural gas-fired generation, in Section 9.2.

Additional language supporting the need for baseload capacity in the region is provided in the South Carolina State Regulation of Public Utilities Review Committee's (PURC's) Energy Policy Report, which is a comprehensive accounting of both the current and future energy requirements in the State of South Carolina. Although produced largely in the context of addressing pending Federal energy policies and establishing strategies for a course of action, the report, which was compiled by the Office of Regulatory Staff including a full public vetting, nonetheless recognized that South Carolina has a "growing baseload electric need" (PURC 2009).

The SCPSA Board of Directors, representing the State of South Carolina, authorized the commitment of Santee Cooper to the proposed project via the resolutions provided in Section 8.1.4.2. In doing so, the SCPSA Board of Directors sanctioned Santee Cooper's pursuit of a generating resource that is used only to supply baseload power. Due to recognized need for baseload capacity within the region and the supporting documentation provided in the preceding discussion, the staff finds that it is reasonable to conclude that Santee Cooper's pursuit of 45 percent of the capacity from the proposed project means the utility has a need to meet a significant percentage of its long-term demand for power by developing baseload generating capacity other than through natural-gas-fired generation or capacity purchases.

(a) Represented as years 2009 through 2013 (SERC 2009)
(b) Represented as years 2013 through 2018 (SERC 2009)

8.3.3 Supply Forecast

The following is a summary of the forecasted cumulative supply for the combined SCE&G and Santee Cooper service territories. The forecasted cumulative supply is evaluated for 2022, which would represent 3 years of commercial operation of both proposed units. The analysis accounts for all known supply-side resources as provided through each respective utility's IRP and as updated via RAI and Comment responses, with the exception of the capacity of the proposed project. By removing the capacity additions of the proposed project, the staff is able to quantify the cumulative supply that is available to service the expected demand for that power. The final demand and supply analysis is provided in Section 8.4.

Table 8-3 provides the cumulative supply forecast for the combined service territories through the summer of 2022.

Table 8-3. 2022 Forecasted Cumulative Supply

	Forecasted Cumulative Supply (MW(e))
SCE&G cumulative supply[(a)]	5660
Santee Cooper cumulative supply[(b)]	5679
Combined cumulative supply	11,339

(a) Available capacity minus the proposed 55 percent of VCSNS Units 2 and 3 (equal to 614 MW(e) X 2)
(b) Available capacity minus the proposed 45 percent of VCSNS Units 2 and 3 (equal to 502 MW(e) X 2)

The staff determined based on the preceding information, that the conclusions are acceptable as reviewed, verified, and approved by respective State regulatory bodies. Electricity supply for the combined utilities, minus the cumulative supply of the proposed project, is forecast to be approximately 11,339 MW(e) in 2022.

8.4 Assessment of Need for Power and NRC Findings

In its final order, the PSCSC provided a single determination of all aspects of the public interest evaluation related to proposed VCSNS Units 2 and 3 stating that, “in this case, the record demonstrates that VC Summer Units 2 and 3 represent capacity that is needed to supply reasonably forecasted customer demands. In addition, the size, type, location, and technology of the Units are the preferable means of doing so with the greatest economy and reliability and with the least impact on the environment” (PSCSC 2008a). The PSCSC also commented directly on the ability of the proposed project to insulate customers from the price volatility and supply risk that are increasingly associated with fossil-fuel-fired generation. The PSCSC further noted that alternative energy sources would likely provide useful supplemental energy for SCE&G systems going forward, but that public convenience and necessity would not be supported by forcing SCE&G customers to rely on the future availability and competitiveness of these energy sources as a substitute for SCE&G constructing and operating additional baseload capacity at this time (PSCSC 2008a). The staff's review of the PSCSC and SCPSA Need for Power evaluation is detailed in Section 8.1.5 above.

SCE&G: The staff reviewed the information provided in PSCSC Docket 2008-196-E and evaluated the assumptions and findings therein. The staff determined that SCE&G submitted a combined application for a CPCN and for a Base Load Review Order to the PSCSC for the design, construction, and operation of a two-unit nuclear power plant. The petition proceedings, public hearings, and independent evaluation by the South Carolina Office of Regulatory Staff confirmed for the record that SCE&G's determination of the need for power equal to 55 percent of the power output of the two-unit plant followed conventional and appropriate practices, including the thorough evaluation of methodologies and assumptions in forecasting, impacts of energy-efficiency and DSM programs, and generation resource planning. The hearing record further demonstrated that the need for additional baseload capacity was justified and that proposed VCSNS Units 2 and 3 would serve the interests of system economy and reliability as the most practicable means for the generation of electric power (PSCSC 2008a).

Santee Cooper: The staff reviewed the information found in the 2008 and 2009 Santee Cooper IRP, the 2009 updated forecast as provided in RAI response NND-09-0320 (SCE&G 2009b), and comment response NND-10-0334 (SCE&G 2010a). The staff evaluated the assumptions and findings therein. The staff further determined that the State of South Carolina appropriately accounted for current and future energy needs through the submittal, independent auditing, and subsequent approval of Generation Resource Plans by the SCPSA Board of Directors. The Board of Directors further authorized Santee Cooper management to pursue an ownership share of 45 percent of the nuclear capacity additions proposed for the VCSNS site, and determined that in consideration of factors set forth in South Carolina Code 58-31-55(A)(3), adoption of the resolutions was in the best interest of the SCPSA, and therefore, the State of South Carolina.

Proposed Need for Power: The final comparison of the combined power supply and demand forecasts for SCE&G and Santee Cooper indicates that both utilities require an expansion of generating capacity within the proposed timeline to maintain adequate generating capacity in support of State, regional, and utility-level capacity requirements, including reserves. The analysis is summarized in Table 8-4.

The outcomes and accuracy of forecasting efforts are subject to confirmation by parties external to the utilities and State Utility Commissions, including SERC's RRS. The RRS conducts seasonal and annual reliability assessments of the SERC region by reviewing the data and

Table 8-4. Final Analysis of the Combined Power Supply and Demand Forecasts for SCE&G and Santee Cooper in 2022

	Cumulative Demand including Reserve Margin in 2022	Cumulative Supply in 2022 Without Units 2 and 3	Total New Capacity Required in 2022 without Units 2 and 3
SCE&G[a]	6805	5660	1145
Santee Cooper[b]	6699	5679	1020
Combined	13,504	11,339	2165

(a) Analysis done using data supplied via SCE&G 2009c.
(b) Analysis done using data supplied via SCE&G (SCE&G 2010a).

studies submitted by SERC member systems. Load forecasting, as provided by the utilities within SERC, is a critical element of the process used to establish the reliability and capacity obligations within SERC; thus, the load forecast receives considerable scrutiny from the SERC RSS to make sure that it represents a reliable estimate of future peak loads and provides the basis upon which to evaluate future capacity requirements. The RSS annual report captures those forecasts and provides a documented assessment assuring that the SERC region is being planned in accordance with the NERC Reliability Standards and applicable SERC Supplements (SERC 2009). The historical predictive capability of SCE&G and Santee Cooper load forecasts compares favorably to the VACAR subregion analysis found in the annual report provided to SERC's Engineering Committee by the RRS (SERC 2009).

In aggregate, the rulings and resolutions constitute the State of South Carolina's application of statutory regulations to conclude that there is a justified need for power in the relevant service territory within the proposed timeline. The staff considered the State's evaluation and determination of the need for baseload capacity for both SCE&G and Santee Cooper within the context of the NUREG-1555 guidelines. The staff accepts as complete and adequate the need-for-power evaluation contained in the State's CPCN ruling as provided by the PSCSC, and in the resolutions provided by the SCPSA Board of Directors regarding the generation resource plans for Santee Cooper.

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9.0 Environmental Impacts of Alternatives

This chapter describes alternatives to the proposed U.S. Nuclear Regulatory Commission (NRC) action for combined construction permits and operating licenses (COLs) and the U.S. Army Corps of Engineers' (USACE's) action for a Department of Army (DA) Individual Permit and discusses the environmental impacts of those alternatives. Section 9.1 discusses the no-action alternative. Section 9.2 addresses alternative energy sources. Section 9.3 reviews the region of interest (ROI) evaluated in the site-selection process, the South Carolina Electric and Gas (SCE&G) site-selection process, details specific to each one of the respective alternative sites, and summarizes and compares the cumulative environmental impacts for the proposed and alternative sites. Section 9.4 examines plant design alternatives. Section 9.5 describes onsite alternatives to reduce impacts on wetlands and natural and cultural resources. Section 9.6 lists the references cited in this chapter.

The need to compare the proposed action with alternatives arises from the requirement in Section 102(2)(c)(iii) of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321) that environmental impact statements (EISs) include an analysis of alternatives to the proposed action. The NRC implements this requirement through its regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51 and its Environmental Standard Review Plan (ESRP) (NRC 2000). The environmental impacts of the alternatives are evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality (CEQ) guidelines (40 CFR 1508.27) and set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. The issues evaluated in this chapter are the same as those addressed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999)[a] with the additional issue of environmental justice. Although NUREG-1437 was developed for license renewal, it provides useful information for the review reported here and is referenced throughout this chapter. Additional guidance on conducting environmental reviews is provided in the Staff Memorandum on "Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements" (NRC 2010a).

As part of the evaluation of permit applications subject to Section 404 of the Clean Water Act, the USACE is required by regulation to apply the criteria set forth in the U.S. Environmental Protection Agency's (EPA's) 404(b)(1) guidelines (40 CFR Part 230; hereafter 404 Guidelines). These guidelines establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404, which governs disposal sites for dredged or fill material. Specifically,

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

the 404 Guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem provided the alternative does not have other significant adverse consequences. An area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed to fulfill the basic purpose of the proposed activity may be considered if it is otherwise a practicable alternative.

9.1 No-Action Alternative

For purposes of an application for COLs, the no-action alternative refers to a scenario in which the NRC would deny the COLs requested by SCE&G. The USACE could also take no action, or deny the permit requests. Upon such a denial by NRC, the construction and operation of two new nuclear units at the Virgil C. Summer Nuclear Station (VCSNS) site in accordance with 10 CFR Part 52 would not occur and the predicted environmental impacts associated with the project would not occur. Preconstruction impacts associated with activities not within the definition of construction in 10 CFR 50.10(a) and 51.4 may occur. The no-action alternative would result in the proposed facility not being built. If no other facility would be built or strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation to be provided by the project would not occur. If no additional conservation measures were enacted to decrease the amount of electrical capacity that would otherwise be required for power in the ROI, then the need for baseload power, discussed in Chapter 8, would not be met. Therefore, the purpose of and need for this project would not be satisfied if the no-action alternative was chosen and the need for power was not met by other means.

If other generating sources were built, either at another site or using a different energy source, the environmental impacts associated with these other sources would eventually occur. As discussed in Chapter 8, there is a demonstrated need for power and SCE&G and Santee Cooper (the State-owned electric and water utility formally called South Carolina Public Service Authority) have regulatory responsibilities in South Carolina to provide electrical service in their respective service territories. This needed power may be provided and supported through a number of alternatives that are discussed in Sections 9.2 and 9.3. Therefore, this section does not include a discussion of other energy alternatives (discussed in Section 9.2) and alternative sites (discussed in Section 9.3) that could meet the need for power.

9.2 Energy Alternatives

The purpose and need for the proposed NRC action (i.e., issuance of COLs) identified in Section 1.3.1 of this EIS is to provide for additional baseload electric generating capacity by 2016 and 2019 within the service territories of SCE&G and Santee Cooper. This section examines the potential environmental impacts associated with alternatives to the construction and operation of a new baseload nuclear generating facility. Section 9.2.1 discusses energy alternatives that do not require new generating capacity, while Section 9.2.2 discusses energy alternatives that require new generating capacity. Other alternatives are discussed in Section 9.2.3. A combination of alternatives is discussed in Section 9.2.4. Section 9.2.5 compares the environmental impacts from new nuclear, coal-fired, and natural-gas-fired generating units, and a combination of alternatives at the VCSNS site.

For analysis of energy alternatives, the review team assumed a bounding target value of 2214 MW(e) of electrical output, or the equivalent electrical capacity of the proposed VCSNS project. The review team also used this level of output in analyzing energy alternatives.

9.2.1 Alternatives Not Requiring New Generating Capacity

The following are three alternatives to the proposed action that do not require SCE&G to construct new generating capacity:

- Purchase the needed electric power from other suppliers.
- Extend the operating life of existing power plants or reactivate retired power plants.
- Implement conservation or demand-side management (DSM) programs.

These alternatives are reviewed in the following sections.

9.2.1.1 Purchased Power

Power to replace the capacity of the proposed new nuclear units would have to be purchased from other generating resources, and likely would be one of those described in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (e.g., coal, natural gas, or nuclear) (NRC 1996). The environmental impacts of coal-fired and natural-gas-fired plants are discussed in Section 9.2.2. Under the purchased power alternative, the environmental impacts of power production would still occur but would likely be located elsewhere within the Southeastern Electric Reliability Council (SERC) region. However, the entire SERC region has been identified as a “Conditional Congestion Area” by the U.S. Department of Energy (DOE) in its 2006 (August) *National Electric Transmission Congestion Study* (DOE 2006a). This status means the movement of bulk power in the future has already been identified to be compromised unless the SERC region has a significant build-out of transmission capabilities in concert with the development of needed generation.

The option to purchase power implies that there is adequate generating capacity available for firm sales and transmission into or within the service territory. Although additional capacity may be available to serve native load from merchant power plants or other similar generators, the capacity from these plants is not considered to be useful in supplying baseload capacity. This premise was confirmed by Public Service Commission of South Carolina (PSCSC) Order 2007-626, which indicated that the risk to low-cost, reliable electricity increased in magnitude as mandatory Requests for Proposals (RFPs) were applied to peaking, intermediate, and baseload capacity requirements, and further concluded that testing the market via RFPs would only be mandatory for new peaking capacity needs (PSCSC 2007). In addition, under the Public Utility Regulatory Policies Act (PURPA 1978), the electric utilities offer the purchase of electrical energy from qualifying facilities. Due to the limited number of PURPA-qualifying facilities in the area, and the limited total available capacity from these facilities, they do not represent a long-term solution for additional baseload capacity in the SCE&G and Santee Cooper service territory.

Both SCE&G and Santee Cooper are actively engaged in evaluating and negotiating firm power-purchase agreements for the time frame under consideration. Previous contracts have been established and are expected to fill intermediate and peaking duty cycles, and are not intended to be competitive with, or replace the need for, the additional baseload capacity. In the Certificate of Environmental Compatibility and Public Convenience and Necessity (CPCN) and Base Load Review Act proceedings, the PSCSC found that the capacity needs in the timeline under consideration would be most reliably and efficiently met through the addition of new baseload capacity to the system consistent with proposed VCSNS Units 2 and 3 (PSCSC 2009a).

Based on the preceding discussion and information detailed in Section 8.3, the review team concludes that purchasing power is not a reasonable alternative to providing new additional baseload capacity commensurate with the proposed project.

9.2.1.2 Extending the Service Life of Existing Plants or Reactivating Retired Plants

Nuclear power facilities are initially licensed by the NRC for a period of 40 years. An operating license can be renewed for up to 20 years, and NRC regulations permit additional license renewals. SCE&G and Santee Cooper jointly own and operate the VCSNS Unit 1 plant located in Jenkinsville, South Carolina. VCSNS Unit 1's license was renewed in April 2004, extending the operating license through 2042. The environmental impacts of continued operation of a nuclear power plant are significantly less than those of construction of a new plant. However, continued operation of an existing nuclear plant does not in and of itself provide additional generating capacity.

Currently, SCE&G and Santee Cooper do not indicate in their energy forecasts or Integrated Resource Plans (IRPs) that they have any retired plants that would be suitable for reactivation, nor does SCE&G have firm plans for retiring any of its generating units. The review team concludes that extending the service life of existing plants or reactivating retired plants is incapable of providing additional baseload capacity commensurate with the proposed project. Therefore, extending the service life of existing plants or reactivating retired plants is not a reasonable alternative to the proposed project.

9.2.1.3 Energy Conservation

SCE&G offers conservation and DSM programs to its customers to reduce peak electricity demands and daily power consumption. As reviewed in Section 8.2.1, the PSCSC, through the CPCN and Base Load Review Act process, fully evaluated existing energy efficiency and DSM (EE/DSM) programs and their impacts on capacity requirements. Collectively, the programs were found to be effective in reducing peaking and intermediate generation capacity requirements, but were not found to eliminate the need for baseload generation capacity that the proposed project would provide. Current energy forecasts and load growth projections incorporate these programs, and have been reported as part of both the IRP forecasting process and the CPCN process. SCE&G provided a comprehensive evaluation of potential new DSM programs to the PSCSC for review and approval, although no ruling has been provided to date (PSCSC 2009b). The review team based its analysis on the approved EE/DSM programs currently implemented; while the proposed new EE/DSM programs would reduce demand, they would not reduce demand to the point where the expected power from the proposed project would not be needed. Further information regarding SCE&G's EE/DSM programs can be found in Section 8.2.

In its 2008 IRP, Santee Cooper provided EE/DSM program-specific information and a planning forecast reflective of its current offerings (Santee Cooper 2008). Santee Cooper maintains a working group formed in 2007 (Conservation and Renewable Energy Department) that is tasked with developing and implementing new EE/DSM programs, in addition to obtaining renewable resources to serve load. The proposed programs undergo a vetting process similar to the PSCSC process. Santee Cooper is showing consistent growth in these programs in its out-year energy forecasts, ranging from 8 to 12 percent annual growth or approximately 300 MW(e) total over the time period ending in 2017, and a total peak-energy-shaving capacity of approximately 7 to 8 percent (Santee Cooper 2008).

Collectively, the implemented EE/DSM programs have been an effective strategy for significantly reducing peak capacity requirements. However, as stated in Section 8.2, the review team concludes that energy conservation is not a viable substitute for the baseload capacity that SCE&G is seeking through the proposed project within the timeline of consideration. Therefore, EE/DSM programs are not a reasonable alternative to the proposed project.

9.2.1.4 Conclusions

Based on the preceding analysis, the review team concludes that the options of purchasing electric power from other suppliers, reactivating retired power plants, extending the operating life of existing power plants, and full implementation of EE/DSM programs are not reasonable alternatives to providing the baseload generation capacity necessary to meet the long-term requirements in the ROI.

9.2.2 Alternatives Requiring New Generating Capacity

This section discusses the environmental impacts of energy alternatives to the proposed action that would require the applicants to build new generating capacity. In keeping with the NRC staff's evaluation of alternatives to renewal of operating licenses, a reasonable set of energy alternatives to the construction and operation of one or more new nuclear units at the VCSNS site should be limited to analysis of discrete power-generation sources and those power-generation technologies that are technically reasonable and commercially viable (NRC 1996). The discussion in Section 9.2.2 is bounded by the individual power-generating alternatives that are considered reasonable and viable as baseload technologies. As described in Chapter 8, baseload designed power in the State of South Carolina is defined as being capable of operating at a capacity factor greater than 70 percent, and exceeding 350 MW(e) (SC Code Ann. 58-33-220). The current mix of power-generation options within the SERC is also an indicator of the feasible choices for power-generation technology; approximately 76 percent of the current fleet within the SERC region is fossil-fired generation (SERC 2009).

Each year, the Energy Information Administration (EIA), a component of the DOE, issues an annual energy outlook. In the *Annual Energy Outlook 2009* (DOE/EIA 2009), the EIA reference case projects that coal-fired capacity would account for approximately 18 percent of total electric generating capacity additions between 2006 and 2030. Coal-fired plants generally are used to meet baseload requirements. The EIA also projects that natural-gas-fired plants would account for approximately 53 percent of new capacity additions during this period. EIA projects that renewable energy sources would account for approximately 22 percent of new capacity additions during the period, and new nuclear plants would account for approximately 5 percent. The EIA projections include baseload, intermittent, and peaking units, and are based on the assumption that providers of new generating capacity would seek to minimize cost while meeting applicable environmental requirements (DOE/EIA 2009).

The discussion in Section 9.2.2 is limited to the individual alternatives that appear to the review team to be viable baseload generation sources: coal-fired and natural-gas combined-cycle-fired generation. The impacts discussed in Section 9.2.2 are estimates based on present technology. Section 9.2.3 addresses alternative generation technologies that have demonstrated commercial acceptance but may be limited in application, total capacity, or technical feasibility when based on the need to supply reliable, baseload capacity.

The review team assumed new generation capacity would be located at the VCSNS site for the coal-fired and natural-gas-fired alternatives. Either natural draft or mechanical draft cooling towers would be used for the coal-fired and natural-gas-fired alternatives. For the purpose of analysis, the electric power transmission lines from these alternatives were assumed to follow the same proposed corridors as the proposed baseload nuclear generating facility at the VCSNS site. These corridors would be developed consistent with the description provided in Section 3.2.

9.2.2.1 Coal-Fired Power Generation

For the coal-fired generation alternative, SCE&G assumed the operation of three pulverized coal-fired units, with a total net capacity of 2214 MW(e) at the VCSNS site (SCE&G 2010b). The associated emissions were determined based on factors contained in the EPA Clearinghouse for Inventories and Emissions Factors (EPA 1998). The emission estimates are based on "as fired" and controlled conditions using both combustion and post-combustion technologies to reduce criteria pollutants. The new coal-fired generation is assumed to have an operating life of 40 years.

The review team also considered integrated gasification combined cycle (IGCC) coal-fired plants as a baseload technology. IGCC is an emerging technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. The technology is cleaner than conventional pulverized coal plants because major pollutants can be removed from the gas stream before combustion. The IGCC alternative also generates less solid waste than the pulverized coal-fired alternative. The largest solid waste stream produced by IGCC installations is slag, which is a black, glassy, sand-like material that is a potentially marketable byproduct. The other large-volume byproduct produced by IGCC plants is sulfur, which is extracted during the gasification process and can be marketed rather than placed in a landfill. IGCC units do not produce significant quantities of fly ash, and process wastes are often minimized through the use of water-reuse technologies, thereby reducing the total outflow. In spite of the preceding advantages, the review team concludes that, at present, IGCC is not a reasonable alternative to a 2000-MW(e) nuclear power-generation facility for the following reasons: (1) IGCC plants are more expensive than comparable pulverized coal plants (NETL 2007), (2) existing IGCC plants have considerably smaller capacity than the proposed 2000-MW(e) nuclear plant, (3) the system reliability of existing IGCC plants has been lower than conventional pulverized coal plants, and (4) a lack of overall plant performance warranties for IGCC plants has hindered commercial financing (NPCC 2005, Appendix I). For these reasons, IGCC plants are not considered further in this EIS.

The review team assumed that coal and limestone would be delivered to the site by train. SCE&G estimates that approximately 500 unit trains per year (each train consisting of 125 cars holding a 100 tons per car) would be needed to deliver coal and limestone to the coal-fired plant (SCE&G 2010b).

Air Quality

The impacts on air quality from coal-fired generation would vary considerably from those of nuclear generation because of emissions of SO_2, nitrogen oxides, carbon monoxide (CO), particulate matter (PM), volatile organic compounds, and hazardous air pollutants such as mercury and lead. SCE&G assumed a plant design that would minimize air emissions through a combination of boiler and combustion technology as well as post-combustion pollutant removal (SCE&G 2010b).

Emissions from the coal-fired alternative such as SO_x (sulfur oxides), nitrogen oxides (including NO and NO_2), CO, and PM would be as follows (SCE&G 2010b):

- SO_2 = 7044 T/yr
- nitrogen oxides = 1495 T/yr
- CO = 1495 T/yr
- PM_{10} (particulate matter with an aerodynamic diameter of 10 microns or less) = 67 T/yr
- $PM_{2.5}$ (particulate matter with an aerodynamic diameter 2.5 microns or less) = 0.17 T/yr.

Based on data from previous NRC EIS documents, the review team determined the preceding emission estimates are reasonable. A new coal-fired plant at the VCSNS site would also have approximately 16,500,000 T/yr of carbon dioxide (CO_2) emissions that could affect climate change.

Coal and limestone (calcium carbonate) for the coal-fired plant would be delivered to the site by train. SCE&G estimated that the coal-fired facility would consume approximately 6.0 million tons per year of pulverized bituminous coal with an ash content of approximately 10 percent. Slaked lime or limestone, used in the flue-gas scrubbing process for control of sulfur dioxide (SO_2) emissions, is made into slurry and injected into the hot effluent combustion gases to remove SO_2. The limestone-based scrubbing solution reacts with SO_2 in the flue gas to form calcium sulfite or calcium sulfate, which precipitates and is removed from the process as sludge. SCE&G estimated that approximately 231,000 T/yr of limestone would be used for flue-gas desulfurization, generating approximately 275,000 T/yr of scrubber sludge that may be re-used in industries such as wall-board manufacturing (SCE&G 2010b).

The acid rain requirements of the Clean Air Act capped the nation’s SO_2 emissions from power plants. SCE&G would need to obtain sufficient pollution credits either from a set-aside pool or purchases on the open market to cover annual emissions from the plant.

New coal-fired generation plants at the VCSNS site would likely need a Prevention of Significant Deterioration (PSD) Permit and an operating permit under the Clean Air Act Amendments of 1990. In addition, the plants would need to comply with new source performance standards (NSPSs) for such plants in 40 CFR Part 60, Subpart Da. The standards establish emission limits for PM and opacity (40 CFR 60.42Da), SO_2 (40 CFR 60.43Da), nitrogen oxides (40 CFR 60.44Da), and mercury (40 CFR 60.45Da).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as in attainment or unclassified for criteria pollutants under the Clean Air Act (40 CFR 51.307(a)). Criteria pollutants under the Clean Air Act are lead, ozone, particulates, CO, NO_2, and SO_2. Ambient air quality standards for criteria pollutants are in 40 CFR Part 50.

The VCSNS site in Fairfield County, South Carolina, is currently in an area designated as in-attainment for all requirements.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when an impairment occurs because of air pollution resulting from human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the days on which visibility is most impaired over the period of the implementation plan and verify no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308(d)(1)). If a new coal-fired power-generation station were located close to a mandatory Class I area, additional air-pollution control requirements could be imposed. The Cape Romaine Wilderness is the only mandatory Class I Federal area within South Carolina. Several Class 1 Federal areas also are in neighboring North Carolina and Georgia. The closest area to the VCSNS site is the Cape Romaine Wilderness, which is approximately 130 mi to the southeast; remaining areas are farther than this distance, and no additional requirements would be expected based on proximity.

The fugitive dust emissions from construction activities would be mitigated using best management practices (BMPs), and such emissions would be temporary. The Generic Environmental Impact Statement (GEIS) for license renewal mentions global warming from CO_2 emissions and acid rain from sulfur oxides and nitrogen oxide emissions as a potential impact (NRC 1996). Adverse human health effects, such as cancer and emphysema, have been associated with the byproducts of coal combustion. Overall, the review team concludes that air quality impacts from coal-fired generation at the VCSNS site would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Waste Management

As the NRC has described in NUREG-1437 (NRC 1996) and verified during its preparation of operating license renewal supplemental EIS analyses since the publication of that document, coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional solid wastes such as spent selective catalytic reduction (SCR) catalyst, and flue-gas scrubber sludge. SCE&G estimated that the coal-fired plants would generate 582,000 T/yr of ash. Significant quantities of the fly ash may be recycled for use in commodity products such as concrete, thereby limiting the total landfill volume. The coal plant would also generate flue-gas scrubber sludge in the form of gypsum, which could also be dewatered and recycled for use in wall-board manufacturing.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (65 FR 32214). The EPA concluded that national regulation is warranted under Subtitle D of the Resource Conservation and Recovery Act of 1976, as amended (RCRA) when coal combustion wastes are disposed of in landfills or surface impoundments, and that regulations under Subtitle D of RCRA (or modifications to existing regulations under the authority of the Surface Mining Control and Reclamation Act) are warranted when the wastes are used to fill surface impoundments or underground mines (65 FR 32214). As of November 2009, EPA is continuing to study the appropriate form for regulation of coal combustion waste products.

Waste impacts on groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses. Construction-related debris would be generated during plant construction activities, and would be disposed of in approved landfills.

For the reasons stated above, the review team concludes that the impacts from waste generated at a coal-fired plant would be MODERATE. The impacts would be clearly noticeable but would not destabilize any important resources.

Human Health

Coal-fired power generation introduces worker risks from coal and limestone mining, worker and public risk from coal and limestone transportation, worker and public risk from disposal of coal-combustion waste, and public risk from inhalation of stack emissions. In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power-plant operations (Gabbard 1993).

The EPA and State agencies (65 FR 32214) base air emission standards and requirements on human health impacts. These agencies impose site-specific emission limits as needed to protect human health. Air emissions from a coal-fired power-generation plant located at the VCSNS site would be regulated by the South Carolina Department of Health and Environmental Control (SCDHEC). Given that the plant would have to comply with health-informed standards in the Clean Air Act and other relevant air emissions regulations, the review team concludes that the human health impacts from the construction and operation of coal-fired generation at the VCSNS would be SMALL.

Other Impacts

Approximately 357 ac of land would need to be permanently converted to industrial use for the powerblock, infrastructure and support facilities, ash and solids disposal, and coal and limestone storage and handling (SCE&G 2010b). This is very close to the estimated 320 ac of permanent land dedication (approximately 500 ac when also accounting for temporary laydown areas) needed for a nuclear facility (see Section 4.1). The land required for new transmission-line corridors would be similar to that reported in Section 4.1 for the transmission lines for the proposed nuclear facility. The land required for new transmission-line corridors would be similar to the proposed action. Land-use changes would affect the offsite coal-mining area that was supplying coal for the plant. In NUREG-1437, the NRC staff estimated that approximately 22,000 ac would be needed for coal mining and waste disposal to supply a 1000-MW(e) coal-fire power plant over its operating life (NRC 1996), which would scale up to almost 49,000 ac for a 2214-MW(e) facility. This is almost five times the estimated 10,000 ac needed to supply fuel to the proposed nuclear plant. The nuclear estimate is based on an estimated need of 113 ac/yr for a 1000-MW(e) nuclear plant, scaled to approximately 250 ac/yr for a 2214-MW(e) nuclear plant, multiplied by 40 years of operation. Commitment of 49,000 ac of land for coal mining would have a noticeable effect on the availability of land in most regions of the United States, but would not be expected to destabilize the availability of land in the typically rural locations used for mining. Based upon the amount of land affected, the review team concludes that land-use impacts would be MODERATE.

The impacts on water use and quality from constructing and operating a coal-fired plant at the VCSNS site would be comparable to the impacts associated with a new nuclear plant because both types of power plants rely on steam turbines to generate 100 percent of the power. Therefore, the review team assumes that the operation of coal-fired power plants located at the VCSNS site would be consistent with the proposed two-unit nuclear power plant. Plant discharges would consist mostly of cooling-tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving waterbody and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by the South Carolina Department of Natural Resources (SCDNR) through a National Pollution Discharge Elimination System (NPDES) permit. Indirectly, water quality could be affected by acids and mercury from air emissions. The water would be consumed because of evaporation from the cooling towers. In NUREG-1437, the NRC staff determined that some erosion and sedimentation would likely occur during construction of new facilities (NRC 1996). Overall, the review team concludes that the water-use and water-quality impacts would be SMALL.

The coal-fired generation alternative would introduce ecological impacts from building and new incremental impacts from operations. The impacts could include wildlife habitat loss and fragmentation, reduced species productivity, and a local reduction in biological diversity. The impacts could occur at the proposed site and at the sites used for coal and limestone mining. Extraction of makeup water for cooling could have adverse impacts on aquatic resources. Cooling-tower drift would have minimal impacts on terrestrial ecology. Storage and disposal of fly ash could affect the aquatic environment. The impacts on threatened and endangered species at the VCSNS site would be similar to the impacts from a new nuclear facility. Overall, the review team concludes that impacts on terrestrial ecology would likely be MODERATE primarily because of the potential impacts associated with the disposal of ash and the large land area affected by mining. The review team further concludes that the impacts on aquatic ecology would likely be SMALL and similar to the proposed action.

Adverse socioeconomic impacts would result from the average number of construction workers and the peak workforce of approximately 2000. However, socioeconomic impacts would be SMALL and consistent with the proposed project with the exception of the likely MODERATE impacts localized to the vicinity of the VCSNS due to traffic- and transportation-related issues. The plant would pay significant property taxes to Fairfield County, South Carolina and the review team concludes that these taxes would have a LARGE and beneficial impact on the county. Other socioeconomic impacts related to building and operation would be SMALL.

The coal-fired units would have emissions stacks that might be as much as 200 ft tall and would be visible offsite during daylight hours. The stacks and associated emissions would likely be visible in daylight hours for distances greater than 40 mi. Cooling towers and associated plumes also would have aesthetic impacts. Natural draft towers could be up to 600 ft high. The powerblock units and associated stacks and cooling towers would also be visible at night because of outside lighting. The Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 200 ft above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2007). A mitigating factor is that the VCSNS site is currently a developed site located in a predominantly rural area. However, the site is near the towns of Jenkinsville and Pomaria, South Carolina, with several towns such as Newberry, Chapin, and Winnsboro located within 15 mi. The visual impacts of a new coal-fired plant could be further mitigated by landscaping and selection of building colors that are consistent with the environment. Visual impacts at night could be mitigated by reduced use of lighting, provided the lighting meets FAA requirements, and appropriate use of shielding. Transmission lines would have a larger aesthetic impact, but would be consistent with the proposed project. Overall, the review team concludes that the aesthetic impacts associated with new coal-fired power generation at the VCSNS site and around the transmission lines would be SMALL because of the amount of cover around the VCSNS site and along likely transmission-line corridors. Coal-fired power generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical draft cooling towers. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. Noise levels from onsite building activities would be attenuated by distance and obstacles such as buildings, vegetation, and topography. Because the site is surrounded by forests and moderate topography, the review team concludes that noise emanating from the project site would be somewhat muffled to surrounding communities and the associated impact would not be significant. It is expected that noise levels experienced by sensitive noise receptors outside of the exclusion area boundary would rapidly attenuate to below 50 dBA (SCE&G 2010b). Noise impacts associated with railroad delivery of coal and lime/limestone would be most significant for residents living in close proximity to the facility and along the railroad route. While there is frequent train transport, and many people are likely to be within hearing distance of the rail line, the short duration of the noise reduces the impact. Therefore, the impacts of noise on residents in close proximity to the facility and of the rail line are considered SMALL.

Historic and cultural resources impacts of locating a new coal-fired plant at the VCSNS site would be similar to the impacts of locating a new nuclear plant at the VCSNS site, as discussed in Sections 4.6 and 5.6. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. The studies would likely be needed for all areas of potential disturbance at the plant site, any offsite affected areas, such as mining and waste-disposal sites, and along associated corridors where new construction would occur, for example, roads and new transmission-line corridors. The review team concludes that the historic and cultural resource impacts at the VCSNS site would be MODERATE and consistent with the proposed project.

As discussed in Sections 4.5 and 5.5, at the VCSNS site there are no environmental pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionate and adverse environmental impacts, with the exception of traffic-related adverse and disproportionate impacts on minority populations in the Jenkinsville area. Mitigation of the traffic-related impacts, such as a traffic-management plan, is discussed in Section 4.5. However, the review team finds that because the traffic-related impacts would be temporary and of short duration in nature, they would be noticeable but not destabilizing to the Jenkinsville community. Therefore, the review team concludes that the environmental justice impacts from building activities related to traffic would be MODERATE. Similar traffic-related impacts would occur during the building of a coal plant at the VCSNS site. Therefore, the review team concludes that the adverse impacts of building a coal-fired plant at the VCSNS site would be SMALL with the exception of the impact due to traffic which would be MODERATE. Other building and operation impacts would be SMALL. In most cases, the impacts would not be detectable or they would be so minor that they would neither destabilize nor noticeably alter any known attribute of the resource. Due to the minor nature of these impacts, mitigation beyond that discussed would not be warranted.

The building and operation impacts of coal-fired power generation at the VCSNS site are summarized in Table 9-1.

Table 9-1. Summary of Environmental Impacts of Coal-Fired Power Generation – 2214 MW(e)

Impact Category	Impact	Comment
Land use	MODERATE	Uses approximately 357 ac for powerblock; coal handling, storage, and transportation facilities; infrastructure facilities; waste disposal; and cooling-water facilities. An additional 49,000 ac of land would be used for mining activities over 40 years. Impacts would also be associated with transmission-line corridors.
Air quality	MODERATE	SO_2 – 7044 T/yr Nitrogen oxides – 1495 T/yr CO – 1495 T/yr PM_{10} – 67 T/yr $PM_{2.5}$ – 0.17 T/yr Small amounts of hazardous air pollutants
Water use and quality	SMALL	Impacts would be comparable to the impacts for new nuclear power units located at the VCSNS site.
Ecology	SMALL to MODERATE	Uses the undeveloped area of the existing VCSNS site. Potential habitat loss and fragmentation, reduced productivity and biological diversity, and impacts on terrestrial ecology from cooling-tower drift. Additional impacts are associated with the building and expansion of transmission-line corridors and mining
Waste management	MODERATE	Total waste volume of combustion wastes including fly ash and flue gas scrubber sludge would exceed 1 million tons per year.
Historic and cultural resources	MODERATE	Impacts would be comparable to the impacts for new nuclear units located at the VCSNS site.
Human health	SMALL	Regulatory controls and oversight are assumed to be protective of human health.
Socioeconomic	LARGE Beneficial to MODERATE Adverse	Impacts would be comparable to the impacts for new nuclear units located at the VCSNS site. Large beneficial impacts derived from tax revenues. Moderate adverse due to localized traffic impacts.
Environmental justice	MODERATE	Impacts would be comparable to the impacts for new nuclear units located at the VCSNS site. There are no environmental pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionate and adverse environmental or health impacts with the exception of traffic-related impacts within the vicinity of the VCSNS.

9.2.2.2 Natural-Gas-Fired Power Generation

For the natural gas alternative, SCE&G assumed operation of three natural-gas-fired plants with a closed-cycle cooling system and cooling towers located at the VCSNS site with a capacity of 2214 MW(e) (SCE&G 2010b). The associated emissions were determined based on factors contained in the EPA Clearinghouse for Inventories and Emissions Factors (EPA 2000). The review team also assumed the construction and operation of transmission lines, as discussed in Section 3.3 of this EIS.

Air Quality

Natural gas is a relatively clean-burning fuel. When compared with a coal-fired plant, natural-gas-fired plants release similar types of emissions such as nitrogen oxides, but in significantly lower quantities. Emission estimates are based on “as fired” and controlled conditions. A new natural-gas-fired power-generation plant would require a PSD Permit and a state-specific operating permit under the Clean Air Act. A new natural-gas-fired, combined-cycle plant would also be subject to the NSPSs specified in 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and nitrogen oxides.

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as in attainment or unclassified under the Clean Air Act. As previously discussed, the VCSNS site in Fairfield County, South Carolina, is currently in an area designated as in attainment for all requirements.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future impairment of visibility and remedying existing impairment in mandatory Class I Federal areas when impairment is from air pollution caused by human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a state, State regulatory agencies must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If a new natural-gas-fired power plant were located close to a mandatory Class I area, additional air-pollution control requirements could be imposed. As discussed previously, there are no mandatory Class I Federal areas within 130 mi of the VCSNS site.

Emissions from a natural-gas-fired plant equipped with appropriate combustion and post-combustion pollution-control technology would have approximately the following emissions (SCE&G 2010b):

- SO_2 – 34 T/yr

- nitrogen oxides – 558 T/yr
- CO – 116 T/yr
- PM_{10} – 97 T/yr
- $PM_{2.5}$ – 97 T/yr.

A natural-gas-fired power plant would also have CO_2 emissions of approximately 5,630,000 T/yr.

The fugitive dust emissions from construction activities would be mitigated using BMPs, and such emissions would be temporary. Other construction and operation impacts, such as the development and use of material laydown areas and parking, would be minor.

The impacts of emissions from a natural-gas-fired power-generation plant would be clearly noticeable, but would not be sufficient to destabilize air resources. Overall, the review team concludes that air quality impacts resulting from construction and operation of new natural-gas-fired power generation at the VCSNS site would be SMALL to MODERATE.

Waste Management

In NUREG-1437, the NRC staff concluded that waste generation from natural-gas-fired technology would be minimal (NRC 1996). The only significant waste generated at a natural-gas-fired power plant would be spent SCR catalyst, which is used to control nitrogen oxide emissions. The spent catalyst would be regenerated or disposed of offsite. Other than spent SCR catalyst, waste generation at an operating natural-gas-fired plant would be largely limited to typical operations and maintenance waste. Minor construction-related debris would be generated during construction activities. Overall, the review team concludes that the waste impacts from natural-gas-fired power generation would be SMALL.

Human Health

In NUREG-1437, the NRC staff identified cancer and emphysema as potential health risks from natural-gas-fired plants (NRC 1996). The risks may be attributable to nitrogen oxide emissions that contribute to ozone formation, which in turn contributes to health risk. Air emissions from a natural-gas-fired power-generation plant located at the VCSNS site would be regulated by the SCDHEC. The human health effects are expected to be either undetectable or minor. Overall, the review team concludes that the impacts on human health from natural-gas-fired power generation would be SMALL.

Other Impacts

The natural-gas-fired generating plant would require approximately 87 ac for the powerblock and support facilities (for 2214 MW(e)). Construction of a natural-gas pipeline from the VCSNS site to the closest natural-gas distribution line would require approximately 318 ac. Thus, the total land-use commitment would be approximately 405 ac (SCE&G 2010b). This is very close to the estimated 320 ac of permanent land dedication (approximately 500 ac when also accounting for temporary laydown areas) needed for a nuclear facility (see Section 4.1).

For a new natural-gas-fired power plant, additional land may be required for natural-gas wells and collection stations. The additional land required is expected to be less than the 10,000 ac needed to support fuel cycle activities over a 40-year operational life of a nuclear plant. Due to the proximity of the VCSNS site to existing natural-gas infrastructure, minimal pipeline(s) would have to be constructed, and pipeline distances would be minimized. The land required for new transmission-line corridors would be similar to that reported in Section 4.1 for the transmission lines for the proposed nuclear facility. The impacts of new transmission-line corridors would have a noticeable but not destabilizing impact along the corridors, consistent with the impacts for building and operating two new nuclear units at the VCSNS site. Therefore, the review team concludes that the land-use impacts from new natural-gas-fired power generation at the VCSNS would be MODERATE. The impacts on water use and quality from constructing and operating a natural-gas-fired combined-cycle power plant at the VCSNS site would be similar to or less than the impacts associated with constructing and operating a new nuclear facility. Closed-cycle cooling with cooling towers is assumed. The impacts on water quality from sedimentation during construction of a natural-gas-fired plant were characterized in NUREG-1437 as SMALL (NRC 1996). NRC staff also noted in NUREG-1437 that the impacts on water quality from operations would be similar to, or less than, the impacts from other generating technologies. Overall, the review team concludes that impacts on water use and quality would be SMALL.

Siting of the natural-gas-fired plant would have ecological impacts. Some of the impact would occur in areas that were previously disturbed during construction of VCSNS Unit 1. Constructing a new underground gas pipeline to the site would cause temporary ecological impacts. Ecological impacts on the plant site and utility easements would not affect threatened and endangered species, although some wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity related to the expansion of transmission-line corridors would be likely. Withdrawal and discharge of makeup water for the cooling system could affect aquatic resources, and elevated total dissolved solids in cooling-tower drift could affect the terrestrial ecology. The review team concludes that impacts on terrestrial ecology would likely be MODERATE due to the impacts of the transmission-line corridors. The review team concludes that the impacts on aquatic ecology would likely be SMALL, similar to the proposed project, as described in Chapters 4 and 5.

Adverse socioeconomic impacts would result from the demands on housing and public services during construction, and the approximately 50 workers needed to operate the natural-gas-fired facility. Overall, the staff concludes that these impacts would be SMALL because of the proximity of the site to the surrounding population area and the relatively small number of workers needed to construct and operate the plant in comparison to nuclear and coal-fired generation alternatives would cause the impacts to be minor. A review of workforce requirements for combined-cycle power plant construction suggests an average workforce of approximately 240 workers for a 550-MW(e) plant, with a peak of 350 workers (Palomar Energy 2003). For the proposed project this would suggest an average peak workforce of approximately 1000 workers, or half of the suggested peak workforce for coal and nuclear plant construction. The plant would pay property taxes to Fairfield County, South Carolina. The review team concludes that the taxes would have a MODERATE and beneficial impact on the county, based on the smaller number of total workers required during construction and operation.

The heat-recovery steam generators, exhaust stacks (approximately 200 ft tall) and associated emissions, cooling towers and associated plumes from the cooling towers, and the gas pipeline compressors would be visible offsite during daylight hours. Noise and light from the plant would be detectable offsite. A mitigating factor is that the VCSNS site is currently a developed site located in a predominantly rural area. Transmission lines would have a larger aesthetic impact, but would be consistent with the proposed project. Overall, the review team concludes that the aesthetic impacts associated with new natural-gas-fired power generation at the VCSNS site and around the transmission lines would be SMALL, similar to the proposed project. Other construction and operation impacts would also be SMALL. In most cases, the impacts would not be detectable or they would be so minor that they would neither destabilize nor noticeably alter any known attribute of the resource.

As discussed in Sections 4.5 and 5.5, at the VCSNS site there are no environmental pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionate and adverse environmental with the exception of traffic-related adverse and disproportionate impacts on minority populations in the Jenkinsville area. However, the review team believes that because the traffic-related impacts are temporary and of short duration in nature, they would be noticeable but not destabilizing to the Jenkinsville community. Therefore, the review team concludes that the environmental justice impacts from building activities related to traffic would be MODERATE. Similar traffic-related impacts would occur during the construction of a nuclear plant at the VCSNS site. Therefore, the review team concludes that the adverse socioeconomic impacts of building a gas-fired plant at the VCSNS site would be minor with the exception of the impact due to traffic, which would be MODERATE.

Historic and cultural resources impacts for a new natural-gas fired plant located at the VCSNS site would be similar to the impacts for a new nuclear plant as discussed in Sections 4.6 and 5.6. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. The studies would likely be needed for all areas of potential disturbance at the plant site, any offsite affected areas, such as mining and waste-disposal sites, and along associated corridors where new construction would occur; for example, roads and new transmission-line corridors. The review team concludes that the historic and cultural resource impacts at the VCSNS would be MODERATE and consistent with the proposed project. The impacts of natural-gas-fired power generation at the VCSNS site are summarized in Table 9-2.

Table 9-2. Summary of Environmental Impacts of Natural-Gas-Fired Power Generation

Impact Category	Impact	Comment
Land use	MODERATE	Approximately 230 ac would be needed for powerblock, cooling towers and support systems, and connection to a natural-gas pipeline. Additional land would be required for gas pipelines, transmission-line corridors, and infrastructure.
Air quality	SMALL to MODERATE	SO_2 – 34 T/yr Nitrogen oxides – 558 T/yr CO – 116 T/yr PM_{10} – 97 T/yr $PM_{2.5}$ – 97 T/yr
Water use and quality	SMALL	Impacts would be similar to or less than the impacts for a new nuclear power plant located at the site.
Ecology	SMALL to MODERATE	Uses the undeveloped area of the existing VCSNS site. Potential habitat loss and fragmentation, reduced productivity and biological diversity, and impacts on terrestrial ecology from cooling-tower drift. Additional impacts are associated with the construction and expansion of transmission-line corridors.
Waste management	SMALL	The only significant waste would be from spent SCR catalyst used for control of nitrogen oxide emissions.
Socioeconomics	MODERATE Beneficial to SMALL Adverse	Construction and operations workforces would be relatively small compared to nuclear and coal plants. Addition to the property tax base, while smaller than for a nuclear or coal-fired plant, would still be noticeable. Construction-related impacts would be noticeable but minimized due to the smaller peak workforce. Operations-related impacts would be minor because of the small workforce involved. The plant and new transmission line would have aesthetic impacts.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and cultural resources	MODERATE	Impacts would be comparable to the impacts for new nuclear units located at the VCSNS site.
Environmental justice	MODERATE	There are no environmental pathways that would lead to disproportionate and adverse impacts on minority and low-income populations with the exception of traffic-related impacts within the vicinity of the VCSNS.

SCR = selective catalytic reduction

9.2.3 Other Alternatives

This section discusses other energy alternatives, the review team's conclusions about the feasibility of each alternative, and the review team's basis for its conclusions. New nuclear units at the proposed site would provide baseload generation. Any feasible alternative to the new units would need to be capable of generating baseload power with high availability and capacity factors. In performing its initial evaluation in its Environmental Report (ER), SCE&G relied heavily on NUREG-1437, the NRC's *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NRC 1996). The review team reviewed the information submitted by SCE&G, conducted an independent review, and finds that SCE&G's conclusion that these generation options are not reasonable alternatives to one or more new nuclear units is acceptable.

The review team has not assigned significance levels to the environmental impacts associated with the alternatives discussed in this section because, in general, the generation alternatives would have to be installed at a location other than the proposed site. Any attempt to assign significance levels would require the review team's speculation about the unknown site.

9.2.3.1 Oil-Fired Power Generation

The EIA's reference case projects that oil-fired power plants would not account for any new electric power-generation capacity in the United States through the year 2030 (DOE/EIA 2009), although oil-firing in combustion turbines is often used to supplement natural-gas feed stock. Oil-fired generation is more expensive than nuclear, natural-gas-fired, or coal-fired generation options, and currently makes up only 1 percent of the existing capacity within the SERC region (SERC 2009). In addition, fluctuations in future oil prices are expected to make oil-fired generation increasingly more expensive. The high cost of oil has resulted in a decline in its use for electricity generation. In Section 8.3.11 of NUREG-1437, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 120 ac of land (NRC 1996). Operation of an oil-fired power plant would have environmental impacts that would be similar to those of a comparably sized coal-fired plant (NRC 1996).

For the preceding economic and environmental reasons, the review team concludes that an oil-fired power plant at or in the vicinity of the proposed VCSNS site would not be a reasonable alternative to construction of a 2214-MW(e) nuclear power-generation facility.

9.2.3.2 Wind Power

The VCSNS site is in a wind power Class 1 region with average wind speed lower than 5.6 m/s (DOE 2009c). Class 1 regions have the lowest potential for generation of wind energy and are considered unsuitable for the development of wind energy (DOE 2008a). The coastal region of South Carolina has been recognized as being capable of supporting intermittent off-shore utility-scale wind generation (DOE 2009c). However, the South Carolina State Regulation of Public Utilities Review Committee (PURC) in their 2009 Energy Policy Report, commented that though capable, "given the limits of current technology, costs, and availability, solar and wind are not practical for utility-scale generation in this State" (SC PURC Energy Policy Report 2009).

The PURC report further indicates that advances in research and development of the resources could change the landscape, and for these reasons, Santee Cooper continues to pursue the potential development of wind-generation resources as part of its renewable energy resource portfolio including partnerships with the DOE, South Carolina Energy Office, and several universities. Although the utility has made no purchased-power commitments, Santee Cooper continues to investigate offshore wind resources on coastal South Carolina, and remains engaged with the development of this potential resource (Santee Cooper 2008).

Though coastal geographies may contain adequate resources in support of on-shore and offshore-based wind turbines, both have considerable environmental and aesthetic challenges (SCE&G 2010b). Additionally, newer wind turbines typically operate at approximately a 36-percent capacity factor (DOE 2009c), compared with 90 percent for a baseload plant such as a nuclear power station (NEI 2007). The largest operating wind farm has a more than 700-MW generating capacity (AWEA 2008a); however, the capacities of most installations or wind farms are under 200 MW. A utility-scale wind-generation plant would generally require about 60 ac/MW(e) of installed capacity, although much of this land could be used for other purposes (AWEA 2008b). Modern wind turbine designs are approaching 5 MW(e); however, it is likely that well over 800 commonly deployed wind turbines would be required to produce the 2214 MW(e) of the proposed nuclear units. Because of the inherent variability of wind as a resource, the capacity from wind turbines may supply baseload power when or if coupled with a power source that is capable of being dispatched when the capacity is required such as energy-storage mechanisms or additional resources such as hydropower (NPCC 2005). This requires both the wind resource and the storage mechanism to be within reasonable proximity of each other, and of commensurate power output when used singly or in combination.

The National Renewable Energy Laboratory (NREL) issued an analysis of offshore windpower in *Large-Scale Offshore Wind Power in the United States—Assessment of Opportunities and Barriers* (NREL 2010). As NREL indicates "… the opportunities for offshore wind are abundant, yet the barriers and challenges are also significant. … Technological needs are generally focused on making offshore wind technology economically feasible and reliable and expanding the resource area to accommodate more regional diversity for future U.S. offshore projects." When energy policies mature and large-scale offshore wind-energy projects become technically feasible, then it can play a significant role in future U.S. energy markets. The NREL report considers the wind-energy potential and the proposed U.S. offshore wind projects and capacities; it divides wind-energy projects into two groups: those within State boundaries (within 3 nautical miles) and those in Federal waters. Regionally, there are currently two projects under consideration. One project in North Carolina waters totaled up to 9 MW(e), and one Federal lease project in Georgia was estimated to be up to 10 MW(e). No other regional wind-energy projects were identified by NREL in either State or Federal waters.

For the preceding reasons, the review team concludes that wind power is not capable of supplying baseload capacity of 2214 MW(e), and is therefore not a reasonable alternative to the proposed project.

9.2.3.3 Solar Power

Solar technologies use energy and light from the sun to provide heating and cooling, light, hot water, and electricity for consumers. Solar-power technologies (both photovoltaic [PV] and solar-thermal) cannot currently compete with conventional nuclear and fossil-fueled technologies in grid-connected, utility-scale applications because of solar power's lower capacity factors and higher capital cost per kilowatt of capacity. In NUREG-1437, the NRC staff determined that the average capacity factor of PV cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 to 40 percent (NRC 1996). As reviewed in Section 8.3.2, Santee Cooper is actively pursuing opportunities in solar power development as part of its committed expansion in renewable energy resources.

Because solar power cannot supply 2214 MW(e) baseload power, the review team concludes that solar-power technologies would not be a reasonable alternative to proposed project.

9.2.3.4 Hydropower

South Carolina has an estimated 480 MW(e) of developable hydroelectric resources (Conner and Francfort 1997). As stated in Section 8.3.4 of NUREG-1437 for license renewal (NRC 1996), the percentage of U.S. generating capacity supplied by hydropower is expected to decline because hydroelectric facilities have become difficult to site as a result of public concerns about flooding, destruction of natural habitat, and alteration of natural river courses. More recently the EIA references expected stable electricity production only from existing hydropower resources through 2030 (DOE/EIA 2008). In NUREG-1437, the staff estimated that land requirements for hydroelectric power are approximately 1 million ac per 1000 MW(e) (NRC 1996).

Because there is an insufficient amount of undeveloped hydropower resource in South Carolina the review team concludes that hydropower is not a feasible alternative to the proposed project.

9.2.3.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload power generation because of the limited geographic availability of the resource (NRC 1996). Geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent (DOE 2006b). South Carolina does not have sufficient high-temperature geothermal resources that are suitable for electricity generation (DOE 2008e).

Therefore, the review team concludes that a geothermal energy facility at or in the vicinity of the proposed VCSNS site would not be a reasonable alternative to the proposed project.

9.2.3.6 Wood Waste

In NUREG-1437, the NRC staff determined that a wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). SCE&G currently receives approximately 1 percent of its total energy from woody-biomass-fired facilities (SCE&G 2009a).

The fuels required are variable and site-specific. Wood-based biomass resources in South Carolina are significant, with an estimated 22 million tons of the resource available each year (SCE&G 2010b). However, significant impediments to the use of wood waste for the generation of electricity are the high cost of fuel delivery in addition to the quantity of acceptable fuel necessary. The larger wood-waste power plants are 40 to 50 MW(e) in size. Estimates in NUREG-1437 suggest that the overall level of construction impacts per megawatt of installed capacity would be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at a significantly smaller scale (NRC 1996). Similar to coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve similar types of combustion and combustion control equipment.

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload power plant, and the small total generating capacity per unit, the review team concludes that wood-waste-fired generating capacity would not be a reasonable alternative to the proposed project.

9.2.3.7 Municipal Solid Waste

Municipal solid-waste facilities incinerate waste and use the resultant heat to produce steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2009d). Municipal waste combustion facilities use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001). Mass-burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. In NUREG-1437, the NRC staff determined that the initial capital cost for municipal solid-waste plants is greater than for comparable steam-turbine technology at wood-waste facilities because of the need for specialized waste-separation and waste-handling equipment for municipal solid waste (NRC 1996). There are 89 waste-to-energy plants that are operating in the United States, with an average of approximately 30 MW(e) per plant (IWSA 2008).

One additional generating resource that uses municipal solid waste as a fuel derivative is the capture and combustion of landfill-based gas (LFG). Santee Cooper currently produces 13 MW(e) from LFG, with plans to double that capacity by the end of 2010 (Santee Cooper 2008).

Given the limited capacity of the plants and limited supply of LFG, the review team concludes that generating electricity from municipal solid waste or LFG is not be a reasonable alternative to the proposed project.

9.2.3.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuel, several other biomass-derived fuels are available for fueling electric generators. These include but are not limited to animal-derived wastes, crop-based biomass, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). However, in NUREG-1437, the NRC determined that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a large baseload generating plant (NRC 1996).

The EIA estimates that biomass will be the largest source of renewable electricity generation among the non-hydropower renewable fuels through 2030 and that significant growth in dedicated biomass power-generation capacity is expected in regions with stringent Renewable Energy Portfolio Standards requirements and limited supplies of lower-cost resources such as wind (DOE/EIA 2008). As reviewed in Section 9.2.3.6, biomass resources are available in South Carolina in the form of woody residues, and they are expected to contribute to the overall production of energy and fuels in the future (South Carolina Energy Office 2007). Furthermore, South Carolina has created a biomass council through its South Carolina Energy Office to capitalize on increasing energy diversity and enhancing environmental quality for South Carolina (South Carolina Energy Office 2007).

Co-firing biomass with coal is possible when low-cost biomass resources are available. Co-firing is the most economic option for the near future to introduce new biomass power generation. These projects require small capital investments per unit of power-generation capacity. Co-firing systems range in size from 1 to 30 MW(e) of bio-power capacity (DOE 2008d).

Construction of a biomass-fired plant would have an environmental impact that would be similar to that of a coal-fired plant, although facilities using wood waste and agricultural residues for fuel would be built on significantly smaller scales. Like coal-fired plants, biomass-fired plants require areas for fuel storage, processing, and waste (i.e., ash) disposal. In addition, operation of biomass-fired plants has environmental impacts, including potential impacts on the aquatic environment and air.

Given the limited capacity of the plants, the review team concludes that biomass-derived, or biomass co-fired fuels used singly or in combination with other fossil fuels do not offer a reasonable alternative to the proposed project.

9.2.3.9 Fuel Cells

Fuel cells work without combustion and its associated environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode, air over a cathode, and then separating the two by an electrolyte. The only byproducts are heat, water, and CO_2. Hydrogen is typically derived from hydrocarbon-based fuels, such as natural gas, by subjecting them to steam reforming or partial oxidation, through gasification of coal or biomass, or through the electrolysis of water.

Phosphoric-acid fuel cells are generally considered first-generation technology. During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications and the first-generation technologies have given way to membrane and solid-oxide-based fuel cells operating consistently at above 50-percent electrical efficiency (DOE 2008b). High-temperature, second-generation fuel cells have achieved increased fuel-to-electricity and thermal efficiencies, giving second-generation fuel-cell systems the ability to generate steam for cogeneration such as in distributed generation type combined heat and power applications.

Research in both stationary and transportation-based fuel cells is intended to provide continuing improvements of both materials and components as they relate to system cost and durability. Currently, the cost of fuel-cell power systems must be reduced before they can be competitive with conventional technologies (DOE 2008c). At the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation (NUREG-1437, Supplement 34). Because fuel cells have not been developed to the point where they are capable of supplying power consistent with the proposed projects purpose and need equal to 2214 MW(e), the review team concludes that fuel-cell-based electricity generation does not offer a reasonable alternative to the proposed project.

9.2.4 Combinations of Alternatives

Individual alternatives to the construction of one or more new nuclear units at the proposed site might not be sufficient on their own to generate SCE&G's target value of 2214 MW(e) of baseload capacity because of the small size of the resource, lack of cost-effective opportunities, or inability to generate baseload capacity. It is conceivable however, that a combination of alternatives might be capable of meeting both the baseload and capacity targets of proposed VCSNS Units 2 and 3. There are many possible combinations of alternatives. It would not be reasonable to examine every possible combination of energy alternatives in an EIS. Doing so would be counter to CEQ's direction that an EIS should be analytic rather than encyclopedic, shall be kept concise, and shall be no longer than absolutely necessary to comply with NEPA and CEQ's regulations (40 CFR 1502.2(a)(c)). Given that the stated objective is for a baseload power generation facility of significant capacity, a fossil energy source, most likely coal or natural gas, would need to be a significant contributor to any reasonable alternative energy combination.

When examining the potential alternatives or combinations of alternatives, SCE&G indicated that the total generating capacity must be commensurate with the proposed 2214-MW(e) project. The selection of a combination of alternatives follows a reasonable set of capabilities determined to be within the proposed region, and supported by review and analysis of the programmatic goals of the applicant, technical maturity, and economics. Section 9.2.2.2 assumes the construction of a 2214-MW(e) natural-gas-fired, combined-cycle generating unit at the proposed site using closed-cycle cooling with cooling towers. For a combined-alternatives option, the review team assessed the environmental impacts of an assumed combination of three 600-MW(e) natural-gas-fired, combined-cycle generating units at the proposed site using closed-cycle cooling with cooling towers, for a total of 1800 MW(e); 174 MW(e) from renewable energy resources such as biomass, solar, wind, and LFG; and 240 MW(e) from conservation and DSM programs for a total of 2214 MW(e). Based on information presented in SCE&G and Santee Coopers IRPs, a review of State and regional programs and policies for the development of renewable resources, and as discussed in the preceding sections of this chapter, the review team believes that these contributions are reasonable and representative.

Natural-gas-fired generation was selected based on its lower environmental impact than a comparatively sized coal-fired unit(s). This type of power generation is capable of the load-following characteristics necessary when deployed in conjunction with renewable energy sources; this capability enables power production to continue when the renewable energy resource is unavailable. To review the potential impacts from a combination of alternatives, a reduction in environmental impacts can only be considered when the power generation from the fossil-fired facility is displaced by the renewable resource. The analysis assumes that the availability of the alternatives in any combination is similar to what would be required of the proposed project.

A summary of the environmental impacts associated with the construction and operation of this combination of alternatives is provided in Table 9-3. The combination of alternatives assumes siting of natural-gas-fired, combined-cycle units at the proposed site and siting of other generating units such as those using renewable resources in the general vicinity (within 100 mi) of the site. Similar to the proposed project, closed-cycle cooling with mechanical draft cooling towers is assumed for all thermal plants.

Table 9-3. Summary of Environmental Impacts of a Combination of Power Sources

Impact Category	Impact	Comment
Land use	MODERATE	A natural-gas-fired plant would have land-use impacts for the powerblock, new transmission-line corridor, cooling towers and support systems, and connection to a natural-gas pipeline. Solar and biomass facilities and associated transmission lines may also have significant land-use impacts as previously discussed.
Air quality	SMALL to MODERATE	Emissions from the natural-gas-fired plant would be approximately [(a)] SO_2 – 28 T/yr Nitrogen oxides – 458 T/yr CO – 95 T/yr PM_{10} – 80 T/yr $PM_{2.5}$ – 80 T/yr CO_2 – 4.1 million T/yr Municipal solid-waste and biomass facilities would also have emissions associated with the combustion of gaseous or solid fuels.
Water use and quality	SMALL	Impacts would not be greater than the impacts associated with a new nuclear power plant located at the proposed site.
Ecology	SMALL to MODERATE	Some of the impacts would occur in areas that were previously disturbed during the construction of existing VCSNS Unit 1. Potential habitat loss and fragmentation and reduced productivity and biological diversity would likely be minimal in that area. Impacts on terrestrial ecology from cooling-tower drift could occur. Solar facilities take up large dedicated tracts of land that may displace existing biological populations and reduce diversity. Biomass production and collection may also result in reduced productivity and loss of habitat unless they are coordinated with existing harvesting practices or needs.
Waste management	SMALL	The only significant waste would be from spent SCR catalyst used for control of nitrogen oxide emissions and ash and slag from biomass and municipal solid-waste sources.
Socioeconomics	MODERATE Beneficial to MODERATE Adverse	Construction and operations workforces would be relatively small. The addition to the property tax base, while smaller than for a nuclear or coal-fired plant, might still be quite noticeable. Construction-related impacts for some renewable sources would be noticeable. Impacts during operation would be minor because of the small workforce involved. The plant and new transmission line would have aesthetic impacts.
Human health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and cultural resources	MODERATE	Impacts would be comparable to the impacts for new nuclear units located at the VCSNS site

Table 9-3. (contd)

Impact Category	Impact	Comment
Environmental justice	MODERATE	There are no environmental pathways that would lead to disproportionate and adverse impacts on minority and low-income populations with the exception of traffic-related impacts within the vicinity of the VCSNS.

(a) Represented as a percentage of the natural-gas combined cycle analysis: 1800/2200 = 82 percent of the total emissions
(b) SCR = selective catalytic reduction

9.2.5 Summary Comparison of Alternatives

Table 9-4 contains a summary of the review team's environmental impact characterizations for constructing and operating new nuclear, coal-fired, and natural-gas-fired, combined-cycle generating units at the proposed site.

Table 9-4. Summary of the Environmental Impacts of New Nuclear, Coal-Fired, Natural-Gas-Fired, and a Combination of Alternatives

Impact Category	Nuclear[(a)]	Coal	Natural Gas	Combination of Alternatives
Land use	MODERATE	MODERATE	MODERATE	MODERATE
Air quality	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Water use and quality	SMALL	SMALL	SMALL	SMALL
Ecology	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Waste management	SMALL	MODERATE	SMALL	SMALL
Socioeconomics	LARGE Beneficial to MODERATE Adverse	LARGE Beneficial to MODERATE Adverse	MODERATE Beneficial to SMALL Adverse	MODERATE Beneficial to MODERATE Adverse
Human health	SMALL	SMALL	SMALL	SMALL
Historic and cultural resources	MODERATE	MODERATE	MODERATE	MODERATE
Environmental justice	MODERATE	MODERATE	MODERATE	MODERATE

(a) From Chapters 4 and 5.

The distinguishing impacts are primarily related to emissions from the alternative generation sources (air quality). A nuclear plant has less impact on air quality than, coal, natural gas, or a combination of alternatives. The land-use impact for the coal-fired alternative is a function of the irretrievable commitment of land due to coal mining. For the combination of alternatives, in proposing a combination of renewable resources such as biomass and wind in addition to the natural-gas-fired capacity, it would be expected that the commitment of land would exceed the natural-gas-fired capacity by itself. This may include further commitment of land for biomass production and harvesting, and the siting of renewable energy resources which would not be co-located on the VCSNS site.

For the energy-generation alternatives discussion, emissions are bound by a review of criteria pollutants and the total tons produced. Accordingly, the coal-fired alternative produces the highest level of criteria pollutants and total air emissions; in total tons, the highest percentage of emissions comes from the release of sulfur during the combustion process followed by nitrogen oxides and carbon monoxide also due to the combustion of coal with air (oxygen). These pollutants can also lead to the development of PM (particulate matter). The natural gas alternative produces the next highest level of emissions. With a reasonably clean fuel stream (methane), the primary pollutants are limited to nitrogen oxides and carbon monoxide. Natural gas, in combination with renewable resources is considered to be slightly less than the natural-gas-fired alternative assuming that when/if the alternative generating source was operable, the natural-gas-fired alternative would not be required to be operating.

Carbon dioxide emissions for the proposed action and energy generation alternatives are discussed in Sections 5.7.2, 9.2.2.1, and 9.2.2.2. Table 9-5 summarizes the CO_2 emission estimates for a 40-year period for the alternatives considered by the review team to be viable for baseload power generation. These estimates are limited to the emissions from power generation and do not include CO_2 emissions for workforce transportation, construction, fuel-cycle, or decommissioning. Among the viable energy-generation alternatives, the CO_2 emissions for nuclear power are a small fraction of the emissions of the other viable energy-generation alternatives. Adding the transportation emissions for the nuclear plant workforce and fuel cycle emissions, would increase the emissions for plant operation over a 40-year period to about 54,000,000 MT. This number is still significantly lower than the emissions for any of the other alternatives.

Table 9-5. Comparison of Direct Carbon Dioxide Emissions for Energy Alternatives

Generation Type	Years	CO_2 Emission (MT)
Nuclear power[(a)]	40	380,000
Coal-fired generation[(b)]	40	600,000,000
Natural gas-fired generation[(c)]	40	205,000,000
Combination of alternatives[(d)]	40	166,000,000

(a) From Section 5.7.2, value is for two units
(b) From Section 9.2.2.1
(c) From Section 9.2.2.2
(d) From Section 9.2.4 (assuming only natural gas generation has significant CO_2 emissions)

On June 3, 2010, EPA issued a rule tailoring the applicability criteria that determines which stationary sources and modifications to existing projects become subject to permitting requirements for greenhouse gas emissions under the Prevention of Significant Deterioration (PSD) and Title V programs of the Clean Air Act (Ref 75 FR 31514). According to the Tailoring Rule, greenhouse gas is a regulated new source review (NSR) pollutant under the PSD major source permitting program if the source (1) is otherwise subject to PSD (for another regulated NSR pollutant) and (2) has a greenhouse gas potential to emit equal to or greater than 75,000 tons per year of CO_2e ("carbon dioxide equivalent" adjusting for different global warming potentials for different greenhouse gases). Such sources would be subject to Best Available Control Technology (BACT). The use of BACT has the potential to reduce the amount of greenhouse gases emitted from stationary source facilities. The implementation of this rule could reduce the amount of greenhouse gases from the values indicated in Table 9-5 for coal and natural gas, as well as from other alternative energy sources that would otherwise have appreciable uncontrolled greenhouse gas emissions. The greenhouse gas emissions from the production of electricity from a nuclear power source are primarily from the fuel cycle and such emissions could be reduced further if the electricity from the assumed fossil fuel source powering the fuel cycle is subject to BACT controls. The emission of greenhouse gases from the production of electrical energy from a nuclear power source is orders of magnitude less than those of the reasonable alternative energy sources. Accordingly, the comparative relationship between the energy sources listed in Table 9-5 would not change meaningfully, even if the greenhouse gas emissions from the nuclear fuel cycle reductions are ignored, because greenhouse gas emissions from the other energy source alternatives would not be sufficiently reduced to make them environmentally preferable to the proposed project.

Carbon dioxide emissions associated with generation alternatives such as wind power, solar power, and hydropower would be associated with workforce transportation, construction, and decommissioning of the facilities. Because these generation alternatives do not involve combustion, the review team considers the emissions to be minor and concludes that the emissions would have a minimal impact. Other energy-generation alternatives involving combustion of oil, wood waste, municipal solid waste, or biomass-derived fuels would have CO_2 emissions from combustion as well as from workforce transportation, plant construction, and plant decommissioning. It is likely that the CO_2 emissions from the combustion process for these alternatives would dominate the other CO_2 emissions associated with the generation alternative. It is also likely that the CO_2 emissions from these alternatives would be the same order of magnitude as the emissions for the fossil-fuel alternatives considered in Sections 9.2.2.1 and 9.2.2.2. However, because these alternatives were determined by the review team not to meet the need for baseload power generation, the review team has not evaluated the CO_2 emissions quantitatively.

As discussed in Chapter 8 of this EIS, the review team has concluded that the need for the additional baseload power generation has been demonstrated. Also, as discussed earlier in this chapter, the review team concludes that the viable alternatives to the proposed action all would involve the use of fossil fuels (coal or natural gas) whether singly or in combination with other alternative energy resources. The review team concludes that the proposed action results in the lowest level of emissions of greenhouse gases among the viable alternatives.

The review team reviewed the available information on the environmental impacts of power-generation alternatives compared to the building and operation of new nuclear units at the VCSNS site. Based on this review, the review team concludes that, from an environmental perspective, none of the energy alternatives is environmentally preferable to building and operation of a new baseload nuclear power generation plant at the VCSNS site.

9.3 Alternative Sites

NRC EISs prepared in conjunction with a COL application must analyze alternatives to the proposed action (10 CFR 51.71(d)). NRC guidance (NRC 2000, the Environmental Standard Review Plan or ESRP) states that the ER, submitted in conjunction with an application for a COL, should include an evaluation of alternative sites to determine if any obviously superior alternative to the proposed site exists. NRC's site-selection process guidance calls for identification of an ROI followed by successive screening to identify candidate areas, potential sites, candidate sites, and the proposed site (NRC 2000). This section includes a discussion of SCE&G's ROI for the proposed siting of a new nuclear power plant, and describes its alternative site-selection process. Because the project involves a partner, this section also includes a review of potential sites located within the Santee Cooper ROI that are located outside of the SCE&G ROI to confirm that in the selection of the VCSNS site, SCE&G did not preclude any known alternative sites that may rank equal to or better than the VCSNS site. This is followed by the review team's description of the alternative sites selected, and discussion of the environmental impacts of locating a unit at each alternative site.

This section describes the SCE&G site-selection process, the review team's evaluation process, the alternative sites selected by SCE&G, and the review team's evaluation of the environmental impacts of locating two new nuclear generating units at each alternative site. The specific resources and components that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were assessed. For the purposes of this alternative sites evaluation, impacts evaluated include NRC-authorized construction, operation, and other cumulative impacts including preconstruction activities. Sections 9.3.3 through 9.3.6 provide a site-specific description of the environmental impacts at each alternative site based on issues such as land use, air quality, water resources, terrestrial and aquatic ecology, socioeconomics and environmental justice, and historic and cultural resources. Section 9.3.7 contains tables of the staff's characterization of the impacts at the alternative sites and comparison with the proposed site to determine if there are any alternative sites that are environmentally preferable to the proposed site.

The review of alternative sites consists of a two-part sequential test (NRC 2000). The first part of the test determines whether any environmentally preferable sites are among the candidate sites. To determine if a site is environmentally preferable, the review team considers whether the applicant has (1) reasonably identified candidate sites, (2) evaluated the likely environmental impacts of construction and operation at these sites, and (3) used a logical means of comparing sites that led to the applicant's selection of the proposed site. Based on its own independent review, the review team then determines whether any of the alternative sites are environmentally preferable to the applicant's proposed site. If the review team determines that one or more alternative sites are environmentally preferable, then it would proceed with the second part of the test.

The second part of the test determines if an environmentally preferable alternative site is obviously superior to the proposed site. The review team must determine that (1) one or more important aspects, either singly or in combination, of an acceptable and available alternative site are obviously superior to the corresponding aspects of the applicant's proposed site, and (2) the alternative site does not have offsetting deficiencies in other important areas. Included in this part of the test is the consideration of estimated costs (i.e., environmental, economic, and time of building the proposed plant) at the proposed site and at the environmentally preferable site or sites (NRC 2000).

9.3.1 Alternative Site-Selection Process

This section includes a discussion of the alternative site-selection processes used to evaluate the siting of the proposed two-unit nuclear power plant project. The site-selection and comparison process focuses on strategically identifying and evaluating sites that represent an acceptable range of alternatives for proposed VCSNS Units 2 and 3 within the stated ROI. This section details the process deployed to strategically identify and screen the ROI in successive steps until four alternative sites were determined and the final VCSNS site was selected.

Due to the joint ownership aspect of the proposed project, the following review includes considerations from both the SCE&G and Santee Cooper siting evaluations. Section 9.3.1.1 outlines SCE&G's siting analysis while Section 9.3.1.2 outlines Santee Cooper's siting analysis. It is noted that at the time the alternative siting analysis took place originally, Santee Cooper was not yet a partner in the project, and therefore the alternative sites developed under the COL application were generally limited to the SCE&G service territory, or located within 15 mi of the franchised service territory to take advantage of land availability, proximity to transmission lines and transportation facilities, and environmental factors (SCE&G 2009b). However, once joint ownership was established, SCE&G undertook an evaluation of the Santee Cooper service territory to confirm that in the selection of the VCSNS site, SCE&G did not overlook or preclude site(s) located within the Santee Cooper service territory that would serve the power needs of both SCE&G and Santee Cooper.

One final consideration that is discussed in more detail in Section 8.2.2 is the following: while there are no legal impediments to SCE&G siting a plant outside of its service territory, enabling legislation provided by the South Carolina General Assembly limits Santee Cooper's participation to existing or future nuclear generation units at or near Parr Shoals in Fairfield County (SC Code Ann. 58-33-200). Authorization for Santee Cooper to partner at another site would require a change in statutory language. Therefore, the siting analysis performed by Santee Cooper was done to confirm the findings of the SCE&G siting analysis, which proposed the VCSNS as the preferred site, rather than to individually determine a proposed site for Santee Cooper.

In successive steps, the process of site selection involves the screening of a group of sites against applied criteria beginning with the ROI. The screening process proceeds through the following steps successfully reducing the ROI to the candidate sites, and final proposed site:

- Region of Interest: Largest geographic area of consideration; for regulated utilities this is considered to be the franchised service territory. Typically, the ROI is screened using exclusionary type criteria to provide a targeted list of acceptable potential sites for further analysis.
- Potential Sites: Discrete parcels of land found within the geographic area of consideration that would support the facility as proposed. Potential sites are screened using suitability criteria to provide an acceptable list of candidate sites. The screening data set is typically of reconnaissance-level detail.
- Candidate Sites: Sites that are considered to be among the best sites in the given ROI that can reasonably be found for the siting and operation of a power plant. Candidate sites are typically evaluated through the application of a more refined set of suitability criteria where the quantifiable weighting and ranking process provides the mechanism through which the proposed site is chosen and evaluated against the other candidate sites.

The identification and validation of the final proposed site from the list of candidate sites is done on an issue-by-issue basis, which allows the applicant to identify the cost and environmental trade-offs associated with developing each one of the candidate sites. Review team visits to each of the candidate sites provides verification of the critical site-suitability criteria and provides a mechanism for deriving reasonable assurance that the proposed site has no unforeseen or fatal flaw that might result in licensing delays, increased costs, or environmental impacts outside of the identified scope.

NUREG-1555, Section 9.3 (III)(12) (NRC 2000) recognizes the potential value of including existing nuclear power plant sites that were "previously found acceptable on the basis of a National Environmental Policy Act (NEPA) review, or have [been] demonstrated to be environmentally acceptable on the basis of operating experience, or allocated to an applicant by a state government from a list of state approved power plant sites."

Of the four candidate sites, VCSNS and the Savannah River Site met the preceding criteria of having been previously characterized and found acceptable after a NEPA review.

The State of South Carolina also lends considerable influence to the siting process, as can be found in the PSCSC language regarding implementation of the Utility Facility Siting and Environmental Protection Act (SC Code Ann. 58-33-160(c)). The statute requires that "the impact of the facility upon the environment must be justified, considering the state of available technology and the nature and economics of the various alternatives and other pertinent considerations." Finally, the Base Load Review Act, "requires the [South Carolina Public Service] Commission to go beyond the public convenience and necessity findings required under the Siting Act and to conduct a full preconstruction prudency review of the proposed Units" (PSCSC 2009a). Prior to issuance of the CPCN, the South Carolina Office of Regulatory Staff independently audited and evaluated the SCE&G site-selection process, criteria used for evaluation, and the final decision to select the VCSNS site as the final proposed site. The PSCSC, in its Findings of Fact and Conclusions of Law, found that the record clearly supported the prudency and reasonableness of the selection of the Jenkinsville site (VCSNS) for VCSNS Units 2 and 3 (PSCSC 2009a).

9.3.1.1 SCE&G Alternative Site-Selection Process

SCE&G's ROI is its legally obligated service area in addition to areas outside, but in close proximity to the ROI that were capable of supporting the proposed project (SCE&G 2010b). This enabled the characterization of areas outside of the franchised service area that maintained siting advantages such as the availability of land, proximity to transmission and transportation infrastructure, and environmental factors.

The designated ROI is consistent with the guidance in NUREG-1555 (NRC 2000). The review team concludes that the ROI used in SCE&G's application is reasonable for consideration and analysis of candidate areas and sites. The review team also finds that SCE&G's basis for defining its ROI did not arbitrarily exclude desirable locations. Figure 9-1 shows the geographic scope of the ROI analysis and the 20 potential sites that were evaluated through the site-selection process.

SCE&G considered three distinct evaluations in the final selection of the VCSNS site. The first siting study was the 1974 Dames and Moore study that screened the ROI and provided 18 potential sites for evaluation (Dames and Moore 1974). Collectively, 18 sites were identified in the initial siting study for evaluation within the ROI: 15 of the sites were greenfield sites and 3 were existing fossil-fired sites. The second siting study, the *South Carolina Electric & Gas (SCE&G) Nuclear Power Plant Siting Study, 2005*, was conducted in 2005 by McCallum-Turner who deployed the Electric Power Research Institute (EPRI) Siting Guide (EPRI 2002) to re-evaluate and update the earlier Dames and Moore study using the most current and available information (McCallum-Turner 2005a). In addition to the previous 18 sites under consideration,

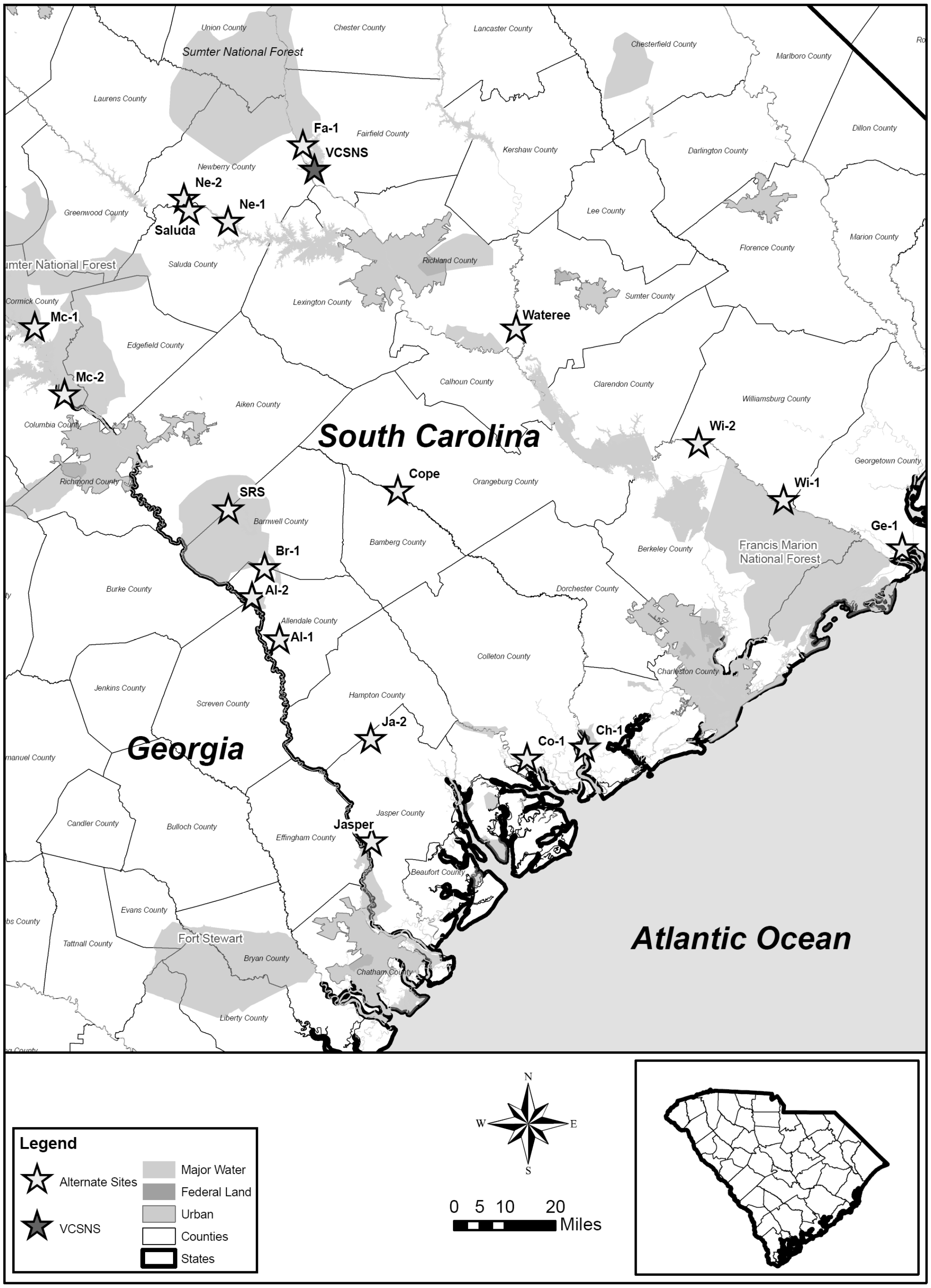

Figure 9-1. Potential Site Locations (Tetra Tech NUS, Inc. 2009)

McCallum-Turner identified the Savannah River Site, an existing Federal nuclear site, and the existing (VCSNS) commercial site for inclusion in the analysis. The site-selection process used guidance provided in NUREG-1555 (NRC 2000) and the EPRI Siting Guide (EPRI 2002). A shortcoming of the second evaluation was simply that SCE&G brought forth only two sites for final characterization, which is inconsistent with NUREG-1555 guidelines which recommend three to five sites in addition to the proposed site (NRC 2000).

The third siting study, the *Nuclear Plant Site Selection Study Report* (Tetra Tech NUS, Inc. 2009), was a compilation of the 1974 and 2005 siting studies. The study was conducted with the expressed intent of verifying that a reasonable suite of viable candidate sites was considered using a single methodology and set of criteria, and determining whether there were any obviously superior sites among the candidate sites for the siting and operation of two Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactors (Tetra Tech NUS, Inc. 2009). In screening the ROI, SCE&G used a dual process to confirm that potential sites were represented by both developed and undeveloped sites. The first process simply made sure that existing nuclear power plant locations, or other NEPA-characterized locations within the ROI, were included on the potential site list that would be subject to further analysis. In doing so, SCE&G included the VCSNS site and the Savannah River Site. The second process evaluated the ROI by applying refined screening criteria to areas that were found to be capable of supporting potential power plants, and were considered either “greenfield” (no development) or “brownfield” (existing power plant) sites.

SCE&G provided key criteria for use as “bounding conditions” to aid in the identification and evaluation of sites for the 2005 McCallum-Turner siting study and the 2009 Tetra Tech NUS, Inc. evaluation. These factors included the following considerations (McCallum-Turner 2005b):

- The sites and evaluations must be consistent with the applicant’s business plans and objectives (Unit 2 commercial by 2016, accurate reflection of need for power, etc).
- The site and siting evaluation must be consistent with NRC site suitability requirements (EPRI Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application dated March 2002 would be used).
- Compliance with NEPA – National Environmental Policy Act of 1969.

SCE&G’s process for screening the 20 potential sites followed a prescriptive methodology by applying exclusionary criteria appropriate to the geography in consideration and the technology involved with constructing and operating the proposed AP1000 nuclear power plant. SCE&G obtained data from publicly available resources such as the Environmental Systems Research Institute geographic information system database, U.S. Geological Survey (USGS), Federal Emergency Management Agency, as well as others, and evaluated and verified potential sites that could support the proposed nuclear power plant. In the selection and application of screening criteria, SCE&G aligned its 10 screening criteria with NUREG-1555 by focusing on the preservation of existing conditions and minimizing impacts at potential sites. Broadly, screening criteria fell into categories that enabled SCE&G to avoid carrying sites forward that demonstrated significant issues that precluded their use for a nuclear power plant, could cause significant impacts or degradation of local natural resources on the site, or posed significant impacts on surrounding terrestrial and aquatic ecosystems (SCE&G 2010b).

The 20 potential sites were quantitatively evaluated using the following exclusionary criteria: seismic, land use, hydrology, geotechnical, terrestrial ecology, aquatic ecology, and demographics. This reconnaissance-level approach evaluated potential sites by critical attributes and enabled the elimination of nine potential sites from more costly and in-depth analysis (Tetra Tech NUS, Inc. 2009). Through this process, SCE&G identified 11 candidate sites from the 20 potential sites that were carried forward for detailed investigation.

The remaining 11 candidate sites were evaluated against EPRI site criteria with both weighting and ranking factors applied to each of the following 10 criteria: cooling-water supply, flooding, population, hazardous land use, ecology, wetlands, railroad access, transmission access, geology/seismic, and land acquisition. Each criterion was then broken down into several respective sub-criteria to quantify the most meaningful set of measurements. For example, cooling-water supply was broken down into five categories, including the presence or absence of a lake or river, minimum flow measurement, average flow measurement, and distance to the water source. In this manner, each of the 11 candidate sites was subject to the application and analysis of 27 distinct sub-criteria (Tetra Tech NUS, Inc. 2009). The resulting weighting and ranking of candidate sites provided SCE&G with clear indications of acceptable alternative sites to carry forward for further analysis and auditing. Based on its site audit, the review team elected to carry one additional site forward, Fairfield 1 (FA-1) site, for full analysis because of its proximity in scoring to the next-highest ranking site.

Based on the guidance provided in NUREG-1555 (NRC 2000), the EPRI Siting Guide (EPRI 2002), and in accordance with the site-selection process described by SCE&G, the applicant selected VCSNS as the proposed site and the three sites that maintained the highest composite scores were selected as alternative sites. The review team elected to include the FA-1 site as an alternative site based on its site audit. Of the four alternative sites, one site was a well-characterized existing nuclear facility; two sites were greenfield sites; and one site was a brownfield site. The four alternative sites presented for comparative evaluation included the following:

- FA-1, Fairfield County (greenfield), South Carolina
- Cope Generating Station site (brownfield), Orangeburg County, South Carolina
- Saluda site (greenfield), Saluda County, South Carolina
- Savannah River (SR) site (at the existing Federal Savannah River Site), Aiken County, South Carolina.

In analyzing each of the four alternative sites, SCE&G performed detailed evaluations considering environmental benefits, strategic business issues such as constructability and cost benefits, and additional non-tangible benefits. Specifically, SCE&G determined that there were advantages to co-locating new nuclear generating units with an existing power plant owned by SCE&G. The following potential advantages of co-location at the VCSNS site were identified in the application (SCE&G 2010b):

- environmental benefits
  - Extensive onsite conditions are known as a result of years of data collection. It is reasonable to assume that the impacts of additional units would be comparable to those of the operating unit.
  - Construction of new transmission-line corridors may be avoided if the existing transmission system can accommodate the increased power generation.
  - The site has already been characterized as mandated by NEPA and was the subject of extensive environmental screening during the original site-selection process.
- constructability and cost benefits
  - Site physical criteria, including geologic and seismic, have been fully characterized.
  - No additional land acquisitions would be necessary and the site could accommodate the land requirements of the new units
  - Construction, operation, and maintenance costs would be reduced because of existing site infrastructure.
- other benefits
  - The VCSNS site has nearby power markets. The VCSNS site personnel have relevant nuclear experience.

The review team considered only environmental matters in its determination of whether an alternative site was environmentally preferable to the proposed site and did not consider non-environmental issues, such as constructability and cost. The review team recognizes, however, that in some cases environmental and cost factors are related. So, for example, a site that requires longer transmission lines will have both higher environmental impacts and higher costs related to those transmission lines.

9.3.1.2 Santee Cooper Alternative Site-Selection Process

The Santee Cooper ROI coincides with several regulated utilities and many of the electric cooperatives within South Carolina. As such, SCE&G evaluated Santee Cooper's ROI by focusing on the 22 counties that lie in northern and northwestern South Carolina and are outside of the SCE&G service territory. This region was not evaluated in the SCE&G siting analysis, which focused only on the SCE&G service territory, and generally aligns with the service territories of Duke Energy and Progress Energy. Figure 9-2 outlines the additional counties reviewed by SCE&G (2009b).

Due to the interconnected transmission system that Santee Cooper maintains in supplying power throughout the ROI, and the fact that the Santee Cooper system coincides with regulated utilities operating in the same region, SCE&G reviewed and evaluated recent alternative site-selection studies prepared by Duke Energy for the William States Lee III Nuclear Station (Duke 2009a) and Progress Energy for the Shearon Harris Nuclear Power Plant (PE 2008) specifically for the South Carolina sites, as well as the siting analysis performed by MACTEC for Santee Cooper's coal-fired Pee Dee Generating Station (MACTEC 2006). Collectively, these site-selection studies accounted for a reconnaissance-level review of over 20 potential sites, and a detailed review of 9 sites located within South Carolina.

Because all nine sites were found to be viable sites based on previous siting studies, SCE&G's evaluation focused primarily on the application of reconnaissance-level criteria to determine if any one of the sites could rank equal to or better than the four alternative sites already identified in the VCSNS siting study. Of primary consideration, and with what might be expected when proposing to site a power plant outside of the franchised service territory or declared ROI, this included criteria such as the ability to own or control the property, distance to and impact on transmission corridor access, proximity to load centers, and critical site-development requirements such as improving water supply and availability. The criteria were consistent with those used in the SCE&G Site Selection Study Report (Tetra Tech NUS, Inc. 2009). In accordance with NUREG-1555 guidelines, which support the use of reconnaissance-level criteria to screen out potential sites from further evaluation, consideration of the Santee Cooper ROI did not "substantially improve" the environmental diversity of SCE&G's siting options (NUREG-1555 [NRC 2000]). Therefore, in the application of criteria, SCE&G did not carry forward any of the nine additional sites for in-depth comparative analysis, because they did not rank equal to or better than the proposed four alternative sites, nor did they improve the environmental diversity of SCE&G siting options.

Three sites evaluated in the Duke Energy service territory were Lee, Keowee, and Middleton Shoals. Each of the sites is currently owned by Duke Energy, and control of the property would be difficult to obtain. Furthermore, the distances to SCE&G high-voltage transmission lines runs from 45 to 85 mi requiring the development of transmission-line corridors, while distances to the major load centers is even farther, requiring extensive transmission system upgrades. Consistent with the siting analysis performed by Duke Energy, each of the sites would likely require site modifications such as the construction of a supplemental water reservoir (SCE&G 2009b). As part of the alternative siting analysis and audit performed for the Lee site COL application, the NRC staff participated in onsite audits of each of the three Duke Energy sites under consideration (Lee, Keowee, and Middleton Shoals). Due to the preceding

Figure 9-2. Santee Cooper Region of Interest (SCE&G 2009b)

considerations, the review team found that the reconnaissance-level information evaluated for the alternative sites in the Lee COL application, in combination with the utility requirements for SCE&G and Santee Cooper, did not indicate that there was a site located within the Duke Energy service territory that would rank higher than the candidate sites in the SCE&G study.

Two sites evaluated in the Progress Energy Carolinas service territory included the existing H.B. Robinson Nuclear Plant site and a greenfield site located in Marion County. The Robinson site, as a Progress Energy-owned site, would require SCE&G and Santee Cooper to acquire rights to construct and operate on it; they would also have to acquire the Marion County site property as well. Similar to the issues discussed previously for candidate sites outside of the SCE&G service territory, the construction and operation of a power plant at either of these sites would require extensive development of transmission-line corridors and transmission system upgrades due to the distances to existing transmission infrastructure and load centers. At the Robinson site, water supply limits due to thermal restrictions on the lake may preclude the successful construction and operation of a two-unit nuclear power plant. Finally, the Marion site may require the construction of a cooling-water reservoir and has considerable wetland acreage onsite (SCE&G 2009b). As part of the alternative siting analysis and audit performed for the Harris site COL application, the NRC staff participated in onsite audits of each of the two Progress Energy Carolina sites under consideration (Robinson and Marion County). Due to the preceding considerations, the review team found that the ground-level information evaluated for the alternative sites in the Harris COL application, in combination with the utility requirements for SCE&G and Santee Cooper, did not indicate that there was a site located within the Progress Energy Carolinas service territory that would rank higher than the candidate sites in the SCE&G study.

Of the six sites evaluated in Santee Cooper's Pee Dee coal-fired power plant siting analysis, two of the sites were in close proximity to the Al-1 and Wateree sites identified by SCE&G in its site-selection process used for the VCSNS siting analysis. Because the two sites evaluated by Santee Cooper shared similar environmental characteristics with the sites identified in the SCE&G site-selection analysis and because there were no significant differences between the two comparable locations, the sites were not carried forward. SCE&G then reviewed the remaining four candidate sites, which included three sites located on the Great Pee Dee River (sites 7, 9, and 10), and one site located on Bull Creek (site 6). Site 7 was the preferred site for the Pee Dee coal-fired project and is the only site owned by either utility. Further, sites 7, 9, and 10 would require the construction of a cooling-water reservoir to ensure adequate water supply in low-flow periods. All four sites would require the development of approximately 65 mi of new transmission-line corridors to connect to the existing SCE&G transmission infrastructure, as well as significant transmission system upgrades to provide power to the major load centers located from 75 to 85 mi away (SCE&G 2009b).

Due to the preceding considerations, the review team found that the reconnaissance-level information evaluated by SCE&G for the alternative sites in the Pee Dee coal-fired project, in combination with the utility requirements for SCE&G and Santee Cooper, did not indicate that there was a site located within the Santee Cooper service territory that would rank higher than the candidate sites in the SCE&G study.

9.3.1.3 Conclusions About the Alternative Site-Selection Process

The review team evaluated the methodology used by SCE&G and concluded that the process for selecting and evaluating alternative sites, including the final proposed VCSNS site, was reasonable and consistent with the guidelines presented in NUREG-1555 and the EPRI Siting Guide.

The review team also evaluated the SCE&G analysis of the Santee Cooper service territory, including site-selection studies performed by Duke Energy, Progress Energy, and MACTEC for Santee Cooper's siting of the Pee Dee coal-fired project. Each of the site-selection studies individually followed a prescriptive process for the comparative evaluation of alternative sites, and included the detailed analysis of nine sites located within the Santee Cooper service territory. The review team concluded that none of the sites identified in the Santee Cooper siting analysis would rank higher than the candidate sites identified in the SCE&G study based on critical siting criteria, such as the proximity to transmission access and load centers, the need for cooling-water reservoirs to ensure adequate water availability, and land availability.

Finally, the review team recognizes the siting precedence established by the State of South Carolina through the PSCSC process as part of the CPCN evaluation and findings (PSCSC 2009a) and the through the South Carolina General Assembly (SC Code Ann. 58-33-200) as part of the legislative language permitting Santee Cooper to participate with SCE&G in the construction and operation of a nuclear power plant at the Fairfield County site. This precedence is afforded "substantial weight" under NUREG-1555 guidelines, having undergone rigorous evaluation and extensive review (NRC 2000).

The review team found that the systematic alternative siting analysis demonstrated a logical selection process and application of screening and exclusionary siting criteria. The analysis enabled the evaluation of the likely environmental impacts associated with the respective sites, including the evaluation of suitability criteria; identified acceptable alternative sites; and clearly provided the mechanism for selection of the final proposed site. The review team evaluated the siting methodology used by SCE&G to select its ROI, potential sites, candidate sites, and alternative sites. Based on SCE&G's description of its process and the review team's evaluation of the criteria used, and as addressed in the analysis in the previous section, the review team determined that the process used to identify alternative sites was a logical approach and was therefore acceptable.

9.3.2 NRC/USACE Alternative Site Evaluation

The four alternative sites (FA-1, CGS, Saluda, and SR) are examined in detail in Sections 9.3.3 through 9.3.6. The review team visited each of the four alternative sites as well as the proposed site in March 2009. Section 9.3.7 contains tables of the review team's characterization of the cumulative impacts of the proposed action at the proposed and alternative sites.

Following the guidance promulgated in ESRP 9.3 (NRC 2000), the review team visited the four alternative sites and collected and analyzed reconnaissance-level information for each of the sites. The review team then used the information provided in the ER, RAI responses, and information from other Federal and State agencies, and information gathered during the visits to each alternative site to evaluate the cumulative impacts of building and operating two new nuclear power plants at those sites. The analysis therefore includes the impacts of NRC-authorized construction and operation as well as potential impacts associated with other actions affecting the same resources. Cumulative impacts occur when the effects of an action are added to or interact with other effects in a particular place and within a particular time; as a result, the cumulative impact assessment entails a more extensive and broader review of possible effects of the action beyond the site boundary.

The cumulative analysis for the impacts at the alternative sites was performed in the same manner as discussed in Chapter 7 for the proposed site except, as specified in ESRP 9.3 (NRC 2000), the analysis was conducted at the reconnaissance level for the alternative sites. To inform the cumulative impacts analysis, the review team researched EPA databases for recent EISs within the state; used an EPA database for permits for water discharges in the geographic area to identify water-use projects; and used www.recovery.gov to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The review team developed tables of the major projects near each alternative site that were considered relevant in the cumulative analysis. The review team used the information to perform an independent evaluation of the direct and cumulative impacts of the proposed action at the alternative sites to determine if one or more of the alternative sites were environmentally preferable to the proposed site.

Included are past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts with the proposed action. For the purposes of this analysis, the past is defined as the time period prior to receipt of the COL application. The present is defined as the time period from the receipt of the COL application until the beginning of activities associated with building proposed Units 2 and 3. The future is defined as the beginning of building activities (construction and preconstruction activities) associated with Units 2 and 3, through operation and eventual decommissioning.

The specific resources and components that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were identified. The affected environment that serves as the baseline for the cumulative impacts analysis is described for each alternative site, and a qualitative discussion of the general effects of past actions is included. The geographic area over which past, present, and future actions could reasonably contribute to cumulative impacts is defined and is described in later sections for each resource area. The analysis for each resource area at each alternative site concludes with a cumulative impact finding (SMALL, MODERATE, or LARGE). For those cases in which the impact level to a resource was greater than SMALL, the review team also discussed whether building and operating the nuclear units would be a significant contributor to the cumulative impact. In the context of this evaluation, “significant” is defined as a contribution that is important in reaching that impact-level determination.

The cumulative impacts are summarized for each resource area in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area. The findings for each resource area at the VCSNS site and each alternative site are then compared in Table 9-35. The results of this comparison are used to determine if any of the alternative sites are environmentally preferable to the proposed site. If any alternative site is determined to be environmentally preferable, the review team would evaluate whether that alternative site was obviously superior.

The impacts described in Chapter 6 of this EIS (e.g., nuclear fuel cycle; decommissioning) would not vary significantly from one site to another. This is true because all of the alternative sites and the proposed site are in low-population areas and because the review team assumes the same reactor design (therefore, the same fuel cycle technology, transportation methods, and decommissioning methods) for all of the sites. As such, these impacts would not differentiate between the sites and would not be useful in the determination of whether an alternative site is environmentally preferable to the proposed site. For this reason, these impacts are not discussed in the evaluation of the alternative sites.

9.3.3 The FA-1 Site

This section covers the review team’s evaluation of the potential environmental impacts of siting a two-unit nuclear power plant at the FA-1 site located in Fairfield County, South Carolina. The following sections describe a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if it were implemented at the FA-1 site and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment are other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the FA-1 site. Other actions and projects considered in this cumulative analysis are described in Table 9-6.

Table 9-6. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the FA-1 Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Energy Projects			
VCSNS Unit 1	VCSNS Unit 1 consists of one 996-MW(e) nuclear power generating plant.	5.5 mi south-southwest of FA-1	VCSNS Unit 1 is currently operational and is licensed to continue operations through August 6, 2042[a]
Carolinas-Virginia Tube Reactor (CVTR)	Experimental pressurized tube heavy water nuclear power reactor	About 7.5 mi south of FA-1	Decommissioned[b]
Independent Spent Fuel Storage Installation	Dry spent-fuel storage	About 8 mi south of FA-1	Proposed[c]
Old Steam Generator Recycle Facility	Decommissioned steam generator storage	About 8 mi south of FA-1	Operational[c]
Lee Nuclear Station	Two Westinghouse AP1000 pressurized water reactors	About 47 mi upstream (north) on Broad River	Proposed new nuclear plant. Operation would begin in 2018-2021[d]
Catawba Nuclear Station, Units 1 and 2	Two 1129-MW(e) Westinghouse reactors	About 50 mi north-northeast of FA-1	Operational[e]
H.B. Robinson Steam Electric Plant, Unit 2	Nuclear power generating plant with one 710-MW(e) unit	About 70 mi east of FA-1	Operational[f]
McGuire Nuclear Station, Units 1 and 2	Two 1100-MW(e) Westinghouse reactors	About 78 mi north-northeast of FA-1	Operational[g]
Vogtle Electric Generating Plant (VEGP)	Nuclear power generating plant with 2 units, VEGP 1 (1109 MW(e)) and VEGP 2 (1127 MW(e))	Approx 80 mi south-southwest of FA-1	Operational[h]
VEGP Units 3 and 4	Nuclear power generating plant with two Westinghouse AP 1000 pressurized water reactors	Approx 80 mi south-southwest of FA-1	Proposed[i] (Pre-construction activities have commenced. NRC Limited Work Authorization has been issued.)
Oconee Nuclear Station, Units 1, 2, and 3	Three 846-MW(e) Babcock and Wilcox reactors	About 92 mi west-northwest of FA-1	Operational[j]
SCE&G Parr Hydroelectric Plant	A 14-MW(e) hydroelectric plant	About 6.9 mi downstream on Broad River	Parr Hydro Plant is currently operational[k]
SCE&G Fairfield Pumped Storage Plant	A 511.2-MW(e) hydroelectric plant. VCSNS Units 2 and 3 would use water supply from this facility.	About 4.1 mi downstream on Parr Reservoir (Broad River)	The Fairfield Pumped Storage Plant is currently operational[c]
SCE&G Parr Combustion Facility	71-MW(e) natural-gas electric generating plant	About 2.0 mi south of VCS&S	Operational[b]

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Buzzard Roost Combustion Turbine Station	A 196-MW oil/gas-fired peaking facility	Approx 35 mi west-southwest of FA-1	Operational[l]
Buzzard Roost Dam	A 15-MW hydroelectric facility	Approx 35 mi west-southwest of FA-1	Operational[m]
Westinghouse Fuel Fabrication Plant in Columbia, South Carolina	Design and fabricate completed nuclear fuel assemblies and fuel-related products, such as top and bottom nozzles, control rods, and zirconium diboride and erbia integral fuel burnable absorbers for pressurized water reactors and Vodo-Vodyanoi Energetichesky Reactors.	About 35 mi southwest of FA-1	Operational[n]
Six Broad River Hydroelectric Projects	Hydroelectric facilities	5 upstream of FA-1 on the Broad River and 1 downstream on the Broad River	Operational[c]
Transmission Lines	Various transmission lines currently exist throughout region and installation of additional lines would occur if new nuclear plants or other large energy projects are built. New transmission lines could require the following: widening of existing corridors, building new corridors, moving facilities within corridors, building new facilities within corridors.	Throughout region	Currently existing as well as the potential for additional transmission lines to be built.
Mining Projects			
Vulcan Materials Company/Blair Quarry	Products include asphalt aggregate, base material, concrete, aggregate, and manufactured sand.	About 5 mi north of FA-1	Operational[o]
Transportation Projects			
South Carolina Strategic Corridor System Plan	Strategic system of corridors forming the backbone of the State's transportation system.	State-wide	Planning document with no explicit schedules for projects, however, many strategic corridors coincide with routes which would/could be used for development at the FA-1 site[p]
Parks and Aquaculture Facilities			
Sumter National Forest	371,000-ac national forest.	About 3.5 mi northwest of FA-1 boundary	Currently managed by U.S. Forest Service[q]

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Parr Hydro Wildlife Management Area	4400-ac wildlife management area	About 5.4 mi south-southwest of FA-1	Currently managed by SCDNR[(c)]
Other parks, forests, and reserves	Several parks, recreation, and conservation areas are located within the 50-mi region. Examples of such areas include Lake Wateree, the Catawba River, Monticello and Parr reservoirs, Broad River, Lake Murray, Dreher Island State Park, Lake Greenwood, Riverbanks Zoo and Garden, Congaree National Park, Harbison State Forest, and Sesquicentennial State Park.	Throughout region	Currently managed by various local, State, and Federal agencies and organizations.
Santee-Cooper Basin Diadromous Fish Passage Restoration Plan and the Santee River Basin Accord	Focus on restoring habitat connectivity for diadromous fish that were historically present within the basin, and includes installation of fish passage facilities at dams on the Broad River	Broad River basin	Currently managed by various State and Federal agencies[(w)]
Other Actions/Projects			
SCE&G Combined Site Emergency Operations Facility	A new combined-site emergency operations facility	10 mi from VCSNS	Operational[(v)]
City of Columbia	Municipal water withdrawals from the Broad River	About 30 mi southeast of FA-1	Ongoing[(c)]
Various hospitals	Medical isotopes	Within 50 mi of FA-1	Operational in Columbia, Lexington, Newberry, Rock Hill, Lancaster, Laurens, Greenwood, and Camden
Cone Mills Carlisle Finishing Co.	Fabric finisher	About 16.5 mi north of FA-1 on Broad River	Currently operational[(r)]
Chemtrade Performance Chemicals, LLC	Industrial inorganic chemicals	About 17.5 mi north of FA-1 on Broad River	Currently operational[(s)]
Newberry County Water & Sewer Authority (NCW&SA)/Cannons Creek Waste Water Treatment Plant (WWTP)	Wastewater treatment	About 8.3 mi southwest of FA-1	Currently operational[(t)]

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
NCW&SA Broad River Wastewater Treatment Facility (WWTF) Phase 1	WWTF currently maintains a non-major NPDES permit.	About 12 mi west of FA-1	Currently operational[(u)]
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroad; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents. There is a low-to-moderate potential for increase urbanization within the Broad River watershed in Newberry and Fairfield Counties, South Carolina. The highest potential for development would be associated with residential development around the reservoirs, the Towns of Prosperity and Pomaria, and the City of Newberry Sumter National Forest would limit urbanization north of FA-1.	Throughout region	Construction would occur in the future, as described in State and local land-use planning documents

(a) Source: NRC 2004
(b) Source: SCE&G 2011
(c) Source: SCE&G 2010b
(d) Source: NRC 2007
(e) Source: NRC 2009a
(f) Source: NRC 2009b
(g) Source: NRC 2009c
(h) Source: NRC 2009e
(i) Source: NRC 2009f
(j) Source: NRC 2009d
(k) Source: EPA 2009g
(l) Source: Duke 2009b
(m) Source: Greenwood County 2008
(n) Source: Westinghouse 2009
(o) Source: SCDHEC 2009c
(p) Source: SCDOT 2009
(q) Source: USFS 2004
(r) Source: EPA 2009c
(s) Source: EPA 2009a
(t) Source: EPA 2009h, k
(u) Source: EPA 2009b
(v) Source: SCE&G 2010e
(w) Source: FWS 2001

As discussed in Sections 2.2.2 and 4.1.2, the applicant updated its original preliminary corridor routing for the VCSNS site. The updated transmission-line routes run within or parallel to existing transmission-line corridors or other existing utility corridors over the majority of the necessary length. Prior to this change and because of its proximity to the VCSNS site, the FA-1 alternative site and its related transmission lines had impact levels similar to the VCSNS site. The review team determined that the revised routing for the VCSNS site is not a discriminator in the comparison between the VCSNS site and the FA-1 site, because it did not change the impact level for any resource area. The comparison of impacts between the VCSNS site and the FA-1 site would not change because the impact level for the VCSNS did not change. Therefore, the review team did not update the transmission-line numbers for the FA-1 site.

The FA-1 site is a privately owned, undeveloped greenfield site located on the eastern bank of the Broad River approximately 2 mi north of the Parr Reservoir, and 1 mi to the west of Monticello Reservoir. Figure 9-3 shows the FA-1 alternative site region.

As an undeveloped greenfield site, FA-1 is primarily forested land composed of rolling hills and steep stream valleys, interspersed with limited amounts of open water and forested wetlands. The site also contains a limited number of residences primarily on the eastern boundary of the site. The site is bounded on the east by County Road 3, on the west by the Broad River, and on the north by State Highway 301 (SC-301). The Sumter National Forest lies to the immediate north of the site.

Locally, the area supports several small, rural, unincorporated communities located within 5 mi of the site. The site is located about 31 mi northwest of Columbia, South Carolina, and approximately 45 mi southwest of Rock Hill, South Carolina.

9.3.3.1 Land Use and Transmission-Line Corridors

In addition to land-use impacts from building and operations at the FA-1 site, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative land-use impacts, including other Federal and non-Federal projects and the projects listed in Table 9-6. For the analysis of land-use impacts at the FA-1 site, the geographic area of interest is considered to be the 50-mi region centered on the FA-1 site plus any transmission-line corridors that extend beyond that range. Most but not all of the transmission-line corridors' length does fall within a 50-mi radius of the site. Land-use planning for transmission-line routing over wide areas must consider land-use plans of adjoining counties and other land-managing agencies, rather than considering one county in isolation. Furthermore, in predominantly rural settings such as that surrounding the FA-1 site, land-use changes occurring substantial distances away from a project site can substantially influence land-use planning decisions close to the site. Roads and other public facilities and services in rural areas tend to serve people who are spread thinly but broadly over large portions of the landscape. Therefore, land-use changes can affect roads and other facilities at greater

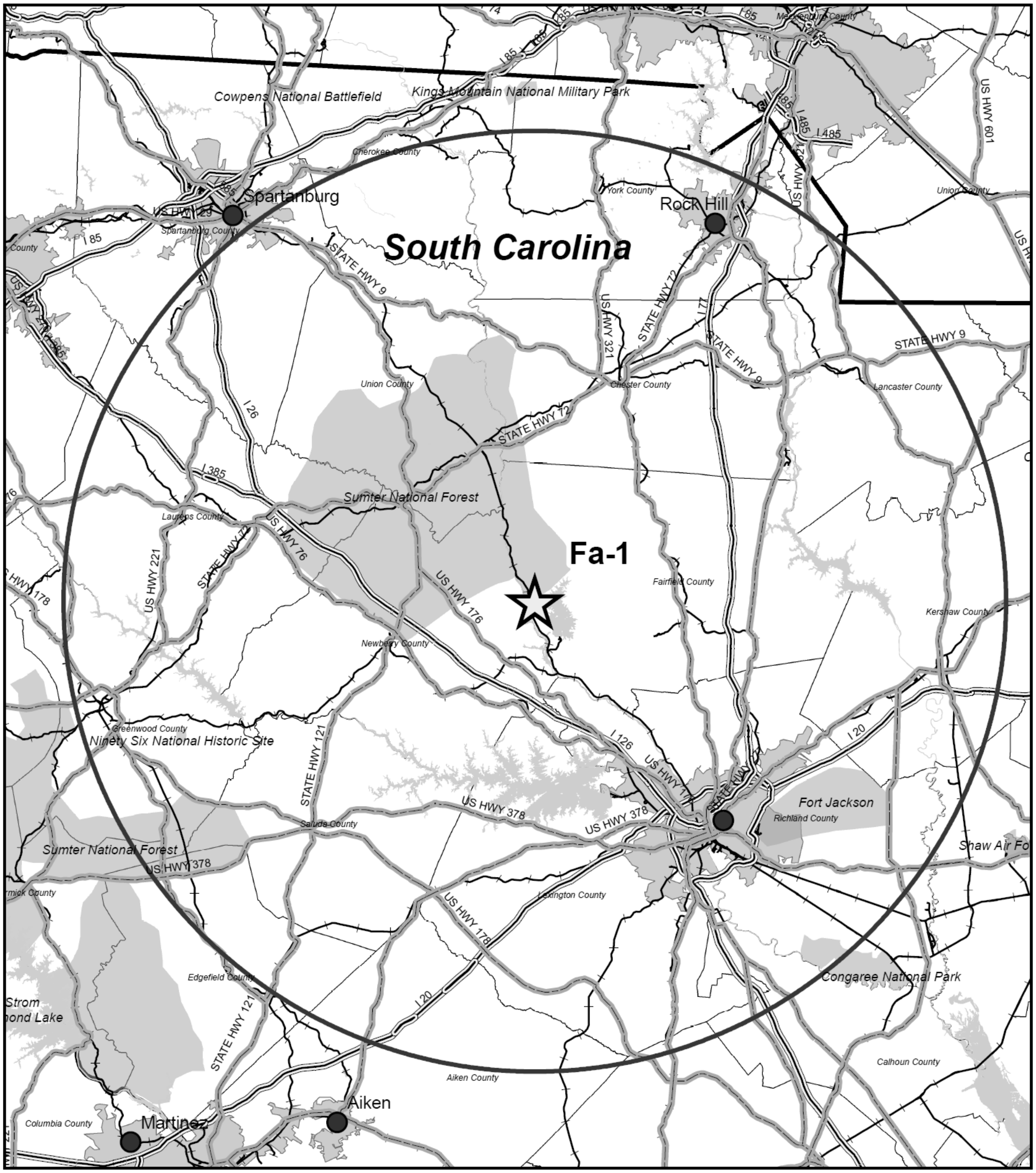

Figure 9-3. FA-1 Alternative Site Region

distances than similar changes in more densely populated areas. The FA-1 site presently is undeveloped and predominantly forested. It is located in a sparsely populated, largely rural area, with forests and small farms composing the dominant land use. Historically, most upland areas have been used for crop production, but presently are used for silviculture. Several electric transmission lines, State routes, and interstate highways currently traverse the region. The current comprehensive land-use plan for Fairfield County (V&A 1997) indicates that the FA-1 site is currently zoned as “Residential Conservation and Development” and links the area with the shoreline of both Monticello Reservoir and the Parr Reservoir, which also have this zoning. A change in zoning would be required to develop the FA-1 site because current zoning discourages nonresidential development from this area (V&A 1997)

Based on GIS analysis of information provided by the applicant (SCE&G 2010a) and the review team’s independent assessment, development of the proposed new units on the FA-1 site would convert existing land uses on about 300 ac of currently forested land to utility uses for the nuclear facility and associated structures and infrastructure. The applicant estimated that five new transmission-line routes would be required, each of which would occupy a 100-ft-wide transmission-line corridor (SCE&G 2010b). Table 9-8 summarizes expected land-use impact parameters for the FA-1 site and transmission lines. The review team used geographic information system data provided by the applicant (SCE&G 2010a) to estimate expected land disturbance. The review team used the most recent information provided by the applicant (SCE&G, 2010b), except where the design data provided in earlier Santee-Cooper documentation (2009c) was not reflected in the revised SCG&E application.

Table 9-7. Land-Use Impact Parameters for the FA-1 Site

Parameter	Value	Source
Required onsite project area (ac)	1141	SCE&G 2010a, 2011
Estimated land-disturbance area (ac)	300	SCE&G 2010a, 2011 and review team analysis
Number of new transmission-line routes – SCE&G (number of routes)	3	SCE&G 2010b
Number of new transmission-line routes – Santee Cooper (number of routes)	2	
Number of new transmission line routes – total (number of routes)	5	
Transmission-line corridor distance – SCE&G (mi)	205	SCE&G 2010b for SCE&G;
Transmission-line corridor distance – Santee Cooper (mi)	242	SCE&G 2009c for Santee Cooper
Transmission-line corridor distance – total (mi)	447	
Transmission-line corridor area – SCE&G (ac)	2237	SCE&G 2010b for SCE&G;
Transmission-line corridor area – Santee Cooper (ac)	3605	review team estimate based on
Transmission-line corridor area – total (ac)	5942	SCE&G 2009c for Santee Cooper

Based on information provided by SCE&G (SCE&G 2009c, d, 2010a) describing dimensions of conceptual transmission-line corridors for the FA-1 site, 447 mi covering about 5942 ac of land would be needed. The proposed routing would use existing corridors to the extent practicable, so that although the linear runs extend 447 mi, somewhat less than that distance would require entirely new corridor. The actual area of land disturbance, used for assessing impacts on terrestrial ecology and cultural resources, is therefore substantially lower than suggested by the overall land-use requirements. The review team concludes that the land-use impact of the transmission-line installation activities would be generally similar to those described for the VCSNS site in Section 4.1.2. SCE&G stated that all land clearing associated with nuclear facility and transmission-line development would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G or Santee Cooper procedures, good construction practices, and established BMPs (SCE&G 2010b).

Because the other projects described in Table 9-6 do not include any significant reasonably foreseeable changes in land-use types within 50 mi of the FA-1 site, there would not be any significant additional cumulative impacts on land use from those activities.

As described above, installation of new transmission-line corridors to support the new units could need as much as 5942 ac over 447 mi of length. If additional transmission lines are built from other energy projects, there would be a cumulative land-use impact from the additional amount of land converted to utility corridor use for transmission lines. Because transmission lines are often co-located and are relatively narrow, the review team expects that the cumulative impact would be consistent with the land-use plans and zoning regulations of the affected counties. Nonetheless, consistent with the review team's analysis in Sections 4.1 and 7.1, multiple new transmission-line corridors could noticeably alter the land-use classification acreage proportions, both within the vicinity of the FA-1 site and within the 50-mi region.

Cumulative land-use impacts within the region would be consistent with existing land-use plans, and the necessary zoning change is not expected to be difficult to obtain. However, due to potential impacts of transmission-line development crossing numerous individual properties, especially where the corridor would not fall within or parallel existing transmission-line corridors and reclassification of acreage within the region caused by transmission-line development, the review team concludes that the cumulative land-use impacts associated with the proposed project at the FA-1 site, related transmission-line corridor development, and other projects in the geographic area of interest would be MODERATE. Considering the land needs noted above, building and operating two new nuclear units at the FA-1 site would be a significant contributor to these impacts.

9.3.3.2 Water Use and Quality

The FA-1 site is a greenfield site located approximately 5 mi from the existing VCSNS site near the eastern bank of the Broad River (see Figure 9-3). The site hydrology, water use, and water quality are discussed in SCE&G (2009e, 2010b) and this section of the EIS draws its information from those sources. Given the FA-1 site's close proximity to the VCSNS site, SCE&G takes the same water-use approach and considers surface water to be the primary source of water for building and operations. In particular, SCE&G proposes using the same waterbodies for both withdrawal (Monticello Reservoir) and discharge (Parr Reservoir) as proposed for the VCSNS site. This approach results in impacts on water use, supply, and quality that are essentially identical to the impacts discussed in Sections 4.2, 5.2, and 7.2 for the VCSNS site.

The differences between the proposed action and the FA-1 alternative with respect to water use and quality are (1) the alternative intake structure from Monticello Reservoir would be from the northern shore rather than the proposed southern shore, (2) the alternative discharge structure would be approximately 5 mi further upstream than the proposed discharge structure, and (3) the alterations to the topography would differ between the alternative and proposed sites. Although detailed analysis would be required to quantify the localized impact differences between the sites for water use and quality in the Broad River or Monticello Reservoir, the impacts that would be different are minor local impacts. There are no notable tributary flows to the Broad River between the alternative and proposed discharge locations aside from the SCE&G Fairfield Pumped Storage Facility (FPSF).

Similar to the discussion in Section 5.2.2.1, surface water at the site is available from the Monticello Reservoir as supplied by the Broad River through the FPSF. Representative historical flow data for water is available for Broad River near Alston, South Carolina (USGS 2008a) (see Table 2-5). Table 9-8 lists the reduction in flow for the Broad River that would occur as a result of being the sole water source for the operation of two units at this site. This table also includes the assessed impact levels. Because withdrawal of surface water to meet the needs of the proposed units would create a reduction of less than 5 percent of the mean annual flow, the associated water-use impact is assessed to be minimal.

Table 9-8. Broad River Reduction in Flow and Assessed Impact Levels

Broad River Flow Condition	River Flow Rate (cfs)	Normal Consumptive Use (cfs)	Percent Flow Reduction	Impact Level
Annual mean flow	6302	62	1.0	Minimal
Lowest annual flow	2153	62	2.9	Minimal

Because all the water needed to support the building and operation of two new units at FA-1 would come from Monticello Reservoir, groundwater-use impacts would be restricted to aquifer dewatering during the building phase. Because this assessment is similar to the one found in Section 4.2.2.2, in that (1) the underlying aquifers demonstrate generally low permeability and (2) excavation dewatering is likely to be temporary and of limited volume, the impact is considered minimal.

Building and operational activities that could affect surface-water quality include hydrologic alterations (e.g., creek or stream drainages or realignment), and water-treatment plant and cooling-tower blowdown discharges. As discussed in Section 4.2.3.1, the development of a stormwater pollution prevention plan with its call for implementation of BMPs would minimize water-quality impacts. As discussed in Section 5.2.3.1, the requirements of a NPDES-permitted outfall would ensure the protection of water quality through compliance with the Clean Water Act. Given the implementation of BMPs and the need for a SCDHEC-issued NPDES permit, the impact on surface-water quality is assessed to be minimal. The impacts of the building and operation of two new units at FA-1 on groundwater quality may occur due to leaching of spilled pollutants and effluents into the subsurface. However, based on experience with other similar facilities, the staff concludes that, with the implementation of BMPs, the impacts on groundwater quality from building and operating two new nuclear units at the FA-1 site would likely be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative impacts analysis considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources. For the analysis of cumulative impacts on surface water, the geographic area of interest for the FA-1 site is considered to be the drainage basin of the Broad River upstream and downstream of the site because this is the resource that would be affected by the proposed project. Key actions that have past, present, and future potential impacts on surface-water supply and surface-water quality in the Broad River basin include operation of VCSNS Unit 1, operation of the FPSF that connects Monticello Reservoir with Parr Reservoir, the Newberry County Water and Sewer Authority (NCW&SA), Broad River Wastewater Treatment Plant (WWTP), the NCW&SA Cannons Creek WWTP, and the SCE&G Parr Hydroelectric Generating Station (or Plant). These are the same as those identified as having potential impacts on surface-water supply and surface-water quality in the Broad River with the proposed action, which are described in Section 7.2.

Increases in consumptive use of water in the Broad River drainage are anticipated in the future and discussed in Section 7.2.1. This earlier discussion notes that Duke Energy is proposing to build two nuclear reactors at the William States Lee III Nuclear Station in Cherokee County, South Carolina (Duke 2009b). Duke has prepared an assessment of water availability and projected use for Broad River to determine the availability of water to support expansions of Duke's generating capability (Duke 2007). Duke considered future agriculture and irrigation projects, power projections, public water supplies and wastewater projections, and future industrial use. Duke also considered future trends in water use such as water reuse, water conservation, and changes in regulations and the regional economy. The Duke study does not consider the impact of climate change. The study states that consumptive water use would increase in the Broad River drainage from the 241.5 cfs in 2006 to 412.9 cfs by 2070. Duke asserts that the study will enable it to plan for water needs and develop water-storage facilities necessary to support the operation of its proposed facilities. Similarly, SCE&G asserts that the impact of consumptive use by VCSNS Units 1, 2, and 3 during low flows can be mitigated by using water from Monticello Reservoir.

As discussed in Section 7.2, the review team is aware of the potential climate changes that could affect the water resources available for cooling and the impacts of reactor operations on water resources for other users. Because the alternative sites are in the same region, the impact of climate change may be similar for all them.

The surface-water-use impacts of building and operating two nuclear power plants at FA-1 are dominated by the increased demands that would occur under normal operation relative to the no-action option for this site. The projected consumptive water use of proposed units is expected to be about 62 cfs or about 1 percent of the average river discharge just downstream of Parr Reservoir. Consequently, the review team concludes that the cumulative impacts of surface-water use would be SMALL.

As discussed in Section 7.2.1, groundwater supplies less than 10 percent of the water used for public supplies in Fairfield County (SCDHEC 2007) and no industrial, agricultural, or power generation uses are identified for groundwater in Fairfield County. Because groundwater-use impacts are limited to the temporary aquifer dewatering during the building phase, the review team concludes that the cumulative impacts of groundwater use would be SMALL. Water-quality information presented above for the impacts of building and operating two new units at the FA-1 alternative site would also apply to evaluation of cumulative impacts. As mentioned above, a SCDHEC-issued NPDES permit would be required to operate the two new nuclear units at this site. Effluent discharge through an NPDES-permitted outfall would ensure that the discharges complied with the Clean Water Act. Such permits are designed to ensure the protection of water quality. The staff also concludes that with the implementation of BMPs, the impacts on groundwater quality from building and operating two new nuclear units at the FA-1 site would likely be minimal. Of the projects listed in Table 7-1, only the SCE&G FPSP lies between the alternative and proposed discharge structures. There are no notable cumulative impacts anticipated with FPSP and FA-1. Given these factors, the review team concludes the cumulative impact on surface-water and groundwater quality would be SMALL.

9.3.3.3 Terrestrial and Wetland Resources

Site Description

The following analysis includes impacts from building and operating the proposed new facilities on terrestrial ecology resources. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-6. For the analysis of terrestrial ecological impacts at the FA-1 site, the geographic area of interest is considered to be a 6 mi-wide area centered on the FA-1 site, plus the associated transmission-line corridors. The 6-mi radius is expected to encompass the ecologically relevant landscape features and species. Because both sites are located in western Fairfield County and the transmission-line corridors for both projects traverse the same general landscape, the FA-1 area of interest substantially overlaps the VCSNS region described in Section 2.2.3.

The FA-1 site is surrounded by a mosaic of forests and farmland, typical of the Piedmont physiographic province. This province begins in the southernmost portion of New York State and stretches in a southwestward direction to approximately mid-Alabama (Godfrey 1980). The Piedmont has been heavily farmed and cultivated, which altered the pre-settlement landscape considerably (Kirkman et al. 2007). The FA-1 site and vicinity is primarily a human-altered landscape that has changed dramatically since the damming of the Broad River and Frees Creek, which created Parr and Monticello reservoirs, respectively. The FA-1 site and associated transmission-line corridors consist of forests, wetlands, open water, and residential areas. The landscape is predominately rural and habitats are typical of the Southern Outer Piedmont ecoregion, consisting of planted and naturally vegetated pine, mixed pine-hardwood, and hardwood forests. Common canopy species include white oak (*Quercus alba*), southern red oak (*Quercus falcata*), black oak (*Quercus velutina*), mockernut (*Carya alba*), and pignut (*Carya glabra*) hickories, intermixed with some loblolly pine (*Pinus taeda*) and shortleaf pine (*Pinus echinata*). Beech (*Fagus grandifolia*), northern red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*), and red maple (*Acer rubrum*) are found on more mesic sites (Griffith et al. 2002).

The associated proposed transmission-line corridors begin in the Southern Outer Piedmont ecoregion and cross the Sandhills into the Coastal Plain ecoregion (see Section 2.4.1.2). Vegetation community types in the Sandhills ecoregion include grassland and early successional habitats, Sandhills pine woodland, seepage slopes, ponds and depressions, blackwater stream systems, and river bottoms (SCDNR 2005). The sandy soils create a xeric environment that supports a distinctive type of vegetation dominated by longleaf pines (*Pinus palustris*) and turkey oaks (*Quercus laevis*). The Coastal Plain, the largest ecoregion in South Carolina, includes bottomland hardwood forest consisting of bottomland oaks, red maple, sweetgum, green ash (*Fraxinus pennsylvanica*), bitternut hickory (*Carya cordiformis*), and cypress-gum swamps dominated by water tupelo (*Nyssa aquatica*), swamp tupelo (*Nyssa biflora*), bald cypress (*Taxodium distichum*), and pond cypress (*Taxodium ascendens*) (Griffith et al. 2002).

Common wildlife associated with the Southern Outer Piedmont ecoregion that may occur on the FA-1 site and associated transmission-line corridors includes white-tailed deer (*Odocoileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), gray squirrel (*Sciurus carolinensis*), opossum (*Didelphis virginiana*), and raccoon (*Procyon lotor*). Various bird, reptile, and amphibian species also reside on the FA-1 site and associated proposed transmission-line corridors (Tetra Tech NUS, Inc. 2009; SCDNR 2005).

The bald eagle (*Haliaeetus leucocephalus*), which is delisted from the Endangered Species Act (ESA) but still protected under the Bald and Golden Eagle Protection Act, occurs in Fairfield and Newberry Counties. One Federally listed species is known to occur in Newberry County – the endangered wood stork (*Mycteria americana*). The proposed transmission-line corridors would cross Aiken, Chester, Colleton, Dorchester, Fairfield, Hampton, Lancaster, Lexington, Newberry, Orangeburg, Richland, and Saluda Counties to connect to the proposed St. George substation in Colleton County (SCE&G, 2010b). Table 9-9 lists all Federally and State-listed species that occur on the FA-1 site and in the vicinity, as well as in the counties crossed by the proposed transmission-line corridors. SCE&G has stated that on-the-ground field surveys would be conducted prior to commencement of ground-disturbing activities on the site or transmission-line corridors (SCE&G 2010b).

Table 9-9. Federally and State-Listed Species That May Occur on the FA-1 Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors

Scientific Name	Common Name	Legal Status	County
Mammals			
Corynorhinus rafinesquii	Rafinesque's big-eared bat	SE	Aiken, Colleton, Dorchester, Hampton, Orangeburg, Richland
Birds			
Charadrius melodus	Piping plover	FT/ST	Colleton
Charadrius wilsonia	Wilson's plover	ST	Colleton
Elanoides forficatus	American swallow-tailed kite	SE	Dorchester
Haliaeetus leucocephalus	Bald eagle	BGEPA/SE	Aiken, Chester, Colleton, Dorchester, Fairfield, Hampton, Lancaster, Lexington, Newberry, Orangeburg, Richland, Saluda
Mycteria americana	Wood stork	FE/SE	Aiken, Colleton, Dorchester, Hampton, Lexington, Newberry, Richland
Picoides borealis	Red-cockaded woodpecker	FE/SE	Aiken, Chester, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland, Saluda
Sterna antillarum	Least tern	ST	Colleton
Reptiles			
Clemmys guttata	Spotted turtle	ST	Aiken, Colleton, Hampton
Gopherus polyphemus	Gopher tortoise	SE	Aiken, Colleton, Dorchester, Hampton

Table 9-9. (contd)

Scientific Name	Common Name	Legal Status	County
Amphibians			
Ambystoma cingulatum	Flatwoods salamander	FT/SE	Orangeburg
Hyla andersonii	Pine barrens treefrog	ST	Richland
Plethodon websteri	Webster's salamander	SE	Saluda
Pseudobranchus striatus	Dwarf siren	ST	Hampton, Orangeburg
Rana capito	Gopher frog	SE	Aiken, Dorchester, Hampton
Vascular Plants			
Amphianthus pusillus	Pool sprite	FT/ST	Lancaster, Saluda
Echinacea laevigata	Smooth coneflower	FE/SE	Aiken, Lancaster, Lexington, Richland
Helianthus schweinitzii	Schweinitz's sunflower	FE/SE	Lancaster, Lexington
Isoetes melanospora	Black-spored quillwort	FE/SE	Lancaster
Lindera melissifolia	Pondberry	FE/SE	Dorchester
Lysimachia asperulifolia	Rough-leaved loosestrife	FE/SE	Richland
Oxypolis canbyi	Canby's dropwort	FE/SE	Colleton, Dorchester, Hampton, Orangeburg, Richland
Ptilimnium nodosum	Harperella	FE/SE	Aiken, Saluda
Trillium reliquum	Relict trillium	FE/SE	Aiken

Sources: SCE&G 2009d; SCDNR 2010; FWS 2010
BGEPA = Bald and Golden Eagle Protection Act; FE = Federally listed as endangered; FT = Federally listed as threatened; SE = State listed as endangered; ST = State listed as threatened

Building Impacts

Based on a preliminary site layout of the footprint provided by SCE&G, approximately 3.1 ac of wetlands present on the site would be affected during building activities for the two proposed units (SCE&G 2010a). SCE&G states that the nuclear facility would be sited to avoid wetlands whenever possible and potential impacts on wetlands near building zones would be minimized through the use of established BMPs (SCE&G 2010b).

Table 9-8 provides information about the number, route, and area of the proposed transmission-line corridors that would serve the proposed new facilities at the FA-1 alternative site. Acreages were determined by calculating the total number of miles and acres of clearing required for right-of-way widening and/or building activities (SCE&G 2009d). SCE&G and Santee Cooper would both have a portion of the new transmission lines and details are provided in Table 9-10 and Table 9-11 (SCE&G 2009d). SCE&G stated that all land clearing associated with nuclear facility and transmission-line creation would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G and Santee Cooper procedures, good construction practices, and established BMPs (SCE&G 2010b).

Table 9-10. SCE&G Transmission-Line Information for the FA-1 Alternative Site

Transmission-Line Segment	Length of Corridor (mi)	Acres of Corridor	Acres of Forested Wetlands	Acres of Nonforested Wetlands	Acres of Open Water
Fairfield-St. George	137	1535	214	41	19
Fairfield-Lake Murray	24	64	1	--	2
Fairfield-VCSNS	6	186	2	--	6
Fairfield-Killian	39	452	21	--	1
Total	206	2237	238	41	28

Source: SCE&G 2009d
NOTE: Acreages were determined by calculating the total number of miles and acres of clearing required for right-of-way widening and/or building activities.

Table 9-11. Santee Cooper Transmission-Line Information for the FA-1 Alternative Site

	New Corridor (21 mi, 255 ac)		Existing Corridor (217 mi, 3302 ac)		Total Corridor (3557 ac)	
Wetlands Estimate	**Acres**	**Percent of Corridors**	**Acres**	**Percent of Corridors**	**Acres**	**Percent of Corridors**
Hydric soils	20	8	1134	34	1154	32
NWI wetlands	14	5	244	7	258	7

Source: SCE&G 2009d
NOTE: Acreages were determined by calculating the total number of miles and acres of clearing required for right-of-way widening and/or building activities.
NWI = National Wetlands Inventory

Past actions in the geographic area of interest that have influenced terrestrial resources include the development and operation of VCSNS Unit 1, located approximately 5.5 mi south-southwest of the FA-1 site. The building of Unit 1 required the creation of Monticello Reservoir by damming Frees Creek. This reservoir flooded approximately 6800 ac of terrestrial habitat (SCE&G 2010b). The development of the SCE&G Parr Hydroelectric Generating Station (or Plant), located approximately 6.9 mi downstream on the Broad River, dammed the Broad River and created Parr Reservoir. This reservoir flooded approximately 4400 ac of terrestrial habitat. The Vulcan Materials Company/Blair Quarry, approximately 5 mi north of the FA-1 site and the FPSF, approximately 4.1 mi downstream on the Broad River, also contributed to the loss of terrestrial habitat. There are no major current projects in the geographic area of interest that would cumulatively affect terrestrial ecological resources in a similar way.

Proposed future actions that would affect terrestrial resources in a similar way to development at the FA-1 site include the proposed SCE&G Combined Site Emergency Operations Facility, which is expected to be sited as close as 5 mi from the proposed FA-1 alternative site.

Transmission-line creation and/or upgrading throughout the designated geographic region of interest and future urbanization would also be expected to occur. There are, however, several areas within the geographic region of interest that would continue to be managed for the benefit of wildlife, including (but not limited to) Sumter National Forest and Parr Hydro Wildlife Management Area.

Impacts on wildlife habitat from building two nuclear units and supporting facilities would be unavoidable. Activities that would affect wildlife include land clearing and grading (temporary and permanent), filling and or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the development areas. Some wildlife, including important species, would perish or be displaced during land clearing for any of the above projects as a consequence of habitat loss, fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities. Undisturbed land adjacent to the project could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels.

Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from noise is expected to be temporary and minor. The creation of new transmission-line corridors could be beneficial for some species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer, northern bobwhite quail (*Colinus virginianus*), eastern meadowlark (*Sturnella magna*), and the gopher tortoise (*Gopherus polyphemus*). Birds of prey, such as red-tailed hawks (*Buteo jamaicensis*) would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in a herbaceous or scrub-shrub condition that could provide improved foraging habitat for some waterfowl and wading birds. However, fragmentation of forests could adversely affect species that are dependent on large tracts of continuous forested habitat.

The review team concludes that the impacts on terrestrial resources from building two new nuclear units and associated transmission lines at the FA-1 site would be noticeable, but not destabilizing.

Operational Impacts

Impacts on terrestrial ecological resources from operation of two new nuclear units at the FA-1 site are primarily attributable to the operation of cooling towers and transmission lines.

Impacts on crops, ornamental vegetation, and native plants from cooling-tower drift cannot be evaluated in detail in the absence of information about the type (mechanical or natural draft), number, and specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information about the type (mechanical or natural draft for a wet cooling system; dry for a dry system) and number of cooling towers at the site. The impacts of cooling-tower drift and bird collisions for existing power plants were evaluated in NUREG-1437 (NRC 1996) and found to be of minor significance for nuclear power plants in general, including those with various numbers and types of cooling towers. On this basis, the review team concludes, for the purpose of comparing the alternative sites, that the impacts of cooling-tower drift and bird collisions with cooling towers resulting from operation of new nuclear units would be minor.

For mechanical draft cooling towers, the anticipated noise level from cooling-tower operation is anticipated to be 55 dBA at 1000 ft (SCE&G 2010b). This noise level is well below the 80 to 85 dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the FA-1 site would not be likely to disturb wildlife beyond 1000 ft from the source. Consequently, the review team concludes that the impacts of cooling-tower noise on wildlife would be minimal.

The impacts associated with transmission-line operation consist of bird collisions with transmission lines and the effects of electromagnetic fields (EMFs) on flora and fauna. The impacts associated with transmission-line corridor maintenance activities include alteration of habitat due to cutting and herbicide application, in floodplains and wetlands as well as uplands.

Transmission lines and associated structures pose a potential avian collision hazard. Bird collisions with transmission lines are recognized as being of minor significance at operating nuclear power plants, including transmission-line corridors with variable numbers of power lines (NRC 1996). Although additional transmission lines would be required for new nuclear units at the alternative sites, increases in bird collisions would be minor and these would not be expected to cause a measurable reduction in local bird populations. Consequently, the incremental number of bird collisions posed by the addition of new transmission lines for new nuclear units would be negligible.

EMFs are unlike other agents (e.g., toxic chemicals and ionizing radiation) that have an adverse impact in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NRC 1996). A review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures (NRC 1996). The impacts of EMFs on terrestrial flora and fauna are recognized as being of small significance at operating nuclear power plants, including transmission systems with variable numbers of power lines (NRC 1996). Therefore, the incremental EMF impact posed by addition of new transmission lines for new nuclear units would be negligible.

Existing roads providing access to the existing transmission-line corridors at the alternative sites would likely be sufficient for use in any expanded corridors; however, new roads would be required during the building of new transmission-line corridors. Management activities (cutting and herbicide application) related to transmission-line corridors and related impacts on floodplains and wetlands in transmission-line corridors are recognized as being of minor significance at operating nuclear power plants, including those with transmission-line corridors of variable widths (NRC 1996). The review team assumes that the same methods of building and vegetation management of corridors currently used by SCE&G and Santee Cooper would be used in the establishment and maintenance of the new corridors. Consequently, the incremental effects of the maintenance of transmission-line corridors and associated impacts on floodplains and wetlands posed by expanding existing corridors or the addition of a new transmission-line corridor for new nuclear units would be negligible.

No other past, present, or future actions in the geographic area of interest were identified that would significantly affect terrestrial habitat and wildlife, including important species in ways similar to those associated with the operation of two new units at the FA-1 site.

The review team concludes that the impacts on terrestrial resources from operating two new nuclear units and associated transmission lines at the FA-1 site would be minimal.

Summary Statement

Impacts on terrestrial ecology resources are estimated based on the information provided by SCE&G and the review team's independent review. There are past, present and future activities in the geographic area of interest that could affect terrestrial ecology in ways similar to the building of two nuclear units at the FA-1 site (Table 9-6). The FA-1 site and some of the associated transmission–line corridors are natural habitats that would be substantially altered by development and maintenance activities, noticeably affecting the level and movement of terrestrial wildlife populations in the area of interest. Other anticipated development projects would further alter wildlife habitats and migration patterns in the surrounding landscape. The review team therefore concludes that the cumulative impacts on baseline conditions for terrestrial ecological resources would be MODERATE. The contribution to the impacts from building and operating the proposed units would not, however, likely result in destabilization of terrestrial resources or populations. Unlike at the VCSNS site, where onsite development activities would affect mostly planted pine forest with soils previously disturbed from building VCSNS Unit 1, site preparation on the FA-1 would affect substantial areas of natural vegetation on undisturbed soils. Building and operating two new nuclear units at the FA-1 site would therefore be a significant contributor, together with the transmission-line impacts, to the MODERATE impact conclusion.

9.3.3.4 Aquatic Resources

The following impact analysis includes impacts from building activities and operations on aquatic ecology resources. The FA-1 site is a greenfield site located approximately 5 mi from the existing VCSNS on the eastern bank of the Broad River. As described by SCE&G (2009e), the Monticello Reservoir would be used to supply makeup water at the FA-1 alternative site, and the blowdown line would be located near the upper extent of Parr Reservoir in the Broad River. The geographic area of interest is considered to be same as for VCSNS as described in Section 7.3.2 and includes the Broad River drainage basin upstream and downstream of the site, Monticello Reservoir, and corresponding intermittent and seasonal streams on the VCSNS site. In addition, waterbodies crossed by the transmission-line corridors are considered as described for terrestrial resources in Section 9.3.3.1, and include the Santee River basin, Broad River basin, Catawba River basin, Ashepoo, Combahee, Edisto river basin, and Pee Dee River basin.

Historically, the Parr Reservoir was created in 1914 by installing a 2000-ft-long dam across the Broad River at Parr Shoals (Figure 2-3) SCE&G (2010b). Before 1977, the surface area of the reservoir was 1850 ac. In 1977, the reservoir level was raised 9 ft, which increased the surface area to approximately 4400 ac. Parr Reservoir is approximately 7 mi long and has an average water depth of 15 ft (SCE&G 2010b). Because of the operation of the FPSF, hydrologic patterns in the Parr Reservoir are variable. Generally, water from the Monticello Reservoir is released through the FPSF into Parr Reservoir throughout the day and early evening to provide hydroelectric power at the FPSF, resulting in a net southward flow in Parr Reservoir. During the night, when electrical demand is lower, water from the Parr Reservoir is pumped upward into the Monticello Reservoir (SCE&G 2010b).

Flow conditions and the 4-day retention time of water in Parr Reservoir generally promote high dissolved-oxygen levels and turbid conditions SCE&G (2010b). According to SCDHEC (2007), water conditions are not optimal for supporting aquatic life at the two SCDHEC water-quality monitoring stations on Parr Reservoir, located near the FPSF and near Parr Shoals Dam, respectively. The total phosphorus concentrations upstream of the site above the intake/discharge canal for the FPSF were found to exceed the standards for supporting aquatic life uses (SCDHEC 2007). At the downstream station near Parr Shoals Dam, elevated copper concentrations were deemed to exceed the aquatic life criterion; therefore, conditions are not optimal for supporting aquatic life at this site. There are no fish-consumption advisories in Parr Reservoir (SCDHEC 2007).

Monticello Reservoir

The Monticello Reservoir was formed by damming Frees Creek, a small tributary of the Broad River that flowed into Parr Reservoir approximately 1 mi upstream of Parr Shoals Dam (SCE&G 2010b). The reservoir is hydraulically connected to Parr Reservoir via the FPSF, and it serves both as an upper pool for the FPSF and as a cooling pond for VCSNS Unit 1 (Figure 2-1). To the northeast, the reservoir contains a subimpoundment (Figure 2-3), which is a 300-ac area owned by SCE&G and co-managed by SCE&G and SCDNR (SCE&G 2010b; SCDNR 2002). The subimpoundment fishery is managed differently from the main reservoir in that SCDNR regulates lower allowable catch limits and limits boat operations to electric motors (SCDNR

2002). The Monticello Reservoir, excluding the subimpoundment, is approximately 6 mi long with a total surface area of 6500 ac. The average water depth is 59 ft and the maximum depth is 126 ft (SCE&G 2010b).

Between 2000 and 2004, SCDHEC evaluated the water quality within the Broad River basin to assess the overall health and conditions of aquatic areas throughout the basin. As part of this assessment, SCDHEC monitored four stations in Monticello Reservoir (Figure 2-12). The closest station to the proposed FA-1 site, Station B-328, yielded water-quality parameters (e.g., dissolved oxygen, pH, toxins, turbidity, nutrients) that met the compliance criteria and standards for supporting aquatic life. Throughout the 5-year monitoring period, Station B-328 yielded indications of improving conditions via a reduction in 5-day biochemical oxygen demand, turbidity, fecal coliform, and total nitrogen and phosphorus concentrations (SCDHEC 2007). Based on analysis of fish tissue, there are no fish consumption advisories on Monticello Reservoir (SCDNR 2009c).

A comprehensive list of aquatic species present in Parr and Monticello reservoirs for proposed VCSNS Units 2 and 3 has been established in Section 2.4.2.3 of this EIS. Due to the close proximity of the FA-1 alternative site to the existing VCSNS site, the community composition of aquatic biota associated with the FA-1 site is likely similar to the existing VCSNS site.

Recreationally Important Species

The identification of species deemed to be recreationally important was derived from published creel surveys (Christie and Stroud 1998, 1999) and game fish outlined in the SCDNR freshwater fishing rules and regulations document (SCDNR 2009e). Section 2.4.2.3 provides a detailed description of some of these species and their life histories associated with Monticello Reservoir.

In South Carolina, largemouth bass (*Micropterus salmoides*) are among the most sought-after sport fish (Bulak and Crane 2009). While largemouth bass occur within waters near the VCSNS site and accounted for 15 to 19 percent of the fishing effort in Monticello Reservoir during the late 1990s, SCDNR creel surveys indicate that fishing effort in Monticello Reservoir was primarily directed at channel catfish (*Ictalurus punctatus*) and blue catfish (*I. furcatus*) (Christie and Stroud 1998, 1999). Data pertaining to fishing efforts do not exist for Parr Reservoir; however, efforts purportedly target catfish species in this reservoir as well (Hayes 1999).

Invasive Species

Of the list of invasive species considered to be a management concern within South Carolina, two plant species, two fish species, and one mollusk species are known to occur in the Parr and Monticello reservoirs and are listed in Table 9-12.

Table 9-12. Aquatic Invasive Species Documented to Occur in the Vicinity of the FA-1 Alternative Site

Common Name	Scientific Name	Type	Invasive Attributes	Occurrence at the VCSNS Site
Alligatorweed	*Alternanthera philoxeroides*	Freshwater plant	Aggressive, rapidly colonizing plant, impacts flow and uptake of water	Parr Reservoir
Water primrose	*Ludwigia uruguayensis*	Freshwater plant	Rhizomatous, chokes shorelines, affects water use and access, decreases flow, clogs water-intake structures	Parr Reservoir
Blue catfish	*Ictalurus furcatus*	Freshwater fish	Can tolerate a range of environmental conditions, piscivorous, competes for prey resources with native catfish	Parr Reservoir, Monticello Reservoir
White perch	*Morone americana*	Freshwater fish	Competes with recreationally important fish such as white bass and crappie	Parr Reservoir, Monticello Reservoir
Asian clam	*Corbicula fluminea*	Freshwater clam	Competes with native mollusks for food and space, alters substrate conditions, high densities clog water-intake structures	Parr Reservoir

Sources: SCDNR 2008; SCE&G 2010b
Survey efforts included multiple methodologies and spanned multiple spatial and temporal scales.

Critical Habitats

No critical habitat has been designated by the U.S. Fish and Wildlife Service (FWS) in the vicinity of the FA-1 site. However, critical habitat for the Carolina heelsplitter (*Lasmigona decorata*) is present in waterbodies proposed for transmission-line crossing in Chester and Lancaster Counties. Designated critical habitat includes 103.2 km of streams and rivers in South Carolina that occur in conjunction with the known populations. The lateral boundaries of the critical habitats for the Carolina heelsplitter are denoted by the ordinary high-water mark along channel edges (67 FR 44502).

Federally and State-Listed Species

There are no known occurrences of threatened or endangered species at the FA-1 alternative site. However, activities to create new transmission-line corridors could potentially affect Federally, proposed Federally, and State-listed freshwater species and would require appropriate Federally or State-mandated mitigation. The proposed transmission-line corridors would cross five counties in the South Carolina Piedmont eco-region (Chester, Fairfield, Lancaster, Newberry, and Saluda) and seven counties in the South Carolina Coastal Plain (Aiken, Colleton, Dorchester, Hampton, Lexington, Orangeburg, and Richland) (SCE&G 2010b).

Table 9-13 lists all Federally, proposed Federally, and State-listed species that may occur on the FA-1 site, the vicinity, and in the counties crossed by the proposed transmission lines.

Table 9-13. Federally, Proposed Federally, and State-Listed Aquatic Species and Critical Habitat That May Occur on the FA-1 Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors

Scientific Name	Common Name	Status	County
Reptiles			
Caretta caretta	Loggerhead sea turtle	FT/ST	Colleton
Chelonia mydas	Green sea turtle	FE	Colleton
Dermochelys coriacea	Leatherback sea turtle	FE	Colleton
Lepidochelys kempii	Kemp's ridley sea turtle	FE	Colleton
Fish			
Acipenser brevirostrum	Shortnose sturgeon	FE/SE	Aiken, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland
Acipenser oxyrinchus oxyrinchus	Atlantic sturgeon	PFE	Aiken, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland
Etheostoma collis	Carolina darter	SE	Fairfield, Richland
Mollusks			
Lasmigona decorata	Carolina heelsplitter	FE/SE	Chester, Fairfield, Lancaster, Richland, Newberry, Saluda, Lexington
Critical Habitat			
Lasmigona decorata	Flat Creek	CH	Lancaster

Sources: SC&EG 2010b; MACTEC 2008; FWS 2010; SCDNR 2010; 67 FR 44502, 75 FR 61904
FE = Federally Endangered, SE = State Endangered, FT = Federally Threatened, PFE = Proposed Federally, ST = State Threatened, CH = Critical Habitat

Santee Cooper has stated that on-the-ground field surveys would be conducted prior to commencement of ground-disturbing activities within transmission-line corridors (MACTEC 2008).

There are four Federally listed species of sea turtles in South Carolina. The loggerhead sea turtle (*Caretta caretta*) is listed as threatened, whereas the green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), and Kemp's ridley sea turtle (*Lepidochelys kempii*) are listed as endangered (FWS 2008). The loggerhead sea turtle is also listed as a State threatened species for Colleton County (SCDNR 2010). The siting of the FA-1-Varnville transmission-line corridor is projected to run to the west of Interstate Highway 95 (I-95), which is well over 50 mi from the coastline, and will not cross any marine habitats (SCE&G 2009d). Therefore, although the four species of sea turtles occur in Colleton County, no activities associated with installation of a new transmission-line corridor for the FA-1 site would affect these species.

The shortnose sturgeon (*Acipenser brevirostrum*) is a State and Federal endangered species (FWS 2008). The shortnose sturgeon has not been reported to occur in the vicinity of the FA-1 site, but the routing of transmission-line corridors for this alternative site is proposed to occur within seven South Carolina counties that are associated with the occurrence of shortnose sturgeon: Aiken, Colleton, Dorchester, Hampton, Lexington, Orangeburg, and Richland Counties. The shortnose sturgeon was initially listed as a Federally endangered species in 1967 and is designated as a species of highest conservation priority by SCDNR (McCord 2006; NMFS 1998). This amphidromous species uses freshwater, estuarine, and marine habitats to complete its life cycle (Rohde et al. 2009; McCord 2006; NMFS 1998). In South Carolina, populations of shortnose sturgeon exist in the Ashepoo, Combahee, and Edisto rivers (flowing to St. Helena Sound); the Pee Dee, Waccamaw, and Black rivers (flowing to Winyah Bay); and the Savannah, Cooper, and Santee rivers. There is also a small landlocked population of shortnose sturgeon in the Santee-Cooper Lake system (Collins et al. 2003).

In freshwater habitats, shortnose sturgeon are associated with soft bottom substrates in deep water. In South Carolina, spawning occurs in freshwaters characterized by low-to-moderate velocities and over substrates that include clay, sand, gravel, and woody debris (Rohde et al. 2009; McCord 2006). Eggs are adhesive and survival is reportedly dependent on water having little turbidity (McCord 2006).

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is not currently listed either Federally or by the State of South Carolina. However, on October 6, 2010, the National Marine Fisheries Service (NMFS) published in the *Federal Register* (75 FR 61904) a proposed rule for listing the Carolina and South Atlantic distinct population segments of the Atlantic sturgeon as endangered under the ESA. In light of this proposed listing, the review team is now considering the Atlantic sturgeon in its analysis.

Characteristics of the early life-history attributes of Atlantic sturgeon, such as age at seaward migration and residence time in freshwater habitats, varies within natal streams as well as across geographic regions (Jenkins and Burkhead 1994). Juveniles migrate from spawning areas toward saline habitats where individuals spend months to years rearing in estuarine environments. In marine environments, Atlantic sturgeon make extensive migrations from their natal estuary presumably to productive foraging grounds (ASSRT 2007). Spawning is believed to occur in flowing water between the salt wedge and the fall line of large rivers. Like the shortnose sturgeon, spawning adults generally migrate upriver during the spring (February to March) in southern rivers. While Atlantic sturgeon have been noted to occur in many South Carolina coastal rivers during the past several decades, specific information detailing population records for each of these rivers is not readily available. There appears to be little quantitative evidence linking the occurrence of Atlantic sturgeon in specific streams and rivers to spawning populations in South Carolina. South Carolina rivers with recent documented occurrences of

Atlantic sturgeon include Waccamaw, Pee Dee, Santee, Cooper, Edisto, Combahee, Coosawatchie, and Savannah Rivers (ASSRT 2007).

The Carolina darter (*Etheostoma collis*) is listed as a State threatened species in Richland County and as a State endangered species in Fairfield County (SCDNR 2010). While there are reported accounts pertaining to the distribution of the Carolina darter within the Piedmont ecoregion, the overall abundance of this species is unknown (Hayes and Bettinger 2006).

The Carolina heelsplitter is a Federally listed aquatic species (FWS 2008). This species has never been found in Monticello Reservoir, Parr Reservoir, or in nearby streams or creeks in the vicinity of the proposed alternative site. However, there are six known populations of the Carolina heelsplitter within the state defined by geographic location: (1) Savannah River tributaries in Edgefield and McCormick Counties, (2) Cuffeytown Creek in Greenwood and McCormick Counties, (3) Lynches River and Flat Creek in Chesterfield, Kershaw, and Lancaster Counties, (4) Gills Creek in Lancaster County, (5) Fishing Creek in Chester County, and (6) Bull Run Creek in Chester County (SCDNR 2006b; 67 FR 44502).

Building Impacts

Building impacts at the FA-1 alternative site would include a new intake structure located on the north end of Monticello Reservoir and a new discharge structure in Parr Reservoir on the Broad River. In addition, activities that include land clearing associated with new infrastructure (roads, site footprint) and upgrading existing features (rail lines) would affect approximately 5344 linear feet of a total of approximately 32,463 linear feet of onsite streams by increasing the number of stream crossings, or by filling streams and removing riparian corridors to accommodate site infrastructure (SCE&G 2010a). Building activities would also affect 1.4 ac of a total of 133.8 ac of open water present on the proposed FA-1 site (SCE&G 2010a). Building impacts would likely include impacts on water quality stemming from direct (e.g., dredging, shoreline excavation) and indirect sources (e.g., stormwater runoff, sedimentation). Impacts from building activities in and near water resources would be minimized through the use of established BMPs (SCE&G 2010b).

Transmission lines and corridors are described in Section 9.3.3.1. For SCE&G lines, approximately 36,075 linear feet of streams and 28 ac of open water are located within the new transmission-line rights-of-way (SCE&G 2009d). The Santee Cooper transmission-line corridors associated with the FA-1 site would include new crossings at an estimated seven stream crossings, three of which would be State navigable waters (MACTEC 2009). One transmission-line corridor would fall within the jurisdiction of the South Carolina Coastal Zone Management Act (SC Code Ann. 48-39-10), thus requiring additional review and certification. SCE&G stated that all land clearing associated with transmission-line creation would be conducted according to Federal State, and local regulations, permit requirements, existing SCE&G or Santee Cooper procedures, good construction practices, and established BMPs (SCE&G 2010b).

Cumulative impacts that could result from the building of two new units at the FA-1 site would be similar to those discussed in Section 7.3.2 of this EIS because the affected waterbodies are the same. Impacts on aquatic biota are expected to be localized and short-term. Past actions in the geographic area of interest that have similarly affected aquatic resources include the building of VCSNS Unit 1, construction of the FPSF that connects Monticello Reservoir with Parr Reservoir, and the creation of Parr Reservoir to provide a pool for the original Parr Hydroelectric Plant located on the Broad River approximately 7 mi southwest of proposed FA-1 alternative site. Proposed future actions that have potential to affect aquatic resources include transmission-line creation and/or upgrading throughout the designated geographic region of interest, and future urbanization.

Operational Impacts

Aquatic impacts associated with operation of the FA-1 alternative site would be associated primarily with intake-related impingement and entrainment losses of aquatic biota within the Monticello Reservoir, water-quality impacts on Parr Reservoir stemming from the discharge line, and stormwater drainage impacts. Specifications associated with the intake structure would include a closed-cycle cooling system designed to meet the EPA's 316(b) Phase I requirements for new facilities (66 FR 65256). The maximum through-screen velocity at the cooling-water intake would be less than 0.5 fps and the intake would not be located near critical habitat. Thus, if the proposed units were located at the FA-1 site, the anticipated impacts on aquatic communities from impingement and entrainment within Monticello Reservoir would be minor.

Operational impacts associated with water quality and discharge cannot be precisely determined without additional detailed analysis. However, based on the review team's experience with other facilities such as the VCSNS Unit 1, the review team concludes that, with proper design, the impacts on aquatic resources from operation of two new nuclear units at the FA-1 site would be minimal.

Habitat restoration activities may result in the re-introduction of diadromous species in Parr Reservoir (FWS 2001). Six diadromous species targeted for restoration in the Broad River basin have not been documented in the vicinity of the Parr Reservoir. However, it is possible that the American eel (*Anguilla rostrata*), American shad (*Alosa sapidissima*), blueback herring (*A. aestivalis*), hickory shad (*A. mediocris*), shortnose sturgeon, and Atlantic sturgeon may establish spawning habitat in Parr Reservoir following restoration activities. Reevaluation of water-flow criteria to accommodate spawning activities by diadromous fish may be needed, as described for the striped bass in Section 5.3.2.1. However, impacts from thermal, chemical, and physical scouring of discharge are expected to be minimal to reintroduced diadromous fish species, as previously described in Section 5.3.2.1.

The review team also concludes that operational impacts on aquatic biota from maintenance of the transmission-line corridors would also be minimal assuming that appropriate BMPs are used.

Cumulative impacts that could result from the operation of two new units at the FA-1 site would be similar to those discussed in Section 7.3.2 for VCSNS Units 2 and 3. Past, present, or future actions in the geographic area of interest that would affect aquatic ecological resources include aquatic biota impacts from the operation of the following facilities: VCSNS Unit 1; the FPSF; the NCW&SA Broad River WWTP; NCW&SA Cannons Creek WWTP; Blair Quarry; SCE&G's Parr Hydroelectric Plant; five licensed hydropower facilities upstream of Parr Reservoir; the proposed William States Lee III Nuclear Station in Cherokee County, South Carolina (Lee Nuclear Station); as well as the implementation of the Santee-Cooper Basin Diadromous Fish Passage Restoration Plan (FWS 2001) and the Santee River Basin Accord (SRBA 2008). Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility may also contribute to cumulative impacts.

Summary Statement

Impacts on aquatic ecology resources are estimated based on the information provided by SCE&G, the State of South Carolina, the FWS, NMFS, and the review team's independent review. There are past and future activities in the geographic area of interest that could affect aquatic ecology resources in ways similar to the building and operation of two units at the FA-1 site. The existence of Parr and Monticello reservoirs that would be used by the FA-1 site for cooling eliminates much of the potential impact associated with water development needed for closed-cycle cooling for a new site. Due to the close proximity of the FA-1 site to VCSNS and the potential reliance of both sites on Monticello and Parr reservoirs for cooling, many of the potential impacts on aquatic resources in the two reservoirs would be the same. Proper siting of associated transmission lines, avoiding habitat for protected species, minimizing interactions with waterbodies and watercourses along the transmission-line corridors, and using BMPs during corridor preparation and tower placement would minimize impacts related to the transmission system. Based on the information provided by SCE&G, the State of South Carolina, FWS, NMFS, and the review team's independent evaluation, the review team concludes that the cumulative impacts of building and operating two new reactors on the FA-1 site combined with other past, present, and future activities on aquatic resources in the Broad River drainage would be SMALL.

9.3.3.5 Socioeconomics

For the analysis of socioeconomic impacts at the FA-1 site, the geographic area of interest is considered to be the 50-mi region centered on the FA-1 site with special consideration of a four-county area, including Fairfield, Lexington, Newberry, and Richland Counties, because that is where the review team expects socioeconomic impacts would be the greatest. In evaluating the socioeconomic impacts of site development and operation at the FA-1 site near Dawkins in Fairfield County, the review team undertook a reconnaissance survey of the region using readily obtainable data from the ER, the alternative site audit, and Federal, State, and local government agencies. The analysis also considers other past, present, and reasonably foreseeable future actions that could affect the same environmental resources, including other Federal and non-Federal projects and the projects listed in Table 9-6. Impacts from both building and station operation are discussed.

Physical Impacts

Many of the physical impacts of building and operation would be similar regardless of the site. Building activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting (if used), and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport materials and equipment. Offsite areas that would support building activities (e.g., borrow pits, quarries, and disposal sites) would be expected to already be permitted and operational.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions (the latter are discussed under aesthetics and recreation). New units would produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, and switchyard equipment. Traffic at the site also would be a source of noise. The review team assumed that the same standard noise protection and abatement procedures proposed for the VCSNS site would be used to control noise coming from the FA-1 site. This practice also would be expected to apply to all alternative sites. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the alternative site.

The new units at the FA-1 site would likely have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the physical impacts of building and operating Units 1 and 2 at the FA-1 site would be minimal.

Demography

The FA-1 site is located in Fairfield County in South Carolina, approximately 31 air mi northwest of the closest economic center, Columbia, South Carolina (2007 population 124,818). Due to the close proximity of FA-1 site to the VCSNS site, the review team assumed the in-migrating project workforce would be similarly distributed. Because 95 percent of the VCSNS workforce live in one of four counties – Fairfield (2007 population 23,333), Lexington (2007 population 243,270), Newberry (2007 population 37,633), and Richland (2007 population 357,734) – these counties compose the economic impact area and are the focus of the following analysis (see Table 2-23).

The construction of VCSNS Unit 1 provides additional context for what the potential cumulative impacts of building the new units at the FA-1 site would be. The NRC was completing its Final Environmental Statement (FES) for the operating license (OL) for VCSNS Unit 1 just as final construction of that unit was winding down over the 1979–1981 period. As such, the OL FES provides a glimpse at the observed socioeconomic impacts from that construction project. At that time the review team noted that the construction contractor commissioned a workforce survey to ascertain information such as the residence pattern of the construction workers. Of the approximately 2400 workers surveyed, 1913, or about 80 percent, came from within the VCSNS region, and 927, or nearly 50 percent, came from either Lexington or Richland Counties (NRC 1981). The review team also observed that more than 70 percent of the workers came from the Central Midlands area, with the remainder coming from outside the region. Currently, 36.8 percent of the VCSNS workforce is located in Lexington County, 18.9 percent in Newberry County, 34.7 percent in Richland County, and 9.5 percent in Fairfield County. The in-migrating population would be expected to reside within this four-county area in the same pattern as the VCSNS workforce. At peak project employment, SCE&G would expect the onsite workforce to be 3600. Based on the close proximity of the FA-1 site to the VCSNS site, the review team used similar labor force assumptions and estimated that 50 percent of the workforce associated with site development (1800) would migrate to the four-county area with their families. Using South Carolina's average household size of 2.53, this would bring the total in-migrating population to 4554. Considering that the estimate of the in-migrating population would be less than 1 percent of the 2007 population estimates for the four-county area, the regional and local demographic impacts of building the proposed two new units at the FA-1 site are expected to be minimal. Once the facility is operational, the workforce would include 930 operations and support workers. The review team expects that as much as 50 percent of these workers would migrate to the four-county area. The review team expects the demographic impacts would be similar to those estimated for the VCSNS site, based on the close proximity of the FA-1 site. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the demographic impacts of building and operating two new nuclear units at the FA-1 site would be minimal.

Taxes and Economy

Using reconnaissance-level information, the review team assumed that if the proposed nuclear facility were located at the FA-1 site, taxes and fee-in-lieu-of-taxes agreements would be similar to those estimated to occur at the VCSNS site. Corporate and personal income taxes along with sales and use taxes would be collected during both building and operations; however property taxes would not be paid until operations begin. Once operations begin, SCE&G likely would have entered into a fee-in-lieu-of-taxes agreement with Fairfield County. Based on the agreement SCE&G has with the County in regard to VCSNS, which has an assessment ratio of 4 percent and a special revenue credit of 20 percent of the fee-in-lieu-of-taxes payments during the first 20 years, SCE&G estimates VCSNS annual payments to be between $13.7 million and $31.6 million over 40 years of the license period. The review team does not expect significant growth in the Fairfield County tax base between now and the start of operations that could otherwise diminish the scale of the tax impact on county revenue. The contribution to the total property tax revenue for Fairfield County would increase by 150 percent to an amount that is more in each year than the current overall total property tax revenue of the county. Therefore, the review team concludes that property tax revenue impacts would be substantial and beneficial for Fairfield County.

The four-county economic impact area had 313,374 people in the labor force in 2009 with an unemployment rate of 9.4 percent, somewhat under the State average of 11.7 percent. Fairfield and Newberry Counties have the smallest economies with a predominantly manufacturing base while Lexington and Richland Counties have larger service-based economies. The wages and salaries of the project workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors.

SCE&G acquired Regional Input-Output Model System (RIMS) II economic multiplier values specific to this economic impact area from the U.S. Bureau of Economic Analysis (BEA 2006). Using the RIMS multiplier of 2.04 (for utility construction industries), the influx of 1800 construction jobs would create 1872 indirect jobs in the economic impact area. This would have a positive impact on the business community and could provide (1) opportunities for new businesses to get started and (2) increased job opportunities for local residents. Once the new units are operational, approximately 930 new operations and support jobs would be added to the local economy. Using the RIMS multiplier of 3.13 (for utility operations industries), an influx of 930 operations and support jobs would create 1981 indirect and induced jobs for a total of 2911 jobs supported within the four-county economic impact area (see Section 5.4.3.1). The new jobs would constitute a minor beneficial impact on the four-county economic impact area. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the economic and tax base impacts of building and operating two new nuclear units at the FA-1 site would be minor in the four-county area, but would be substantial in Fairfield County.

Transportation and Housing

A new access road would be constructed to access the FA-1 site. The plant entrance road would be accessed from SR-34 via Pearson Road and Dawkins Road. SC-34 is an east-west paved two-lane highway with a 2008 annual average daily traffic (AADT) count of 1600 vehicles between the Fairfield County line and SC-215, the closest segment measured by SCDOT

(SCDOT 2009). SC-34 connects with SC-215 to the east and I-26 and US-176 to the west. A rail spur from the existing Norfolk Southern railroad would be constructed adjacent to the site. Based on the analysis in Section 4.5, an additional 1800 cars could be on the road at shift change. Also, project deliveries of 100 trucks per day are expected (SCE&G 2010a). Because access to the FA-1 site would be provided using two-lane county roads through the Dawkins area, the review team estimates traffic volumes during the project would likely represent a 50- to 125-percent increase or more above baseline levels of affected roadways, based on analysis of the VCSNS site (see Section 4.4.4.1). The review team concludes that these impacts would be significant and would likely be especially acute during periods of shift change. These impacts would be further exacerbated by truck traffic and site delivery traffic that have no other route options available. The review team expects these impacts would be of short duration and temporary, and would be substantially mitigated by traffic management planning by SCE&G, but they would be noticeable in the local vicinity. Operation impacts would be significantly lower than the building phase impacts of traffic due to the much smaller workforce and because roads likely would have been improved during the building phase.

Approximately 1800 construction workers are predicted to migrate into the region during peak project employment. Approximately 400 operations workers could migrate into the region by the time the facility becomes operational. Construction workers may choose to buy housing, rent, use mobile homes, or stay in a hotel/motel, while operations workers would likely choose to buy a house. According to the 2000 U.S. Census there were 246,119 housing units in the four-county economic impact area, of which 7738 in Lexington County, 2779 in Newberry County, 9692 in Richland County, and 1416 in Fairfield County were vacant, for a total of 21,625 vacant units (SCE&G 2010b). The review team expects that the in-migrating workforce could be absorbed fairly easily by the region and the impacts would likely be minimal during both building and operation. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that transportation and housing impacts of building and operating two new nuclear units at the FA-1 site would be minor across the four-county area, and would be noticeable in Fairfield County, though not destabilizing.

Public Services and Education

In-migrating construction workers and plant operations workers would likely affect local municipal water, wastewater treatment facilities, and other public services in the region. The in-migrating workers represent a small portion of the total population of Fairfield County and likely would not have a noticeable impact on their public services. During operations the impact on public services would likely be minimal.

Within the four-county area there are 162 public schools serving almost 111,000 students, with an average student-to-teacher ratio of 13.3 to 1, as discussed in Section 2.5.2.7. The total number of students in the public school systems surrounding the FA-1 site has grown over the past decade as the population of the region as a whole has grown. The largest public school districts in the area plan to construct new schools prior to the start of major site-development activities. The number of in-migrating workers and their families is not likely to be significant and would be dispersed across the four-county area in roughly the proportion of the current operations workforce for VCSNS Unit 1 (see Table 4-5). Based on visits to the region and consultations with local officials, the review team expects that project-related students that would enter the local school systems would not noticeably alter current growth projections. During operation, this impact on schools would be significantly less due to the lower number of in-migrating students. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the public services and education impacts of building and operating two new nuclear units at the FA-1 site would be minor.

Aesthetics and Recreation

The four-county area is a defined tourism region called Capital City/Lake Murray Country. The region includes Congaree National Park, parts of Sumter National Forest, and several large State Recreation Areas (see Table 2-26). Near the FA-1 site are several trails and State heritage preserves that offer wildlife viewing, hunting, camping, boating, fishing, and other recreational activities. The site is close to the Sumter National Forest. No recreation would take place on the FA-1 site during the project or over the life of the plant (SCE&G 2010b).

Most development would occur near the center of the property and wouldn't be visible from afar except from elevated areas. The intake and outfall structures on the Broad River would be visible. During certain weather conditions, cooling-tower plumes may also be visible. The review team concludes that the visual impact of a nuclear facility on this site would be minor on the aesthetics and recreational resources in the area. The impacts would be similar to those at the VCSNS site. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that public aesthetics and recreation impacts of building and operating two new nuclear units at the FA-1 site would be minimal.

Summary of Project-Related Socioeconomic Impacts

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. In summary, on the basis of information provided by SCE&G and the review team's independent evaluation, the review team concludes that the impacts of building and operating a new nuclear plant at the FA-1 site on socioeconomics would be minimal and adverse for most of the region but could be noticeable but not destabilizing for Fairfield County in terms of transportation impacts during the building phase. During operation, these impacts are expected to be minimal. Impacts on aesthetics are expected to be minor. The impacts on the Fairfield County tax base during operations likely would be substantial and beneficial; however only minor beneficial impacts would result in the rest of the region.

Cumulative Impacts

The projects identified in Table 9-6, particularly the future urbanization of the Columbia metropolitan area, have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Because the projects within the review area identified in Table 9-6 would be consistent with applicable land-use plans and control policies, the review team considers the cumulative socioeconomic impacts from the projects to be minimal.

For the analysis of socioeconomic impacts at the FA-1 site, the geographic area of interest is considered to be the 50-mi region centered on the FA-1 site, with special consideration of Fairfield, Lexington, Newberry, and Richland Counties, because that is where the review team expects socioeconomic impacts to be the greatest.

The FA-1 site is located in a rural area of western Fairfield County. The site itself is near the Monticello Reservoir, which is surrounded by wetlands and pine forest, with sparse residential development. The site is near metropolitan Columbia, the Richland County Seat and capital of South Carolina. However, Fairfield County is much more rural than Richland County, and is governed from the County Seat of Winnsboro. As the economic hub of the Central Midlands, the City of Columbia is the center of government and industry for a wide area in central South Carolina. Relatively recently, the I-26 corridor has seen significant commercial and residential development in the areas of West Columbia and Irmo. The University of South Carolina and several regional medical facilities have attracted a well-educated workforce to this area. Fort Jackson, a large military installation in Columbia, is supported by nearly 4000 civilian employees.

The cumulative impact analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on a given region, including other Federal and non-Federal projects and the projects listed in Table 9-6. The projects identified in Table 9-6 have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Adverse cumulative impacts would include physical impacts (on workers and the local public, buildings, transportation, and visual aesthetics) and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and schools).

The FA-1 site is located in Fairfield County, within 5 mi of the VCSNS site. As such, the economic impacts associated with the FA-1 site are expected to be similar to those analyzed in Sections 4.4 and 5.4, which are cumulative by nature. As indicated in Section 7.4, the economic impacts associated with activities listed in Table 9-6 have already have been considered as part of the socioeconomic baseline presented in Section 2.5. For example, the economic impacts of existing enterprises such as mining, other electrical utilities, etc., are part of the base used for establishing the RIMS II multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team's assessment of reasonably foreseeable future impacts. Thus, there are no cumulative impacts associated with building and operating the two proposed units at the FA-1 site beyond those already evaluated in Sections 4.4 and 5.4 for the VCSNS site.

The review team concludes there would be a SMALL and beneficial cumulative impact on tax revenues in the four county area and a LARGE and beneficial cumulative impact on tax revenues in Fairfield County. The review team also identified a MODERATE and adverse cumulative impact on the transportation in the Dawkins area that would be localized and temporary (limited to only "rush hour" traffic and the peak building employment period). The review team concludes that cumulative impacts on other socioeconomic impact categories would be SMALL and adverse. Building and operating a new plant at the FA-1 site would make a significant incremental contribution to both adverse and beneficial impact levels.

9.3.3.6 Environmental Justice

In addition to impacts from building and operations, the review team considered other past, present, and reasonably foreseeable future actions that could contribute to disproportionately high and adverse impacts on minority and low-income populations at the FA-1 site, including other Federal and non-Federal projects and the projects listed in Table 9-6. For this analysis, the geographic area of interest is considered to be the 50-mi region centered on the FA-1 site. Because both sites are located in western Fairfield County, the FA-1 region substantially overlaps the VCSNS region described in Section 2.2.3.

The FA-1 site is located in a rural area of western Fairfield County. The site itself is near the Monticello Reservoir, which is surrounded by wetlands and pine forest, with sparse residential development. The site is near metropolitan Columbia, the Richland County Seat and capital of South Carolina. However, Fairfield County is much more rural than Richland County and is governed from the County Seat of Winnsboro. The immediate vicinity of the FA-1 site was affected substantially by the VCSNS Unit 1 construction and the creation of Monticello Reservoir as part of the FPSF project as land was acquired and cleared for development.

From an environmental justice perspective, the review team determined there is a potential for minority populations to experience disproportionately high and adverse environmental impacts. Although Richland County and immediately adjacent counties are urban population centers, there are a number of farms within the region. The review team found low-income, African American and aggregated minority populations that exceed the percentage criteria established in Section 2.6.1 and required further consideration in the environmental justice analysis. Several of these populations are clustered in the vicinity of the FA-1 site (see Figure 9-4 and Figure 9-5).

Figure 9-4. Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the FA-1 Site

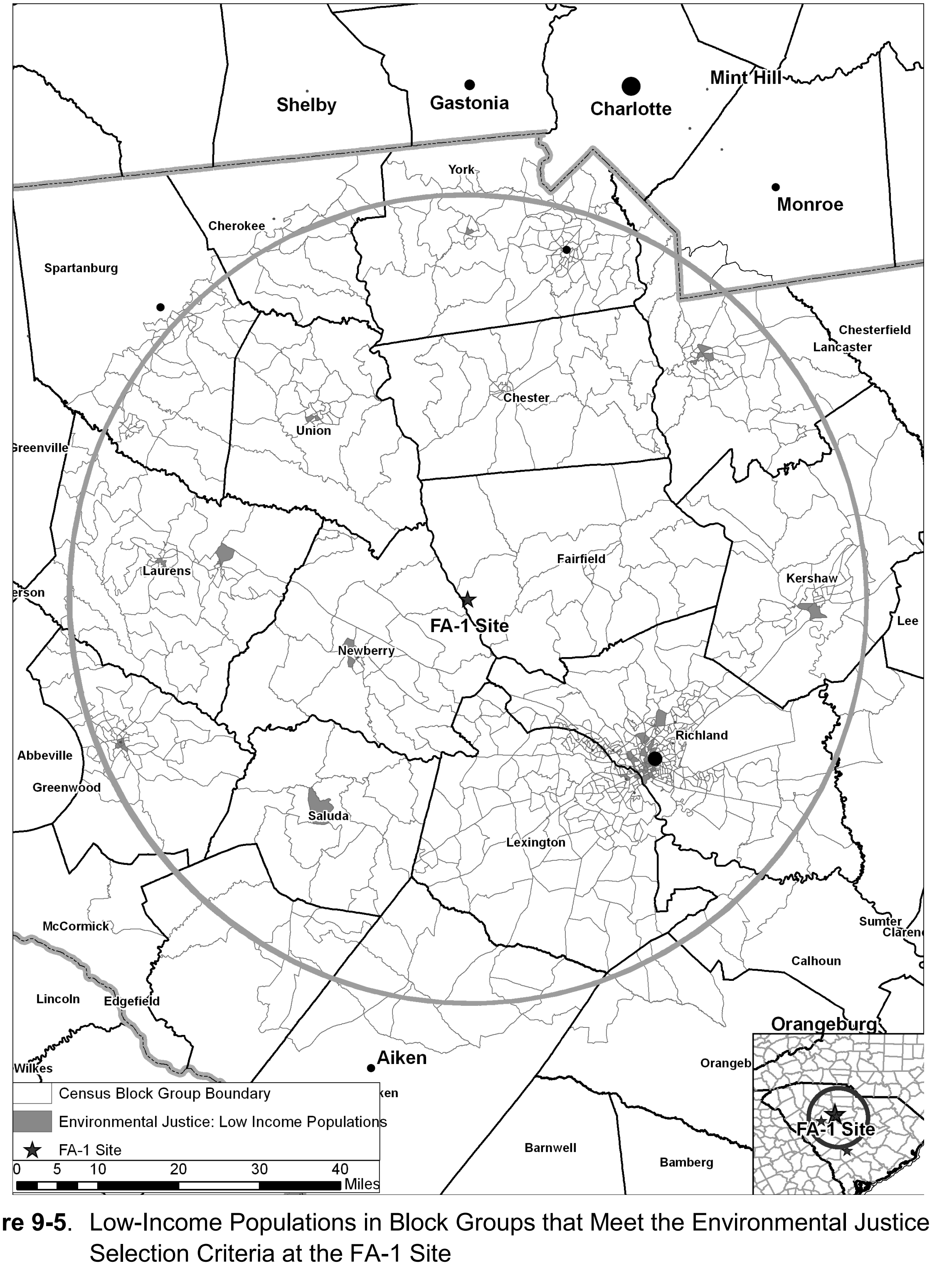

Figure 9-5. Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the FA-1 Site

Because the other projects described in Table 9-6 do not include any significant reasonably foreseeable changes in socioeconomic impacts within 50 mi of the FA-1 site, the review team concluded there would not be any significant additional cumulative environmental justice impacts in the region from those activities. Any economic impacts associated with activities listed in Table 9-6 already have been considered as part of the socioeconomic baseline presented in Section 2.5. For example, the economic impacts of existing enterprises such as mining, other electrical utilities, etc., are part of the base used for establishing the RIMS II multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team's assessment of reasonably foreseeable future impacts.

Because of the proximity of the FA-1 site to the proposed VCSNS site, the review team relied upon its analysis and conclusions for the proposed site (see Sections 4.5 and 5.5 of this EIS) in determining the hypothetical impacts of construction at the FA-1 site. The review team based its environmental justice determinations on the methodology discussed in Section 2.6.1, including a closer look at potential areas of interest using a series of health and physical considerations. As found for the VCSNS site, the review team determined the only consideration that required greater scrutiny at the FA-1 site was related to roads and traffic. Under the limitations of a reconnaissance-level analysis, the review team found no other health or physical considerations and no unique characteristics or practices that could lead to a disproportionately high and adverse impact on any minority or low-income community within the FA-1 region.

Because access to the FA-1 site would be provided using two-lane roads through the Dawkins community, the review team estimates traffic volumes during building activities are likely to represent a 50- to 125-percent increase or more above baseline levels of affected roadways, based on analysis of the VCSNS site (see Section 4.4.4.1). The review team concludes that these impacts would be significant and would likely be especially acute during periods of shift change. These impacts would be further exacerbated by truck traffic and site delivery traffic that have no other route options available. The review team expects these impacts would be of short duration and temporary. Because the review team concluded noticeable impacts from project activities could occur in an area with an environmental justice population of interest, the activities would constitute a disproportionately high and adverse impact on local environmental justice populations. However, these impacts would be of short duration and temporary.

Based on the above considerations, information provided by SCE&G, visits to the site, and the review team's independent review, the review team concludes that within the context of the wider region, locating the proposed action at the FA-1 site would not contribute additional cumulative impacts beyond impacts described in Chapters 4 and 5 for the VCSNS site. The review team did not identify any other environmental pathways by which disproportionately high and adverse impacts could affect minority or low-income populations or communities. The review team concludes that local disproportionately high and adverse impacts do not increase expected cumulative impacts on minority and low-income populations across the wider region.

Based on its evaluation, the review team concludes that cumulative environmental justice impacts associated with building and operating two new nuclear units at the FA-1 site would be SMALL, with the exception of a limited MODERATE disproportionately high and adverse impact from traffic during peak project employment. Building two new nuclear units at the FA-1 site would be a significant contributor to these impacts.

9.3.3.7 Historic and Cultural Resources

The following cumulative impact analysis includes building and operating two new nuclear generating units at the FA-1 site. The analysis also considers other past, present, and reasonably foreseeable future actions that could affect cultural resources, including other Federal and non-Federal projects and the projects listed in Table 9-6. For the analysis of cultural impacts at the FA-1 site, the geographic area of interest is considered to be the Area of Potential Effect (APE) that would be defined for this proposed undertaking. This includes the physical APE, defined as the area directly affected by the site-development and operation activities at the site and transmission lines, and the visual APE. The visual APE is defined as an additional 1-mi radius around the physical APE as a reasonable assumption for defining a maximum distance from which the structures can be seen.

Reconnaissance activities in a cultural resource review have particular meaning. For example, these activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing its EISs, the review team relies upon reconnaissance-level information to perform its alternative site evaluation. Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the FA-1 site the following information was used:

- SCE&G ER (SCE&G 2010b) – including the National Park Service National Register Information
- NRC Alternative Sites Visit, March 2009 (NRC 2010b).

The FA-1 site is a greenfield site that is forested and primarily undeveloped. Historically, the site and vicinity were largely undisturbed and likely contained intact archaeological sites associated with the past 10,000 years of human settlement. Over time, the FA-1 site has been disturbed by forestry practices (SCE&G 2009e). The physical and visual APEs for a proposed plant at the FA-1 site do not appear to have any historic properties located within the area likely to be affected by building or operating new plants. No archaeological and/or architectural surveys have been conducted at the FA-1 site.

Two significant cultural resources are known to be located within 2 mi of the FA-1 site (SCE&G 2009e). These two sites are the McMeekin Rock Shelter and the Blair Mound, both of which are listed in the National Register of Historic Places (NRHP or the National Register) (SCE&G

2009e). The project has the potential to affect resources through visual impacts from buildings and transmission lines. Impacts on these resources may occur as a result of significant alterations to the visual landscape within the geographic area of interest.

The footprint and land required to accommodate the building of two nuclear units on the FA-1 site are described in Section 9.3.3.1. SCE&G has stated that as part of the site-selection process known cultural resource locations would be considered as avoidance areas (SCE&G 2009f, g). SCE&G has also stated that if the proposed project was sited at the FA-1 site, identification of cultural resources would be accomplished through cultural resource surveys. The results would be used in the site-planning process to avoid cultural resource impacts. If significant cultural resources were identified by these surveys, SCE&G would also develop protective measures similar to what they have in place for the VCSNS site. In addition, inadvertent discovery procedures would be developed if cultural resources were discovered during site-development activities (SCE&G 2009f).

The transmission lines associated with the two nuclear units on the FA-1 site are described in Section 9.3.3.1. If the proposed project was sited at the FA-1 site, the review team assumes SCE&G and Santee Cooper would conduct their transmission-line-related cultural resource activities in ways similar to what they have committed to do for the VCSNS site, as described in Section 4.6.

Past actions in the geographic area of interest that have similarly affected historic and cultural resources include forestry practices at the FA-1 site and any road development and logging activities associated with those practices. No current or planned projects were identified in Table 9-6 that may contribute to cumulative impacts on historic and cultural resources in the geographic area of interest. Activities associated with building two nuclear units and supporting facilities that can potentially directly affect historic and cultural resources include land-clearing, excavation, and grading activities. Given SCE&G's site-planning process and no known cultural resources at the FA-1 site based on reconnaissance-level information, the impacts on cultural resources due to site-development activities would be negligible.

In addition, visual impacts from transmission lines may result in significant alterations to the visual landscape within the geographic area of interest. Given that there are no known cultural resources where the historic setting and character of the resources are important, the visual impacts would be negligible. The review team assumes that SCE&G and Santee Cooper would develop management agreements in consultation with the State Historic Preservation Officer (SHPO) similar to the ones that have been developed for VCSNS.

Impacts on historic and cultural resources from operation of two new nuclear units at the FA-1 site include those associated with the operation of new units and maintenance of transmission lines. The review team assumes that the same procedures currently used by SCE&G and Santee Cooper would be used for onsite and offsite maintenance activities.

Consequently, the incremental effects of the maintenance of transmission-line corridors and operations of the two new units and associated impacts on cultural resources would be negligible in the physical and visual APEs.

Table 9-6 identifies projects within the geographic area of interest and includes transmission lines; transportation improvements described in the South Carolina Strategic Corridor System Plan (SCDOT 2009); other parks, forests, and reserves; and future urbanization. These projects could affect historic and cultural resources in a manner similar to those associated with the operation of two new units.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear generating units on the FA-1 site would be SMALL. This impact-level determination reflects no known cultural resources that could be affected; however, if the FA-1 site was to be developed, then cultural resource surveys may reveal important historic properties that could result in greater cumulative impacts.

9.3.3.8 Air Quality

Because FA-1 is located only 5.5 mi from the VCSNS site, the air quality impacts of building and operating a nuclear facility at the FA-1 site would be similar to the air quality impacts at the VCSNS site. As described in Sections 4.7 and 5.7, the review team determined that the impacts of building and operating two new nuclear units on air quality at the VCSNS site would be SMALL. Therefore, the impacts of building and operating two new nuclear units on air quality at the FA-1 site would be minimal.

The FA-1 site is located in the Columbia Intrastate Air Quality Control Region, which is designated as being unclassified or in attainment with the National Ambient Air Quality Standards (NAAQSs) (40 CFR 81.108). The resource area defined for this evaluation is Fairfield County, South Carolina. A single county was selected because designations of attainment or non-attainment are made on a county-by-county basis. As listed in Table 9-6, sources of gaseous emissions in Fairfield County include the VCSNS Unit 1 and the SCE&G Parr Steam Combustion Facility. Gaseous emissions from Unit 1 include sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides associated with the intermittent operation of diesel generators (NRC 2004). The SCE&G Parr Combustion Facility located approximately 2 mi south of the VCSNS site and uses four natural-gas turbines to generate electricity. Gaseous emissions from the Parr Combustion Facility include sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides. Future development of the region around the VCSNS site could lead to increases in gaseous emissions related to transportation. Table 7-1 lists low-to-moderate potential for growth within Fairfield County. Given the intermittent operation of the diesel generators at both the existing Unit 1 and proposed Units 2 and 3, the low-to-moderate potential for growth in the county, and given the area is currently in attainment, the review team concludes the cumulative impacts, including the impacts from building and operating two new units on air quality, would be SMALL for criteria pollutants.

Greenhouse gas emissions related to nuclear power are discussed in Chapters 4, 5, and 6. As pointed out in Chapter 7, the impacts of the emissions are independent of emission location. Consequently, the discussions in the previous chapters and in Section 9.2.5 are applicable to two AP1000 reactors located at the FA-1 site. The impacts of greenhouse gas emissions at the FA-1 site considered in isolation would be minor, and the cumulative impact of greenhouse gas emissions would also be MODERATE, primarily due to national and world-wide impacts of emissions of greenhouse gases. Building and operating two new nuclear units at the FA-1 site would not be a significant contributor to the MODERATE impact.

9.3.3.9 Nonradiological Health Impacts

The following analysis considers nonradiological health impacts from building and operating the proposed new facilities. The analysis also includes past, present, and reasonably foreseeable future actions that impact the nonradiological health, including other Federal and non-Federal projects and the projects listed in Table 9-6. For the analysis of nonradiological health impacts at the FA-1 site, the geographic area of interest is considered to be the 6-mi area centered on the FA-1 site and the associated transmission-line corridors. The 6-mi radius is expected to encompass all nonradiological health impacts. Because the FA-1 site is located in close proximity to the VCSNS site, the geographic areas of interest overlap each other somewhat and are substantially the same in terms of characteristics. The VCSNS site vicinity (6-mi radius) is described in detail in Chapter 2.

Building Impacts

Nonradiological health impacts from building two new nuclear units on construction workers and members of the public at the FA-1 alternative site would be similar to those evaluated in Section 4.8. They include occupational injuries, noise, vehicle exhaust, and dust. Applicable Federal and State regulations on air quality and noise would be complied with during the site-preparation and building phase. The FA-1 site is located in a rural area and building impacts would likely be negligible on the surrounding populations that are classified as medium- and low-population areas.

Past actions in the geographic area of interest that have similarly affected nonradiological health include the development and operation of the VCSNS Unit 1, located approximately 5.5 mi south-southwest of the FA-1 site; the development of the SCE&G Parr Hydroelectric Plant, located approximately 6.9 mi downstream on the Broad River; the Vulcan Materials Company/Blair Quarry, approximately 5 mi north of the FA-1 site; and the FPSF, approximately

4.1 mi downstream on the Broad River. There are no major current projects in the geographic area of interest that would have a cumulative impact on nonradiological health in a similar way.

Proposed future actions that would affect nonradiological health in a similar way to development at the FA-1 site include the SCE&G Combined Site Emergency Operations Facility that may be located as close as 5 mi from the proposed FA-1 alternative site. Transmission-line creation and/or upgrading throughout the designated geographic region of interest and future urbanization would also be expected to occur. The review team concludes that the cumulative impacts on nonradiological health from building two new nuclear units and associated transmission lines at the FA-1 site would be minimal.

Operational Impacts

Occupational health impacts on operational employees would include those associated with the operation of cooling towers and transmission lines and they are fully described in Section 5.8. Based on the configuration of the proposed new units at the FA-1 site (closed-cycle, wet cooling system with mechanical draft cooling towers), etiological agents would not likely increase the incidence of waterborne diseases in the vicinity of the site. Impacts on workers health from occupational injuries, noise, and EMFs would be similar. Noise and EMFs would be monitored and controlled in accordance with applicable Occupational Safety and Health Administration (OSHA) regulations.

No past, present, or future actions in the geographic area of interest were identified that would significantly affect nonradiological health in ways similar to those associated with the operation of two new units at the FA-1 site. The review team therefore concludes that the impacts on nonradiological health from operating two new nuclear units and associated transmission lines at the FA-1 site would be minimal.

Summary Statement

Impacts on nonradiological health from building and operation of two new units at the FA-1 site are estimated based in the information provided by SCE&G and the review team’s independent evaluation. The review team concludes that nonradiological health impacts on construction workers and the public resulting from the building of two new nuclear units and associated transmission lines at the FA-1 site would be minimal. The review team also expects that the occupational health impacts on the operations employees and the public of two new nuclear units at the FA-1 site would be minimal. Finally, the review team concludes that cumulative impacts from related past, present, and future actions in the geographic area of interest to nonradiological health would be SMALL. The staff is not able to come to conclusions about the chronic impacts of EMFs on public health.

9.3.3.10 Radiological Impacts of Normal Operations

The following impact analysis includes radiological impacts on the public and workers from building activities and operations for two nuclear units at the FA-1 alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects and the projects listed in Table 9-6. As described in Section 9.3.3, the FA-1 site is a greenfield site; there are currently no nuclear facilities on the site. The geographic area of interest is the area within a 50-mi radius of the FA-1 site. Facilities potentially affecting radiological health within this geographic area of interest are the existing VCSNS Unit 1, the proposed independent spent fuel storage (ISFSI) facility at the VCSNS Unit 1, the proposed Lee Units 1 and 2, and the Westinghouse Fuel Fabrication Plant outside of Columbia, South Carolina. In addition, there are likely to be hospitals and industrial facilities within 50 mi of the FA-1 site that use radioactive material.

The radiological impacts of building and operating the proposed two AP1000 plants at the FA-1 site include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. The impacts are expected to be similar to those at the VCSNS site.

The radiological impacts of the VCSNS Unit 1 include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring program conducted around VCSNS Unit 1. In addition, the ongoing radiological environmental monitoring program conducted around VCSNS Unit 1 indicates that there are no significant cumulative radiological impacts from operation of the Westinghouse Fuel Fabrication Plant. The proposed ISFSI would produce negligible direct radiation offsite as discussed in Section 4.9.1. The ER submitted to the NRC as part of the application for the proposed plants at the Lee site indicates that operation of the proposed Lee reactors would result in radiological impacts from direct radiation and liquid and gaseous radioactive effluents. The Lee ER indicates that these pathways would result in low doses to people and biota offsite that would be well below regulatory limits (Duke 2009b). The NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the FA-1 site. This conclusion is based on data from the radiological environmental monitoring programs conducted around currently operating nuclear power plants. Based on the information provided by SCE&G and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 plants and other existing and planned projects and actions in the geographic area of interest around the FA-1 site would be SMALL.

9.3.3.11 Postulated Accident Impacts

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the FA-1 alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and the projects listed in Table 9-6. As described in Section 9.3.3, the FA-1 site is a greenfield site; there currently are no nuclear facilities on the site. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the FA-1 alternative site. Existing facilities potentially affecting radiological accident risk within this geographic area of interest are the existing VCSNS Unit 1; H.B. Robinson Unit 1; Oconee Units 1, 2, and 3; Catawba Units 1 and 2; McGuire Units 1 and 2; and Vogtle Units 1 and 2. Other proposed reactors within this geographic area of interest include two AP1000 reactors at the Lee Nuclear Station and two AP1000 reactors at the Vogtle site. The Westinghouse Fuel Fabrication Plant outside of Columbia, South Carolina, is also within the geographic area of interest.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of design basis accidents (DBAs) at the VCSNS site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The AP1000 design is independent of site conditions and the meteorology of the FA-1 and VCSNS sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the FA-1 site would be minimal. Because the meteorology, population distribution, and land use for the FA-1 alternative site are expected to be similar to the proposed VCSNS site, risks from a severe accident for an AP1000 reactor located at the FA-1 alternative site are expected to be similar to those analyzed for the proposed VCSNS site. These risks for the proposed VCSNS site are presented in Tables 5-17 and 5-19 and are well below the median value for current-generation reactors. In addition, as discussed in Section 5.11.2, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's[(a)] safety goals (51 FR 30028). For existing plants within the geographic area of interest (VCSNS Unit 1; H.B. Robinson Unit 1; Oconee Unit 1, 2, and 3; Catawba Units 1 and 2; McGuire Units 1 and 2; and Vogtle Units 1 and 2), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1). Finally, according to the Lee Nuclear Station Environmental Report (Duke 2009a) and the EIS for the Vogtle Early Site Permit (ESP) (NRC 2008a), the risks from these proposed sites are also well below current-generation reactors and meet the Commission's safety goals. There is no irradiated fuel at the Westinghouse Fuel Fabrication Plant, and the plant is designed to prevent inadvertent

(a) The Commission is the body of up to five NRC commissioners that formulates policies, develops regulations governing nuclear reactor and nuclear material safety, issues orders to licensees, and adjudicates legal matters.

criticalities; therefore, the additional risk is not significant in the evaluation of the cumulative severe accident risk for a nuclear power plant at the FA-1 site. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the FA-1 alternative site would be SMALL.

9.3.4 The Cope Generating Station Site

This section covers the review team's evaluation of the potential environmental impacts of siting a two-unit nuclear power plant at the Cope Generating Station (CGS) site located in Orangeburg County, South Carolina, 1.5 mi southwest of the town of Cope. The following sections describe a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if it were implemented at the CGS site and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment are other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the CGS site. Other actions and projects considered in this cumulative analysis are described in Table 9-14.

The CGS is located in a predominantly rural area. The undeveloped sections on the site consist primarily of mixed pine and hardwood stands, wetland mixed hardwood forest, and cypress-gum swamplands. Wetlands are predominantly located along the floodplain of the Edisto River (South Fork), which crosses the SCE&G property 1 mi south of the CGS. A conservation easement granted to the Congaree Land Trust encompasses and protects 400 ac of wetlands located along the Edisto River at the site. Figure 9-6 shows the CGS alternative site region.

Table 9-14. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cope Generating Station Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Energy Projects			
Cope Generating Station	A 430-MW(e) coal-fired electrical generating plant	In same general location	Operational[(a)]
VCSNS Unit 1	VCSNS Unit 1 consists of one 996-MW(e) nuclear power generating plant.	About 65 mi north of Cope	Operational[(b)]
Vogtle Electric Generating Plant (VEGP)	Nuclear power generating plant with 2 units, VEGP 1 (1109 MW(e)) and VEGP 2 (1127 MW(e))	Within 50 mi of Cope	Operational[(c)]

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
VEGP Units 3 and 4	Nuclear power generating plant with two Westinghouse AP1000 pressurized water reactors	About 45 mi west-southwest of Cope	Proposed[(d)] (Pre-construction activities have commenced. NRC Limited Work Authorization has been issued.)
H.B. Robinson Steam Electric Plant, Unit 2	Nuclear power generating plant with one 710-MW(e) unit	About 90 mi northeast of Cope	Operational[(e)]
Westinghouse Fuel Fabrication Plant in Columbia, South Carolina	Design and fabricate completed nuclear fuel assemblies and fuel-related products	About 40 mi north of Cope	Operational[(f)]
Savannah River Site Mixed Oxide (MOX) Fuel Fabrication Facility	Nuclear fuel fabrication	About 40 mi west of Cope	Construction of the MOX facility began in August 2007; operation is expected to begin in 2016[(g)]
Other Actions/Projects:			
U.S. Department of Energy Savannah River Site	Research and industrial complex	About 40 mi west of Cope	Operational[(h)]
Barnwell Low-Level Radioactive Waste Disposal Facility	Low-level radioactive waste disposal	About 25 mi west of Cope	Operational[(i)]
Charleston Naval Weapons Station	Radiological materials	About 65 mi east-southeast of Cope	Operational[(j)]
Various hospitals	Medical isotopes	Within 50 mi of Cope	Operational in Orangeburg, Berkeley, Calhoun, Bamberg, Dorchester, Barnwell, Allendale, Richland and Lexington Counties.
Kaiser Agricultural Chemicals	Chemical facility	About 1 mi east-northeast of Cope	Listed on the EPA Facility Registry System
Rockland-Bamberg Industries	Fabric coating mill	About 5 mi south-southwest of Cope	Operational[(k)]
Town of Norway	Sewage Treatment System Discharge	About 8 mi northwest of Cope	Operational[(l)]
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroad; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents.	Throughout region.	Construction would occur in the future, as described in State and local land-use planning documents

(a) Source: SCE&G 2009h

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status

(b) Source: NRC 2004
(c) Source: NRC 2009e
(d) Source: NRC 2009f
(e) Source NRC 2009b
(f) Source: Westinghouse 2009
(g) Source: DOE 2009a
(h) Source: DOE 2009b
(i) Source: South Carolina Energy Office 2009
(j) Source: SCE&G 2010b
(k) Source: EPA 2009e
(l) Source: EPA 2009f

The CGS, and an adjacent greenfield site, were originally identified in a 1974 siting evaluation for facilities development. The current CGS site has an existing 430-MW(e) coal-fired plant that has been in commercial operation since 1996. As a currently operational power plant, existing infrastructure includes rail access, transmission and distribution systems, and developed water resources. The existing power plant and associated support facilities are located on approximately 550 ac. The primary source of cooling water for the CGS is pumped groundwater, with supplemental water supply provided through withdrawal of excess flow from the Edisto River. No additional land would need to be acquired for an expansion of generating capacity at the site (SCE&G 2010b).

9.3.4.1 Land Use and Transmission-Line Corridors

In addition to land-use impacts from building and operations, the cumulative analysis for the CGS site considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative land-use impacts, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of land-use impacts at the CGS site, the geographic area of interest is considered to be the 50-mi region centered on the CGS site, plus any transmission-line corridors that extend beyond that range. Most but not all of the transmission-line corridor length falls within a 50-mi radius of the site. Land-use planning for transmission-line routing over wide areas must consider land-use plans of adjoining counties and other land-managing agencies, rather than considering one county in isolation. Furthermore, in predominantly rural settings such as that surrounding the CGS site, land-use changes occurring substantial distances away from a project site can substantially influence land-use planning decisions close to the site.

Roads and other public facilities and services in rural areas tend to serve people who are spread thinly but broadly over large portions of the landscape. Therefore land-use changes can affect roads and other facilities at greater distances than similar changes in more densely populated areas

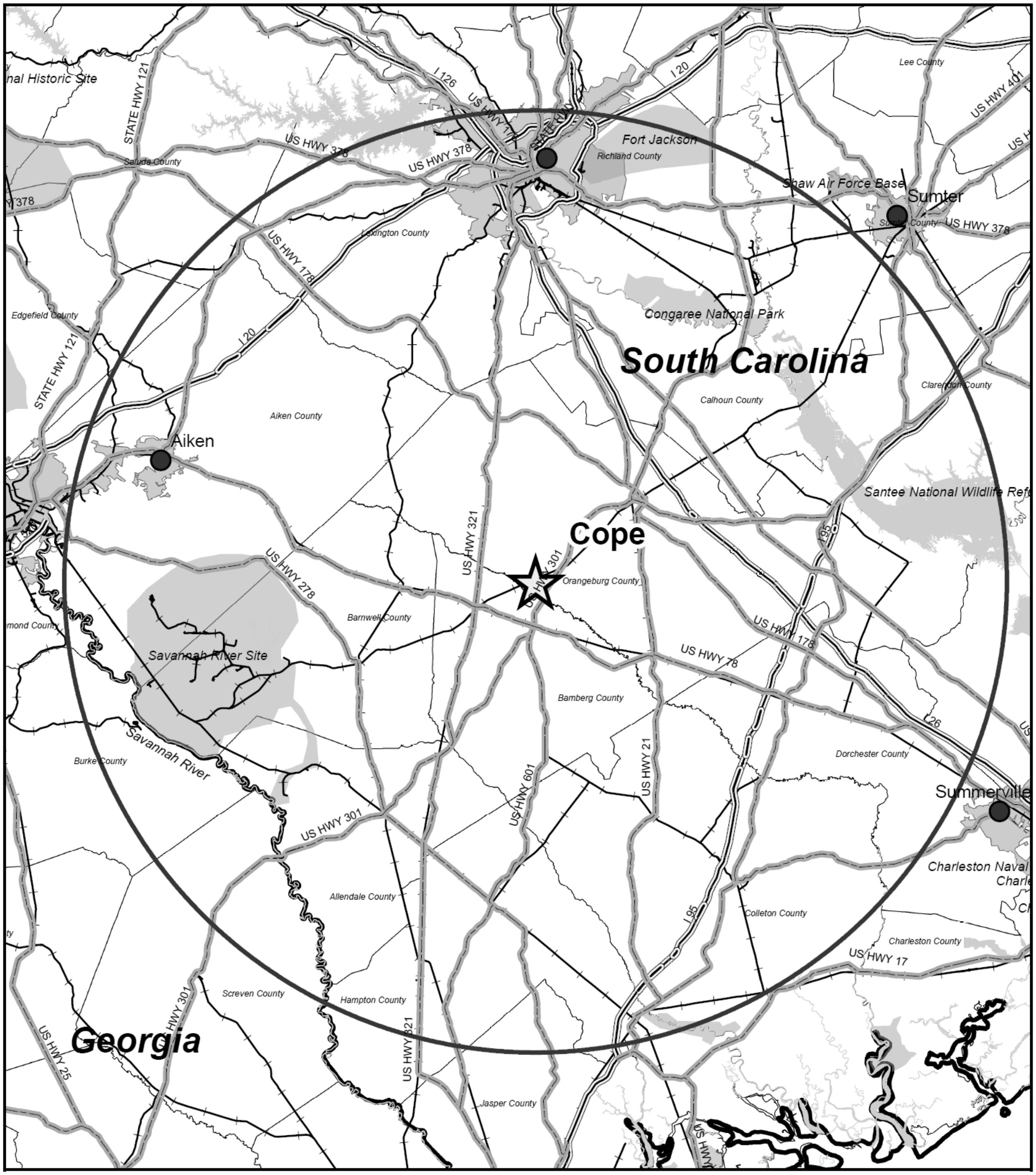

Figure 9-6. The CGS Alternative Site Region

The CGS site is located in a sparsely populated, largely rural area, with forests and small farms composing the dominant land use. Historically, the area has been used for crop production, and agriculture and silviculture are the dominant land uses in the vicinity. Several electric transmission lines, State routes, and interstate highways currently traverse the region. Because the site already hosts a power station, the review team believes location of nuclear units there would not be inconsistent with existing zoning.

Based on information provided by the applicant and the review team's independent assessment, development of the proposed new units would require about 200 ac on the CGS site that would be configured to fit generally within the existing developed footprint with the current CGS coal plant. Table 9-15 summarizes expected land-use impact parameters for the CGS site and transmission lines. The review team used GIS data provided by the applicant (SCE&G 2010a) to estimate expected land disturbance. The review team used the most recent information provided by the applicant (SCE&G, 2010b), except where the design data provided in earlier Santee-Cooper documentation (2009c) was not reflected in the revised SCE&G application.

Table 9-15. Land-Use Impact Parameters for the CGS Site

Parameter	Value	Source
Required onsite project area (ac)	1143	SCE&G 2010a, 2011
Estimated land-disturbance area (ac)	200	SCE&G 2010a, 2011 and review team analysis
Number of new transmission-line routes – SCE&G (number of routes)	2	SCE&G 2010b
Number of new transmission-line routes – Santee Cooper (number of routes)	3	
Number of new transmission-line routes – total (number of routes)	5	
Transmission-line corridor distance – SCE&G (mi)	56	SCE&G 2010b
Transmission-line corridor distance – Santee Cooper (mi)	106	
Transmission-line corridor distance – total (mi)	162	
Transmission-line corridor area – SCE&G (ac)	377	SCE&G 2010b
Transmission-line corridor area – Santee Cooper (ac)	802	
Transmission-line corridor area – total (ac)	1179	

SCE&G estimates that the new units would require the addition of five 230-kV transmission lines, each of which would occupy a 100-ft-wide transmission-line corridor. Based on information provided by SCE&G (2010d) describing dimensions of conceptual transmission-line corridors for the CGS site, approximately 162 mi covering about 1179 ac of land would be affected. The review team concludes that the land-use impacts of the transmission-line installation activities would be generally similar to those described for the VCSNS site in Section 4.1.2. SCE&G stated that all land clearing associated with nuclear facility and transmission-line development would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G or Santee Cooper procedures, good construction practices, and established BMPs (SCE&G 2010b).

Because the other projects described in Table 9-14 do not include any reasonably foreseeable changes in land-use types within 50 mi of the CGS site, there would not be any significant additional cumulative impacts on land use from those activities.

As described above, installation of new transmission-line corridors to support the new units have the potential to affect as much as 1179 ac over 162 mi of length. If additional transmission lines are built from other energy projects, there would be a cumulative land-use impact from the additional amount of land converted to utility corridor use for transmission lines. Because transmission lines are often co-located and are relatively narrow, the review team expects that the cumulative impact would be consistent with the land-use plans and zoning regulations of the affected counties. Nonetheless, consistent with previous discussions, multiple new transmission-line corridors could noticeably alter the land-use classification acreage proportions, both within the vicinity of the CGS and within the 50-mi region.

Cumulative land-use impacts within the region would be consistent with existing land-use plans and zoning. However, due to the potential reclassification of acreage within the region caused by the transmission-line development, the review team concludes that the cumulative land-use impacts associated with the proposed project at the CGS site, related transmission-line corridor development, and other projects in the geographic area of interest would be MODERATE. Considering the land needs noted above, building and operating two new nuclear units at the CGS site would be a significant contributor to these impacts.

9.3.4.2 Water Use and Quality

The CGS site hydrology, water use, and water quality are discussed in ER Section 9.3.3.2 (SCE&G 2010b); this section draws from information presented in the ER. Additional material for this alternative site is available in the Nuclear Plant Site Selection Study Report (Tetra Tech NUS, Inc. 2009). SCE&G currently uses groundwater as the primary source of water for operations and surface water as a backup source for the existing CGS. Groundwater is currently withdrawn on the site from the Middendorf aquifer and the Black Creek aquifer to support operation of the 430-MW(e) coal-fired plant onsite. These aquifers have high transmissivities and local well yields exceed 1000 gpm (2.2 cfs) (SCE&G 2010b). Two additional units at the CGS site would require an additional 83 cfs of total water withdrawal resulting in a 62-cfs consumptive loss through evaporation in the cooling towers and a 21-cfs return to the Edisto River as blowdown. Reliance solely on groundwater to meet station water demand would require an additional 28 groundwater wells, which would likely draw down the aquifer and result in interference with other local wells. Conversely, using the surface water from the adjacent South Fork Edisto River as the sole water source to support two new units at the site would exceed the 5-percent withdrawal limit of the river's annual mean flow required by EPA's Phase I regulations in 40 CFR 125.84(b)(3)(i). While the CGS site hydrology poses some challenges to supporting the building and operation of two new units, these challenges could be met by using both groundwater and surface water in combination with other water-saving mitigation strategies, such as hybrid or dry cooling towers, or the construction of a cooling-water storage reservoir. Specific water consumption and mitigation strategies could include 5-percent consumptive use from the South Fork Edisto River, makeup groundwater withdrawn at a sustainable level, and the use of dry cooling towers and/or hybrid cooling towers to make up for any cooling-water shortfalls.

Representative historical flow data for water years 1991–2008 is available for the South Fork Edisto River near Cope, South Carolina (USGS 2008b). The average flow is slightly lower than what is reported in the ER for this station due to the difference in periods covered. Table 9-16 lists the South Fork Edisto River reduction in flow that would occur if 5 percent of the annual mean flow of the river was relied on as a partial water source for the operation of two units at this site.

Table 9-16. South Fork Edisto River Reduction in Flow and Assessed Impact Levels

South Fork Edisto River Flow Condition	River Flow Rate (cfs)	Withdrawal Rate (cfs)	Percent River Flow Reduction
Annual mean flow	678	34	5
Lowest annual flow	304	34	11.2

Withdrawal of water from the South Fork Edisto River would be limited to 5 percent of the mean annual flow. Withdrawal of enough groundwater to meet the needs of the proposed units would likely create significant drawdowns at other local wells and might be difficult to sustain. Water-use impacts would likely require some mitigation, such as the use of dry cooling towers or hybrid cooling towers, or the construction of a cooling-water storage reservoir to supplement water requirements during certain times of the year.

SCE&G does not describe its proposed method for disposing of cooling-tower blowdown, but indicates that a SCDHEC-issued NPDES permit would be required to operate the nuclear project at this site. Effluent discharge through an NPDES-permitted outfall would ensure that the discharges complied with the Clean Water Act. Such permits are designed to ensure the protection of water quality, and therefore the impact on water quality from station blowdown to the Edisto River is assessed to be minimal.

Impacts of building and operation of the proposed units on groundwater quality may occur due to leaching of spilled pollutants and effluents. However, based on the review team's experience with other facilities, the review team concludes that, with the implementation of BMPs, the impacts on groundwater quality from building and operating two new nuclear units at the CGS site would likely be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that affect the same environmental resources. For the cumulative analysis of impacts on surface water, the geographic area of interest for the CGS site is considered to be the drainage basin of the South Fork Edisto River upstream and downstream of the site, because this is the resource that would be affected by the proposed project. Key actions that have past, present, and future potential impacts on water supply and water quality in the South Fork Edisto River basin include the building and operation of the existing coal-fired plant at CGS, the sewage-treatment plant discharge for the town of Norway, and industrial activities in the South Fork Edisto River basin. For the cumulative analysis of impacts on groundwater, the geographic area of interest for the CGS site is considered to be the areas of the Middendorf and Black Creek aquifers up-gradient and down-gradient of the site.

The surface-water-use impacts of building and operating two nuclear power plants at this site are dominated by the water demands associated with station operation. The projected surface-water withdrawal for the proposed units is expected to be no more than 34 cfs or a maximum of 5 percent of the average river discharge of 678 cfs near the site, and therefore the surface-water-use impacts are assessed to be SMALL.

Increases in consumptive use of water in the South Fork Edisto River drainage is anticipated in the future. The impacts of other projects listed in Table 9-14 within this resource’s geographic area of interest are considered in the analysis included above or would have little or no impact on surface-water use.

Impacts on groundwater use would be localized and temporary during building. Potential impacts on groundwater use during operations are anticipated to be significant because the two additional units on the CGS site would rely on groundwater to meet a significant portion of its water-supply needs. Because withdrawal of enough groundwater to meet the needs of the proposed units would adversely affect other local wells by noticeably drawing down the groundwater levels over time, water-use impacts are assessed to be MODERATE. Using both surface water and groundwater may require some mitigation such as the use of dry cooling towers, hybrid cooling towers, or the construction of a cooling-water reservoir. Building and operating two new nuclear units at the CGS site would be a significant contributor to the MODERATE impact. As discussed in Section 7.2, the review team is aware of the potential climate changes that could affect the water resources available for cooling and the impacts of reactor operations on water resources for other users. The impact of climate change would be similar for all the alternative sites.

Point and non-point sources have affected the water quality of the South Fork Edisto River upstream and downstream of the CGS site, including the impact of operating the CGS, the sewage-treatment plant discharge for the town of Norway, and industrial activities in the South

Fork Edisto River valley. Water-quality information presented above for the impacts of building and operating two new units at the CGS would also apply to evaluation of cumulative impacts. The impacts of other projects listed in Table 9-14 are either considered in the analysis included above or would have little or no impact on surface-water quality. As mentioned above, a SCDHEC-issued NPDES permit would be required to operate the nuclear project at this site including disposing of cooling-tower blowdown. Effluent discharge through an NPDES-permitted outfall would ensure that the discharges complied with the Clean Water Act. Such permits are designed to ensure the protection of water quality. The review team also concludes that with the implementation of BMPs, the impacts on groundwater quality from building and operating two new nuclear units at the CGS site would likely be minimal, and therefore concludes that the cumulative impact on surface and groundwater quality would be SMALL.

9.3.4.3 Terrestrial and Wetland Resources

Site Description

The following impact analysis includes impacts from building and operating the proposed new facilities on terrestrial ecology resources. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of terrestrial ecological impacts at the CGS site, the geographic area of interest is considered to be the 6-mi region centered on the CGS site, plus the associated transmission-line corridors. This 6-mile radius is expected to encompass the ecologically relevant landscape features and species.

The CGS site would be in the same general location as the existing CGS 430-MW(e) coal-fired electrical generating plant (SCE&G 2010b). Habitats present on the proposed CGS site and associated transmission-line corridors are typical of those found in the Middle Atlantic Coastal Plain ecoregion. The southern floodplain forests include bottomland hardwood forest (bottomland oaks, red maple, sweetgum, green ash, bitternut hickory) and cypress-gum swamp (water tupelo, swamp tupelo, bald cypress, and pond cypress) (Griffith et al. 2002). Understory vegetation in the cypress-gum swamp community is sparse; however, a variety of wildlife species use this habitat, from amphibians to mammals. The CGS site includes primarily cypress-gum swamp, wetland mixed hardwoods, planted pine, and old fields (SCE&G 2010b).

Common wildlife species present on the CGS project site (and in the vicinity) include many game species: white-tailed deer, eastern cottontail, gray squirrel, opossum, and raccoon, wild turkey (*Meleagris gallpavo*), northern bobwhite quail, mourning dove (*Zenaida macroura*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), wood duck (*Aix sponsa*), mink (*Mustela vision*), otter (*Lontra canadensis*), and beaver (*Castor canadensis*) (SCE&G 2010b).

SCE&G has not conducted any on-the-ground studies to determine whether threatened or endangered species occur on the proposed CGS project site; however, four Federally listed species are known to occur in Orangeburg and Bamberg Counties. These species include the delisted bald eagle (still protected by the Bald and Golden Eagle Protection Act), and endangered species such as the red-cockaded woodpecker (*Picoides borealis*), the wood stork, the threatened flatwoods salamander (*Ambystoma cingulatum*), and one vascular plant, the Canby's dropwort (*Oxypolis canbyi*).

In addition to the Federally listed species, the State of South Carolina has several listed species known to occur in the counties of the proposed site and vicinity, including those crossed by transmission lines. They include one mammal, two birds, two reptiles, and two amphibians (see Table 9-17 below), including endangered species such as Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), the gopher tortoise, and the gopher frog (*Rana capito*) and State threatened species such as Wilson's plover (*Charadrius wilsonia*), least tern (*Sterna antillarum*), spotted turtle (*Clemmys guttata*), and the dwarf siren (*Pseudobranchus striatus*).

Table 9-17. Federally and State-Listed Species That May Occur on the CGS Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors

Scientific Name	Common Name	Legal Status	County
Mammals			
Corynorhinus rafinesquii	Rafinesque's big-eared bat	SE	Aiken, Allendale, Bamberg, Dorchester, Hampton, Orangeburg
Birds			
Haliaeetus leucocephalus	Bald eagle	BGEPA/SE	Aiken, Allendale, Bamberg, Dorchester, Hampton, Orangeburg
Mycteria americana	Wood stork	FE/SE	Aiken, Allendale, Bamberg, Colleton, Dorchester, Hampton
Picoides borealis	Red-cockaded woodpecker	FE/SE	Aiken, Allendale, Bamberg, Hampton, Orangeburg
Sterna antillarum	Least tern	ST	Dorchester
Reptiles			
Clemmys guttata	Spotted turtle	ST	Aiken, Allendale, Bamberg, Hampton
Gopherus polyphemus	Gopher tortoise	SE	Aiken, Allendale, Dorchester, Hampton

Table 9-17. (contd)

Scientific Name	Common Name	Legal Status	County
Amphibians			
Ambystoma cingulatum	Flatwoods salamander	FT/SE	Orangeburg
Rana capito	Gopher frog	SE	Hampton, Orangeburg
Pseudobranchus striatus	Dwarf siren	ST	Hampton, Orangeburg
Vascular Plant			
Echinacea laevigata	Smooth coneflower	FE/SE	Aiken, Allendale
Oxypolis canbyi	Canby's dropwort	FE/SE	Allendale, Bamberg, Dorchester, Hampton, Orangeburg
Ptilimnium nodosum	Harperella	FE/SE	Aiken
Trillium reliquum	Relict trillium	FE/SE	Aiken

Sources: SCE&G 2009d; SCDNR 2010; FWS 2010
BGEPA = Bald and Golden Eagle Protection Act; FE = Federally listed as endangered; FT = Federally listed as threatened; SE = State listed as endangered; ST = State listed as threatened

SCE&G has stated that on-the-ground field surveys would be conducted prior to commencement of any ground-disturbing activities on the site or transmission-line corridors as part of the permitting process (SCE&G 2010b).

Building Impacts

SCE&G stated that the proposed project could be designed and sited to fit generally into previously disturbed land within the existing CGS site boundary (SCE&G 2010b). Based on a preliminary site layout of the footprint provided by SCE&G, approximately 15.9 ac of wetlands present on the site would be affected during building activities for the two proposed units (SCE&G 2010a). SCE&G states that the nuclear facility would be sited to avoid wetlands whenever possible and potential impacts on wetlands near building zones would be minimized through the use of established BMPs (SCE&G 2010b).

Table 9-15 provides information about the number, route, and area of the proposed transmission-line corridors that would serve the proposed new facilities at the CGS alternative site. SCE&G and Santee Cooper would both have a portion of the new transmission lines and details are provided in Table 9-18 and Table 9-19 below (SCE&G 2009d).

Table 9-18. SCE&G Transmission-Line Information for the CGS Alternative Site

Transmission-Line Segment	Length of Corridor (mi)	Acres of Corridor	Acres of Forested Wetlands	Acres of Nonforested Wetlands	Acres of Open Water
Cope-Orangeburg	22	32	0.3	1	--
Cope-St. George	34	345	103	42	0.4
Total	56	377	104	43	0.4

Source: SCE&G 2009d

Table 9-19. Santee Cooper Transmission-Line Information for the CGS Alternative Site

	New Corridor (106 mi, 802 ac)		Existing Corridor (0 ac)		Total Corridor (802 ac)	
Wetlands Estimate	**Acres**	**Percent of Corridors**	**Acres**	**Percent of Corridors**	**Acres**	**Percent of Corridors**
Hydric soils	471	59	0	NA	471	59
NWI wetlands	138	17	0	NA	138	17

Source: SCE&G 2009d
NA = Not applicable; NWI = National Wetlands Inventory

One of the transmission lines would be in the Coastal Zone region of South Carolina, which would require review and certification under the South Carolina Coastal Zone Management Act. Due to the routing in the coastal zone and the amount of wetlands present within the proposed corridors, new lines could incur substantial wetland impacts. SCE&G stated that all land clearing associated with transmission-line development would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G and Santee Cooper procedures, and established BMPs (SCE&G 2010b).

Past actions in the geographic area of interest that have similarly affected terrestrial resources include the development and operation of the CGS, located in the same general location as the CGS site. The building of the existing CGS facilities resulted in the clearing of approximately 550 ac of terrestrial resources to accommodate the power plant and associated buildings. The Kaiser Agricultural Chemical Company, located less than 1 mi east-northeast of the CGS site, also contributed to the loss of terrestrial habitat in the region. There are no major current projects in the geographic area of interest that would have a cumulative impact on terrestrial ecological resources in a similar way.

Proposed future actions that would affect terrestrial resources in a similar way to development at the CGS site would include transmission-line development and/or upgrading throughout the designated geographic region of interest, and future urbanization would also be expected to occur.

Impacts from building two nuclear units and supporting facilities on wildlife habitat would be unavoidable, and activities that would affect wildlife include land clearing and grading (temporary and permanent), filling and or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the development areas. Some wildlife, including some individuals of important species, would perish or be displaced during land clearing for any of the above projects as a consequence of habitat loss, fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities. Undisturbed land adjacent to the project could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from noise is expected to be temporary and minor. The creation of new transmission-line corridors could be beneficial for some species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer, northern bobwhite quail, eastern meadowlark, and the gopher tortoise. Birds of prey, such as red-tailed hawks, would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in a herbaceous or scrub-shrub condition that could provide improved foraging habitat for some waterfowl and wading birds. However, fragmentation of forests could adversely affect species that are dependent on large tracts of continuous forested habitat.

Based on the information provided by SCE&G and the review team's independent review, the review team concludes that the impacts on terrestrial ecological resources from the building of two new nuclear units at the CGS site could be minimal. Because of the uncertainty about the possible routing of new transmission-line corridors, the review team concludes that the terrestrial resource impacts associated with the building of new transmission lines for the CGS site could be noticeable, although not ecologically destabilizing.

Operational Impacts

Impacts on terrestrial ecological resources from the operation of two new nuclear units at the CGS site primarily include those associated with cooling towers and transmission lines. Impacts resulting from the operation of cooling towers and transmission lines are discussed in detail in Section 9.3.3.3 and would apply to the CGS site.

No other past, present, or future actions in the geographic area of interest were identified that would significantly affect terrestrial habitat and wildlife, including important species, in ways similar to those associated with the operation of two new units and the associated transmission lines at the CGS site. The review team concludes that the impacts of operating two new units and associated transmission lines at the CGS site on terrestrial resources and wetlands would be minimal.

Summary Statement

Impacts on terrestrial ecology resources are estimated based on the information provided by SCE&G and the review team's independent review. Past and future activities in the geographic area of interest could affect wildlife and wildlife habitat in ways similar to the building of two units at the CGS site. Although much of the land disturbance would occur within existing developed areas on the CGS site, other affected areas on the site as well as some of the associated transmission-line corridors are natural habitats that would be substantially altered by development and maintenance activities, noticeably affecting the level and movement of terrestrial wildlife populations in the area of interest. Other anticipated development projects would further alter wildlife habitats and migration patterns in the surrounding landscape. The review team concludes that cumulative impacts on baseline conditions for terrestrial resources would be MODERATE.

9.3.4.4 Aquatic Resources

The following impact analysis includes impacts from building activities and operations on aquatic ecology resources. The CGS alternative site is located between Roberts Swamp and Snake Swamp (Sam Branch), which drain into the South Fork Edisto River watershed (SCDHEC 2004a; SCE&G 2010b), which falls within Orangeburg, Barnwell, and Bamberg Counties. This 164,149-ac watershed lies within the Upper and Lower Coastal Plain ecoregions of South Carolina (SCDHEC 2004a). Within the South Fork Edisto River watershed (Hydrologic Unit Code [HUC] 03050204-050), 18.7 percent of the area is classified as forested wetland swamps. Water and nonforested wetland marshes make up less than 1 percent of the land cover in this watershed (SCDHEC 2004a). The geographic area of interest is the South Fork Edisto River watershed because this region is the most likely to show impacts on water quality relative to the water-quality criteria for aquatic biota affected by CGS site activities.

Historically, water-quality conditions within the South Fork Edisto River region have been and still are influenced by natural conditions and land-use practices. With no impoundments, the Edisto River is one of the longest blackwater rivers in the United States (SCDHEC 2005). A blackwater system is characterized by water-quality conditions that are characterized by naturally low pH and dissolved oxygen concentrations (SCDHEC 2004a). Near the vicinity of the proposed CGS alternative site, the upstream and downstream SCDHEC monitoring stations meet the water-quality criteria optimal for supporting aquatic life and have no restrictions for recreational use. However, a trend in increasing fecal coliform concentrations has been noted (SCDHEC 2004a), and elevated mercury concentrations within the watershed have resulted in a fish-consumption advisory. The SCDHEC (2009a) advises no consumption of bowfin (*Amia calva*), chain pickerel (*Esox niger*), and largemouth bass, and suggests limited consumption of redear sunfish (*Lepomis microlophus*) and redbreast sunfish (*L. auritus*) from the South Fork Edisto River.

Recreationally Important Species

The South Fork Edisto River is a known fishing area with largemouth bass, flat bullhead (*Ameiurus platycephalus*), and channel catfish being the most sought-after sport fish on the river (Angler Guide 2009). Catfish species are prized recreationally for consumption, and while adult catch sizes are modest (30–60 cm), channel catfish have been caught in excess of 1 m in length (Rohde and Parnell 1994).

Invasive Species

No invasive or nuisance species have been specifically identified within the South Fork Edisto River near the proposed CGS site.

Critical Habitats

No critical habitat has been designated by the FWS in the vicinity of the CGS site.

Federally and State-Listed Species

Federally, proposed Federally, and State-listed threatened and endangered species that may occur in the vicinity of the CGS site or in aquatic habitats crossed by the proposed transmission-line corridors are listed in Table 9-20. The proposed transmission-line corridors would cross Aiken, Allendale, Bamberg, Dorchester, Hampton, and Orangeburg Counties which lie mostly within the South Carolina coastal plain (SCE&G 2010b). SCE&G has stated that on-the-ground field surveys would be conducted upon determination of final routes and prior to commencement of any building activities related to the site or transmission-line corridors as part of the permitting process (SCE&G 2010b).

Table 9-20. Federally, Proposed Federally, and State-Listed Aquatic Species That May Occur on the CGS Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors:

Scientific Name	Common Name	Status	County
Fish			
Acipenser brevirostrum	Shortnose sturgeon	FE/SE	Aiken, Allendale, Dorchester, Hampton, Orangeburg,
Acipenser oxyrinchus oxyrinchus	Atlantic sturgeon	PFE	Aiken, Allendale, Dorchester, Hampton, Orangeburg

Sources: SCE&G 2009d; FWS 2010; SCDNR 2010; 75 FR 61904
FE = Federally Endangered, SE = State Endangered, PFE = Proposed Federally Endangered

The shortnose sturgeon is the only Federally listed aquatic species known to occur in Orangeburg County. The shortnose sturgeon is a State and Federal endangered species (FWS 2008). It is unknown whether the shortnose sturgeon occurs in the immediate vicinity of the proposed alternative site; however, populations are known to reside downstream in the Edisto River. It is unknown whether shortnose sturgeon migrate up the South Fork Edisto River, and no reliable records are available to document this species for this sub-basin. The shortnose sturgeon was initially listed as a Federally endangered species in 1967 and is designated as a species of highest conservation priority by SCDNR (McCord 2006; NMFS 1998). This amphidromous species uses freshwater, estuarine, and marine habitats to complete its life cycle (Rohde et al. 2009; McCord 2006; NMFS 1998).

In South Carolina, populations of shortnose sturgeon exist in the Ashepoo, Combahee, and Edisto rivers (flowing to St. Helena Sound); the Pee Dee, Waccamaw, and Black rivers (flowing to Winyah Bay); and the Savannah, Cooper, and Santee rivers. There is also a small landlocked population of shortnose sturgeon in the Santee-Cooper Lake system (Collins et al. 2003).

In freshwater habitats, shortnose sturgeon are associated with soft bottom substrates in deep water. In South Carolina, spawning occurs in fresh waters characterized by low-to-moderate velocities and over substrates that include clay, sand, gravel, and woody debris (Rohde et al. 2009; McCord 2006). Eggs are adhesive and survival is reportedly dependent on water having little turbidity (McCord 2006).

The Atlantic sturgeon is not currently listed either Federally or by the State of South Carolina. However, on October 6, 2010, the NMFS published in the *Federal Register* (75 FR 61904) a proposed rule for listing the Carolina and South Atlantic distinct population segments of the Atlantic sturgeon as endangered under the ESA. In light of this proposed listing, the -review team is now considering the Atlantic sturgeon in its analysis.

Characteristics of the early life-history attributes of Atlantic sturgeon, such as age at seaward migration and residence time in freshwater habitats, varies within natal streams as well as across geographic regions (Jenkins and Burkhead 1994). Juveniles migrate from spawning areas toward saline habitats where individuals spend months to years rearing in estuarine environments. In marine environments, Atlantic sturgeon make extensive migrations from their natal estuary presumably to productive foraging grounds (ASSRT 2007). Spawning is believed to occur in flowing water between the salt wedge and the fall line of large rivers. Like the shortnose sturgeon, spawning adults generally migrate upriver during the spring (February to March) in southern rivers. While Atlantic sturgeon have been noted to occur in many South Carolina coastal rivers during the past several decades, specific information detailing population records for each of these rivers is not readily available. There appears to be little quantitative evidence linking the occurrence of Atlantic sturgeon in specific streams and rivers to spawning populations in South Carolina. South Carolina rivers with recent documented occurrences of Atlantic sturgeon include Waccamaw, Pee Dee, Santee, Cooper, Edisto, Combahee, Coosawatchie, and Savannah Rivers (ASSRT 2007).

Building Impacts

The proposed alternative site would be located within the existing footprint of the CGS, adjacent to the coal-fired facility. SCE&G (2010b) has indicated that the makeup water for the cooling system would be derived from groundwater sources, but may also include water from the South Fork Edisto River. The CGS alternative site requires additional intake and discharge structures that are discrete from the existing structures associated with the CGS and installation activities may impose temporary, localized impacts on aquatic biota in the South Fork Edisto River. Impacts on water quality would stem from direct (e.g., dredging, shoreline excavation) and indirect sources (e.g., stormwater runoff, sedimentation). Building associated with new infrastructure (e.g., roads, site footprint) and upgrading existing features (e.g., railroad lines) would affect approximately 432 linear feet out of a total of approximately 16,041 linear feet of onsite streams; however, there would be no impacts on the approximately 9.8 ac of open water on the site (SCE&G 2010a).

Because the CGS alternative site footprint would likely occupy previously disturbed land adjacent to the existing coal facility, impacts on aquatic biota in nearby streams or ponds would likely be minimized during building activities. However, site-specific information pertaining to aquatic habitat and/or important aquatic biota is unavailable. Based on the absence of occurrence information, building in the vicinity of the intake and discharge structures may result in impacts on important species, but impacts are likely to be temporary and largely mitigated by the use of appropriate water-quality BMPs.

Table 9-15 provides information about the number, route, and area of the proposed transmission-line corridors that would serve the proposed new facilities at the CGS alternative site. Installation of the new transmission lines may include upgrading existing transmission-line corridors, or the development of new transmission-line corridors. One transmission-line corridor would fall within the jurisdiction of the South Carolina Coastal Zone Management Act, thus requiring additional review and certification. Transmission-line corridors would be maintained by either SCE&G or Santee Cooper. For SCE&G lines, approximately 4363 linear feet of streams and 0.4 ac of open water are located within the new transmission-line rights-of-way (SCE&G 2009d). The new Santee Cooper transmission-line corridors associated with the CGS site would include an estimated 72 stream crossings, 4 of which would cross State navigable waters, such as the South Fork Edisto River, and the Salkehatchie River (MACTEC 2009). SCE&G stated that all land clearing associated with transmission-line creation would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G or Santee Cooper procedures, good construction practices, and established BMPs (SCE&G 2010b).

Past actions in the geographic area of interest that have affected aquatic resources, including important species, in ways similar to those associated with the building of two new units at the CGS alternative site include the construction of the existing CGS coal-fired plant, located adjacent to the CGS alternative site. Proposed future actions that would affect aquatic resources in a similar way to development at the CGS alternative site would include transmission-line creation and/or upgrading throughout the designated geographic area of interest, and future urbanization.

Operational Impacts

Operational impacts expected to occur at the CGS alternative site would be dependent on site-specific characteristics that include plant specifications (e.g., water sources, discharge design) as well as the occurrence of important aquatic biota. Impacts on aquatic biota within the South Fork Edisto River as a result of intake-related impingement and entrainment losses would depend on the final source of makeup water. If groundwater were to be used as the source of cooling-water makeup, impingement and entrainment would be nonexistent. However, if water were to be withdrawn from the river using conventional technology, there would be impingement and entrainment losses to aquatic biota. Several intake/discharge configurations are designed to minimize impacts on aquatic biota. SCE&G has stated that "[t]he design of the intake structure would comply with the requirements of Section 316(b) [Phase I regulations] of the Clean Water Act, thereby reducing the potential impacts of entrainment and impingement to sensitive species." Nevertheless, there is still the potential for noticeable impacts on aquatic resources due to water withdrawal for cooling-system makeup water from the South Fork Edisto River as described in Section 9.3.4.2; it is dependent upon the degree to which the South Fork Edisto River would be used as a cooling-water source.

Operational impacts associated with water quality and discharge cannot be precisely determined without additional detailed analysis. However, based on the review team's experience with other facilities, the review team concludes that, with proper design, the thermal and chemical impacts on aquatic resources from operation of two new nuclear units at the CGS site would likely be minimal except during periods of low flow or drought conditions when impacts on aquatic biota from discharge of station blowdown to the river could be noticeable.

The review team also concludes that operational impacts on aquatic biota from maintenance of the transmission-line corridors would be minimal assuming that appropriate BMPs are used.

Cumulative impacts that could result from the operation of two new units at the CGS site would include intake-related impingement and entrainment losses and chemical and thermal discharge from station blowdown. Past, present, or future actions in the geographic area of interest that would affect aquatic ecological resources include aquatic biota impacts from the operation of a sewage-treatment plant for the town of Norway, South Carolina, located approximately 7.6 mi to the northwest of the CGS alternative site, which discharges into the Willow Swamp area of the South Fork Edisto River, and the CGS coal-fired plant, located immediately adjacent to the proposed CGS site, which discharges into the South Fork Edisto River. Both plants are compliant with NPDES permitting for discharges (SCE&G 2010b). Thermal and chemical discharges from the proposed nuclear units, when combined with the effluents from the existing coal-fired plant, may create significant NPDES challenges because the portion of the Edisto River adjacent to the site is relatively narrow, with low river velocities. Detailed information necessary to address these unknowns is not available, nor is site-specific information regarding the presence of important aquatic biota. Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility may also contribute to cumulative impacts.

Summary Statement

Impacts on aquatic ecology resources are estimated based on the information provided by SCE&G, the State of South Carolina, FWS, NMFS, and the review team's independent review. There are past and future activities in the geographic area of interest that could affect aquatic ecology resources in ways similar to the building and operation of two units at the CGS site. Overall, the cumulative impact of building and operating two new units at the CGS site is expected to be SMALL to MODERATE. Effects on aquatic biota may be SMALL if habitat for protected species is avoided through proper siting; BMPs are used during building, both at the site and along the new transmission lines; and groundwater is used for part of the station cooling water. However, if siting of buildings or ancillary services and transmission-line corridor routing is unable to avoid waterbodies with known populations of protected species, there may be noticeable effects on populations of these important organisms. In addition, due to the relatively low-flow rates in the South Fork Edisto River, the use of river water for station cooling could adversely affect aquatic biota due to intake-related impingement and/or entrainment losses, as well as from station blowdown effects, particularly during periods of drought. Therefore, it is possible that aquatic biota may be noticeably altered due to the building and operating of two additional units at the CGS, thereby resulting in a MODERATE impact. Building and operating two new nuclear units at the CGS would be a significant contributor to the MODERATE impact.

9.3.4.5 Socioeconomics

For the analysis of socioeconomic impacts at the CGS site, the geographic area of interest is considered to be the 50-mi region centered on the CGS site with special consideration of Orangeburg, Bamberg, Lexington, Colleton, Aiken, and Barnwell Counties, because that is where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of project development and operation at the CGS site in Orangeburg County, just north of the town of Bamberg, South Carolina, the review team undertook a reconnaissance survey of the region using readily obtainable data from the ER, the alternative site audit, and Federal, State, and local government agencies. The analysis also considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources, including other Federal and non-Federal projects and the projects listed in Table 9-14. Impacts from both building and station operation are discussed.

Physical Impacts

Many of the physical impacts of building and operation would be similar regardless of the site. Building activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting (if used), and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport construction materials and equipment. Offsite areas that would support building activities (e.g., borrow pits, quarries, and disposal sites) would be expected to be already permitted and operational.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions (the latter are discussed under aesthetics and recreation). New units would produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, and switchyard equipment. Traffic at the site also would be a source of noise. The review team assumed that the same standard noise protection and abatement procedures used for the VCSNS site would be used to control noise coming from the CGS site. This practice also would be expected to apply to all alternative sites. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the alternative site.

The new units at the CGS site would likely have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce. Based on the information provided by SCE&G and the review team’s independent evaluation, the review team concludes that the physical impacts of building and operating two new nuclear units at the CGS site would be minimal.

Demography

The CGS is located in Orangeburg County, South Carolina, approximately 35 air mi from Columbia, South Carolina (2007 population 124,818), the closest major economic center. The 2007 population of Orangeburg County was 89,952, Bamberg County was 15,452, Lexington County was 243,270, Colleton County was 38,903, Aiken County was 152,307, and Barnwell County was 22,975 for a total population of 562,859 for the six counties (see Table 2-23).

Ninety percent of the current CGS workforce resides in Orangeburg, Bamberg, Lexington, Colleton, Aiken, and Barnwell Counties. The review team expects the in-migrating population would reside within this six-county area in about the same pattern as the existing CGS workforce. However, because of the proximity of the town of Bamberg to the site, the review team expects Bamberg County would receive a noticeable influx of workers (SCE&G 2010b).

Therefore, these six counties compose the economic impact area and are the focus of the following analysis. Because of the rural nature of the two sites and the fact that the CGS site also hosts an existing power plant, development of the proposed new units on the CGS site would have similar socioeconomic impacts in most respects to adding two new units to the VCSNS site. Building the new units would require 3600 workers at the peak of the project. The review team believes that because the economic impact area includes portions of two larger metropolitan areas (Aiken and Columbia), migration patterns would be similar to those expected at the VCSNS site. About 50 percent of the construction workforce or 1800 workers would migrate to the economic impact area in rough proportion to the current operating workforce of the CGS. The demographic impacts of the project are expected to be minor, with the exception of Bamberg County, where the impact likely would be noticeable. As the building period winds down, the operations staff would be hired, eventually reaching a workforce of 930. Based on review team assumptions for the VCSNS site and similarity of the economic impact areas, the review team expects that 50 percent of the operations workforce or 465 employees would migrate to the region. The review team expects the demographic impact during operations to be minimal.

Taxes and Economy

Using reconnaissance-level information, the review team assumed that if the proposed nuclear facility were located at the CGS site, taxes and fee-in-lieu-of-taxes agreements would be similar to those estimated to occur at the VCSNS site. Corporate and personal income taxes along with sales and use taxes would be collected during both building and operation, but property taxes would not be paid until operations begin. Once operations begin, SCE&G likely would have entered into a fee-in-lieu-of-taxes agreement with Orangeburg County. Based on the agreement SCE&G has with Fairfield County in regard to VCSNS, which has an assessment ratio of 4 percent and a special revenue credit of 20 percent of the fee-in-lieu-of-taxes payments during the first 20 years, SCE&G estimates VCSNS annual payments to be between $13.7 million and $31.6 million over 40 years of the license period. The review team does not expect significant growth in the Orangeburg County tax base between now and the start of operations that could diminish the scale of the tax impact on county revenue. If SCE&G entered into a similar agreement for the CGS site, the tax payments would increase Orangeburg County property tax revenues (currently $86.5 million (SCBCB 2007)) by 16 to 37 percent. The total fee-in-lieu-of-taxes payments to Orangeburg County are expected to be substantial and beneficial during operations.

Aiken, Bamberg, Colleton, and Lexington Counties have service-based economies while the Barnwell and Orangeburg County economies are dominated by manufacturing (SCE&G 2010b). Aiken and Lexington Counties have the largest economies followed by Orangeburg and Barnwell Counties, and the smallest economies are in Bamberg and Colleton Counties. The wages and salaries of the workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors.

SCE&G acquired RIMS II economic multiplier values specific to this economic impact area from the U.S. Bureau of Economic Analysis (BEA 2006; SCE&G 2010b), which permit detailed examination of potential economic impacts with individual multipliers attributable to construction activities and plant operations activities. Using the RIMS multiplier of 1.34, the 3600 construction jobs would create 1224 indirect jobs in the economic impact area, for a total of 4824 jobs supported by the project. Because the review team assumes 50 percent of the project workforce would migrate to the region, the approximate net employment effect of the project would be 2412 new jobs spread over the six counties. This would have a beneficial but temporary impact on the business community and could provide (1) opportunities for new businesses to get started and (2) increased job opportunities for local residents. Once the new units are operational, approximately 930 new operations jobs would be added to the local economy. Using a multiplier of 1.70 jobs, the 930 operations and support jobs would create 651 indirect jobs in the economic impact area, for a total of 1581 jobs supported by plant operations. Because the review team assumes 50 percent of the workforce would migrate to the region, the approximate net employment effect of operations would be 790 new jobs spread over the six counties. The new jobs from project-related activities would constitute a minor beneficial impact on the six-county economic impact area, but these impacts would be noticeable in Orangeburg and Bamberg Counties. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the combination of economic and tax base impacts of building and operating two new nuclear units at the CGS site would be minor in the six-county area, but would be substantial in Orangeburg County and noticeable in Bamberg County.

Transportation and Housing

The CGS is accessed by US-301/601, SC-193, and the plant entrance road. US-301/601 is a four-lane divided highway that runs north-south through Orangeburg and Bamberg Counties. SC-193 is a paved two-lane road that has been upgraded between the plant entrance and US-301/601 to accommodate existing plant traffic. The 2005 AADT count for US-301/601 was 7800 south of the site and 7600 north of the site. The second nuclear facility access route is via SC-332, SC-1144, and the plant entrance road. SC-332 is a paved two-lane east-west route north of the site with an AADT count of 500 vehicles. Based on the analysis in Section 4.5, an additional 1800 cars could be on the road at shift change. Also, project-related deliveries of 100 trucks per day are expected (SCE&G 2010b). Access to the site would be from one of three approaches depending on worker residence. Several routes link the various cities and towns in the economic impact area with the CGS site. The review team expects that although the peak workforce represents significant vehicle traffic, the availability of multiple access routes would help disperse site-related traffic, and impacts would be less noticeable than at the

VCSNS site. Because the review team expects these impacts would be of short duration and temporary, and would be substantially mitigated by traffic management planning by SCE&G, the review team concludes traffic-related impacts would be minor.

Approximately 1800 construction workers could migrate into the region during peak project employment. Approximately 465 operations workers could migrate into the region by the time the facility becomes operational. Construction workers may choose to buy housing, rent, use mobile homes, or stay in a hotel/motel, while operations workers would likely choose to buy a house. According to the 2000 U.S. Census, there were 227,719 housing units in the six-county area, of which 6400 in Aiken County, 1007 in Bamberg County, 1170 in Barnwell County, 3659 in Colleton County, 7738 in Lexington County, and 5186 in Orangeburg County were vacant, for a total of 25,160 vacant units (SCE&G 2010b). Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that transportation and housing impacts of building and operating two new nuclear units at the CGS site would be minimal across the six-county area and the wider region.

Public Services and Education

In-migrating construction workers and plant operations workers would likely affect local municipal water, wastewater treatment facilities, and other public services in the region. The in-migrating workers represent a small portion of the total population of Orangeburg County and likely would not have a noticeable impact on their public services. During operations the impact on public services would likely be minimal.

SCE&G reports in its ER (SCE&G 2010b) that during the 2004–2005 school year, Aiken County had 40 preschool through 12th grade (PK-12) schools, Bamberg County had 7 schools, Barnwell County had 11 schools, Colleton County had 12 schools, Lexington County had 66 schools, and Orangeburg County had 30 schools. Total enrollment for Aiken, Bamberg, Barnwell, Colleton, Lexington and Orangeburg Counties for the 2004–2005 school year was 25,299, 2744, 4721, 6592, 51,276, and 15,449, respectively. A maximum of 938 students are expected to migrate into the six-county area during peak project employment and this number would decline to 484 during operations. This would increase the student population during peak project employment in Aiken County by 0.3 percent, Bamberg County by 7.9 percent, Barnwell County by 1.3 percent, Colleton County by 0.2 percent, Lexington County by 0.2 percent, and Orangeburg County by 2.4 percent. During operations, the student body population increase in Aiken, Bamberg, Barnwell, Colleton, Lexington, and Orangeburg Counties would be 0.2 percent, 4.1 percent, 0.8 percent, 0.7 percent, 0.1 percent, and 1.3 percent, respectively (SCE&G 2010b). Building and operating a nuclear facility on the CGS site would have a minor impact on education, with the exception of a more noticeable impact on Bamberg County during peak project employment. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that public services and education impacts of building and operating two new nuclear units at the CGS site would be minor, except for a noticeable impact on education services in Bamberg County during peak project employment.

Aesthetics and Recreation

No recreational facilities exist within the site boundary. There are nine State parks and one national recreational area (Congaree National Park) within 50 mi of the plant. With the exception of the South Fork Edisto River, there are no national and State recreational areas within 6 mi of the site. The North and South Fork Edisto rivers merge 10 mi from the site to form the Edisto River. These three rivers provide numerous recreational activities such as fishing, hunting, boating, and nature study.

The visual aesthetics of the site have already been altered by the existing coal-fired unit. The upper portions of the stacks are visible from most of the surrounding area, while other existing facilities are visible from nearby roads and from the South Fork Edisto River. The proposed project would be visible from some offsite locations and the cooling towers would be visible during operations. Project activities would increase the noise level at the site, but given the rural nature in the vicinity of the proposed site, this would likely not have a significant impact. The CGS site is already connected to the electric grid with existing transmission lines traversing mostly agricultural land, and the addition of new lines would not add significantly to the existing visual impact. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that public aesthetics and recreation impacts of building and operating two new nuclear units at the CGS site would be minimal.

Summary of Project-Related Socioeconomics

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. In summary, on the basis of information provided by SCE&G and the review team's independent evaluation, the review team concludes that the adverse impacts of building and operating a new nuclear plant at the CGS site on socioeconomics would be minimal for most of the region but could be noticeable, but not destabilizing, for Bamberg County in terms of education system impacts during peak project employment. Noticeable demographic impacts may be possible in Orangeburg and Bamberg Counties during the building phase, depending on worker settlement patterns. During operations, these impacts are expected to be minimal. Impacts on aesthetics are expected to be minor. The impacts on the Orangeburg County tax base during operations likely will be substantial and beneficial; however only minor beneficial tax impacts would result in the rest of the region. The new jobs from project-related activities would constitute a minor beneficial impact on the six-county economic impact area, and these impacts would be most noticeable in Orangeburg and Bamberg Counties.

Cumulative Impacts

The projects identified in Table 9-14, particularly the future urbanization of the Columbia, South Carolina, and Augusta, Georgia, metropolitan areas, have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Because the projects within the review area identified in Table 9-14 would be consistent with applicable land-use plans and control policies, the review team considers the cumulative socioeconomic impacts from the projects to be minimal.

For the analysis of socioeconomic impacts at the CGS site, the geographic area of interest is considered to be the 50-mi region centered on the CGS site, with special consideration of Orangeburg, Bamberg, Lexington, Colleton, Aiken, and Barnwell Counties, because that is where the review team expects socioeconomic impacts to be the greatest.

The CGS site is located in a rural area of southern Orangeburg County. The site currently hosts a 430-MW(e) coal-fired power station that is surrounded by wetlands and pine forest, with residential and agricultural development in the vicinity. The site is about 4.5 mi north of Bamberg (2007 population 3463), the Bamberg County Seat and about 13.5 mi southwest of Orangeburg (2007 population 12,756), the Orangeburg County Seat. The 50-mi region includes Columbia and Aiken, South Carolina, two larger urban areas. The economy of the region has been and continues to be largely agriculture-based. Most of the current CGS workforce (90 percent) lives in Orangeburg, Bamberg, Lexington, Colleton, Aiken, and Barnwell Counties (SCE&G 2010b). The review team believes these six counties make up the economic impact area. The review team expects the project workforce would be distributed within the economic impact area in approximately the same proportion as the existing CGS workforce.

The cumulative impact analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on a given region, including other Federal and non-Federal projects and the projects listed in Table 9-14. The projects listed in Table 9-14 have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Adverse cumulative impacts would include physical impacts (on workers and the local public, buildings, transportation, and visual aesthetics) and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and schools).

Economic impacts associated with activities listed in Table 9-14 already have been considered as part of the socioeconomic baseline used for establishing the RIMS II multipliers. Regional planning efforts and associated demographic projections available at a reconnaissance level formed the basis for the review team’s assessment of reasonably foreseeable future impacts. Therefore, the review team concludes there would be a LARGE and beneficial cumulative impact on tax revenues in Orangeburg County. The review team also identified a MODERATE and adverse cumulative demographic and education system impacts in Orangeburg and Bamberg Counties. The review team concludes that cumulative impacts on other socioeconomic impact categories would be SMALL and adverse. Building and operating a new plant at the CGS site would make a significant incremental contribution to both adverse and beneficial impact levels.

9.3.4.6 Environmental Justice

In addition to environmental justice impacts from building and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to disproportionately high and adverse impacts on minority and low-income populations, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of environmental justice impacts at the CGS site, the geographic area of interest is considered to be the 50-mi region centered on the CGS site.

The CGS site is located in a rural area of southern Orangeburg County. The site currently hosts a 430-MW(e) coal-fired power station that is surrounded by wetlands and pine forest, with residential and agricultural development in the vicinity. The site is about 4.5 mi north of Bamberg (2007 population 3463), the Bamberg County Seat, and about 13.5 mi southwest of Orangeburg (2007 population 12,756), the Orangeburg County Seat. The 50-mi region includes Columbia and Aiken, South Carolina, two larger urban areas. The economy of the region has been and continues to be largely agriculture-based. Most of the current CGS workforce (90 percent) lives in Orangeburg, Bamberg, Lexington, Colleton, Aiken, and Barnwell Counties (SCE&G 2010b).

From an environmental justice perspective, the review team determined there is a potential for minority and low-income populations to experience disproportionately high and adverse environmental impacts. In and around the town of Bamberg, the review team found low-income, African American and aggregated minority populations that exceed the percentage criteria established in Section 2.6.1 and required further consideration in the environmental justice analysis. Furthermore, several of these populations are clustered in the vicinity of the CGS site (see Figure 9-7 and Figure 9-8).

Because the other projects described in Table 9-14 do not include any significant reasonably foreseeable changes in socioeconomic impacts within 50 mi of the CGS site, the review team concluded there would not be any significant additional cumulative environmental justice impacts in the region from those activities. Any economic impacts associated with activities listed in Table 9-14 already have been considered as part of the socioeconomic baseline. For example, the economic impacts of existing enterprises such as mining, other electrical utilities, etc., are part of the base used for establishing the RIMS II multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team’s assessment of reasonably foreseeable future impacts.

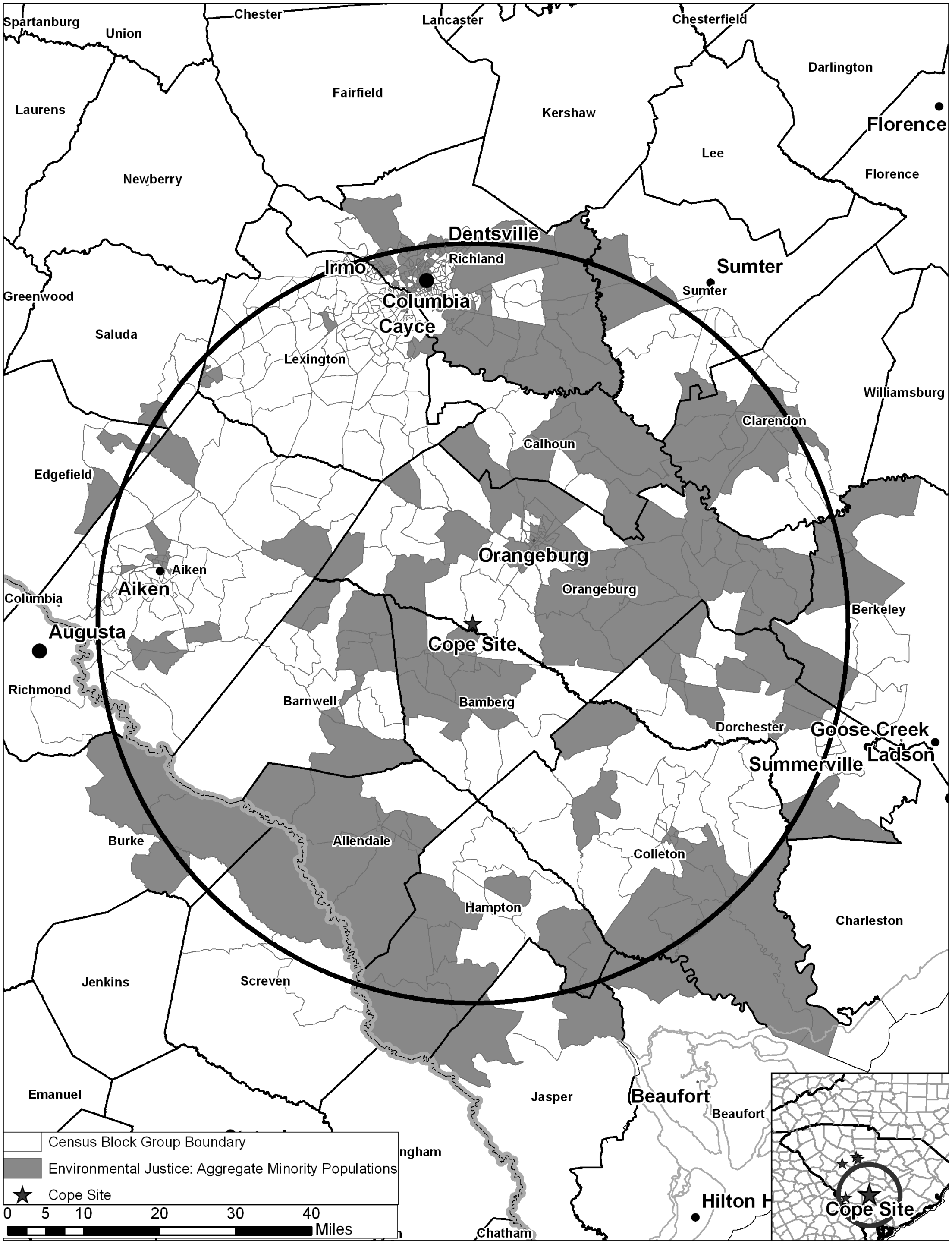

Figure 9-7. Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the CGS Site

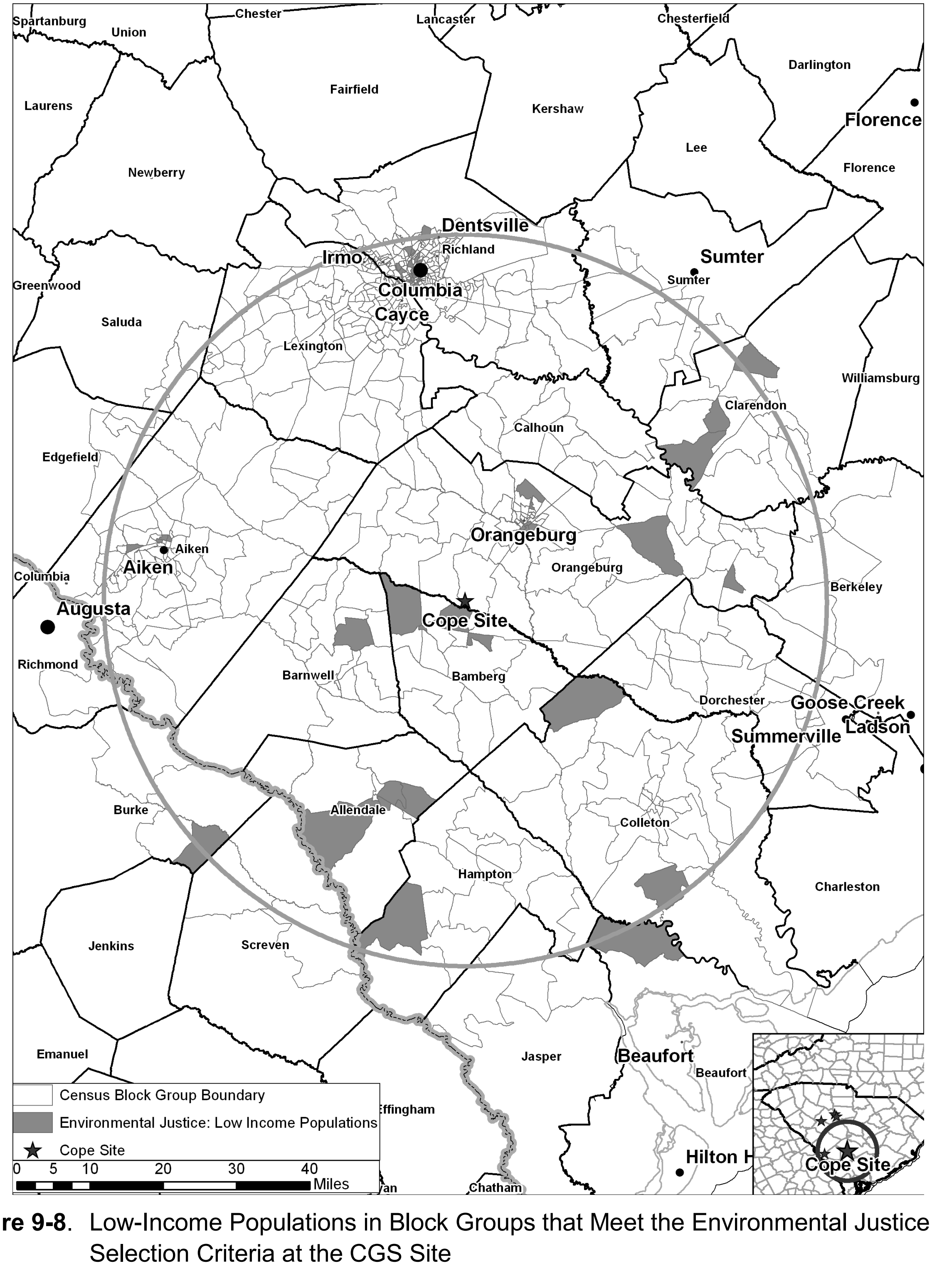

Figure 9-8. Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the CGS Site

The review team based its environmental justice determinations on the methodology discussed in Section 2.6.1, including a closer look at potential areas of interest using a series of health and physical considerations. Because of the rural nature of the two sites and the fact that the CGS site also hosts an existing power plant, the review team determined the hypothetical development of the proposed new units on the CGS site would have similar environmental justice impacts in most respects to adding two new units to the VCSNS site. However, as discussed in Section 9.3.4.6, the traffic-related impacts expected at the VCSNS site and the FA-1 site would not be expected at the CGS site because of the extensive road network providing access to the site from many directions. Under the limitations of a reconnaissance-level analysis, the review team found no other health or physical considerations and no unique characteristics or practices that could lead to a disproportionately high and adverse impact on any minority or low-income community at the CGS site.

Based on the above considerations, information provided by SCE&G, visits to the site, and the review team's independent review, the review team concludes that when viewed in the context of the wider region, locating the proposed action at the CGS site would not contribute additional cumulative impacts beyond the impacts described in Chapters 4 and 5 for the VCSNS site. Furthermore, the based on the above discussion, the review team determined any traffic-related impacts would be less than those described in Chapters 4 and 5 for the VCSNS site. The review team concluded that the environmental justice impacts would be minimal locally and would not create pathways to increase expected cumulative impacts on minority and low-income populations in the region. Based on its evaluation, the review team concludes that cumulative environmental justice impacts associated with building and operating two new nuclear units at the CGS site would be SMALL.

9.3.4.7 Historic and Cultural Resources

The following cumulative impact analysis includes building and operating two new nuclear generating units at the CGS Site. The analysis also considers other past, present, and reasonably foreseeable future actions that could impact cultural resources, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of cultural impacts at the CGS site, the geographic area of interest is considered to be the APE that would be defined for this proposed undertaking. This includes the physical APE, defined as the area directly affected by the site-development and operation activities at the site and transmission lines, and the visual APE. The visual APE is defined as an additional 1-mi radius around the physical APE as a reasonable assumption for defining a maximum distance from which the structures can be seen.

Reconnaissance activities in a cultural resource review have particular meaning. For example, these activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing its EISs, the review team relies upon reconnaissance-level information to perform its alternative site evaluation. Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the CGS site the following information was used:

- SCE&G ER (SCE&G 2010b) – including records held by the South Carolina Institute of Archeology and Anthropology and the South Carolina Department of Archives and History, which include the results of a cultural resource survey completed in 1991 prior to construction of the CGS.
- NRC Alternative Sites Visit, March 2009.

Historically, the CGS site and vicinity was largely undisturbed by land development and likely contained intact archaeological sites associated with the past 10,000 years of human settlement. Over time, the CGS site has been disturbed first by forestry practices and later by development of the coal-fired facility (SCE&G 2009g, 2010b). Eight standing structures were identified in 1991, none were determined to be eligible for the National Register. The closest archaeological sites identified near the CGS include a ceramic scatter and a lithic scatter that are located 5 mi away. The physical and visual APEs for a proposed plant at the CGS site do not appear to have any significant historic properties located within the area likely to be affected by building or operating new plants. The Cope Depot is the closest significant National Register-listed resource to the CGS site (within 6 mi of the CGS site) (SCE&G 2010b). In addition, SCE&G found that there are 94 historic sites listed in the National Register within several counties in the vicinity of the CGS site (SCE&G 2010b).

The footprint and land required to accommodate the building of two nuclear units on the CGS site are described in Section 9.3.4.1. SCE&G has stated that if the proposed project was sited at the CGS site, the project would be developed in previously disturbed areas (SCE&G 2010b). SCE&G has also stated that identification of cultural resources would be accomplished through cultural resource surveys. The results would be used in the site-planning process to avoid cultural resource impacts. If significant cultural resources were identified by these surveys, SCE&G would also develop protective measures similar to what it has in place for the VCSNS site. In addition, inadvertent discovery procedures would be developed if cultural resources were discovered during site-development activities (SCE&G 2009f).

The transmission lines associated with the two nuclear units on the CGS site are described in Section 9.3.4.1. If the proposed project is located at the CGS site, the staff assumes SCE&G and Santee Cooper would conduct their transmission-line-related cultural resource activities in ways similar to what they committed to do for the VCSNS site described in Section 4.6.

Past actions in the geographic area of interest that have similarly affected historic and cultural resources include forestry practices at the CGS site, road development and logging activities associated with those practices, development of the coal-fired plant, and ground-clearing associated with building the Kaiser Agricultural Chemical Plant.

Activities associated with building two nuclear units and supporting facilities that can potentially affect historic and cultural resources include land clearing, excavation and grading activities. Given SCE&G's site-planning process, and the lack of significant cultural resources known to exist at the CGS site based on reconnaissance-level information and the land disturbance where the new plant would be located, the impacts on cultural resources due to site-development activities would be negligible.

In addition, visual impacts from transmission lines may result in significant alterations to the visual landscape within the geographic area of interest. Given that there are no known cultural resources where the historic setting and character of the resources are important, the visual impacts would be negligible. The staff assumes that SCE&G and Santee Cooper would develop management agreements in consultation with the SHPO similar to the ones that have been developed for VCSNS.

Impacts on historic and cultural resources from operation of two new nuclear units at the CGS site include those associated with the operation of new units and maintenance of transmission lines. The review team assumes that the same procedures currently used by SCE&G and Santee Cooper would be used for onsite and offsite maintenance activities. Consequently, the incremental effects of the maintenance of transmission-line corridors and operations of the two new units and associated impacts on cultural resources would be negligible in the physical and visual APEs.

Table 9-14 identifies projects within the geographic area of interest and includes the CGS, Kaiser Agricultural Chemical, and future urbanization. These projects could affect historic and cultural resources in a manner similar to those associated with the operation of two new units.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear generating units on the CGS site would be SMALL. This impact-level determination reflects no known cultural resource surveys, which may reveal important historic properties that could result in greater cumulative impacts.

9.3.4.8 Air Quality

Because the CGS site is located in a climate regime similar to the VCSNS site, the air quality impacts of building and operating a nuclear facility at the CGS site would be similar to the air quality impacts at the VCSNS site. As described in Sections 4.7 and 5.7, the review team determined that the impacts of building and operating two new nuclear units on air quality at the VCSNS site would be SMALL. Therefore, the impacts of building and operating two new nuclear units on air quality at the CGS site would be minimal.

The CGS site is located in the Augusta-Aiken Interstate Air Quality Control Region, which is designated as being in attainment with the NAAQSs (40 CFR 81.341) (SCE&G 2010b). The resource area defined for this evaluation is Orangeburg County, South Carolina. A single county was selected because designations of attainment or non-attainment are made on a county-by-county basis. As listed in Table 9-14, sources of gaseous emissions near the proposed location include the CGS. The CGS is a 430-MW(e) coal-fired electrical generating plant, and emissions include sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides. Given the intermittent operation of the diesel generators at the proposed two new units, and that Orangeburg County is currently in attainment, the review team concludes the cumulative impacts, including the impacts from building and operating two new units on air quality, would be SMALL.

Greenhouse gas emissions related to nuclear power are discussed in Chapters 4, 5, and 6. As pointed out in Chapter 7, the impacts of the emissions are independent of emission location. Consequently, the discussions in the previous chapters and in Section 9.2.5 are applicable to two AP1000 reactors located at the CGS site. The impacts of greenhouse gas emissions at the CGS site considered in isolation would be minor, and the cumulative impact of greenhouse gas emissions would be MODERATE, primarily due to national and world-wide impacts of emissions of greenhouse gases. Building and operating two new nuclear reactor units at the CGS site would not be a significant contributor to the MODERATE impact.

9.3.4.9 Nonradiological Health Impacts

The following analysis includes direct, indirect, and cumulative impacts from building and operating the proposed new facilities. The analysis also considers past, present, and reasonably foreseeable future actions that impact the nonradiological health resources, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of nonradiological health impacts at the CGS site, the geographic area of interest is considered to be the 6-mi area centered on the CGS site and the associated transmission-line corridors. This 6-mi radius is expected to encompass all nonradiological health impacts.

Building Impacts

Nonradiological health impacts from building two new nuclear units on construction workers and members of the public at the CGS site would be similar to those evaluated in Section 4.8. They include occupational injuries, noise, vehicle exhaust, and dust. Applicable Federal and State regulations on air quality and noise would be complied with during the site-preparation and building phase. The CGS site is located in a rural area and building impacts would likely be negligible on the surrounding populations that are classified as medium- and low-population areas.

Past actions in the geographic area of interest that have similarly affected nonradiological resources include the development and operation of the CGS, located in the same general location as the CGS site, and the Kaiser Agricultural Chemical Company, located less than 1 mi east-northeast of the CGS site. There are no major current projects in the geographic area of interest that would cumulatively impact nonradiological health in a similar way.

Proposed future actions that would affect nonradiological health in a similar way to development at the CGS site would include transmission-line creation and/or upgrading throughout the designated geographic region of interest, and future urbanization would also be expected to occur. The review team concludes that the impacts on nonradiological health from building two new nuclear units and associated transmission lines at the CGS site would be minimal.

Operational Impacts

Occupational health impacts on operational employees would include those associated with the operation of cooling towers and transmission lines, as described in Section 5.8. Based on the configuration of the proposed new units at the CGS site (closed-cycle, wet cooling system with mechanical draft cooling towers), etiological agents would not likely increase the incidence of waterborne diseases in the vicinity of the site. Impacts on workers health from occupational injuries, noise, and EMFs would be similar. Noise and EMFs would be monitored and controlled in accordance with applicable OSHA regulations.

No past, present, or future actions in the geographic area of interest were identified that would significantly affect nonradiological health in ways similar to those associated with the operation of two new units at the CGS site. The review team therefore concludes that the impacts on nonradiological health from operating two new nuclear units and associated transmission lines at the CGS site would be minimal.

Summary Statement

Impacts on nonradiological health from development and operation of two new units at the CGS site are estimated based in the information provided by SCE&G and the review team's independent evaluation. The review team concludes that health impacts on construction workers and the public resulting from the development of two new nuclear units at the CGS site would be SMALL. The review team expects that the occupational health impacts on the operations employees of two new nuclear units at the CGS site would be SMALL. Similarly, impacts on public health of two new nuclear units operating at the CGS site would be expected to be SMALL.

There are past and future activities in the geographic area of interest that could affect nonradiological health in ways similar to the building of two units at the CGS site. The review team concludes, however, that cumulative impacts from past, present, and future actions on nonradiological health from building and operating two new units at the CGS would be SMALL. The staff is not able to come to conclusions about the chronic impacts of EMFs on public health.

9.3.4.10 Radiological Impacts of Normal Operations

The following impact analysis includes radiological impacts on the public and workers from building activities and operations for two nuclear units at the CGS alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects and the projects listed in Table 9-14. As described in Section 9.3.4, a 430-MW(e) coal-fired generating plant is located at the CGS site along with an adjacent greenfield site; there are currently no nuclear facilities on the site. The geographic area of interest is the area within a 50-mi radius of the CGS site. Facilities potentially affecting radiological health within this geographic area of interest are the operating Vogtle Electric Generating Plant (VEGP) Units 1 and 2, the proposed VEGP Units 3 and 4, DOE's Savannah River Site (SRS), the Mixed Oxide (MOX) Fuel Fabrication Facility at the SRS, the Energy Solutions (Barnwell) Low-Level Radioactive Waste Disposal Facility, and the Westinghouse Fuel Fabrication Plant outside of Columbia, South Carolina. In addition, there are likely to be hospitals and industrial facilities within 50 mi of the CGS site that use radioactive material.

The radiological impacts of building and operating the proposed two AP1000 plants at the CGS site include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. The impacts are expected to be similar to those estimated for the VCSNS site.

The radiological impacts of existing VEGP Units 1 and 2 also include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways result in low doses to people and biota offsite that are well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring program conducted around the Vogtle site. The EIS for proposed VEGP Units 3 and 4 indicates that operation of the proposed reactors would result in radiological impacts form direct radiation and liquid and gaseous radioactive effluents. The EIS indicates that these pathways would result in low doses to people and biota offsite that would be well below regulatory limits (NRC 2008b).

SRS, the MOX Fuel Fabrication Facility at SRS, the Barnwell Low-Level Radioactive Waste Disposal Facility, and the Westinghouse Fuel Fabrication Plant are all located 25 mi or more from the CGS site. The NRC staff concludes that these non-reactor facilities are located far enough from the CGS site that there would be no significant cumulative radiological impact. This conclusion is consistent with the results of the ongoing radiological environmental monitoring program conducted around the Vogtle site. In addition, the NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the CGS site. This conclusion is based on data from the radiological environmental monitoring programs conducted around currently operating nuclear power plants.

The NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 plants and other existing and planned projects and actions in the geographic area of interest around the CGS site would be SMALL.

9.3.4.11 Postulated Accident Impacts

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the CGS alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and the projects listed in Table 9-14. As described in Section 9.3.4, a 430-MW(e) coal-fired generating plant is located at the CGS site along with an adjacent greenfield site; there are currently no nuclear facilities on the site. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the CGS alternative site. Existing facilities potentially affecting radiological accident risk within this geographic area of interest are the existing VCSNS Unit 1, H.B. Robinson Unit 1, and VEGP Units 1 and 2. In addition, two AP1000 reactors have been proposed at the Vogtle site. DOE's SRS, the MOX Fuel Fabrication Facility at the SRS, the Energy Solutions (Barnwell) Low-Level Radioactive Waste Disposal Facility, and the Westinghouse Fuel Fabrication Plant outside of Columbia, South Carolina are also within the geographic area of interest.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the VCSNS site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The AP1000 design is independent of site conditions, and the meteorology of the CGS alternative and VCSNS sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the CGS alternative site would be minimal. Because the meteorology, population distribution, and land use for the CGS alternative site are expected to be similar to the proposed VCSNS site, risks from a severe accident for an AP1000 reactor located at the CGS alternative site are expected to be similar to those analyzed for the proposed VCSNS site. These risks for the proposed VCSNS site are presented in Tables 5-17 and 5-19 and are well below the median value for current-generation reactors. In addition, as discussed in Section 5.11.2, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest (VCSNS Unit 1, H.B. Robinson Unit 1, and VEGP Units 1 and 2), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1). According to the Vogtle ESP (NRC 2008b), the risks from this proposed site are also well below current-generation reactors and meet the Commission's safety goals.

There are no reactors currently operating at DOE's SRS; however, there is some severe accident risk associated with the spent nuclear fuel and other high-level radioactive wastes that may be processed or stored at SRS. The severe accident risks associated with stored spent fuel at operating nuclear power plants are lower than the risks for severe accidents involving the reactor core. Likewise, the severe accident risks associated any spent reactor fuel or other high-level radioactive waste processed or stored at SRS would be lower than the risks for severe accidents involving the reactor core. There is no irradiated fuel at the Westinghouse Fuel Fabrication Plant or the MOX Fuel Fabrication Facility at SRS, and these facilities are designed to prevent inadvertent criticalities. Other facilities at SRS and the Barnwell Low-Level Radioactive Waste Disposal Facility may contain substantial amounts of radioactive material, but there is no credible severe accident risk like there is for an operating reactor. Therefore, the additional risk from these facilities is not significant in the evaluation of the cumulative severe accident risk for a nuclear power plant at the CGS site.

On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the CGS alternative site would be SMALL.

9.3.5 The Saluda Site

This section covers the review team's evaluation of the potential environmental impacts of siting a two-unit nuclear power plant) at the Saluda site in Saluda County, South Carolina. The following sections describe a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if it were implemented at the Saluda site and other actions in the same geographic area were assessed. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment are other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Saluda site. Other actions and projects considered in this cumulative analysis are described in Table 9-21.

Table 9-21. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Saluda Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Energy Projects			
VCSNS Unit 1	VCSNS Unit 1 consists of one 996-MW(e) nuclear power generating plant.	About 25 mi east of the Saluda site	VCSNS Unit 1 is currently operational and is licensed to continue operations through August 6, 2042[a]
Carolinas-Virginia Tube Reactor (CVTR)	Experimental pressurized tube heavy water nuclear power reactor	About 24 mi east of the Saluda site	Decommissioned[b]
Independent Spent Fuel Storage Installation	Dry spent-fuel storage	About 25 mi east of the Saluda site	Proposed[c]
Old Steam Generator Recycle Facility	Decommissioned steam generator storage	About 25 mi east of the Saluda site	Operational[c]
Lee Nuclear Station	Two Westinghouse Advanced Passive 1000 (AP1000) pressurized water reactors	About 60 mi north of the Saluda site	Proposed new nuclear plant. Operation would begin in 2018-2021[d]
Vogtle Electric Generating Plant (VEGP)	Nuclear power generating plant with 2 units, VEGP 1 (1109 MW(e)) and VEGP 2 (1127 MW(e))	About 70 mi south of the Saluda site	Operational[e]
VEGP Units 3 and 4	Nuclear power generating plant with two Westinghouse AP1000 pressurized water reactors	About 70 mi south of the Saluda site	Proposed[f] (Pre-construction activities have commenced. NRC Limited Work Authorization has been issued.)
H.B. Robinson Steam Electric Plant, Unit 2	Nuclear power generating plant with one 710-MW(e) unit	About 90 mi east of the Saluda site	Operational[g]
Catawba Nuclear Station, Units 1 and 2	Two 1129-MW(e) Westinghouse reactors	About 70 mi northeast of the Saluda site	Operational[h]
Oconee Nuclear Station, Units 1, 2 and 3	Three 846-MW(e) Babcock and Wilcox reactors	About 80 mi west-northwest of the Saluda site	Operational[i]
McGuire Nuclear Station, Units 1 and 2	Two 1100-MW(e) Westinghouse reactors	About 96 mi northeast of the Saluda site	Operational[j]
SCE&G Parr Hydroelectric Plant	A 14-MW(e) hydroelectric plant	About 24 mi east of the Saluda site	Parr Hydro Plant is currently operational[k]
SCE&G Fairfield Pumped Storage Plant	A 511.2-MW(e) hydroelectric plant. VCSNS Units 2 and 3 will use water supply from this facility.	About 25 mi east of the Saluda site	The Fairfield Pumped Storage Plant is currently operational[c]

Table 9-21. (contd)

Project Name	Summary of Project	Location	Status
SCE&G Parr Combustion Facility	71-MW(e) natural-gas electric generating plant	About 2.0 mi south of VCSNS	Operational[b]
SCE&G Combined Site Emergency Operations Facility	A new combined-site emergency operations facility	10 mi from VCSNS	Operational[v]
Buzzard Roost Combustion Turbine Station	A 196-MW oil/gas-fired peaking facility	About 6 mi west of Saluda site	Operational[l]
Buzzard's Roost Dam	A 15-MW hydroelectric facility	About 6 mi west of Saluda site	Operational[m]
Saluda Dam (SCE&G, commonly called the Lake Murray Dam)	A 206-MW hydroelectric facility; the Saluda Dam created Lake Murray	About 32 mi southeast of Saluda site	Operational, currently in process of relicensing[n]
McMeekin Station	252-MW coal-fired plant	About 32 mi southeast of Saluda site	Operational
Westinghouse Fuel Fabrication Plant in Columbia SC	Design and fabricate completed nuclear fuel assemblies and fuel-related products	About 42 mi east of Saluda site	Operational[o]
Mining Projects			
Hanson Brick East/Minchew Pit	Surface mining operation for Hanson Brick	About 2 mi southwest of the Saluda site	Operational[p]
Hanson Brick East/Bauknight Pit	Surface mining operation for Hanson Brick	About 8 mi southwest of the Saluda site	Operational[p]
Hanson Brick East/Hicks Pit	Surface mining operation for Hanson Brick	About 10 mi west-southwest of the Saluda site	Operational[p]
Transportation Projects			
South Carolina Strategic Corridor System Plan	Strategic system of corridors forming the backbone of the State's transportation system.	State-wide	Planning document with no explicit schedules for projects; however, many strategic corridors coincide with routes that would/could be used for development at the CGS site[q]
Other Facilities			
International Paper Silverstreet Chip Mill	Paper mill	About 2 mi northwest of the Saluda site	Operational[r]
George Hugh Connelly WWTP Newbury/Bush River WWTF	Waste water treatment facilities	Within 10–15 mi of the Saluda site	Operational[s]

Table 9-21. (contd)

Project Name	Summary of Project	Location	Status
Ninety Six CPW Pier 96 WWTP WR Wise WTF Wilson Creek WWTP NCW&SA/Broad River WWTP			
Parks and Aquaculture Facilities			
Greenwood State Park	Small park on Lake Greenwood	About 10 mi west of the Saluda site.	Currently managed by South Carolina Department of Parks, Recreation and Tourism[t]
Sumter National Forest	371,000-acre national forest.	Throughout 40- to 50-mi region.	Currently managed by U.S. Forest Service[u]
Parr Hydro Wildlife Management Area	4400-acre wildlife management area	About 20 mi east-northeast	Currently managed by SCDNR[b]
Other parks, forests, and reserves	Several parks, recreation, and conservation areas are located within the 50-mi region. Examples of such areas include the following: Lake Wateree, the Catawba River, Monticello and Parr reservoirs, Broad River, Lake Murray, Dreher Island State Park, Lake Greenwood, Riverbanks Zoo and Garden, Congaree National Park, Harbison State Forest, and Sesquicentennial State Park.	Throughout region	Currently managed by various local, State, and Federal agencies and organizations.
Other Actions/Projects			
Various hospitals	Medical isotopes	Within 50 mi	Operational in Columbia, Lexington, Newberry, Rock Hill, Lancaster, Laurens, Greenwood, and Camden
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroad; construction of water- and/or wastewater-treatment and distribution	Throughout region.	Construction would occur in the future, as described in State and local land-use planning documents

Table 9-21. (contd)

Project Name	Summary of Project	Location	Status
	facilities and associated pipelines, as described in local land-use planning documents.		

(a) Source: NRC 2004
(b) Source: SCE&G 2011
(c) Source: SCE&G 2010b
(d) Source: NRC 2007
(e) Source: NRC 2009e
(f) Source: NRC 2009f
(g) Source: NRC 2009b
(h) Source: NRC 2009a
(i) Source: NRC 2009d
(j) Source: NRC 2009c
(k) Source: EPA 2009g
(l) Source: Duke 2009b
(m) Source: Greenwood County 2008
(n) Source: SCE&G 2009i
(o) Source: Westinghouse 2009
(p) Source: EPA 2009i
(q) Source: SCDOT 2009
(r) Source: EPA 2009j
(s) Source: EPA 2009k
(t) Source: South Carolina Department of Parks, Recreation and Tourism 2009
(u) Source: USFS 2004
(v) Source: SCE&G 2010e

The Saluda site is an undeveloped property owned by SCE&G in Saluda County on the Saluda River arm of Lake Murray at the confluence with Mill Creek. The site is bounded on the north side by the Saluda River arm of Lake Murray and SC-121 borders the eastern portion of the site. Figure 9-9 shows the Saluda alternative site region.

The Saluda site is an SCE&G-owned, greenfield site located in a predominantly rural area of Saluda County characterized by moderately rolling topography. The undeveloped sections of the site consist primarily of pine, hardwood, and mixed forested land with a significant portion of the forest land dedicated to silviculture and routine harvesting. There has historically been little use of the site for any alternative purposes other than its current use, but it is maintained by SCE&G as a potential site for future development if required.

9.3.5.1 Land Use and Transmission-Line Corridors

In addition to land-use impacts from building and operations, the cumulative analysis for the Saluda site also considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative land-use impacts, including other Federal and non-Federal

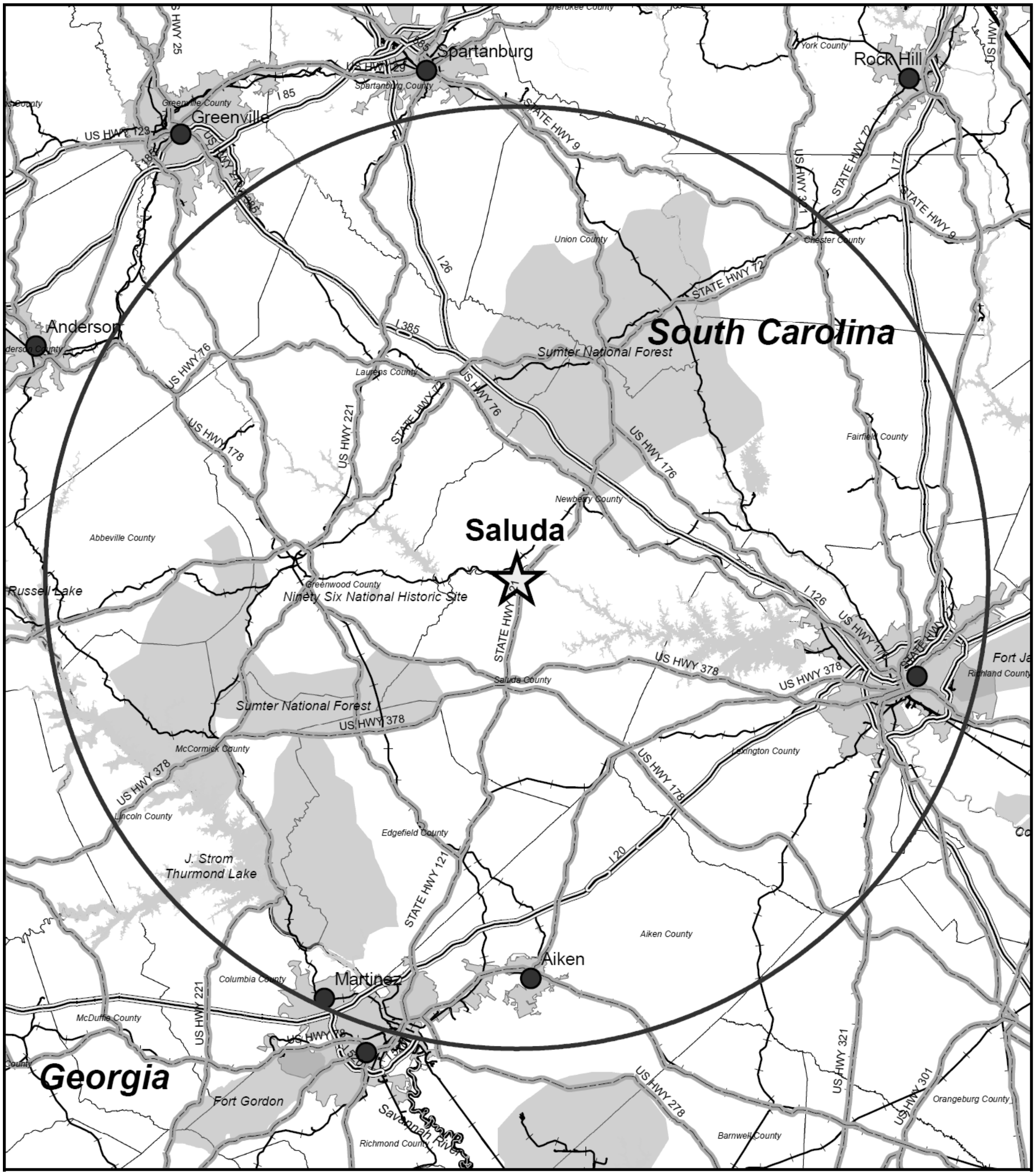

Figure 9-9. Saluda Alternative Site Region

projects and the projects listed in Table 9-21. For the analysis of land-use impacts at the Saluda site, the geographic area of interest is considered to be the 50-mi region centered on the Saluda site, plus any transmission-line corridors that extend beyond that range. Most but not all of the transmission-line corridor length falls within a 50-mi radius of the site. Land-use planning for transmission-line routing over wide areas must consider land-use plans of adjoining counties and other land-managing agencies, rather than considering one county in isolation. Furthermore, in predominantly rural settings such as that surrounding the Saluda site, land-use changes occurring substantial distances away from a project site can substantially influence land-use planning decisions close to the site.

The Saluda site presently is mostly undeveloped and predominantly forested. It is located in a sparsely populated, largely rural area, with forests and small farms composing the dominant land use, typical of much of rural South Carolina. Historically, most upland areas have been used for crop production, but presently are used for silviculture. Several electric transmission lines, State routes, and interstate highways currently traverse the region. In many respects the Saluda site is similar to the VCSNS site, although it is much smaller. The land is owned by SCE&G and the review team expects that development of the site for power generation would not be inconsistent with local land-use plans and zoning ordinances.

To meet the land requirements for the project, the applicant would have to acquire additional land to bring the size of the site to at least 1233 ac (SCE&G 2010a). Development of the proposed new units would disturb about 415 ac of mostly forested land. State Highway SC-121 would need to be slightly rerouted to avoid exclusion area boundaries, affecting about 50 ac of the land included in the above total. Because the site is undeveloped, additional land would be needed to construct access roads. A makeup water intake line, approximately 9 mi long, would be constructed along the Saluda River valley from the site to a location near the confluence of the Bush River and Lake Murray. Table 9-22 summarizes expected land-use impact parameters for the Saluda site and transmission lines. The review team used GIS data provided by the applicant (SCE&G 2010a) to estimate expected land disturbance. The review team used the most recent information provided by the applicant (SCE&G, 2010b), except where the design data provided in earlier Santee-Cooper documentation (2009c) was not reflected in the revised SCE&G application.

Table 9-22. Land-Use Impact Parameters for the Saluda Site

Parameter	Value	Source
Required onsite project area (ac)	1233	SCE&G 2010a, 2011
Estimated land-disturbance area (ac)	415	SCE&G 2010a, 2011 and review team analysis
Number of new transmission-line routes – SCG&E (number of routes)	2	SCE&G 2010b
Number of new transmission-line routes – Santee Cooper (number of routes)	5	

Table 9-22. (contd)

Parameter	Value	Source
Number of new transmission-line routes – total (number of routes)	7	
Transmission-line corridor distance – SCE&G (mi)	147	SCE&G 2010b for SCE&G; SCE&G 2009c for Santee Cooper
Transmission-line corridor distance – Santee Cooper (mi)	325	
Transmission-line corridor distance – total (mi)	472	
Transmission-line corridor area – SCE&G (ac)	1649	SCE&G 2010b for SCE&G; review team analysis based on SCE&G 2009c for Santee Cooper
Transmission-line corridor area – Santee Cooper (ac)	4112	
Transmission-line corridor area – total (ac)	5761	

SCE&G estimates the new units would require the addition of seven 230-kV transmission lines, each of which would occupy a 100-ft-wide transmission-line corridor. Based on information provided by SCE&G, (SCE&G 2010d) describing the dimensions of conceptual transmission-line corridors for the Saluda site, approximately 472 mi covering 5761 ac of land would be needed. The proposed routing would use existing corridors to the extent practicable, so that although the linear runs extend 472 mi, somewhat less than that distance would require entirely new corridor. The actual area of land disturbance, used for assessing impacts on terrestrial ecology and cultural resources, is therefore somewhat lower than suggested by the overall land-use requirements. The review team concludes that the land-use impact of the transmission-line installation activities would be somewhat greater than those described for the VCSNS site in Section 4.1.2. SCE&G stated that all land clearing associated with nuclear facility and transmission-line development would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G or Santee Cooper procedures, good construction practices, and established BMPs (SCE&G 2010b).

Because the other projects described in Table 9-21 do not include any reasonably foreseeable significant changes in land-use types within 50 mi of the Saluda site, there would not be any significant additional cumulative impacts on land use from those activities.

As described above, installation of new transmission-line corridors to support the proposed new units could need as much as 5761 ac over 472 mi of length; however, the review team expects that final routing would lead to significantly less land-use impacts. If additional transmission lines are built from other energy projects, there would be a cumulative land-use impact from the additional amount of land converted to utility corridor use for transmission lines. Because transmission lines are often co-located and are relatively narrow, the review team expects that the cumulative impact would be consistent with the land-use plans and zoning regulations of the affected counties. However, multiple new transmission-line corridors could noticeably alter the land-use classification acreage proportions, both within the vicinity and within the 50-mi region.

Cumulative land-use impacts within the region would be consistent with existing land-use plans and zoning. However, due to the potential reclassification of acreage within the region caused by the transmission-line development, the review team concludes that the cumulative land-use impacts associated with the proposed project at the Saluda site, related transmission-line corridor development, and other projects in the geographic area of interest would be MODERATE. Considering the land needs noted above, building and operating two new nuclear units at the Saluda site would be a significant contributor to these impacts.

9.3.5.2 Water Use and Quality

Saluda site hydrology, water use, and water quality are discussed in ER Section 9.3.3.3.3 (SCE&G 2010b); this EIS section draws from information presented in the ER and in responses to subsequent requests by the review team for additional information, as well as the Nuclear Plant Site Selection Study Report (Tetra Tech NUS, Inc. 2009).

The cooling- and service-water supply for a two-unit nuclear generating station located at the Saluda site would most likely be Lake Murray, a run-of-the-river impoundment on the Saluda River near Columbia, South Carolina (SCE&G 2010b). A 9-mi-long pipeline would be needed to transfer water to and from the lake to the nuclear facility. Lake Murray's surface area is over 49,000 ac and the total and useable water storages for the reservoir are 2,200,000 and 1,056,000 ac-ft, respectively. The mean annual inflow to Lake Murray is 2595 cfs. Two nuclear units located at the Saluda site would withdraw approximately 83 cfs of makeup water from Lake Murray. Sixty-two cubic feet per second would be consumptively lost through evaporation and drift from the station cooling towers and 21 cfs would be returned via pipeline to the lake at the discharge location.

For the purposes of assessing water-use impacts, the review team compared the station consumptive water loss from evaporation and drift from the cooling towers (62 cfs) to the mean annual inflow to Lake Murray (2595 cfs). The consumptive water loss would be about 2.4 percent of the average annual inflow. Based on the use of Lake Murray as the source of cooling water and sink for blowdown, the large storage capacity of the reservoir, the relatively high mean annual inflow to the reservoir from the upstream tributaries when compared to the anticipated consumptive losses related to station operation, and the lack of reliance on the free flowing section of the Saluda River near the site for a source of cooling water, the review team concludes the impact on surface waters of two units at the Saluda site would be negligible.

SCE&G does not plan to use groundwater for the project, so no impacts on groundwater supply are expected (SCE&G 2010b).

SCE&G indicates that blowdown from the proposed units would be discharged to Lake Murray upstream of the intake embayment (SCE&G 2010b). A SCDHEC-issued NPDES permit would be required to operate the nuclear project at this site. Effluent discharge through an NPDES-permitted outfall would ensure that the discharges complied with the Clean Water Act. Such permits are designed to ensure the protection of water quality and therefore the impact on water quality is assessed to be minor.

Impacts of building and operation of the proposed units on groundwater quality may occur due to leaching of spilled pollutants and effluents into the subsurface. However, based on the review team's experience with other facilities, the review team concludes that with the implementation of BMPs the impacts on groundwater quality from building and operating two new nuclear units at the Saluda site would likely be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that affect the same environmental resources. For the cumulative analysis of impacts on surface water, the geographic area of interest for the Saluda Site is considered to be the drainage basin of the Saluda River upstream of the site and Lake Murray because this is the resource that would be affected by the proposed project. Key actions that have past, present, and future potential impacts on water supply and water quality in Lake Murray and the Saluda River basin include Buzzards Roost Dam and Saluda Dam on the Saluda River. These dams serve to increase the reliability of water supply to the region and to provide power. The McMeekin Station, a 252-MW coal-fired plant located just below Saluda Dam, has past, present, and future impacts on water quality and water supply in the region because it uses Lake Murray as a source of cooling water.

Water Use

The surface-water-use impacts of building and operating two nuclear power plants at the Saluda site are dominated by the higher demands that would occur under normal operation. The projected consumptive water use of proposed units from Lake Murray is expected to be about 62 cfs or approximately 2.4 percent of the average inflow to Lake Murray. The average flow rate is influenced by upstream cumulative consumptive uses of current users. Increases in consumptive use of water in the Saluda River drainage is anticipated in the future. The impacts of operational projects listed in Table 9-21 are considered in the above analysis or would have little or no impact on surface-water use.

Because of the availability of surface water and the relatively low yield of groundwater wells no groundwater would be used during building and operations. Potential impacts on groundwater use would be limited to groundwater withdrawal for dewatering excavations. Dewatering, if required, would require limited withdrawal of water because of the low permeability of the geologic materials in this area and would be temporary.

As discussed in Section 7.2 the review team considered potential climate changes that could affect the water resources available for cooling and the impacts of reactor operations on water resources for other users. The impact of climate change would be similar for all of the alternative sites.

The review team concludes that the cumulative impact of past, present, and future uses of water resources, both surface water and groundwater including any incremental impact associated with the building and operation of two units at the Saluda site would be SMALL.

Water Quality

Water-quality impacts of building and operation of the proposed units are described above in the context of current conditions in the Saluda River. The conditions include the impact of operating Buzzards Roost Dam and Lake Murray Dam. The impacts of other projects listed in Table 7-1 are either considered in the analysis included above or would have little or no impact on surface-water quality. As mentioned above, blowdown water from the site would be discharged to Lake Murray and the requirements of the NPDES-permitted outfall would ensure that the discharges comply with the Clean Water Act and therefore the impact on surface-water quality is assessed to be minor.

Impacts of the building and operation of the proposed units on groundwater may occur due to leaching of spilled pollutants and effluents into the subsurface. However, based on the review team's experience with other facilities, the review team concludes that with the implementation of BMPs the impacts on groundwater from building and operating two new nuclear units at the Saluda site would likely be minimal. Due to the low permeability of geologic materials on the site and in the surrounding region no impacts on groundwater quality off the site are anticipated, and therefore no cumulative impacts on groundwater quality are anticipated.

The review team also concludes that with the implementation of BMPs, the impacts on groundwater quality from building and operating two units at the Saluda would likely be minimal and therefore, concludes the cumulative impact on surface and groundwater quality would be SMALL.

9.3.5.3 Terrestrial and Wetland Resources

Site Description

The following impact analysis includes impacts from building and operating the proposed new facilities on terrestrial ecology resources. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-21. For the analysis of terrestrial ecological impacts at the Saluda site, the geographic area of interest is considered to be the 6-mi region centered on the Saluda site, plus the associated transmission-line corridors.

This 6-mi radius is expected to encompass the ecologically relevant landscape features and species. The natural history of the site is similar to that of the VCSNS site, described in Section 2.4.1.

The Saluda site is a predominately forested greenfield site(SCE&G 2010b). The land surrounding the proposed site is predominately rural and habitats are typical of the Southern Outer Piedmont ecoregion, consisting of planted and naturally vegetated pine, mixed pine-hardwood, and hardwood forests. Common canopy species include white oak, southern red oak, black oak, mockernut and pignut hickories, intermixed with some loblolly pine and shortleaf pine. Beech, northern red oak, tulip poplar, and red maple are found on more mesic sites (Griffith et al. 2002).

The associated proposed transmission-line corridors begin in the Southern Outer Piedmont ecoregion and cross the Sandhills into the Coastal Plain ecoregion (see Section 2.2.2). Vegetation community types in the Sandhills ecoregion include grassland and early successional habitats, Sandhills pine woodland, seepage slopes, ponds and depressions, blackwater stream systems, and river bottoms (SCDNR 2005). The sandy soils create a xeric environment that supports a distinctive type of vegetation dominated by longleaf pines and turkey oaks. The Coastal Plain, the largest ecoregion in South Carolina, include bottomland hardwood forest consisting of bottomland oaks, red maple, sweetgum, green ash, bitternut hickory, and cypress-gum swamps dominated by water tupelo, swamp tupelo, bald cypress, and pond cypress (Griffith et al. 2002).

Common wildlife associated with the Piedmont ecoregion that also occur on the Saluda site and proposed transmission-line corridors include white-tailed deer, eastern cottontail, gray squirrel, opossum, and raccoon. Various bird, reptile, and amphibian species also reside on the Saluda site (SCE&G 2010b).

No Federally listed species are known to occur on the Saluda site, but formal surveys have not been conducted. Two species are listed as endangered in Saluda County: the red-cockaded woodpecker, and the vascular plant harperella (*Ptilimnium nodosum*). The pool-sprite (*Amphianthus pusillus*) is listed as threatened. The wood stork is the only Federally listed species in neighboring Newberry County. In addition to the Federally listed species, the State of South Carolina has listed Webster's salamander (*Plethodon websteri*) as endangered in Saluda County.

The proposed transmission-line corridors would cross Aiken, Calhoun, Chester, Colleton, Dorchester, Fairfield, Hampton, Greenwood, Lancaster, Laurens, Lexington, Newberry, Orangeburg, Richland, and Saluda Counties to connect to the proposed St. George substation in Colleton County (SCE&G, 2010b). Table 9-23 lists all Federally and State-listed species that occur in counties crossed by the proposed transmission-line corridors. SCE&G has stated that on-the-ground field surveys would be conducted prior to commencement of any ground-disturbing activities related to the site or transmission-line corridors as part of the permitting process (SCE&G 2010b).

Table 9-23. Federally and State-Listed Species That May Occur on the Saluda Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors

Scientific Name	Common Name	Legal Status	County
Mammals			
Corynorhinus rafinesquii	Rafinesque's big-eared bat	SE	Aiken, Colleton, Dorchester, Hampton, Orangeburg, Richland
Birds			
Charadrius melodus	Piping plover	FT/ST	Colleton
Charadrius wilsonia	Wilson's plover	ST	Colleton
Elanoides forficatus	American swallow-tailed kite	SE	Dorchester
Haliaeetus leucocephalus	Bald eagle	BGEPA/SE	Aiken, Chester, Colleton, Dorchester, Fairfield, Greenwood, Hampton, Lancaster, Lexington, Newberry, Orangeburg, Richland, Saluda
Mycteria americana	Wood stork	FE/SE	Aiken, Colleton, Dorchester, Hampton, Lexington, Newberry, Richland
Picoides borealis	Red-cockaded woodpecker	FE/SE	Aiken, Chester, Colleton, Dorchester, Hampton, Laurens, Lexington, Orangeburg, Richland, Saluda
Sterna antillarum	Least tern	ST	Colleton
Reptiles			
Clemmys guttata	Spotted turtle	ST	Aiken, Colleton, Hampton
Gopherus polyphemus	Gopher tortoise	SE	Aiken, Colleton, Dorchester, Hampton
Amphibians			
Ambystoma cingulatum	Flatwoods salamander	FT/SE	Orangeburg
Hyla andersonii	Pine barrens tree frog	ST	Richland
Plethodon websteri	Webster's salamander	SE	Saluda
Pseudobranchus striatus	Dwarf siren	ST	Hampton, Orangeburg
Rana capito	Gopher frog	SE	Aiken, Dorchester, Hampton

Table 9-23. (contd)

Scientific Name	Common Name	Legal Status	County
Vascular Plants			
Amphianthus pusillus	Pool sprite	FT/ST	Lancaster, Saluda
Echinacea laevigata	Smooth coneflower	FE/SE	Aiken, Lancaster, Lexington, Richland
Helianthus schweinitzii	Schweinitz's sunflower	FE/SE	Lancaster, Lexington
Isoetes melanospora	Black-spored quillwort	FE/SE	Lancaster
Lindera melissifolia	Pondberry	FE/SE	Dorchester
Lysimachia asperulifolia	Rough-leaved loosestrife	FE/SE	Richland
Oxypolis canbyi	Canby's dropwort	FE/SE	Colleton, Dorchester, Hampton, Orangeburg, Richland
Ptilimnium nodosum	Harperella	FE/SE	Aiken, Saluda
Trillium reliquum	Relict trillium	FE/SE	Aiken

Sources: SCE&G 2009d; SCDNR 2010; FWS 2010
BGEPA = Bald and Golden Eagle Protection Act; FE = Federally listed as endangered; FT = Federally listed as threatened; SE = State listed as endangered; ST = State listed as threatened

Building Impacts

The review team estimated that the proposed project would require clearing of approximately 415 ac of terrestrial habitats. Because the site is greenfield, a substantial amount of infrastructure to facilitate the building and operation of a new nuclear power facility would be required. Additional land would be disturbed for the building of roads, railroad spur, a bridge, and anew makeup-water line (SCE&G 2010b). Based on a preliminary site layout of the tabletop footprint provided by SCE&G, the review team estimates that approximately 7.3 ac of wetlands present on the site would be affected during building activities for the two proposed units (SCE&G 2010a).

Table 9-22 provides information about the number, route, and area of the proposed transmission-line corridors that would serve the proposed new facilities at the Saluda alternative site. Acreages were determined by calculating the total number of miles and acres of clearing required for right-of-way widening and/or development activities (SCE&G 2009d). SCE&G and Santee Cooper would both have a portion of the new transmission lines and details are provided in the Table 9-24 and Table 9-25 below (SCE&G 2009d).

Table 9-24. SCE&G Transmission-Line Information for the Saluda Alternative Site

Transmission-Line Segment	Length of Corridor (mi)	Acres of Corridor	Acres of Forested Wetlands	Acres of Nonforested Wetlands	Acres of Open Water
Saluda-Saluda Switching	14	157	6	0.3	0.1
Saluda Switching-St. George	101	1143	180	40	4
Saluda-VCSNS-Parr	1	12	--	--	--
Saluda-VCSNS	30	337	11	1	14
Total	146	1649	197	41	18

Source: SCE&G 2009d
NOTE: Acreages were determined by calculating the total number of miles and acres of clearing required for right-of-way widening and/or development activities.

Table 9-25. Santee Cooper Transmission-Line Information for the Saluda Alternative Site

	New Corridor (108 mi, 807ac)		Existing Corridor (213 mi, 3257 ac)		Total Corridor (4064 ac)	
Wetlands Estimate	Acres	Percent of Corridors	Acres	Percent of Corridors	Acres	Percent of Corridors
Hydric soils	73	9	1135	35	1208	30
NWI wetlands	9	1	255	8	264	6

Source: SCE&G 2009d
NWI = National Wetlands Inventory
NOTE: Acreages were determined by calculating the total number of miles and acres of clearing required for right-of-way widening and/or development activities.

SCE&G stated that all land clearing associated with plant and transmission-line site preparation and development would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G and Santee Cooper procedures, and established BMPs (SCE&G 2010b).

Past actions in the geographic area of interest that have similarly affected terrestrial resources include the development and operation of the Buzzard's Roost Combustion Turbine Station, located approximately 6 mi west of the Saluda site. The building of this 196-MW oil/gas-fired peaking facility resulted in the loss of terrestrial habitat. The development of the Buzzard's Roost Dam, located approximately 6 mi west of the Saluda site, dammed the Saluda River and created Lake Greenwood. The creation of Lake Greenwood flooded approximately 11,400 ac of terrestrial habitat (SCDPRT 2009). The Hanson Brick East/Minchew Plant, approximately 2 mi southwest of the Saluda site, and the International Paper Silverstreet Chip Mill, approximately 2 mi from the Saluda site, also contributed to the loss of terrestrial habitat. There are no major current projects in the geographic area of interest that would cumulatively affect terrestrial ecological resources in a similar way.

Proposed future actions that would affect terrestrial resources in a similar way to development at the Saluda site would include transmission-line building and/or upgrading throughout the designated geographic region of interest, and future urbanization would also be expected to occur.

Impacts from building two nuclear units and supporting facilities on wildlife habitat would be unavoidable. Activities that would affect wildlife include land clearing and grading (temporary and permanent), filling and or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the affected areas. Some wildlife, including some individuals of important species, would perish or be displaced during land clearing for any of the above projects as a consequence of habitat loss, fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities. Undisturbed land adjacent to the project could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from noise is expected to be temporary and minor. The creation of new transmission-line corridors could be beneficial for some species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer, northern bobwhite quail, eastern meadowlark, and the gopher tortoise. Birds of prey, such as red-tailed hawks would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in a herbaceous or scrub-shrub condition that could provide improved foraging habitat for some waterfowl and wading birds. However, fragmentation of forests could adversely affect species that are dependent on large tracts of continuous forested habitat.

The review team concludes that the impacts on terrestrial resources from building two new nuclear units and associated transmission lines at the Saluda site would be noticeable, but not destabilizing.

Operational Impacts

Impacts on terrestrial ecological resources from the operation of two new nuclear units at the Saluda site primarily include those associated with cooling towers and transmission lines. Impacts resulting from the operation of cooling towers and transmission lines are discussed in detail in Section 9.3.3.3 and would apply to the Saluda site.

No past, present, or future actions in the geographic area of interest were identified that would significantly affect terrestrial habitat and wildlife including important species in ways similar to those associated with the operation of two new units.

The review team concludes that the impacts of operating two new units and associated transmission lines at the Saluda site on terrestrial resources and wetlands would be minimal.

Summary Statement

Impacts on terrestrial ecology resources are estimated based in the information provided by SCE&G and the review team's independent review. There are past and future activities in the geographic area of interest that could affect wildlife and wildlife habitat in ways similar to the building of two units at the Saluda site.

The Saluda site and some of the associated transmission lines are natural habitats that would be substantially altered by development and maintenance activities, noticeably affecting the level and movement of terrestrial wildlife populations in the area of interest. Other anticipated development projects would further alter wildlife habitats and migration patterns in the surrounding landscape. The review team therefore concludes that cumulative impacts on baseline conditions for terrestrial resources would be MODERATE. Building and operating two new nuclear units and associated transmission lines at the Saluda site would be significant contributor to the MODERATE impact.

9.3.5.4 Aquatic Resources

The following impact analysis includes impacts from building activities and operations on aquatic ecology resources. The Saluda River basin consists of 21 watersheds that span 2523 mi^2 across the Blue Ridge, Piedmont, and Sand Hills physiographic provinces (SCDHEC 2004b). The Saluda alternative site is located on the Saluda River, downstream of the confluence with Mill Creek and upstream of the Little River watershed confluence. This segment of the river drains into the Saluda River arm of Lake Murray (SCDHEC 2004b; SCE&G 2010b). The site vicinity falls within the Saluda River/Lake Murray watershed (HUC 03050109-150) in the Piedmont ecoregion. Within the 182,441 ac of the Saluda River/Lake Murray watershed, there are 276.8 mi of streams and over 3430.5 ac of lake waters (SCDHEC 2004b). The geographic region of interest would include the Saluda River and Lake Murray to the Saluda Dam structure as the most affected waterbodies.

Historically, Lake Murray was created by impoundment of the Saluda River in 1930 as a part of a hydroelectric project by Santee Cooper (iDATA 2009). Of the seven reservoirs and impoundments in the Saluda River basin, Lake Murray is the largest, covering 48,000 ac that are bordered by 691 mi of shoreline (Kleinschmidt 2005; SCDNR 2009d). The aquatic habitats associated with Lake Murray include a diversity of open water, shallow coves, and wetlands. Submerged artificial structures have been installed throughout the lake by SCDNR to attract fish for recreational anglers (SCDNR 2009a). Lake Murray serves multiple purposes; it is used for hydroelectric generation, maintenance of downstream water quality, industrial and municipal water supply, irrigation, and recreation (SCE&G 2010b).

Near the proposed Saluda alternative site, SCDHEC has reported on water-quality conditions at two stations within the Saluda River/Lake Murray watershed. The following information was derived from the SCDHEC report titled *Watershed Water Quality Assessment: Saluda River Basin* (SCDHEC 2004b). At the nearest upstream monitoring station, approximately 9 river miles from the vicinity of the proposed alternative site, SCDHEC determined that water-quality conditions were hampered by elevated copper concentrations from unknown sources. Water quality is optimal for supporting aquatic life because the values exceed the acute criteria. Recreational uses, however, are not restricted. At the nearest downstream monitoring station, approximately 2 river miles downstream from the vicinity of the proposed alternative site, water quality is suboptimal for supporting aquatic life; however, there are no restrictions for recreational activities.

Elevated mercury concentrations within the Saluda River have resulted in a fish-consumption advisory for the Saluda River from Lake Greenwood Dam to the Congaree River in Columbia, SC; however, this advisory does not include Lake Murray, which has no advisories (SCDHEC 2011). The SCDHEC (2011) suggests that consumption of largemouth bass and bluegill (*Lepomis macrochirus*) be limited to one meal per week. Bowfin consumption is advised not to exceed one meal per month.

As described in Section 9.3.5.2, the proposed intake and discharge structures would be located in Lake Murray over 9 mi downstream of the nuclear facility (SCE&G 2009b). The SCDHEC (2004b) monitoring results indicated that the pH did not meet the established criteria, which resulted in the assessment that water quality is not able to support aquatic life near the monitoring station in the vicinity of the proposed intake and discharge structures.

Recreationally Important Species

Lake Murray provides abundant recreational opportunities, the most popular being recreational fishing (Kleinschmidt 2007). Recreational species found in Lake Murray include largemouth bass, redear sunfish, bluegill, striped bass (*Morone saxatilis*), white bass (*M. chrysops*), white catfish (*Ameiurus catus*), channel catfish, crappie (*Pomoxis spp*.), and white perch (*M. americana*) (Kleinschmidt 2005). There is also a small commercial bait fishery for blueback herring on the lake. The most predominant forage fish within the lake are threadfin (*Dorosoma petenense*) and gizzard shad (*D. cepedianum*) (Kleinschmidt 2005).

Invasive Species

Invasive aquatic plants encompass an estimated 100 ac in Lake Murray and include hydrilla (*Hydrilla verticillata*), Illinois pondweed (*Potamogeton illinoensis*), water primrose (*Ludwigia uruguayensis*), and alligatorweed (*Alternanthera philoxeroides*). Management strategies for invasive vegetation in Lake Murray include the introduction of sterile grass carp (*Ctenopharyngodon idella*), mechanical harvesting, and the targeted application of aquatic herbicides (SCDNR 2009b).

Critical Habitats

No critical habitat has been designated by the FWS in the vicinity of the Saluda site. However, critical habitat for the Carolina heelsplitter is present in waterbodies proposed for transmission-line crossing in Chester and Lancaster Counties. Designated critical habitat includes 103.2 km of streams and rivers in South Carolina that occur in conjunction with the known populations. The lateral boundaries of the critical habitats for the Carolina heelsplitter are denoted by the ordinary high-water mark along channel edges (67 FR 44502).

Federally and State-Listed Species

Federally, proposed Federally, and State-listed species that may occur in the vicinity of the site or in aquatic habitats crossed by the proposed transmission-line corridors are listed in Table 9-26. The proposed transmission-line corridors would cross Chester, Fairfield, Greenwood, Lancaster, Laurens, Newberry, and Saluda Counties, which lie entirely or mostly within the Piedmont ecoregion. The remaining counties include Aiken, Colleton, Dorchester, Hampton, Lexington, Orangeburg, and Richland Counties and lie entirely or mostly within the Coastal Plain ecoregion (SCE&G 2010b). SCE&G has stated that on-the-ground field surveys would be conducted upon determination of final routes and prior to commencement of any building activities related to the site or transmission-line corridors as part of the permitting process (SCE&G 2010b).

Table 9-26. Federally, Proposed Federally, and State-Listed Aquatic Species That May Occur on the Saluda Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors

Scientific Name	Common Name	Status	County
Reptiles			
Caretta caretta	Loggerhead sea turtle	FT/ST	Colleton
Chelonia mydas	Green sea turtle	FE	Colleton
Dermochelys coriacea	Leatherback sea turtle	FE	Colleton
Lepidochelys kempii	Kemp's ridley sea turtle	FE	Colleton
Fish			
Acipenser brevirostrum	Shortnose sturgeon	FE/SE	Aiken, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland
Acipenser oxyrinchus	Atlantic sturgeon	PFE	Aiken, Colleton, Dorchester, Hampton, Lexington, Orangeburg, Richland
Etheostoma collis	Carolina darter	SE	Fairfield, Richland
Mollusks			
Lasmigona decorata	Carolina heelsplitter	FE/SE	Chester, Fairfield, Greenwood, Lancaster, Laurens, Lexington, Newberry, Saluda

Sources: SCE&G 2010b; FWS 2010, 2011; SCDNR 2010; 75 FR 61904
FE = Federally Endangered, SE = State Endangered, FT = Federally Threatened, PFE = Proposed Federally Endangered

There are four Federally listed species of sea turtles in South Carolina. The loggerhead is listed as threatened whereas the green sea, leatherback and Kemp's ridley sea turtles are listed as endangered (FWS 2008). The loggerhead sea turtle is also listed as a State threatened species for Colleton County (SCDNR 2010). The siting of the Pomaria-Varnville transmission-line right-of-way is projected to run to the west of I-95, which is well over 50 mi from the coastline, and does not cross any marine habitats (MACTEC 2009). Therefore, although the four species of sea turtles occur in Colleton County, no activities associated with transmission lines for the Saluda site would affect these species.

The shortnose sturgeon is a State and Federal endangered species (FWS 2008). It is unknown whether the shortnose sturgeon occurs in the immediate vicinity of the proposed alternative site; however, populations are known to reside in the Edisto River, which is proposed for transmission corridor crossing. The shortnose sturgeon was initially listed as a Federally endangered species in 1967 and is designated as a species of highest conservation priority by SCDNR (McCord 2006; NMFS 1998). This amphidromous species uses freshwater, estuarine, and marine habitats to complete its life cycle (Rohde et al. 2009; McCord 2006; NMFS 1998). In South Carolina, populations of shortnose sturgeon exist in the Ashepoo, Combahee, and Edisto rivers (flowing to St. Helena Sound); the Pee Dee, Waccamaw, and Black rivers (flowing to Winyah Bay); and the Savannah, Cooper, and Santee rivers. There is also a small landlocked population of shortnose sturgeon in the Santee-Cooper Lake system (Collins et al. 2003).

In freshwater habitats, shortnose sturgeon are associated with soft bottom substrates in deep water. In South Carolina, spawning occurs in freshwaters characterized by low-to-moderate velocities and over substrates that include clay, sand, gravel, and woody debris (Rohde et al. 2009; McCord 2006). Eggs are adhesive and survival is reportedly dependent on water having little turbidity (McCord 2006).

The Atlantic sturgeon is not currently listed either Federally or by the State of South Carolina. However, on October 6, 2010, the NMFS published in the *Federal Register* (75 FR 61904) a proposed rule for listing the Carolina and South Atlantic distinct population segments of the Atlantic sturgeon as endangered under the ESA. In light of this proposed listing, the review team is now considering the Atlantic sturgeon in its analysis.

Characteristics of the early life-history attributes of Atlantic sturgeon, such as age at seaward migration and residence time in freshwater habitats, varies within natal streams as well as across geographic regions (Jenkins and Burkhead 1994). Juveniles migrate from spawning areas toward saline habitats where individuals spend months to years rearing in estuarine environments. In marine environments, Atlantic sturgeon make extensive migrations from their natal estuary presumably to productive foraging grounds (ASSRT 2007). Spawning is believed to occur in flowing water between the salt wedge and the fall line of large rivers. Like the shortnose sturgeon, spawning adults generally migrate upriver during the spring (February to March) in southern rivers. While Atlantic sturgeon have been noted to occur in many South

Carolina coastal rivers during the past several decades, specific information detailing population records for each of these rivers is not readily available. There appears to be little quantitative evidence linking the occurrence of Atlantic sturgeon in specific streams and rivers to spawning populations in South Carolina. South Carolina rivers with recent documented occurrences of Atlantic sturgeon include Waccamaw, Pee Dee, Santee, Cooper, Edisto, Combahee, Coosawatchie, and Savannah Rivers (ASSRT 2007).

The Carolina darter is listed as a State endangered species in Fairfield County and as a State threatened species in Richland County (SCDNR 2010). While there are reported accounts pertaining to the distribution of the Carolina darter within the Piedmont ecoregion, the overall abundance of this species is unknown (Hayes and Bettinger 2006).

The Carolina heelsplitter is a Federally listed aquatic species (FWS 2008). It is unknown whether the Carolina heelsplitter occurs in the vicinity of the proposed alternative site. However, there are six known populations of the Carolina heelsplitter within the state defined by geographic location; (1) Savannah River tributaries in Edgefield and McCormick Counties, (2) Cuffeytown Creek in Greenwood and McCormick Counties, (3) Lynches River and Flat Creek in Chesterfield, Kershaw, and Lancaster Counties, (4) Gills Creek in Lancaster County, (5) Fishing Creek in Chester County, and (6) Bull Run Creek in Chester County (SCDNR 2006b; 67 FR 44502).

Building Impacts

Cooling-system makeup water would be derived from the Lake Murray arm of the Saluda River, which is also proposed to receive station blowdown water (SCE&G 2009b). The transport of cooling-system makeup water and plant discharge water between the intake and discharge structures to the proposed plant would require the installation of a 9-mi-long pipeline along the Saluda River Valley from Lake Murray to the nuclear facility. As previously mentioned in Section 9.3.5.3, the installation footprint for this task would require disturbing approximately 55 ac (SCE&G 2010b). Installation activities associated with new intake and discharge structures would likely include impacts on water quality stemming from direct (e.g., dredging, shoreline excavation, removal of riparian vegetation) and indirect sources (e.g., stormwater runoff, sedimentation). These activities would result in temporary displacement of fish within the vicinity of the intake and discharge construction areas. Sedimentation due to disturbances of the shoreline and bottom could affect local benthic populations; however, the impacts on aquatic organisms would be temporary and largely mitigable through the use of appropriate BMPs.

The proposed alternative site would require the disturbance of undeveloped land to accommodate the infrastructure necessary for plant operations (i.e., cooling towers, switchyard, powerblock, roads). Development of the site would also include a rail spur to connect to the nearest rail line, which is located approximately 1.2 mi northwest of the proposed site. The spur would require constructing new supports for a rail line across the Saluda River (SCE&G 2010b).

Building activities that include land clearing associated with new infrastructure (roads, site footprint) and upgrading existing features (railroad lines) would affect approximately 6106 linear feet out of a total of approximately 28,508 linear feet of onsite streams and approximately 1.3 ac out of a total of 17.2 ac of open water (SCE&G 2010a). Transmission-line corridors would be maintained by SCE&G or Santee Cooper, respectively. Approximately 26,457 linear feet of streams and 18 ac of open water are located within the new SCE&G transmission-line corridors (SCE&G 2009d). The new Santee Cooper transmission-line corridors associated with the Saluda site would include an estimated 54 stream crossings, 11 of which would be State navigable waters crossings (MACTEC 2009). One transmission-line corridor would fall within the jurisdiction of the South Carolina Coastal Zone Management Act, thus requiring additional review and certification. SCE&G stated that all land clearing associated with plant and transmission-line site preparation and development would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G or Santee Cooper procedures, and established BMPs (SCE&G 2010b).

No past or present actions in the geographic area of interest were identified that would significantly affect aquatic resources, including important species, in ways similar to those associated with the building of two new units at the Saluda site. Proposed future actions that would affect aquatic resources in a similar way to development at the Saluda alternative site would include transmission-line creation and/or upgrading throughout the designated geographic area of interest, and future urbanization.

Operational Impacts

Aquatic impacts associated with operation of the Saluda alternative site would include intake-related impingement and entrainment losses of aquatic biota as well as water-quality impacts near the vicinity of the intake and discharge structures at Lake Murray. There are several intake/discharge configurations designed to minimize impacts on aquatic biota. Assuming SCE&G would use a closed-cycle cooling system designed to meet the EPA's 316(b) Phase I requirements for new facilities (66 FR 65256), the intake would have a maximum through-screen velocity at the cooling-water intake of less than 0.5 fps and adverse impacts on aquatic biota from impingement and entrainment effects would not be anticipated. Operational impacts associated with water quality and discharge are likely to be minor and discharges would be NPDES compliant. The diverse fish found within Lake Murray exhibit a range of life-history characteristics that include a variety of habitat associations during certain life phases. It is unknown whether the intake and/or discharge areas support important aquatic life-history events. Impacts would likely be greatest on nonmotile benthic aquatic organisms that occur within the vicinity of the discharge. However, based on the review team's experience with other facilities sited on large reservoirs, the review team concludes that with proper design the impacts on aquatic resources from operation of two new nuclear units at the Saluda site would likely be minimal.

The review team also concludes that operational impacts on aquatic biota from maintenance of the transmission-line corridors would also be minimal assuming that appropriate BMPs are used.

Cumulative impacts that could result from the operation of two new units at the Saluda site would include intake-related impingement and entrainment losses, and chemical and thermal discharge of station blowdown. Although detailed information regarding the presence of important aquatic biota in the vicinity of the discharge effluent is unknown, NPDES permitting requirements are likely to minimize any potential impact for additional discharge to the Saluda River from the operation of two units at the Saluda site. Past, present, or future actions in the geographic area of interest that would affect aquatic ecological resources include aquatic biota impacts from the operation of the Saluda Dam, a 206-MW hydroelectric facility 32 mi to the southeast, which created Lake Murray, and the International Paper Silverstreet Chip Mill, which discharges to the Saluda River within 2 mi of the Saluda alternative site. The International Paper Silverstreet Chip Mill is compliant with NPDES permitting for discharges (SCE&G 2010b). Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility may also contribute to cumulative impacts.

Summary Statement

Impacts on aquatic ecology resources are estimated based on the information provided by SCE&G, the State of South Carolina, FWS, NMFS, and the review team's independent review. There are past and future activities in the geographic area of interest that could affect aquatic ecology resources in ways similar to the building and operation of two units at the Saluda site. Proper siting of intake and discharge structures; avoiding critical habitat or habitat for protected species; proper siting of associated transmission lines; minimizing interactions with waterbodies and watercourses along the transmission-line corridors; and using appropriate BMPs during site development, transmission-line installation, and corridor maintenance. Based on the information provided by SCE&G, the State of South Carolina, FWS, NMFS, and the review team's independent evaluation, the review team concludes that the cumulative impacts of building and operating two new reactors on the Saluda site combined with other past, present, and future activities on aquatic resources in the Saluda River drainage would be SMALL.

9.3.5.5 Socioeconomics

For the analysis of socioeconomic impacts at the Saluda site, the geographic area of interest is considered to be the 50-mi region centered on the Saluda site with special consideration of the four-county area, including Saluda, Lexington, Newberry, and Richland Counties, because that is where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of building and operations at the Saluda site in Saluda County, South Carolina, the review team undertook a reconnaissance survey of the region using readily obtainable data from the ER, the alternative site audit, Federal, State, and local government agencies. The analysis also considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources, including other Federal and non-Federal projects and the projects listed in Table 9-21. The impacts of building and operating the new units are discussed below.

Physical Impacts

Many of the physical impacts of building and operation would be similar regardless of the site. Building activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting (if used), and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport construction materials and equipment. Offsite areas that would support building activities (e.g., borrow pits, quarries, and disposal sites) would be expected to be already permitted and operational.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions (the latter are discussed under aesthetics and recreation). New units would produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, and switchyard equipment. Traffic at the site also would be a source of noise. The review team assumed that same standard noise protection and abatement procedures used for the VCSNS site would be used to control noise coming from the Saluda site. This practice also would be expected to apply to all alternative sites. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the alternative site.

The new units at the Saluda site would likely have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the physical impacts of building and operating two new nuclear units at the Saluda site would be minimal.

Demography

The Saluda site is located in Saluda County in South Carolina, approximately 34 air mi southeast of the closest economic center, Columbia, South Carolina (2007 population 124,818). Due to the Saluda site's close proximity to the VCSNS site, the review team assumed that the in-migrating workforce would be similarly distributed. Because 95 percent of the VCSNS workforce lives in one of four counties, and the staff assumes a similar distribution around the Saluda site – Saluda (2007 population 18,748), Lexington (2007 population 243,270), Newberry

(2007 population 37,633), and Richland (2007 population 357,734) – counties compose the economic impact area and are the focus of the following analysis (see Table 2-23).

Currently, 36.8 percent of the VCSNS workforce is located in Lexington County, 18.9 percent in Newberry County, 34.7 percent in Richland County, and 9.5 percent in Fairfield County. The in-migrating population would be expected to reside within a four-county area in a similar pattern to the VCSNS workforce, with Saluda County being the host county instead of Fairfield County. At peak project employment, SCE&G would expect the onsite workforce to be 3600. Based on the close proximity of the Saluda site to the VCSNS site, the review team used similar labor force assumptions and estimated that 50 percent of the project workforce (1800) would migrate to the four-county economic impact area with their families. Using South Carolina's average household size of 2.53, this would bring the total in-migrating population to 4554. Considering that the estimate of the in-migrating population would be less than 1 percent of the population of the economic impact area in 2007, the regional and local demographic impacts of the project are expected to be minimal. Once the facility is operational, the workforce would include 800 operations workers and 130 site support personnel for a total of 930 workers for the operation of the facility. The review team expects that as much as 50 percent of these workers would migrate to the economic impact area. The review team expects the demographic impacts would be similar to those estimated for the VCSNS site, based on the close proximity of the Saluda site. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the demographic impacts of building and operating two new nuclear units at the Saluda site would be minimal.

Taxes and Economy

Using reconnaissance-level information, the review team assumed that if the proposed nuclear facility were located at the Saluda site, taxes and fee-in-lieu-of-taxes agreements would be similar to those estimated to occur at the VCSNS site. Corporate and personal income taxes along with sales and use taxes would be collected during the project, but property taxes would not be paid until operations begin. Once operations begin, SCE&G would have likely entered into a fee-in-lieu-of-taxes agreement with Saluda County. Based on the agreement SCE&G has with Fairfield County in regard to VCSNS, which has an assessment ratio of four percent and a special revenue credit of 20 percent of the fee-in-lieu-of-taxes payments during the first 20 years, SCE&G estimates VCSNS annual payments to be between $13.7 million and $31.6 million over 40 years of the license period. If SCE&G entered into a similar agreement with Saluda County for the Saluda site, the tax payments would increase Saluda County property tax revenues (currently $10.7 million [SCBCB 2007]) by 128 to 295 percent. The total fee-in-lieu-of-taxes payments to Saluda County are expected to be substantial and beneficial during operations.

The four-county economic impact area had 313,374 people in the labor force in 2009 with an unemployment rate of 9.4 percent, which is under the State average of 11.7 percent. Saluda and Newberry Counties have the smallest economies with a predominantly manufacturing base, while Lexington and Richland Counties have larger service-based economies. The wages and salaries of the project workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors.

SCE&G acquired RIMS II economic multiplier values specific to this economic impact area from the U.S. Bureau of Economic Analysis (BEA 2006), which permit detailed examination of potential economic impacts with individual multipliers attributable to construction activities and plant operations activities. Using the RIMS multiplier of 2.02, the 3600 construction jobs would create 3672 indirect jobs in the economic impact area, for a total of 7272 jobs supported by the project. Because the review team assumes 50 percent of the project workforce would migrate to the region, the approximate net employment effect of the project would be 3636 new jobs spread over the four counties. This would have a beneficial but temporary impact on the business community and could provide (1) opportunities for new businesses to get started and (2) increased job opportunities for local residents. Once the new units are operational, approximately 930 new operations jobs would be added to the local economy. Using a multiplier of 3.34, the 930 operations and support jobs would create 2176 indirect jobs in the economic impact area, for a total of 3106 jobs supported by plant operations. Because the review team assumes 50 percent of the workforce would migrate to the region, the approximate net employment effect of operations would be 1553 new jobs spread over the four counties. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the economic and tax base impacts of building and operating two new nuclear units at the Saluda site would be minor in the four-county area, but would be substantial in Saluda County.

Transportation and Housing

The nuclear facility entrance would be accessed by SC-121, a north-south paved two-lane road that has a 2005 AADT count of about 4000 vehicles between Saluda and Newberry Counties. Similar to the VCSNS site, a new access road would be constructed to access the Saluda site from SC-121. Because access to the Saluda site would be provided using a single two-lane highway (SC-121), the review team estimates traffic volumes during peak project employment are likely to represent a 25- to 45-percent increase or more above baseline levels of affected roadways, based on analysis of the VCSNS site (see Section 4.4.4.1). The review team concludes that these impacts would be noticeable and would likely be especially acute during periods of shift change. These impacts would be further exacerbated by truck traffic and site delivery traffic that have no other route options available. The review team concludes traffic-related impacts would be locally acute, but of short duration and temporary, and would be substantially mitigated by traffic management planning by SCE&G. A rail spur, linking the site with the Norfolk Southern rail line in the Newberry area, would be constructed to deliver the heaviest components and construction materials to the site. Because of existing impoundments on the Saluda River, the review team concludes that barge service to the Saluda site would not be feasible. The review team concludes that the transportation impacts from building the new units at the Saluda site would be minor in the region, but noticeable in the immediate vicinity along SC-121 and mitigation may be warranted. Facility operations would likely have a minimal impact on the transportation network.

Approximately 1800 construction workers could migrate into the region during peak project employment. Approximately 465 operations workers could migrate into the region by the time the facility becomes operational. Construction workers may choose to buy housing, rent, use mobile homes, or stay in a hotel/motel, while operations workers would likely choose to buy a house. According to the 2000 U.S. Census there were 246,119 housing units in the four-county area, of which 7738 in Lexington County, 2779 in Newberry County, 9692 in Richland County, and 1416 in Saluda County were vacant, for a total of 21,625 vacant units (SCE&G 2010b). The review team expects that the in-migrating workforce could be absorbed fairly easy by the region and the impacts likely would be minimal.

Public Services and Education

In-migrating construction workers and plant operations workers would likely impact local municipal water, wastewater treatment facilities, and other public services in the region. The in-migrating workers represent a small portion of the total population of Saluda County and likely would not have a noticeable impact on their public services. During operations the impact on public services would likely be minimal.

SCE&G reports in its ER (SCE&G 2010b) that during the 2004–2005 school year, Lexington County had 66 PK-12 schools, Newberry County had 14 schools, Richland County had 93 schools, and Saluda County had 5 schools. Total enrollment for Lexington, Newberry, Richland, and Saluda Counties for the 2004-2005 school year was 51,276, 5948, 50,159, and 2149, respectively. A maximum of 938 students are expected to migrate into the four-county area, during peak project employment and would decline to 484 during operations. This would increase the student population during peak project employment in Lexington County by 0.7 percent, Newberry by 3 percent, Richland by 0.6 percent, and Saluda by 4.1 percent. During operation, this impact on schools would be significantly less due to the lower number of in-migrating students. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that public services and education impacts of building and operating two new nuclear units at the Saluda site would be minimal.

Aesthetics and Recreation

The four-county area is a defined tourism region called Capital City/Lake Murray Country. The region includes Congaree National Monument, parts of Sumter National Forest, and a couple of State parks. Near the Saluda site are several trails and State heritage preserves that offer wildlife viewing, hunting, camping, boating, fishing, and other recreational activities. Based on the review team's visit to this site, public dispersed recreation activities such as hunting and fishing occur on the site. Public boating access to the Saluda River currently exists. These uses would be precluded if the site were to be developed (SCE&G 2010b).

Most development would occur near the center of the property and wouldn't be visible from afar except from elevated areas. The intake and discharge structures would be located on the Lake Murray approximately 9 mi southeast of the site. These and other structures may be visible from certain angles. During certain weather conditions the cooling tower plumes may also be visible. The review team concludes that taken together, the visual impact of the project on this site would have a noticeable impact on the aesthetics and recreational resources in the area. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that noticeable public aesthetics and recreation impacts would result from building and operating two new nuclear units at the Saluda site.

Summary of Project-Related Socioeconomics

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. In summary, on the basis of information provided by SCE&G and the review team's independent evaluation, the review team concludes that the adverse impacts of building and operating a new nuclear plant at the Saluda site on socioeconomics would be minimal for most of the region. Impacts could be noticeable but not destabilizing for Saluda County in terms of transportation during the building phase and aesthetics and recreation impacts during both the building and operating phases. The impacts on the Saluda County tax base during operations likely would be substantial and beneficial; however only minor beneficial tax impacts would result in the rest of the region.

Cumulative Impacts

The projects identified in Table 9-21, particularly the future urbanization of the Columbia metropolitan area, have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Because the projects within the review area identified in Table 9-21 would be consistent with applicable land-use plans and control policies, the review team considers the cumulative socioeconomic impacts from the projects to be minimal.

For the analysis of socioeconomic impacts at the Saluda site, the geographic area of interest is considered to be the 50-mi region centered on the Saluda site, with special consideration of Saluda, Lexington, Newberry, and Richland Counties, because that is where the review team expects socioeconomic impacts to be the greatest.

The Saluda site is located in a rural area of northern Saluda County. The site currently is a greenfield site surrounded pine forests and wetlands, with primarily agricultural development and forestry production in the vicinity. The site is about 9 mi southwest of Newberry (2007 population 10,893), the Newberry County Seat and about 12 mi north of Saluda (2007 population 2935), the Saluda County Seat. The 50-mi region includes Columbia and Aiken, South Carolina, two larger urban areas. The economy of the region has been and continues to be largely agriculture-based. Newberry County has significant manufacturing employment. The review team believes development of the Saluda site would have demographic impacts similar to the original development of the VCSNS site, because Saluda County is somewhat similar to Fairfield County. The review team expects that the economic impact area for the Saluda site would include Saluda, Newberry, Lexington, and Richland Counties. The review team assumes the project workforce would be distributed within the economic impact area in approximately the same proportion as the existing VCSNS workforce, with the exception that the workforce attributed to Fairfield County would be attributed to Saluda County. SCE&G made these assumptions as part of its alternative sites analysis (SCE&G 2010b), and the review team did not find them unreasonable.

The cumulative impact analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on a given region, including other Federal and non-Federal projects and the projects listed in Table 9-21. The projects listed in Table 9-21 have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Adverse cumulative impacts would include physical impacts (on workers and the local public, buildings, transportation, and visual aesthetics) and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and schools).

Economic impacts associated with activities listed in Table 9-21 already have been considered as part of the socioeconomic baseline used for establishing the RIMS II multipliers. Regional planning efforts and associated demographic projections available at a reconnaissance level formed the basis for the review team's assessment of reasonably foreseeable future impacts. Therefore, the review team concludes there would be a LARGE and beneficial cumulative impact on tax revenues in Saluda County. The review team also identified a MODERATE and adverse cumulative transportation impact during the building phase, aesthetics, and recreation impacts in Saluda County during both the building and operating phases. The review team concludes that cumulative impacts on other socioeconomic impact categories would be SMALL and adverse. Building and operating a new plant at the Saluda site would make a significant incremental contribution to both adverse and beneficial impact levels.

9.3.5.6 Environmental Justice

In addition to environmental justice impacts from building and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to disproportionately high and adverse impacts on minorities and low-income populations, including other Federal and non-Federal projects and the projects listed in Table 9-21. For the analysis of environmental justice impacts at the Saluda site, the geographic area of interest is considered to be the 50-mi region centered on the Saluda site.

The Saluda site is located in a rural area of northern Saluda County. The site currently is a greenfield site surrounded by pine forests and wetlands, with primarily agricultural development and forestry production in the vicinity. The site is about 9 mi southwest of Newberry (2007 population 10,893), the Newberry County Seat and about 12 mi north of Saluda (2007 population 2935), the Saluda County Seat.

The review team based its environmental justice determinations on the methodology discussed in Section 2.6.1, including a closer look at potential areas of interest using a series of health and physical considerations. The review team determined there is a potential for minority and low-income populations to experience disproportionately high and adverse environmental impacts. Although Richland County and immediately adjacent counties are urban population centers, there are a number of farms within the region. The review team found low-income, African American and aggregated minority populations that exceed the percentage criteria established in Section 2.6.1 and required further consideration in the environmental justice analysis. However, none of these populations is clustered in the immediate vicinity of the Saluda site (see Figure 9-10 and Figure 9-11).

Because the other projects described in Table 9-21 do not include any significant reasonably foreseeable changes in socioeconomic impacts within 50 mi of the Saluda site, the review team concluded there would not be any significant additional cumulative environmental justice impacts in the region from those activities. Any economic impacts associated with activities listed in Table 9-21 already have been considered as part of the socioeconomic baseline. For example, the economic impacts of existing enterprises such as mining, other electrical utilities, etc., are part of the base used for establishing the RIMS II multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team's assessment of reasonably foreseeable future impacts.

Figure 9-10. Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Saluda Site

Figure 9-11. Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Saluda Site

Because access to the Saluda site would be provided using a single two-lane road in the vicinity, the review team estimates traffic volumes during building activities are likely to represent a 50- to 125-percent increase or more above baseline levels of the affected roadway. The review team concludes that these impacts would be significant and would likely be especially acute during periods of shift change. The impacts would be further exacerbated by truck traffic and site delivery traffic that have no other route options available. The review team expects the impacts would be of short duration and temporary, and could be substantially mitigated by traffic-management planning by SCE&G. Because the traffic impacts would take place in areas without an environmental justice population of interest, the review concluded no pathway exists for disproportionately high and adverse impacts on minority or low-income populations.

Based on the above considerations, information provided by SCE&G, visits to the site, and the review team's independent review, the review team concludes that when viewed in the context of the wider region, locating the proposed action at the Saluda site would not contribute additional cumulative impacts beyond the impacts described in Chapters 4 and 5 for the VCSNS site. The review team did not identify any other environmental pathways by which disproportionately high and adverse impacts could affect minority or low-income populations or communities. Under the limitations of a reconnaissance-level analysis, the review team found no other health or physical consideration and no unique characteristics or practices that could lead to a disproportionately high and adverse impact on any minority or low-income community within the region surrounding the Saluda site. Based on its evaluation, the review team concludes that cumulative environmental justice impacts associated with building and operating two new nuclear units at the Saluda site would be SMALL.

9.3.5.7 Historic and Cultural Resources

The following cumulative impact analysis includes building and operating two new nuclear generating units at the Saluda site. The analysis also considers the other past, present, and reasonably foreseeable future actions that could impact cultural resources, including other Federal and non-Federal projects and the projects listed in Table 9-21. For the analysis of cultural impacts at the Saluda site, the geographic area of interest is considered to be the APE that would be defined for this proposed undertaking. This includes the physical APE, defined as the area directly affected by the site-development and operation activities at the site and transmission lines, and the visual APE. The visual APE is defined as an additional 1-mi radius around the physical APE as a reasonable assumption for defining a maximum distance from which the structures can be seen.

Reconnaissance activities in a cultural resource review have particular meaning. For example, these activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing its EISs, the review team relies upon reconnaissance-level information to perform its alternative site evaluation. Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the Saluda Site the following information was used:

- SCE&G ER (SCE&G 2010b) – including National Park Service National Register Information system and documents associated with the Saluda Hydro relicensing project.
- NRC Alternative Sites Visit, March 2009.

The Saluda site is a greenfield site. Historically, the Saluda site and vicinity was largely undisturbed by land development and likely contained intact archaeological sites associated with the past 10,000 years of human settlement. Over time, the Saluda site has been disturbed by forestry practices (SCE&G 2009g). The physical and visual APEs for a proposed plant at the Saluda site do not appear to have any historic properties located within the area likely to be affected by building or operating new plants. No archaeological and/or architectural surveys have been conducted at the Saluda site. Significant cultural resources have been located in the Saluda River/Lake Murray watershed located adjacent to the Saluda site (SCE&G 2010b). SCE&G's records search identified more than 150 archaeological sites, 8 historic structures, 32 historic home sites, and 5 historic cemeteries, most of which have not been evaluated for their eligibility for listing in the National Register (SCE&G 2010b)

The footprint and land required to accommodate the building of two nuclear units on the Saluda site are described in Section 9.3.5.1. SCE&G has stated that as part of the site-selection process, known cultural resource locations would be considered as avoidance areas (SCE&G 2009f, g). SCE&G has also stated that if the proposed project was sited at the Saluda site, identification of cultural resources would be accomplished through cultural resource surveys. The results would be used in the site-planning process to avoid cultural resource impacts. If significant cultural resources were identified by these surveys, SCE&G would also develop protective measures similar to what it has in place for the VCSNS site. In addition, inadvertent discovery procedures would be developed if cultural resources were discovered during site-development activities (SCE&G 2009f).

The transmission lines associated with the two nuclear units on the Saluda site are described in Section 9.3.5.1. If the proposed project was sited at the Saluda site, the staff assumes SCE&G and Santee Cooper would conduct their transmission-line-related cultural resource activities in ways similar to what they have committed to do for the VCSNS site, as described in Section 4.6.

Past actions in the geographic area of interest that have similarly affected historic and cultural resources include forestry practices at the Saluda site and any road development and logging activities associated with those practices. None of the projects listed in Table 9-21 is located within the geographic area of interest, and therefore they have no potential for cumulative impact on cultural resources.

Activities associated with building two nuclear units and supporting facilities that can potentially directly affect historic and cultural resources include land clearing, excavation and grading activities. Given SCE&G's site-planning process, and the lack of significant cultural resources known to exist at the Saluda site based on reconnaissance-level information, and the land disturbance where the new plant would be located, the impacts on cultural resources due to site-development activities would be negligible.

In addition, visual impacts from transmission lines may result in significant alterations to the visual landscape within the geographic area of interest. Given that there are no known cultural resources where the historic setting and character of the resources are important, the visual impacts would be negligible. The staff assumes that SCE&G and Santee Cooper would develop management agreements in consultation with the SHPO similar to the ones that have been developed for VCSNS.

Impacts on historic and cultural resources from operation of two new nuclear units at the Saluda site include those associated with the operation of new units and maintenance of transmission lines.

The staff assumes that the same procedures currently used by SCE&G and Santee Cooper would be used for onsite and offsite maintenance activities. Consequently, the incremental effects of the maintenance of transmission-line corridors and operations of the two new units and associated impacts on cultural resources would be negligible.

Table 9-21 identifies projects within the geographic area of interest and includes the South Carolina Strategic Corridor System Plan; Sumter National Forest; other parks, forests, and reserves; and future urbanization that could affect historic and cultural resources in a manner similar to those associated with the operation of two new units. Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear generating units on the Saluda site would be SMALL. This impact-level determination reflects no known cultural resources that could be affected; however, if the Saluda site was to be developed, then cultural resource surveys may reveal important historic properties that could result in greater cumulative impacts.

9.3.5.8 Air Quality

Because the Saluda site is located in a climate regime similar to the VCSNS site, the air quality impacts of building and operating a nuclear facility at the Saluda site would be similar to the air quality impacts at the VCSNS site. As described in Sections 4.7 and 5.7, the review team determined that the impacts of building and operating two new nuclear units on air quality at the

VCSNS site would be SMALL. Therefore, the impacts of building and operating two new nuclear units on air quality at the Saluda site would be minimal.

The Saluda site is located in the Greenwood Interstate Air Quality Control Region, which is designated as being unclassified or in attainment with the NAAQSs (40 CFR 81.341) (SCE&G 2010b). The resource area defined for this evaluation is Saluda County, South Carolina. The single county was selected because designations of attainment or non-attainment are made on a county-by-county basis. None of the projects listed in Table 9-21 is within Saluda County. Given the intermittent operation of the diesel generators at the proposed two new units, and that Saluda County is currently in attainment, the review team concludes the cumulative impacts, including the impacts from building and operating two new units on air quality, would be SMALL.

Greenhouse gas emissions related to nuclear power are discussed in Chapters 4, 5, and 6. As pointed out in Chapter 7, the impacts of the emissions are independent of emission location. Consequently, the discussions in the previous chapters and in Section 9.2.5 are applicable to two AP1000 reactors located at the Saluda site. The impacts of greenhouse gas emissions at the Saluda site considered in isolation would be minimal, and the cumulative impact of greenhouse gas emissions would be MODERATE, primarily due to national and world-wide impacts of emissions of greenhouse gases. Building and operating two new nuclear units at the Saluda site would not be a significant contributor to the MODERATE impact.

9.3.5.9 Nonradiological Health Impacts

The following impact analysis for the Saluda site includes impacts from building and operating the proposed new facilities. The analysis also considers past, present, and reasonably foreseeable future actions that affect the nonradiological health resources, including other Federal and non-Federal projects and the projects listed in Table 9-21. For the analysis of nonradiological health impacts at the Saluda site, the geographic area of interest is considered to be the 6-mi area centered on the Saluda site and the associated transmission-line corridors. This 6-mi radius is expected to encompass all nonradiological health impacts.

Building Impacts

Nonradiological health impacts from building two new nuclear units on construction workers and members of the public at the Saluda site would be similar to those evaluated in Section 4.8. They include occupational injuries, noise, vehicle exhaust, and dust. Applicable Federal and State regulations on air quality and noise would be complied with during the site-preparation and building phase. The Saluda site is located in a rural area and building impacts would likely be negligible on the surrounding populations that are classified as medium- and low-population areas.

Past actions in the geographic area of interest that have similarly affected nonradiological health include the development and operation of the Buzzard's Roost Combustion Turbine Station, located approximately 6 mi west of the Saluda site; the construction of the Buzzard's Roost Dam, located approximately 6 mi west of the Saluda site; the Hanson Brick East/Minchew Plant, approximately 2 mi southwest of the Saluda site; and the International Paper Silverstreet Chip Mill, approximately 2 mi from the Saluda site. There are no major current projects in the geographic area of interest that would cumulatively affect nonradiological health in a similar way.

Proposed future actions that would affect nonradiological health in a similar way to development at the Saluda site would include transmission-line creation and/or upgrading throughout the designated geographic region of interest, and future urbanization would also be expected to occur. The review team concludes that the cumulative impacts on nonradiological health from building two new nuclear units and associated transmission lines at the Saluda site would be minimal.

Operational Impacts

Occupational health impacts on operational employees would include those associated with plant operation and operation of the associated transmission lines, as are fully described in Section 5.8. Based on the configuration of the proposed new units at the Saluda site (closed-cycle, wet cooling system with mechanical draft cooling towers), etiological agents would not likely increase the incidence of waterborne diseases in the vicinity of the site. Impacts on workers' health from occupational injuries, noise, and electric fields would be similar. Noise and electric fields would be monitored and controlled in accordance with applicable OSHA regulations.

No past, present, or future actions in the geographic area of interest were identified that would significantly affect nonradiological health in ways similar to those associated with the operation of two new units at the Saluda site. The review team therefore concludes that the impacts on nonradiological health from operating two new nuclear units and associated transmission lines at the Saluda site would be minimal.

Summary Statement

Impacts on nonradiological health from the building and operation of two new units and associated transmission lines at the Saluda site are estimated based in the information provided by SCE&G and the review team's independent evaluation. The review team concludes that health impacts on construction workers and the public resulting from the building of two new nuclear units at the Saluda site would be SMALL. The review team expects that the occupational health impacts on the operations employees of two new nuclear units at the

Saluda site would be SMALL. Similarly, impacts on public health of two new nuclear units operating at the Saluda site would be expected to be SMALL.

There are past and future activities in the geographic area of interest that could affect nonradiological health in ways similar to the building of two units at the Saluda site. The review team concludes, however, that cumulative impacts from past, present, and future actions on nonradiological health from building and operating two new units at the Saluda would be SMALL. The staff is not able to come to conclusions about the chronic impacts of EMFs on public health.

9.3.5.10 Radiological Impacts of Normal Operations

The following impact analysis includes radiological impacts on the public and workers from building activities and operations for two nuclear units at the Saluda alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects and the projects listed in Table 9-21. As described in Section 9.3.5, Saluda is a greenfield site; there are currently no nuclear facilities at this site. The geographic area of interest is the area within a 50-mi radius of the Saluda site. Facilities potentially affecting radiological health within this geographic area of interest are the existing VCSNS Unit 1 nuclear power plant, the Old Steam Generator Recycle Facility, the proposed ISFSI facility at VCSNS Unit 1, and the Westinghouse Fuel Fabrication Plant outside of Columbia, South Carolina. In addition, there are likely to be hospitals and industrial facilities within 50 mi of the Saluda site that use radioactive materials.

The radiological impacts of building and operating the proposed two AP1000 plants at the Saluda site include doses from direct radiation and liquid and gaseous radioactive effluents. These sources would result in low doses to people and biota offsite that would be well below regulatory limits. The impacts are expected to be similar to those estimated for the VCSNS site.

The radiological impacts of existing VCSNS Unit 1 (including the Old Steam Generator Recycle Facility) include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that are well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring program conducted around the VCSNS site. The proposed ISFSI would produce negligible direct radiation offsite as discussed in Section 4.9.1.

The Westinghouse Fuel Fabrication Plant is located over 40 mi from the Saluda site. The NRC staff concludes that this non-reactor facility is located far enough from the Saluda site that there would be no significant cumulative radiological impact. This conclusion is consistent with the results of the ongoing radiological environmental monitoring program conducted around the VCSNS site. In addition, the NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Saluda site. This conclusion is based on data from the radiological environmental monitoring programs conducted around currently operating nuclear power plants.

Based on the information provided by SCE&G and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 plants and other existing and planned projects and actions in the geographic area of interest around the Saluda site would be SMALL.

9.3.5.11 Postulated Accident Impacts

The following impact analysis includes radiological impacts from postulated accidents from the operation of two nuclear units at the Saluda alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and the projects listed in Table 9-21. As described in Section 9.3.5, Saluda is a greenfield site; there are currently no nuclear facilities at the site. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Saluda alternative site. Facilities potentially affecting radiological accident risk within this geographic area of interest are the existing VCSNS Unit 1; H.B. Robinson Unit 1; Oconee Units 1, 2, and 3; McGuire Units 1 and 2; Catawba Units 1 and 2; and VEGP Units 1 and 2. Two AP1000 reactors have been proposed at the Lee site and two AP1000 reactors have been proposed at the Vogtle site as well. Also the Westinghouse Fuel Fabrication Plant outside of Columbia, South Carolina, is within the geographic area of interest.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the VCSNS site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The AP1000 design is independent of site conditions, and the meteorology of the Saluda alternative and VCSNS sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Saluda alternative site would be minimal.

Because the meteorology, population distribution, and land use for the Saluda alternative site are expected to be similar to the proposed VCSNS site, risks from a severe accident for an AP1000 reactor located at the Saluda alternative site are expected to be similar to those analyzed for the proposed VCSNS site. The risks for the proposed VCSNS site are presented in Tables 5-17 and 5-19 and are well below the median value for current-generation reactors. In addition, as discussed in Section 5.11.2, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest (VCSNS Unit 1; H.B. Robinson Unit 1; Oconee Units 1, 2, and 3; McGuire Units 1 and 2; Catawba Units 1 and 2; and VEGP Units 1 and 2), the

Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1). Finally, according to the Lee Nuclear Station ER (NRC 2007) and the Vogtle ESP (NRC 2008a), the risks from these proposed sites are also well below current-generation reactors and meet the Commission's safety goals. There is no irradiated fuel at the Westinghouse Fuel Fabrication Plant, and the plant is designed to prevent inadvertent criticalities; therefore, the additional risk is not significant in the evaluation of the cumulative severe accident risk for a nuclear power plant at the Saluda site. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the Saluda alternative site would be SMALL.

9.3.6 The Savannah River Alternative Site

This section covers the review team's evaluation of the potential environmental impacts of siting a two-unit nuclear power plant at the Savannah River (SR) alternative site, which would be co-located at DOE's SRS in Aiken, Barnwell, and Allendale Counties in South Carolina. The following sections describe a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if it were implemented at the SR alternative site and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment are other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the SR alternative site. Other actions and projects considered in this cumulative analysis are described in Table 9-27.

The greater SRS itself is quite large at 310 mi^2, as part of the current reindustrialization effort at the site, selected locations have been proposed as potential sites for the development of both Federal and privately held industrial projects. Accordingly, SCE&G is considering a portion of the site located on the Aiken County-Barnwell County line (SCE&G 2010b). Figure 9-12 shows the SR alternative site region.

The SRS is an industrial complex that has been extensively studied and characterized as the Federal government has supported nuclear materials based research and development there since the site opened in the early 1950s. Additionally, the SRS is home to a DOE National Laboratory and the nation's first designated National Environmental Research Park.

Table 9-27. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Savannah River Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Energy Projects			
Vogtle Electric Generating Plant (VEGP)	Nuclear power generating plant with 2 units, VEGP 1 (1109 MW(e)) and VEGP 2 (1127 MW(e))	About 17 mi southwest of the SR alternative site	Operational[(a)]
VEGP Units 3 and 4	Nuclear power generating plant with two Westinghouse AP 1000 pressurized water reactors	About 17 miles southwest of the SR alternative site	Proposed[(b)] (Pre-construction activities have commenced. NRC Limited Work Authorization has been issued.)
Cope Generating Station	A 430-MW(e) coal-fired electrical generating plant	About 33 mi east of the SR alternative site	Operational[(c)]
VCSNS Unit 1	VCSNS Unit 1 consists of one 996-MW(e) nuclear power generating plant.	About 70 mi north of the SR alternative site	Operational[(d)]
Hatch Nuclear Plant	Nuclear power generating plant with 2 units, Hatch 1 (876 MW(e)) and Hatch 2 (883 MW(e))	About 100 mi south of the SR alternative site	Operational
Savannah River Site Mixed Oxide (MOX) Fuel Fabrication Facility	Nuclear fuel fabrication	About 5 mi southwest of the SR alternative site	Construction of MOX Facility began in August 2007; operation is expected to begin in 2016[(e)]
Mining Projects			
Hibbits Dirt Pit Mine	Nonmetallic minerals	About 10 mi northwest of the SR alternative site	Permit expired in May 2009[(f)]
Threlko Inc/ Holly #1 Mine	Nonmetallic minerals	About 12.4 mi northwest of the SR alternative site	Operational[(g)]
Eagle Construction/ Robert Collins Pit	Nonmetallic minerals	About 10 miles southwest of the SR alternative site	Operational[(g)]
Transportation Projects			
South Carolina Strategic Corridor System Plan	Strategic system of corridors forming the backbone of the State's transportation system.	State-wide	Planning document with no explicit schedules for projects; however, many strategic corridors coincide with routes that would/could be used for development at the SR alternative site[(h)]

Table 9-27. (contd)

Project Name	Summary of Project	Location	Status
Other Actions/Projects			
Clariant Corporation Martin Plant	Dyes	About 21 mi south-southeast of the SR site	Operational[i]
International Paper Company	Logging	About 20 mi west of the SR alternative site	Operational[j]
Other Actions/Projects			
U.S. Department of Energy Savannah River Site	Research and industrial complex	Same general location as the SR alternative site	Operational[k]
Barnwell Low-Level Radioactive Waste Disposal Facility	Low-level radioactive waste disposal	About 8 mi east of the SR alternative site	Operational[l]
Various hospitals	Medical isotopes	Within 50 mi	Operational in Columbia, Lexington, Newberry, Rock Hill, Lancaster, Laurens, Greenwood, and Camden
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroad; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents.	Throughout region	Construction would occur in the future, as described in state and local land-use planning documents

(a) Source: NRC 2009e
(b) Source: NRC 2009f
(c) Source: SCE&G 2009h
(d) Source: NRC 2004
(e) Source: DOE 2009a
(f) Source: EPA 2009l
(g) Source: EPA 2009m
(h) Source: SCDOT 2009
(i) Source: EPA 2009n
(j) Source: EPA 2009o
(k) Source: DOE 2009b
(l) Source: South Carolina Energy Office 2009

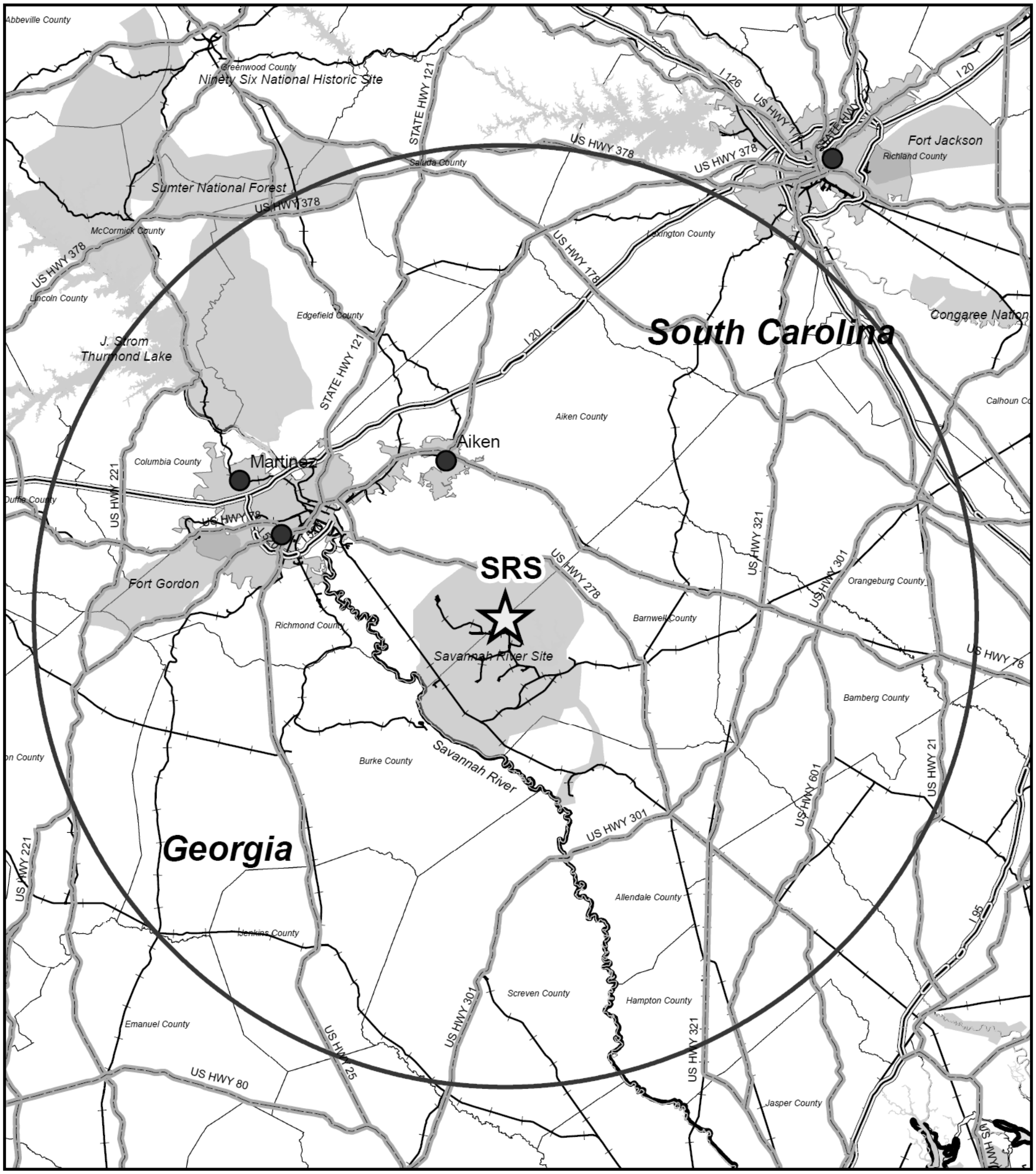

Figure 9-12. Savannah River Alternative Site Region

9.3.6.1 Land Use and Transmission-Line Corridors

In addition to land-use impacts from building and operations, the cumulative analysis for the SR alternative site considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative land-use impacts, including other Federal and non-Federal projects and the projects listed in Table 9-27.

For the analysis of land-use impacts at the SR alternative site, the geographic area of interest is considered to be the 50-mi region centered on the SR alternative site, plus any transmission-line corridors that extend beyond that range. Most but not all of the transmission-line corridor length falls within a 50-mi radius of the site. Land-use planning for transmission-line routing over wide areas must consider land-use plans of adjoining counties and other land-managing agencies, rather than considering the SR alternative site in isolation. Furthermore, in predominantly rural settings such as that surrounding the SR alternative site, land-use changes occurring substantial distances away from a project site can substantially influence land-use planning decisions close to the site.

Roads and other public facilities and services in rural areas tend to serve people who are spread thinly but broadly over large portions of the landscape. Therefore land-use changes can affect roads and other facilities at greater distances than similar changes in more densely populated areas.

The SRS presently is moderately developed, but predominantly forested. The site is a large tract that houses several existing nuclear facilities as part of its DOE mission. It is located in a sparsely populated, largely rural area straddling Aiken and Barnwell Counties, with forests and small farms composing the dominant land use in the vicinity of the site boundary. The site was acquired by the Federal government for development of nuclear weapons facilities after World War II, and consequently is quite large with ample room for development. Several electric transmission lines, State routes, and interstate highways currently traverse the region. As indicated in Section 9.3.6, the site is being actively marketed for development of nuclear facilities. A portion of the SRS has been designated as a National Environmental Research Park (NERP) to be set aside for specifically for environmental and ecological research.

Based on information provided by the applicant and the review team's independent assessment, development of the proposed new units on the SR alternative site would disturb about 534 ac of mostly forested land. A portion of the disturbed land would encroach upon the NERP. SCE&G estimated that the new units would require the addition of five 230-kV transmission lines, each of which would occupy a 100-ft-wide transmission-line corridor. Table 9-28 summarizes expected land-use impact parameters for the SR alternative site and transmission lines. The review team used GIS data provided by the applicant (SCE&G 2010a) to estimate expected land disturbance.

Table 9-28. Land-Use Impact Parameters for the SR Alternative Site

Parameter	Value	Source
Required project area (ac)	1281	SCE&G 2010a, 2011
Estimated land-disturbance area (ac)	534	SCE&G 2010a, 2011 and review team analysis
Number of new transmission–line routes – SCE&G (number of routes)	2	SCE&G 2010b
Number of new transmission-line routes – Santee Cooper (number of routes)	3	
Number of new transmission-line routes – total (number of routes)	5	
Transmission-line corridor distance – SCE&G (mi)	121	SCE&G 2010b
Transmission-line corridor distance – Santee Cooper (mi)	138	
Transmission-line corridor distance – Total (mi)	259	
Transmission-line corridor area – SCE&G (ac)	1093	SCE&G 2010b
Transmission-line corridor area – Santee Cooper (ac)	1171	
Transmission line corridor area – total (ac)	2264	

Based on information provided by SCE&G (SCE&G 2010d) describing dimensions of conceptual transmission-line corridors for the SR alternative site, approximately 259 mi covering 2264 ac of land would be affected. The review team concludes that the land-use impact of the transmission-line installation activities would be generally higher than those described for the VCSNS site in Section 4.1.2. SCE&G stated that all land clearing associated with nuclear facility and transmission-line development would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G or Santee Cooper procedures, good construction practices, and established BMPs (SCE&G 2010b).

Because the other projects described in Table 9-27 do not include any significant reasonably foreseeable changes in land-use types within 50 mi of the SR alternative site, there would not be any significant additional cumulative impacts on land use from those activities.

As described above, installation of new transmission-line corridors to support the new units has the potential to affect as much as 2264 ac over 259 mi of length for SCE&G lines. If additional transmission lines are built under other energy projects, there would be a cumulative land-use impact from the additional amount of land converted to utility corridor use for transmission lines. Because transmission lines are often co-located and are relatively narrow, the review team expects that the cumulative impact would be consistent with the land-use plans and zoning regulations of the affected counties. However, multiple new transmission-line corridors could noticeably alter the land-use classification acreage proportions, both within the vicinity of the SR alternative site and within the 50-mi region.

Cumulative land-use impacts within the region would be consistent with existing land-use plans and zoning. However, due to the potential reclassification of acreage within the region caused by the transmission-line development, the review team concludes that the cumulative land-use impacts associated with the proposed project at the SR alternative site, related transmission-line corridor development, and other projects in the geographic area of interest would be MODERATE. Considering the land needs noted above, building and operating two new nuclear units at the CGS site would be a significant contributor to these impacts.

9.3.6.2 Water Use and Quality

SR alternative site hydrology, water use, and water quality are discussed in ER Section 9.3.3.1.3, and this EIS section draws from information presented in the ER (SCE&G 2010b). The primary source of surface water is the Savannah River, which bounds SRS on it southern boundary. Additional material for this alternative site is available in the *Nuclear Plant Site Selection Study Report* (Tetra Tech NUS, Inc. 2009), the NRC staff's recent testimony to the Atomic Safety and Licensing Board in the matter of the VEGP Units 3 and 4 ESP review, the VEGP Units 3 and 4 COL application ER, and the Vogtle ESP EIS (NUREG 1872, NRC 2008a). The Vogtle site is in the vicinity of the SR alternative site and reactors at this site would rely on the same water resource (Savannah River) as does the existing and proposed Vogtle units.

The Savannah River annual mean and lower annual mean flows measured near Augusta, Georgia, were reported as 9200 and 4470 cfs, respectively, for the 1952–2005 period. The review team examined the annual average flow data for the USGS Augusta station (HUC 03060106, Site Number 02197000) and confirmed that the lowest annual flow for the period reported in the ER was 4470 cfs; however, the review team found that 2008 provided an even lower annual average of 4194 cfs (USGS 2008c). The annual mean flow for 1952–2008 reported by the USGS is 9047 cfs, which is lower than the value for the 1952–2005 period found in the ER. Both updated values of flow are used in Table 9-29.

Table 9-29. Savannah River Reduction in Flow and Assessed Impact Levels

Savannah River Flow Condition	River Flow Rate (cfs)	Normal Consumptive Use (cfs)	Percent Flow Reduction
Annual mean flow	9047	62	0.7
Lowest annual flow	4194	62	1.5

Consumptive use rates for two AP1000 reactors are estimated to be the same as reported in Chapter 3 of this EIS (62 cfs). Operation of the two proposed units at the SR alternative site would require less than 1 percent of the mean annual flow in the Savannah River and would require approximately 1.5 percent of the lowest average annual flow reported for 1952–2008. Therefore, the review team concludes that impacts from surface-water use for building and operation of the proposed project would be minimal.

SCE&G indicates in the ER that groundwater would be used for potable water during building and operations. During 2005, 2.1 billion gallons of water were withdrawn from the Crouch Branch aquifer to support current site operations at the SRS with only localized impacts on water levels. SCE&G estimates that activities associated with the proposed units would increase this withdrawal rate by approximately 0.03 percent (SCE&G 2010b). Therefore, the review team concludes that impacts from groundwater use for building and operation of the proposed project would be minimal.

A SCDHEC-issued NPDES permit would be required to operate the nuclear project at this site. Effluent discharge through an NPDES-permitted outfall would ensure that the discharges complied with the Clean Water Act. Such permits are designed to ensure the protection of water quality and therefore the impact on surface-water quality is assessed to be minimal.

Impacts of the building and operation of the proposed units on groundwater quality may occur due to leaching of spilled pollutants and effluents into the subsurfaces. However, based on the review team's experience with other facilities, the review team concludes that with the implementation of BMPs the impacts on groundwater quality from building and operating two new nuclear units at the SR alternative site would likely be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that affect the same environmental resources. For the cumulative analysis of impacts on surface water, the geographic area of interest for the SR alternative site is considered to be the drainage basin of the Savannah River upstream and downstream of the site, because this is the resource that would be affected by the proposed project. Key actions that have past, present, and future potential impacts on water supply and water quality in the Savannah River basin include operating SCE&G's existing Urquhart Station (a fossil-fueled electrical generating plant) (SCE&G 2009j, 2010b), operating and decommissioning DOE facilities at the SRS, operating two existing nuclear power plants at the Vogtle site, building and operating two new power plants proposed for the Vogtle site, building and operating the proposed SCE&G power plants, and other municipal and industrial activities in the Savannah River basin.

<u>Water Use</u>

The surface-water-use impacts of building and operating two nuclear power plants at the SR alternative site are dominated by the higher demands that would occur under normal operation. The projected consumptive water use of proposed units is expected to be about 62 cfs, or less than 1 percent of the average river discharge of 9047 cfs near the site. This average river flow reflects cumulative consumptive uses of current users upstream of the Augusta gauging station.

In testimony to the Atomic Safety Licensing Board regarding the ESP review for proposed VEGP Units 3 and 4, the NRC staff estimated the consumptive use of all existing water users between the Vogtle site and Thurmond Dam to be 79 cfs. Based on streamflow and discharge records from Thurmond Dam, the NRC staff also concluded at the hearing that the reach between Thurmond Dam and the proposed site is accumulating streamflow from tributaries that more than offset the existing consumptive water uses. Based on revised information for the expected consumptive use of VEGP Units 3 and 4, the estimated combined consumptive use for Units 1, 2, 3, and 4 is 132 cfs (Southern 2009). The consumptive water use by all of these users is 211 cfs and the combined consumptive water-use impact, including the proposed new units at the SR alternative site, would be 273 cfs (Table 9-30). Because the combined consumptive use is below 5 percent of the mean annual flow, the impact is assessed to be minimal.

As discussed in Section 7.2, the review team is aware of the potential climate changes that could affect the water resources available for cooling and the impacts of reactor operations on water resources for other users. Because all of the alternative sites are in the same region, the impact of climate change may be similar for all of the alternative sites.

Table 9-30. Savannah River Reduction in Flow and Combined Water-Use Impact

Savannah River Flow Condition	Flow Rate (cfs)	Normal Combined Consumptive Use (cfs)	Percent Flow Reduction	Impact Level
Annual mean flow	9047	273	3.0	SMALL
Lower annual flow	4194	273	6.5	SMALL

Increases in consumptive use of water in the Savannah River drainage is anticipated in the future. The impacts of the other operational projects listed in Table 9-27 are considered in the analysis included above or would have little or no impact on surface-water use.

As indicated above, groundwater would be used as a potable water source during building and operations. Due to the high yields for the aquifers in this region demonstrated by past use at the SRS, no significant impact is anticipated on other nearby users of groundwater. Therefore, the review team concludes that the cumulative impacts from surface-water and groundwater use for building and operation of the proposed project would be SMALL.

Water Quality

Point and non-point sources have affected the water quality of the Savannah River upstream and downstream of the SRS. Water-quality information presented above for the impacts of building and operating two new units at the SR alternative site would also apply to evaluation of cumulative impacts. As mentioned above, a SCDHEC-issued NPDES permit would be required to operate the nuclear project at this site. Effluent discharge through an NPDES-permitted outfall would ensure that the discharges complied with the Clean Water Act. Such permits are designed to ensure the protection of water quality. The review team also concludes that with the implementation of BMPs, the impacts on groundwater quality from building and operating two new nuclear units at the SR alternative site would likely be minimal, and therefore concludes the cumulative impact on surface and ground water quality would be SMALL.

The impacts of other projects listed in Table 9-27 are either considered in the analysis included above or would have little or no impact on surface-water quality.

9.3.6.3 Terrestrial and Wetland Resources

Site Description

The following impact analysis includes impacts from building and operating the proposed new facilities on terrestrial ecology resources. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-27. For the analysis of terrestrial ecological impacts at the SR alternative site, the geographic area of interest is considered to be the 6-mi region centered on the SR alternative site, plus the associated transmission-line corridors. This 6-mi radius is expected to encompass the ecologically relevant landscape features and species.

The SR alternative site and associated transmission lines would be located in the Sandhills ecoregion of South Carolina and lies on the Aiken/Barnwell County line approximately 25 mi southeast of the city limits of Augusta, Georgia (SCE&G 2010b). The proposed project site would be located on Federal land, surrounded by the greater SRS. Undeveloped areas of the SRS consist mainly of forests and swampland that are managed by the U.S. Forest Service for the DOE (SCE&G 2010b).

The vegetation communities typical of the Sandhills ecoregion include pine-scrub oak sandhill (longleaf pine, turkey oak, blackjack oak, bluejack oak, and wiregrass) xeric sandhill scrub (longleaf pine, turkey oak, wiregrass), and streamhead pocosins (pond pine, red maple, tulip poplar, and evergreen shrubs) (Griffith et al. 2002). The primary cover type at the proposed SR alternative site is planted pine. Since the 1950s, loblolly and slash pine (*Pinus elliottii*) have been grown and harvested as part of a designated forest timber unit to remove and sell harvestable timber (SCE&G 2010b).

Common wildlife species found in the Sandhills ecoregion pine forests that occur on the forested areas of the SR alternative site are white-tailed deer, eastern cottontail, gray squirrel, opossum, and raccoon. A variety of bird species also inhabit the site and include wild turkey, northern mockingbird (*Mimus polyglottos*), and several species of warblers (SCE&G 2010b). A high diversity of reptiles and amphibians reside in the various habitats present on the greater

SRS. The Savannah River Ecology Lab (along with the University of Georgia and others) has documented over a million individuals representing 100 species of reptiles and amphibians on the SRS – the most that have been captured on public land in the entire United States (University of Georgia 2009).

Eight Federally listed species are known to occur in the vicinity of the proposed SR alternative site and/or within the associated proposed transmission-line corridors (SCE&G 2010b). Endangered species include the wood stork, red-cockaded woodpecker, Canby's dropwort, harperella, relict trillium (*Trillium reiquum*), smooth coneflower (*Echinacea laevigata*), pondberry (*Lindera melissifolia*), and American chaffseed (*Schwalbea americana*). The American alligator (*Alligator mississippiensis)* is Federally listed as threatened due to its similarity in appearance to the endangered American crocodile (*Crocodylus acutus*) (SCDNR 2006a; FWS 2008).

In addition to the Federally listed species above, five State-listed species are known to occur in Barnwell, Aiken, Allendale, Bamberg, Lexington, Orangeburg, or Hampton Counties. These endangered species include Rafinesque's big-eared bat, bald eagle, gopher tortoise, and the gopher frog. The spotted turtle is State-listed as threatened (SCDNR 2006a). See Table 9-31 for Federally and Stated-listed species that may occur on the SR alternative site.

SCE&G stated it would perform detailed ecological surveys to protect Federally and State-listed threatened and endangered species that may occur on the project site as part of the permitting process prior to commencing any building activity for the nuclear facility or associated transmission lines (SCE&G 2010b).

Table 9-31. Federally and State-Listed Species That May Occur on the SR Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors

Scientific Name	Common Name	Legal Status	County
Mammals			
Corynorhinus rafinesquii	Rafinesque's big-eared bat	SE	Aiken, Allendale, Bamberg, Barnwell, Hampton, Orangeburg
Birds			
Haliaeetus leucocephalus	Bald eagle	BGEPA/SE	Aiken, Allendale, Bamberg, Barnwell, Hampton, Lexington, Orangeburg
Mycteria americana	Wood stork	FE/SE	Aiken, Allendale, Bamberg, Hampton, Lexington
Picoides borealis	Red-cockaded woodpecker	FE/SE	Aiken, Allendale, Bamberg, Barnwell, Hampton, Lexington, Orangeburg

Table 9-31. (contd)

Scientific Name	Common Name	Legal Status	County
Reptiles			
Clemmys guttata	Spotted turtle	ST	Aiken, Allendale, Bamberg, Barnwell, Hampton
Gopherus polyphemus	Gopher tortoise	SE	Aiken, Allendale, Hampton
Amphibians			
Ambystoma cingulatum	Flatwoods salamander	FT/SE	Orangeburg
Rana capito	Gopher frog	SE	Aiken, Barnwell, Hampton, Orangeburg
Pseudobranchus striatus	Dwarf siren	ST	Hampton, Orangeburg
Vascular Plants			
Echinacea laevigata	Smooth coneflower	FE/SE	Aiken, Allendale, Barnwell, Lexington
Helianthus schweinitzii	Schweinitz's sunflower	FE/SE	Lexington
Oxypolis canbyi	Canby's dropwort	FE/SE	Allendale, Bamberg, Barnwell, Hampton, Orangeburg
Ptilimnium nodosum	Harperella	FE/SE	Aiken, Barnwell
Trillium reliquum	Relict trillium	FE/SE	Aiken

Sources: SCE&G 2009d; SCDNR 2010; FWS 2010
BGEPA = Bald and Golden Eagle Protection Act; FE = Federally listed as endangered; FT = Federally listed as threatened; SE = State listed as endangered; ST = State listed as threatened

Building Impacts

The SR alternative site is mostly planted pine (SCE&G 2010b). Building activities at the proposed site would affect approximately 14.6 ac of wetlands (SCE&G 2010a). SCE&G stated that although there are over 300 Carolina bays (elliptical depressions concentrated along the Atlantic seaboard that vary in size from one to several thousand acres) on the greater SRS, there would be few impacts on streams or wetlands on the project site (SCE&G 2010a, b). SCE&G stated that the nuclear facility could be sited to avoid wetlands whenever possible and potential impacts on wetlands near building zones would be minimized through the use of BMPs (SCE&G 2010b).

Table 9-28 provides information about the number, route, and area of the proposed transmission-line corridors that would serve the proposed new facilities at the SR alternative site. SCE&G and Santee Cooper would both build and maintain a portion of the new transmission lines and details are provided in Table 9-32 and Table 9-33 (SCE&G 2009d).

Table 9-32. SCE&G Transmission-Line Information for the SR Alternative Site

Transmission-Line Segment	Length of Corridor (mi)	Acres of Corridor	Acres of Forested Wetlands	Acres of Nonforested Wetlands	Acres of Open Water
SRS-Cope-Edenwood	93	854	159	8	4
SRS-SRP	7	56	--	6	--
SRS-Urquhart	22	183	9	--	--
Total	122	1093	168	14	4

Source: SCE&G 2009d

Table 9-33. Santee Cooper Transmission-Line Information for the SR Alternative Site

	New Corridor (1171 ac)		Existing Corridor (0 ac)		Total Corridor (1171 ac)	
Wetlands Estimate	Acres	Percent of Corridors	Acres	Percent of Corridors	Acres	Percent of Corridors
Hydric soils	324	28	0	NA	324	28
NWI wetlands	65	6	0	NA	65	6

Source: SCE&G 2009d
NA = Not applicable; NWI = National Wetlands Inventory

The new lines could cause significant wetland impacts through wetland conversion due to forest clearing. SCE&G stated that all land clearing associated with nuclear facility and transmission-line development would be conducted in accordance with Federal, State, and local regulations, permit requirements, existing SCE&G and Santee Cooper procedures, and established BMPs (SCE&G 2010b).

Past actions in the geographic area of interest that have similarly affected terrestrial resources include the construction of DOE's SRS, portions of which are located less than 1 mi from the SR alternative site. The building of the DOE SRS contributed to the loss of terrestrial habitat. The MOX Fuel Fabrication Facility at the DOE SRS, which began construction in 2007 approximately 5 mi west of the SR alternative site (see Table 9-27) is a project in the geographic area of interest that would cumulatively affect terrestrial ecological resources in a similar way.

Proposed future actions that would affect terrestrial resources in a similar way to development at the SR alternative site would include the operation of the SRS MOX Fuel Fabrication Facility (located approximately 5 mi from the alternative SR site), transmission-line creation and/or upgrading throughout the designated geographic region of interest, and future urbanization, which would also be expected to occur. However, a large portion of land, approximately 14,000 ac, within the geographic region of interest has been set aside for nondestructive environmental research. This tract of land is managed for the benefit of wildlife and is designated as a National Environmental Research Park (SCE&G 2010b). It is important to note that a portion of the 14,000 ac of the wildlife preserve would be cleared and developed as part of the proposed action (SCE&G 2010b).

Impacts from building two nuclear units and supporting facilities on wildlife habitat would be unavoidable, and activities that would affect wildlife include land clearing and grading (temporary and permanent), filling and or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the affected areas. Some wildlife, including important species, would perish or be displaced during land clearing for any of the above projects as a consequence of habitat loss, fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities. Undisturbed land adjacent to the project could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from noise is expected to be temporary and minor. The creation of new transmission-line corridors could be beneficial for some species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer, northern bobwhite quail, eastern meadowlark, and the gopher tortoise. Birds of prey, such as red-tailed hawks would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in a herbaceous or scrub-shrub condition that could provide improved foraging habitat for waterfowl and wading birds. However, fragmentation of forests could affect species that are dependent on large tracts of continuous forested habitat.

The review team concludes that the impacts on terrestrial resources from building two new nuclear units and associated transmission lines at the SR alternative site would be noticeable, but not destabilizing.

Operational Impacts

Impacts on terrestrial ecological resources from the operation of two new nuclear units at the SR alternative site primarily include those associated with cooling towers and transmission lines. Impacts resulting from the operation of cooling towers and transmission lines are discussed in detail in Section 9.3.3.3 and would apply to the SR alternative site.

No past, present, or future actions in the geographic area of interest were identified that would significantly affect terrestrial habitat and wildlife, including important species, in ways similar to those associated with the operation of two new units.

The review team concludes that the impacts of operating two new units and associated transmission lines at the SR alternative site on terrestrial resources and wetlands would be minimal.

Summary Statement

Impacts on terrestrial ecology resources are estimated based on the information provided by SCE&G and the review team's independent review. There are past and future activities in the geographic area of interest that could affect wildlife and wildlife habitat in ways similar to the building of two units at the SR alternative site. The SR alternative site and some of the associated transmission-line corridors are natural habitats that would be altered by development and maintenance activities, noticeably affecting the level and movement of terrestrial wildlife populations in the area of interest. Other anticipated development projects would further alter wildlife habitats and migration patterns in the surrounding landscape. The review team therefore concludes that cumulative impacts on baseline conditions for terrestrial resources would be MODERATE. Building and operating two new nuclear units and associated transmission lines at the SR alternative site would be a significant contributor to the MODERATE impact.

9.3.6.4 Aquatic Resources

The following impact analysis includes impacts from building activities and operations on aquatic ecology resources. The SRS encompasses 310 mi^2 of land that are within the boundaries of three counties in South Carolina: Aiken, Barnwell, and Allendale. The Savannah River basin encompasses 10,577 mi^2 within the states of North Carolina, South Carolina, and Georgia. In the State of South Carolina, the Savannah River basin includes 35 watersheds and flows through the Blue Ridge, Piedmont, and Coastal Plain physiographic provinces (SCDHEC 2003). The SR alternative site falls within the Lower Savannah River basin and is encompassed by two watersheds: the Savannah River (HUC 03060106-110) and the Upper Three Runs (HUC 03060106-100) (SCDHEC 2003). The geographic region of interest includes both the Upper Three Runs and Savannah River watersheds, based on the most affected waterbodies of the SR alternative site.

The following information was derived from the SCDHEC report titled *Watershed Water Quality Assessment: Savannah River Basin* (SCDHEC 2003). Of the 157,409 ac within the watershed associated with the proposed plant footprint, aquatic resources include forested wetlands (9.9 percent), water (0.2 percent), and nonforested wetlands (0.1 percent). There are approximately 224 mi of streams and 198 ac of lake waters within the Upper Three Runs watershed. Monitoring data from three waterbodies (Upper Three Runs, Cedar Creek, and Tims Branch) indicate that water quality would fully support aquatic life. Upper Three Runs and Tims Branch are blackwater systems, which are typified by naturally low-pH conditions. Historically, the SR alternative site is a part of the larger DOE SRS, which is a large industrial complex now involved in various regulated cleanup activities from nuclear weapon production or nuclear materials preparation and storage that began in the early 1950s (DOE 2009b).

Recreationally Important Species

The Savannah River supports diverse fisheries that are ecologically, recreationally, and commercially important. Recreationally and or commercially important fish within the vicinity of the SR alternative site include catostomids (i.e., suckers), ictalurids (i.e., catfish, bullheads, madtoms), moronids (i.e., temperate basses), centrarchids (i.e., sunfishes), and mugilids (e.g., mullets). Esocids (i.e., pikes and pickerels) are recreationally important fish, and they may also be considered a keystone species due to their keen predatory capabilities. Some members of the percid family are recreationally and commercially important (e.g., perches); others (e.g., darters) are sensitive to disturbance and serve as indicators of ecosystem health (Marcy et al. 2005).

Industrial contamination within the Savannah River has resulted in fish advisories within the watershed. Contaminants of concern include mercury, cesium, and strontium (Burger et al. 2001). In the vicinity of the SR alternative site, SCDHEC (2009b) advises avoiding the consumption of bowfin, restricting the consumption of largemouth bass to one meal per month, and restricting the consumption of chain pickerel and spotted sucker (*Minytrema melanops*) to one meal per week.

Invasive Species

Asian clam (*Corbicula fluminea*) has been documented within the vicinity of the SR alternative site on the Savannah River (The Catena Group 2007).

Critical Habitats

No critical habitat has been designated by the FWS in the vicinity of the SR alternative site.

Federally and State-Listed Species

Federally, proposed Federally, and State-listed species that may occur in the vicinity of the SR alternative site or waterbodies associated with transmission-line corridors are listed in Table 9-34. The proposed transmission-line corridors lie entirely or mostly within the Coastal Plain ecoregion and would cross Aiken, Allendale, Bamberg, Barnwell, Hampton, Lexington and Orangeburg Counties (SCE&G 2009d). SCE&G has stated that on-the-ground field surveys would be conducted upon determination of final routes and prior to commencement of any building activities related to the site or transmission-line corridors as part of the permitting process (SCE&G 2010b). Aquatic species listed for Burke County, Georgia, are also included because the Savannah River separates South Carolina and Georgia at the SR alternative site.

Table 9-34. Federally, Proposed Federally, and State-Listed Aquatic Species That May Occur on the SR Alternative Site, Including the Vicinity and Associated Transmission-Line Corridors

Scientific Name	Common Name	Status	County
Fish			
Acipenser brevirostrum	Shortnose sturgeon	FE/SE	Aiken, Allendale, Barnwell, Burke, Hampton, Lexington, Orangeburg
Acipenser oxyrinchus	Atlantic sturgeon	PFE	Aiken, Allendale, Barnwell, Burke, Hampton, Lexington, Orangeburg
Moxostoma robustum	Robust redhorse	SE	Burke
Mollusks			
Lasmigona decorata	Carolina heelsplitter	FE/SE	Lexington
Fusconaia masoni	Atlantic pigtoe	SE	Burke

Sources: SCE&G 2010b; FWS 2010, 2011; SCDNR 2010; GDNR 2010; 75 FR 61904
FE = Federally Endangered, SE = State Endangered, FT = Federally Threatened, PFE = Proposed Federally Endangered

Shortnose Sturgeon

The shortnose sturgeon, State-endangered in Georgia and South Carolina, is the only Federally listed aquatic species known to occur in Aiken and Barnwell Counties, South Carolina, and in Burke County in Georgia (GDNR 2010; SCDNR 2010; FWS 2010). The shortnose sturgeon was initially listed as a Federally endangered species in 1967 and is designated as a species of highest conservation priority by SCDNR (McCord 2006; NMFS 1998). This amphidromous species uses freshwater, estuarine, and marine habitats to complete its life cycle (Rohde et al. 2009; McCord 2006; NMFS 1998). In South Carolina, populations of shortnose sturgeon exist in the Ashepoo, Combahee, and Edisto rivers (flowing to St. Helena Sound), the Pee Dee, Waccamaw, and Black rivers (flowing to Winyah Bay); and the Savannah, Cooper, and Santee rivers. There is also a small landlocked population of shortnose sturgeon in the Santee-Cooper Lake system (Collins et al. 2003). In freshwater habitats, shortnose sturgeon are associated with soft bottom substrates in deep water. In South Carolina, spawning occurs in fresh waters characterized by low-to-moderate velocities and over substrates that include clay, sand, gravel and woody debris (Rohde et al. 2009; McCord 2006). Spawning is known to occur in the Savannah River upstream of the SRS facility, and larval shortnose sturgeon were collected in the vicinity of SRS during ichthyoplankton surveys conducted between 1982 and 1985 (Wike 1998). Eggs are adhesive and survival is reportedly dependent on water having little turbidity (McCord 2006).

Atlantic Sturgeon

The Atlantic sturgeon is not currently listed either Federally or by the State of South Carolina. However, on October 6, 2010, the NMFS published in the *Federal Register* (75 FR 61904) a proposed rule for listing the Carolina and South Atlantic distinct population segments of the Atlantic sturgeon as endangered under the ESA. In light of this proposed listing, the review team is now considering the Atlantic sturgeon in its analysis.

Characteristics of the early life-history attributes of Atlantic sturgeon, such as age at seaward migration and residence time in freshwater habitats varies within natal streams as well as across geographic regions (Jenkins and Burkhead 1994). Juveniles migrate from spawning areas toward saline habitats where individuals spend months to years rearing in estuarine environments. In marine environments, Atlantic sturgeon make extensive migrations from their natal estuary presumably to productive foraging grounds (ASSRT 2007). Spawning is believed to occur in flowing water between the salt wedge and the fall line of large rivers. Like the shortnose sturgeon, spawning adults generally migrate upriver during the spring (February to March) in southern rivers. While Atlantic sturgeon have been noted to occur in many South Carolina coastal rivers during the past several decades, specific information detailing population records for each of these rivers is not readily available. There appears to be little quantitative evidence linking the occurrence of Atlantic sturgeon in specific streams and rivers to spawning populations in South Carolina. South Carolina rivers with recent documented occurrences of Atlantic sturgeon include Waccamaw, Pee Dee, Santee, Cooper, Edisto, Combahee, Coosawatchie, and Savannah Rivers (ASSRT 2007). Atlantic sturgeon are known to occur and spawn in the Savannah River, with records documenting 70 individuals having been captured since 1999 (ASSRT 2007). Although specific spawning locations have not been identified, sturgeon larvae have been collected near the SRS (Paller et al. 1986). A fall-spawning migration also may occur in some southern rivers (ASSRT 2007).

Robust Redhorse

The robust redhorse (*Moxostoma robustum*) is listed as endangered by the State of Georgia, which shares the Savannah River watershed with South Carolina (FWS 2008). The robust redhorse is known to occur in the Savannah River near the vicinity of the proposed SR alternative site (Marcy et al. 2005). Robust redhorse prefer medium-to-large creeks and rivers with gravel or rocky substrate. Spawning season lasts from March to May and fry reach sexual maturity in 4 to 5 years (Rohde and Parnell 1994).

Atlantic Pigtoe

The Atlantic pigtoe is State-listed as endangered for Burke County, Georgia. The Atlantic pigtoe is found in habitats that consist of coarse sand and gravel at the downstream edge of riffles associated with fairly pristine, well oxygenated streams (Bogan and Alderman 2004). Although this species was first described in the Savannah River, there are no records of occurrences in the Savannah River near the SR alternative site (NRC 2008a).

Building Impacts

Because the SRS is a former nuclear power plant site, the vicinity of the SR alternative site includes some of the infrastructure (e.g., roads, railroad lines, buildings) necessary to support a new facility. SCE&G has indicated that existing roads and railroad lines on the SRS would be used where practicable (SCE&G 2010b); however, SCE&G's proposed locations of the powerblock, switchyard, and cooling towers do not occur within the footprint of existing facilities, so disturbance of aquatic ecosystems may be required during building activities.

Cooling-system makeup water would be derived from the Savannah River, which is also proposed to receive station blowdown water (SCE&G 2009b). Installation of new intake and discharge structures would result in the temporary displacement of aquatic biota within the affected areas. There would be impacts on water quality stemming from direct (e.g., dredging, shoreline excavation, removal of riparian vegetation) and indirect sources (e.g., stormwater runoff, sedimentation). In addition, activities that include land clearing associated with new infrastructure (roads, site footprint) and upgrading existing features (railroad lines) would affect approximately 1628 linear feet out of a total of approximately 6911 linear feet of onsite streams and the entire 0.6 ac of open water present onsite (SCE&G 2010a).

New transmission lines and corridors are a necessary component of the proposed SR alternative site, because the existing infrastructure cannot support the energy transport needs of the proposed new units (SCE&G 2010b). According to SCE&G (2010b), the new transmission-line corridors would be required. The transmission-line corridors would be maintained by SCE&G or Santee Cooper, respectively. For SCE&G lines, transmission-line corridors would be associated with approximately 15,594 linear feet of streams and approximately 4 ac of open water are located within the new transmission-line rights-of-way (SCE&G 2009d). The new Santee Cooper transmission-line corridors associated with the SR alternative site would include an estimated 70 stream crossings, 3 of which would be State navigable waters crossings (MACTEC 2009). SCE&G stated that all land clearing associated with plant and transmission-line site preparation and development would be conducted according to Federal, State, and local regulations, permit requirements, existing SCE&G or Santee Cooper procedures, and established BMPs (SCE&G 2010b). Past or present actions in the geographic area of interest that have the potential to affect aquatic ecological resources in ways similar to those associated with the building of the proposed new units at the SR alternative site include the construction of VEGP Units 1 and 2 across the Savannah River and approximately 5 river mi downstream from the SR alternative site and the MOX Fuel Fabrication Facility at the DOE SRS, which began construction in 2007 approximately 5 mi west of the SR alternative site (see Table 9-27). Operation of the MOX facility would be a future action. A proposed future action that would affect aquatic resources in a similar way to development at the SR alternative site would include building VEGP Units 3 and 4, which, depending on the timing for building these two new units, may coincide with building the new units at the SR alternative site. The impacts on the Savannah River for building the new VEGP units are expected to be minimal (NRC 2008a).

Additional future actions include transmission-line creation and/or upgrading throughout the designated geographic region of interest and future urbanization.

Operational Impacts

Aquatic impacts associated with the operation of the SR alternative site would include intake-related impingement and entrainment losses of aquatic biota as well as water-quality impacts near the vicinity of the intake and discharge structures in the Savannah River. There are several intake/discharge configurations designed to minimize impacts on aquatic biota. Assuming SCE&G would use a closed-cycle cooling system designed to meet the EPA's 316(b) Phase I requirements for new facilities (66 FR 65256), the intake would have a maximum through-screen velocity at the cooling-water intake of less than 0.5 fps. Additionally, the cooling water intake would meet the EPA intake flow-to-source water volume criterion. Adverse impacts on aquatic biota from impingement and entrainment effects would not be anticipated.

Operational impacts associated with water quality and discharge are likely to be minimal and NPDES compliant. The diverse fish found within the vicinity of the SR alternative site exhibit a range of life-history characteristics that include a variety of habitat associations during certain life phases. Impacts would likely be greatest on nonmotile benthic aquatic organisms that occur within the vicinity of the discharge area. Based on the review team's experience with other facilities, the review team concludes that with proper design the impacts on aquatic resources from operation of two new nuclear units at the SR alternative site would likely be minimal.

The review team also concludes that operational impacts on aquatic biota from maintenance of the transmission-line corridors would be minimal assuming appropriate BMPs are used.

Cumulative Impacts

Cumulative impacts that could result from the operation of two new units at the SR alternative site would include intake-related impingement and entrainment losses and chemical and thermal discharge from station blowdown. Past and present actions in the geographic area of interest that have the potential to affect aquatic ecological resources include the operation of the DOE SRS, which has current NPDES permits for the D-Area Powerhouse and industrial inorganic chemicals that are discharged into the Savannah River; the VEGP nuclear energy facility whose water withdrawals and discharges to the Savannah River are controlled by a Georgia Department of Natural Resources NPDES permit; and the SCE&G's Urquhart Station, a fossil fuel steam electric generating plant whose withdrawals and discharges to the Savannah River are controlled by a SCDHEC NPDES permit.

The former Savannah River Plant (SRP) began operation during the 1950s and has been the focus of many environmental investigations since that time (Marcy et al. 2005). The rates of impingement of aquatic biota from the formerly operating SRP were reported to be low (compared to other facilities) during a 1977 study. Bluespotted sunfish (*Enneacanthus gloriosus*), warmouth (*Lepomis gulosus*), channel catfish, and yellow perch (*Perca flavescens*) were among the most commonly impinged species. Of these common species, no single species accounted for more than 10 percent of the samples (McFarlane et al. 1978). Thermal discharge associated with the SRP was correlated with species assemblages and abundance of fish in the vicinity of the plant (Paller and Saul 1986). Species assemblages in the intake canal were dominated by bluegill, redbreast sunfish, and black crappie (*Pomoxis nigromaculatus*). Habitats with elevated thermal conditions had larger proportions of channel catfish, white catfish, largemouth bass, and coastal shiner (*Notropis petersoni*), and a lower proportion of flat bullhead. The low impingement rates reported from the SRS, despite higher withdrawal rates and through-screen velocities than those planned for the SR alternative site, support the conclusion that impingement rates at the new intake would not result in a detectable impact on the Savannah River fishery.

Recently, Georgia Power conducted both entrainment (Georgia Power 2008) and impingement (Georgia Power 2009) assessments to characterize current entrainment and impingement rates at VEGP Units 1 and 2 and to project impacts for proposed VEGP Units 3 and 4. These data were also compared with SRS entrainment and impingement studies. The results from these recent assessments indicate that entrainment and impingement effects on fishery resources of the Savannah River from VEGP Units 1 and 2 are minimal and that anticipated effects from proposed Units 3 and 4 would not be significant (Georgia Power 2008, 2009).

Future actions in the geographic area of interest that would affect aquatic ecological resources in ways similar to those associated with the operation of the proposed new units at the SR alternative site include the operation of two additional units at the VEGP site. The operation of proposed VEGP Units 3 and 4 would use the Savannah River for cooling water and discharge of station blowdown in a manner similar to the operating VEGP Units 1 and 2 (NRC 2008a). Impingement and entrainment for intake operation of proposed VEGP Units 3 and 4 were determined to result in minor impacts, as were the potential impacts for thermal and chemical discharges to the Savannah River (NRC 2008a). Water use from the Savannah River for six reactors is not likely to result in noticeable impacts as described in Section 9.3.6.2. Anthropogenic activities such as industrial development near the vicinity of the nuclear facility may also contribute to future cumulative impacts.

Summary Statement

Impacts on aquatic ecology resources are estimated based on the information provided by SCE&G, the State of South Carolina, FWS, NMFS, and the review team's independent review. There are past and future activities in the geographic area of interest that could affect aquatic ecology resources in ways similar to the building and operation of two units at the SR alternative site. Proper siting of facilities; avoiding habitat for protected species and minimizing interactions with waterbodies and watercourses along the transmission-line corridors; and using appropriate

BMPs during intake and discharge installation, corridor preparation, and tower placement would minimize impacts. Based on the information provided by SCE&G, the State of South Carolina, FWS, NMFS, and the review team's independent evaluation, the review team concludes that the cumulative impacts of building and operating two new reactors on the SR alternative site combined with other past, present, and future activities on aquatic resources in the Savannah River drainage would be SMALL.

9.3.6.5 Socioeconomics

For the analysis of socioeconomic impacts at the SR alternative site, the geographic area of interest is considered to be the 50-mi region centered on the SR alternative site with special consideration of Richmond and Columbia Counties in Georgia and Aiken and Barnwell Counties in South Carolina, because that is where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of site development and operation at the SR alternative site, the review team undertook a reconnaissance survey of the region using readily obtainable data from the ER, the alternative site audit, and Federal, State, and local government agencies. The analysis also considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources, including other Federal and non-Federal projects and the projects listed in Table 9-27. The impacts from both building and station operation are discussed below.

Physical Impacts

Many of the physical impacts of building and operation would be similar regardless of the site. Building activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting (if used), and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport construction materials and equipment. Offsite areas that would support building activities (e.g., borrow pits, quarries, and disposal sites) would be expected to be already permitted and operational.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions (the latter are discussed under aesthetics and recreation). New units would produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, and switchyard equipment. Traffic at the site also would be a source of noise. The review team assumed that the same standard noise protection and abatement procedures used for the VCSNS site would be used to control noise coming from the SR alternative site. This practice also would be expected to apply to all alternative sites. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the alternative site.

The new units at the SR alternative site would likely have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the physical impacts of building and operating two new nuclear units at the SR alternative site would be minimal.

Demography

The SRS, within which the SR alternative site is situated, is located in Aiken, Barnwell, and Allendale Counties in southwestern South Carolina, approximately 25 mi southeast of Augusta, Georgia. The SRS is bordered by the Savannah River to the southwest for about 35 mi. The closest economic center is Aiken, South Carolina (2007 population 29,218), approximately 18 mi from the SRS (USCB 2009). The population within the 50-mi radius of the site is estimated to be 766,127 (SCE&G 2010b).

Currently, 84 percent of the SRS workforce lives in one of four counties, distributed as follows: Richmond (20.2 percent) and Columbia (11.9 percent) Counties in Georgia and Aiken (60.7 percent) and Barnwell (7.1 percent) Counties in South Carolina (SCE&G 2010b). The in-migrating population would be expected to reside within this four-county area in the same pattern as the existing workforce. Therefore, these four counties compose the economic impact area and are the focus of the following analysis.

At the peak of the plant building activities, SCE&G would expect the workforce onsite to be 3600. Because of the rural nature of the two sites and the fact that the SRS also hosts existing nuclear facilities, development of the proposed new units on the SR alternative site would have similar socioeconomic impacts in most respects to adding two new units to the VCSNS site. The review team concludes that because the economic impact area includes portions of two larger metropolitan areas (Aiken and Augusta), migration patterns would be similar to those expected at the VCSNS site. About 50 percent or 1800 would migrate to the economic impact area in rough proportion to the current operating workforce of the SRS. Using South Carolina's average household size of 2.53, this would bring the total in-migrating population to 4554. Considering that the estimate of the in-migrating population represents about 1.1 percent of the population of the economic impact area in 2000, the review team expects the regional demographic impacts of the project to be minor. Once the facility is operational, SCE&G estimates that the workforce would be about 800 employees. SCE&G also estimates that the additional 130 site support workforce already exists at the SRS, based on nuclear facilities already operating there, and additional support workers would not be needed (SCE&G 2010b). The review team assumed 50 percent of these workers would migrate into the four-county economic impact area, similar to what would be expected at the VCSNS site. The review team expects the demographic impact during operations to be minimal. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the demographic impacts of building and operating two new nuclear units at the SR alternative site would be minimal.

Taxes and Economy

According to SCE&G, in lieu of property taxes, SRS currently pays a fee to the counties whose land area includes the SRS. The proposed site sits on the Aiken/Barnwell County line, currently Aiken County receives $800,000 and Barnwell County receives $2 million annually. The proposed nuclear facility would increase the fee base to the two counties for the life of the proposed project. The review team finds that increased fees from the proposed project based on the value of the new facilities would likely be paid to Aiken and Barnwell Counties. These fee increases are likely to increase the SRS proportion of property tax revenues in Aiken and Barnwell Counties by some noticeable percentage (SCE&G 2010b).

The wages and salaries of the project workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors. SCE&G acquired RIMS II economic multiplier values specific to this economic impact area from the U.S. Bureau of Economic Analysis (BEA 2006), which permit detailed examination of potential economic impacts with individual multipliers attributable to construction activities and plant operations activities. Using the RIMS multiplier of 1.75, the 3600 construction jobs would create 2700 indirect jobs in the economic impact area, for a total of 6300 jobs supported by the project. Because the review team assumes 50 percent of the project workforce would migrate to the region, the approximate net employment effect of the project would be 3150 new jobs spread over the four counties. This would have a beneficial but temporary impact on the business community and could provide (1) opportunities for new businesses to get started and (2) increased job opportunities for local residents. Once the new units are operational, approximately 800 new operations jobs would be added to the local economy. Using a multiplier of 2.64, the 800 operations and support jobs would create 1312 indirect jobs in the economic impact area, for a total of 2112 jobs supported by plant operations. Because the review team assumes 50 percent of the workforce would migrate to the region, the approximate net employment effect of operations would be 1056 new jobs spread over the four counties. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that the economic and tax base impacts of building and operating two new nuclear units at the SR alternative site would be minor in the four-county area, but would be noticeable in Aiken and Barnwell Counties.

Transportation and Housing

The proposed site can be accessed by a number of routes. The transportation network includes one east-west interstate highway (I-20), north-south US-1 and US-25/SC-121, and east-west US-78 and US-278. There are several other US and State highways in the SRS region. Delays are currently experienced around the Savannah River bridges on I-20, US-25, and US-1. Sufficient railroad lines exist near the site. Given the extensive transportation network that exists in the SRS region and implementation of traffic-control measures such as staggering shifts, the review team expects transportation impacts from building and operating a nuclear facility on the SR alternative site to be minor.

Approximately 1800 construction workers would migrate into the region during peak project employment. Approximately 465 operations workers would migrate into the region by the time the facility becomes operational. Construction workers may choose to buy housing, rent, use mobile homes, or stay in a hotel/motel, while operations workers would likely choose to buy a house. According to the 2000 U.S. Census there were 187,811 housing units in the four-county area, of which 6400 in Aiken County 1170 in Barnwell County, 8392 in Richmond County, and 2201 in Columbia County were vacant, for a total of 18,163 vacant units (SCE&G 2010b). The review team expects that the in-migrating workforce could be absorbed by the region and the impacts would likely be minimal, but if a higher than expected number of workers decided to reside in one of the smaller counties such as Aiken or Barnwell County then the impact would be more noticeable. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that transportation and housing impacts of building and operating two new nuclear units at the SR alternative site would be minor across the four-county area, and would be noticeable in Aiken and Barnwell Counties but not destabilizing.

Public Services and Education

In-migrating construction workers and plant operations workers would likely affect local municipal water, wastewater treatment facilities, and other public services in the region. The in-migrating workers represent a small portion of the total population of Aiken or Barnwell Counties and likely would not have a noticeable impact on their public services. During operations the impact on public services would likely be minimal.

SCE&G reports in its ER (SCE&G 2010b) that during the 2004–2005 school year, Aiken County had 40 PK-12 schools, Barnwell County had 11 schools, Richmond County had 89 schools, and Columbia County had 29 schools (SCE&G 2010b). Total enrollment for Aiken, Barnwell, Richmond, and Columbia Counties for the 2004–2005 school year was 25,299, 4721, 34,141, and 20,570, respectively. A maximum of 938 students are expected to migrate into the four-county area, during peak project employment and this number would decline to 484 during operations. Based on the analysis in the demography section above, it is expected that approximately 60.7 percent of the students would settle in Aiken County, 7.1 percent in Barnwell County, 20.2 percent in Richmond, and 11.9 percent in Columbia County. This would increase the student population in Aiken County by 2.3 percent, Barnwell County by 1.4 percent, Richmond County by 0.6 percent, and Columbia County by 0.5 percent. During facility operations, the increase in student body would be one percent for Aiken County, 0.6 percent for

Barnwell County, 0.2 percent for Richmond County, and 0.2 percent for Columbia County (SCE&G 2010b). During operation, this impact on schools would be significantly less due to the lower number of in-migrating students. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that public services and education impacts of building and operating two new nuclear units at the SR alternative site would be minor.

Aesthetics and Recreation

The SRS is government-owned and not open to the public, but certain recreational activities such as guided tours, controlled deer hunts, and environmental studies are allowed on the site. Other recreational areas within 50 mi of the SRS include Sumter National Forest, Santee National Wildlife Refuge, Thurmond Lake, Crackerneck Wildlife Management Area, and various other State, county, and local parks. The intake structures would be visible to people recreating on the Savannah River in the immediate vicinity. Other facility structures would be similar to existing structures in the area and mainly hidden by river bends, elevated terrain, and vegetation (SCE&G 2010b). Project activities would increase the noise level at the site, but because of its location on an industrial site, this would likely only impact the current industrial residents. Based on the information provided by SCE&G and the review team's independent evaluation, the review team concludes that public aesthetics and recreation impacts of building and operating two new nuclear units at the SR alternative site would be minimal.

Summary of Project-Related Socioeconomics

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. In summary, on the basis of information provided by SCE&G and the review team's independent evaluation, the review team concludes that the adverse impacts of building and operating a new nuclear plant at the SR alternative site on socioeconomics would be minimal for most of the region but could be noticeable but not destabilizing for Aiken and Barnwell Counties in terms of housing impacts during the building phase. During operation, these impacts are expected to be minimal. Impacts on aesthetics are expected to be minor. The impacts on the tax base of Aiken and Barnwell Counties during operations likely would be noticeable and beneficial; however only minor beneficial tax impacts would result in the rest of the region.

Cumulative Impacts

The projects identified in Table 9-27, particularly the future urbanization of the metropolitan area of Augusta, Georgia, have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Because the projects within the review area identified in Table 9-27 would be consistent with applicable land-use plans and control policies, the review team considers the cumulative socioeconomic impacts from the projects to be minimal.

For the analysis of socioeconomic impacts at the SR alternative site, the geographic area of interest is considered to be the 50-mi region centered on the SR alternative site, with special consideration of Richmond and Columbia Counties in Georgia and Aiken and Barnwell Counties in South Carolina, because that is where the review team expects socioeconomic impacts to be the greatest.

The SRS is a large site covering parts of Aiken, Barnwell, and Allendale Counties in southwestern South Carolina. The employment in the area surrounding the SR alternative site is a mixture of State and local government, retail, manufacturing, and construction. The majority of the region's workforce resides to the north in Aiken, Lexington, and Orangeburg in South Carolina, or in Richmond and Columbia Counties in Georgia to the northwest of the site. Since 2001, however, there has been a shift away from the manufacturing sector towards other sectors. While still the largest single employment sector the in the region, manufacturing's decline during the period of 2001 to 2007 was approximately 15 percent. Hardest hit by the contraction of the manufacturing sector has been Burke County, Georgia, part of the Augusta metropolitan area, which lost approximately 11,555 manufacturing jobs during this period of time (BEA 2009). The healthcare and social assistance sector was the fastest growing sector in the region, having grown approximately 23 percent from 31,368 employees in 2001 to 38,668 employees in 2007 (BEA 2009). The United States Army Base, Fort Gordon, located in Richmond County and Columbia County, Georgia, also employs approximately 16,000 active personnel in addition to 3800 civilian employees (Augusta 2008). The facilities located at the SRS itself, although employing fewer now than it has in the past, continues to employ approximately 13,373 people combined as of 2003, 7845 (83 percent) of whom live in Aiken, Barnwell, or Richmond Counties (Augusta 2008).

The cumulative impact analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on a given region, including other Federal and non-Federal projects and the projects listed in Table 9-27. The projects listed in Table 9-27 have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Adverse cumulative impacts would include physical impacts (on workers and the local public, buildings, transportation, and visual aesthetics) and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and schools).

Because most projects described in Table 9-27 do not include any significant reasonably foreseeable changes in socioeconomic impacts within 50 mi of the SR alternative site, the review team determined there would be no significant additional cumulative socioeconomic impacts in the region from those activities. Economic impacts associated with activities listed in Table 9-27 already have been considered as part of the socioeconomic baseline used for establishing the RIMS II multipliers. Regional planning efforts and associated demographic projections available at a reconnaissance level formed the basis for the review team's assessment of reasonably foreseeable future impacts. For example, the construction and operation of the SRS MOX Fuel Fabrication Facility is currently in year 3 of construction. The NRC estimated that at project peak employment a total of 1820 jobs would be supported by that project including direct and indirect employment (NRC 2005). Also, the VEGP received an ESP from NRC for two nuclear units to be constructed about 17 mi south of the SRS in Burke County, Georgia. The NRC staff estimated that project would require 3500 direct construction jobs at peak employment, and the project is underway with an in-service date expected in 2016 if the NRC issues a COL. Of the 3500 direct jobs at peak employment, the NRC staff expects 2500 to migrate to the economic impact area, generating an additional 900 indirect jobs, for a total employment impact of 3400 jobs at peak construction (NRC 2008b). The review team concludes that because current employment numbers would reflect jobs created by these projects in their current state of progress, these projects already have been accounted for in the socioeconomic baseline of the Augusta and Aiken metropolitan areas, and would not noticeably increase the current cumulative economic activity. Upon operation of the VEGP Units 3 and 4, the NRC staff concluded that Burke County, Georgia would experience substantial beneficial tax revenue impacts, but that these impacts would be minor elsewhere in the Augusta metropolitan area.

The review team concludes that the socioeconomic impacts of the building and operation of a new two-unit nuclear plant at the SR alternative site would be SMALL and adverse across most of the region, but could be MODERATE and adverse for Aiken and Barnwell Counties in terms of housing impacts during the building phase. The cumulative impacts on the tax base of Aiken and Barnwell Counties during plant building and operation likely would be MODERATE and beneficial. The review team concludes that cumulative impacts on other socioeconomic impact categories would be SMALL and adverse. Building and operating a new plant at the SR alternative site would make a noticeable incremental contribution to these impact levels.

9.3.6.6 Environmental Justice

In addition to environmental justice impacts from building and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to disproportionately high and adverse impacts on minorities and low-income populations, including other Federal and non-Federal projects and the projects listed in Table 9-27. For the analysis of environmental justice impacts at the SR alternative site, the geographic area of interest is considered to be the 50-mi region centered on the SR alternative site.

The SRS is a large site covering parts of Aiken, Barnwell, and Allendale Counties in southwestern South Carolina. The farms and residents in the area were affected by the original acquisition of the lands in the 1940s and 1950s making up the current site.

From an environmental justice perspective, the review team determined there is a potential for minority and low-income populations to experience disproportionately high and adverse environmental impacts. Bordering the SRS, the review team found low-income, African American and aggregated minority populations that exceed the percentage criteria established in Section 2.6.1, including the city of Aiken (2007 population 29,218) within the vicinity of the SR alternative site (see Figure 9-13 and Figure 9-14), that required further consideration in the environmental justice analysis.

Because the other projects described in Table 9-27 do not include any significant reasonably foreseeable changes in socioeconomic impacts within 50 mi of the SR alternative site, the review team concludes there would not be any significant additional cumulative environmental justice impacts in the region from those activities.

For example, the review team considered the impacts of the SRS MOX Fuel Fabrication Facility and VEGP Units 3 and 4. In the case of the MOX facility, the NRC staff concluded that environmental justice impacts would be minor (NRC 2005). The NRC staff concluded that only minor environmental justice impacts would be expected from construction and operation of Units 3 and 4 at the VEGP (NRC 2008b). Any economic impacts associated with activities listed in Table 9-27 already have been considered as part of the socioeconomic baseline. For example, the economic impacts of existing enterprises such as mining, other electrical utilities, etc., are part of the base used for establishing the RIMS II multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team's assessment of reasonably foreseeable future impacts.

Because of the rural nature of the two sites and the fact that the SRS also hosts an existing power plant, development of the proposed new units on the SR alternative site would have similar environmental justice impacts in most respects to adding two new units to the VCSNS site. However, as discussed in Section 9.3.3.6, the traffic-related impacts expected at the VCSNS site and the FA-1 site would not be expected at the SR alternative site because of the extensive road network providing access to the site from many directions. The review team expects that other potential environmental justice impacts would be similar to those analyzed for the VCSNS site, and would not result in disproportionately high and adverse impacts on minority or low-income populations.

Based on the above considerations, information provided by SCE&G, visits to the site, and the review team's independent review, the review team concludes that when viewed in the context of the wider region, locating the proposed action at the SR alternative site would not contribute additional cumulative impacts beyond the impacts described in Chapters 4 and 5 for the VCSNS site. The review team did not identify any environmental pathways by which disproportionately

Figure 9-13. Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Savannah River Alternative Site

Figure 9-14. Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Savannah River Alternative Site

high and adverse impacts could affect minority or low-income populations or communities. Under the limitations of a reconnaissance-level analysis, the review team found no other health or physical considerations and no unique characteristics or practices that could lead to a disproportionately high and adverse impact on any minority or low-income community within region around the SR alternative site. Therefore, the review team concludes that the environmental justice impacts would be minimal locally and would not create pathways to increase expected cumulative impacts on minority and low-income populations in the region.

Based on its evaluation, the review team concludes that cumulative environmental justice impacts associated with building and operating two new nuclear units at the SRS would be SMALL.

9.3.6.7 Historic and Cultural Resources

The following cumulative impact analysis includes building and operating two new nuclear generating units at the SR alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that could impact cultural resources, including other Federal and non-Federal projects and the projects listed in Table 9-27. For the analysis of cultural impacts at the SR alternative site, the geographic area of interest is considered to be the APE that would be defined for this proposed undertaking. This includes the physical APE, defined as the area directly affected by the site-development and operation activities at the site and transmission lines, and the visual APE. The visual APE is defined as an additional 1-mi radius around the physical APE as a reasonable assumption for defining a maximum distance from which the structures can be seen.

Reconnaissance activities in a cultural resource review have particular meaning. For example, these activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing its EISs, the review team relies upon reconnaissance-level information to perform its alternative site evaluation. Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the SR alternative site the following information was used:

- SCE&G ER (SCE&G 2010b) – including the National Park Service National Register Information and information from the Savannah River Archaeological Research Program
- NRC EIS for the MOX facility (NRC 2005)
- NRC Alternative Sites Visit, March 2009.

Historically, the SRS and vicinity was largely undisturbed by land development and likely contained intact archaeological sites associated with the past 10,000 years of human settlement. Over time, portions of the SRS have been disturbed by forestry practices and development of the Federal nuclear facility (SCE&G 2009g, 2010b). The Savannah River Archaeological Research Program has extensive knowledge of the cultural resources located on the greater SRS, because the program has been conducting cultural resources work at DOE's Federal facility since the early 1970s. The SRS contains over 1000 prehistoric and historic American Indian and Euro-American cultural resources, most of which have not been formally evaluated for listing in the National Register (SCE&G 2010b). SCE&G also conducted a search to identify National Register properties within the five counties around the SR alternative site. SCE&G found that there are 103 properties listed in the National Register within those counties, but that none are within 6 mi of the SR alternative site (SCE&G 2010b). Extensive cultural resources knowledge of the SRS has resulted in the categorization of the SRS based on the potential for archaeological resources to be present. The proposed alternative site location is located in an area that is considered to have a low potential to contain archaeological resources (SCE&G 2010b) due to a general low density of archaeological sites in the area. The physical and visual APEs for a proposed plant at the SR alternative site do not appear to have any historic properties located within the area likely to be affected by building or operating new plants.

The footprint and land required to accommodate the building of two nuclear units on the SRS site are described in Section 9.3.6.1. To accommodate the building of two nuclear units on the SR alternative site, SCE&G would need to clear approximately 500 ac of undeveloped land for the nuclear facility and associated structures and infrastructure (SCE&G 2010b). SCE&G has stated that as part of the site-selection process known cultural resource locations would be considered as avoidance areas (SCE&G 2009f, g). SCE&G has also stated that if the proposed project was sited at the SR alternative site, identification of cultural resources would be accomplished through cultural resource surveys. The results would be used in the site-planning process to avoid cultural resource impacts. If significant cultural resources were identified by these surveys, SCE&G would also develop protective measures similar to what it has in place for the VCSNS site. In addition, inadvertent discovery procedures would be developed if cultural resources were discovered during site-development activities (SCE&G 2009f).

The transmission lines associated with the two nuclear units on the SRS site are described in Section 9.3.6.1. If the proposed project was sited at the SR alternative site, the staff assumes SCE&G and Santee Cooper would conduct their transmission-line-related cultural resource activities in ways similar to what they have committed to do for the VCSNS site, as described in Section 4.6.

Past actions in the geographic area of interest that have similarly affected historic and cultural resources include forestry practices at the SRS and any road development and logging activities associated with those practices. None of the projects listed in Table 9-27 is located within the geographic area of interest and therefore, they have no potential for cumulative impact on cultural resources.

Activities associated with building two nuclear units and supporting facilities that can potentially directly affect historic and cultural resources include land clearing, excavation, and grading. Given SCE&G's site-planning process, and the lack of significant cultural resources known to exist at the SR alternative site based on reconnaissance-level information and the land disturbance where the new plant would be located, the impacts on cultural resources due to site-development activities would be negligible.

In addition, visual impacts from cooling towers and transmission lines could result in significant alterations to the visual landscape within the geographic area of interest. Given that there are no known cultural resources where the historic setting and character of the resources are important, the visual impacts would be negligible. The staff assumes that SCE&G and Santee Cooper would develop management agreements in consultation with the SHPO similar to the ones that have been developed for the VCSNS site.

Impacts on historic and cultural resources from operation of two new nuclear units at the SR alternative site include those associated with the operation of new units and maintenance of transmission lines. The staff assumes that the same procedures currently used by SCE&G and Santee Cooper would be used for onsite and offsite maintenance activities. Consequently, the incremental effects of the maintenance of transmission-line corridors and operations of the two new units and associated impacts on cultural resources would be negligible.

Table 9-27 identifies projects within the geographic area of interest and includes the South Carolina Strategic Corridor System Plan, DOE's Savannah River Site, and future urbanization that could affect historic and cultural resources in a manner similar to those associated with the operation of two new units.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear generating units on the SR alternative site would be SMALL. This impact-level determination reflects no known cultural resources that could be affected; however, if the SR alternative site was to be developed, then cultural resource surveys may reveal important historic properties that could result in greater cumulative impacts.

9.3.6.8 Air Quality

Because the SR alternative site is located in a climate regime similar to the VCSNS site, the air quality impacts of building and operating a nuclear facility at the SR alternative site would be similar to the air quality impacts at the VCSNS site. As described in Sections 4.7 and 5.7, the review team determined that the impacts of building and operating two new nuclear units on air quality at the VCSNS site would be SMALL. Therefore, the impacts of building and operating two new nuclear units on air quality at the SR alternative site would be minimal.

The SR alternative site is located in the Augusta-Aiken Interstate Air Quality Control Region, which is designated as being in attainment with the NAAQSs (40 CFR 81.341) (SCE&G 2010b). The resource area defined for this evaluation includes Aiken and Barnwell Counties, South Carolina. Two counties were selected in this case because the SR alternative site could be located in either county. In general, designations of attainment or non-attainment are made on a county-by-county basis. As listed in Table 9-27, sources of gaseous emissions in Aiken and Barnwell Counties include facilities at DOE's SRS. The DOE SRS is classified as a major source and includes approximately 22 emission units that have a SCDHEC Air Quality Permit (TV-0080-0041). Emissions from these sources include, but are not limited to, sulfur dioxide, particulates, and nitrogen oxides (SRS 2009). Given the intermittent operation of the diesel generators at two new units, and that both Aiken and Barnwell Counties are currently in attainment, the review team concludes that the cumulative impacts, including the impacts from building and operating two new units, on air quality would be SMALL.

Greenhouse gas emissions related to nuclear power are discussed in Chapters 4, 5, and 6. As pointed out in Chapter 7, the impacts of the emissions are independent of emission location. Consequently, the discussions in the previous chapters and in Section 9.2.5 are applicable to two AP1000 reactors located at the SR alternative site. The impacts of greenhouse gas emissions at the SR alternative site considered in isolation would be minimal, and the cumulative impact of greenhouse gas emissions would be MODERATE, primarily due to national and world-wide impacts of emissions of greenhouse gases. Building and operating two new nuclear units at the SR alternative site would not be a significant contributor to the MODERATE impact.

9.3.6.9 Nonradiological Health Impacts

The following analysis for the SR alternative site includes impacts from building and operating the proposed new facilities. The analysis also considers past, present, and reasonably foreseeable future actions that affect the nonradiological health resources, including other Federal and non-Federal projects and the projects listed in Table 9-27. For the analysis of nonradiological health impacts at the SR alternative site, the geographic area of interest is considered to be the 6-mi area centered on the SR alternative site and the associated transmission-line corridors. This 6-mi radius is expected to encompass all nonradiological health impacts.

Building Impacts

Nonradiological health impacts from building two new nuclear units on construction workers and members of the public at the SR alternative site would be similar to those evaluated in Section 4.8 for the proposed site. They include occupational injuries, noise, vehicle exhaust, and dust. Applicable Federal and State regulations on air quality and noise would be complied with during the site-preparation and building phase. The SR alternative site is located in a rural area and building impacts would likely be negligible on the surrounding populations. These areas are classified as medium- and low-population areas.

There is only one past action in the geographic area of interest that has similarly affected nonradiological health and it is the construction of the DOE SRS, portions of which are located within less than 1 mi of the SR alternative site. There are no major current projects in the geographic area of interest that would cumulatively affect nonradiological health in a similar way.

Proposed future actions that would affect nonradiological health in a similar way to development at the SR alternative site would include the building and operation of the SRS MOX Fuel Fabrication Facility (located approximately 5 mi from the proposed SR alternative site), transmission-line creation and/or upgrading, and future urbanization that would occur throughout the designated geographic region of interest. The review team concludes that the cumulative impacts on nonradiological health from building two new nuclear units and associated transmission lines at the SR alternative site would be minimal considering the low population density on and around the SR alternative site and its position within a DOE-controlled tract of more than 300 mi^2 of land.

Operational Impacts

Occupational health impacts on operational employees would include those associated with plant operation and operation of the associated transmission lines, as described in Section 5.8. Based on the configuration of the proposed new units at the SR alternative site (closed-cycle, wet cooling system with mechanical draft cooling towers), etiological agents would not likely increase the incidence of waterborne diseases in the vicinity of the site. Impacts on workers' health from occupational injuries, noise, and EMFs would be similar to the proposed site. Noise and EMFs would be monitored and controlled in accordance with applicable OSHA regulations.

No past, present, or future actions in the geographic area of interest were identified that would significantly affect nonradiological health in ways similar to those associated with the operation of two new units at the SR alternative site. The review team therefore concludes that the impacts on nonradiological health from operating two new nuclear units and associated transmission lines at the SR alternative site would be minimal.

Summary Statement

Impacts on nonradiological health from the building and operation of two new units at the SR alternative site were estimated based in the information provided by SCE&G and the review team's independent evaluation. The review team concludes that health impacts on construction workers and the public resulting from the building of two new nuclear units at the SR alternative site would be SMALL. The review team expects that the occupational health impacts on the operations employees of two new nuclear units at the SR alternative site would be SMALL. Similarly, impacts on public health of two new nuclear units operating at the SR alternative site would be SMALL.

There are past and future activities in the geographic area of interest that could affect nonradiological health in ways similar to the building of two units at the SR alternative site. The review team concludes, however, that cumulative impacts from past, present, and future actions on nonradiological health from building and operating two new units at the SR alternative site would be SMALL. The staff is not able to come to conclusions about the chronic impacts of EMFs on public health.

9.3.6.10 Radiological Impacts of Normal Operations

The following impact analysis includes radiological impacts on the public and workers from building activities and operations for two nuclear units at the SR alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects and the projects listed in Table 9-27. As described in Section 9.3.6, SRS is a DOE site. There are no reactors currently operating at the SRS, but there are mothballed reactors and other nuclear facilities on the SRS. The geographic area of interest is the area within a 50-mi radius of the SR alternative site. Facilities potentially affecting radiological health within this geographic area of interest are operating VEGP Units 1 and 2, proposed VEGP Units 3 and 4, the facilities throughout the DOE SRS containing radioactive material, the MOX Fuel Fabrication Facility at the SRS, and the Energy Solutions (Barnwell) Low-Level Radioactive Waste Disposal Facility. In addition, there are likely to be hospitals and industrial facilities within 50 mi of the SR alternative site that use radioactive material.

The radiological impacts of building and operating the proposed two AP1000 plants at the SR alternative site include doses from direct radiation and liquid and gaseous radioactive effluents. These sources would result in low doses to people and biota offsite that would be well below regulatory limits. The impacts are expected to be similar to those estimated for the VCSNS site.

The radiological impacts of existing VEGP Units 1 and 2 include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that are well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring program conducted around the Vogtle site. The EIS for proposed VEGP Units 3 and 4 indicates that operation of the proposed reactors would result in radiological impacts from direct radiation and liquid and gaseous radioactive effluents. The EIS indicates that these pathways would result in low doses to people and biota offsite that would be well below regulatory limits (NRC 2008b).

The SRS has active high-level radioactive waste processing facilities, processing and storage facilities for radioactive materials used in defense applications, mothballed nuclear reactors, and other nuclear facilities that would potentially have an impact on radiological health. The radiological impacts of the various facilities at SRS and the SRS MOX facility would include doses from direct radiation and liquid and gaseous radioactive effluents. The radiological impacts from the Barnwell Low-Level Radioactive Waste Disposal Facility could also include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways result in low doses to people and biota offsite that are below applicable DOE and NRC regulatory limits. SRS conducts a radiological environmental monitoring program that measures radiation and concentrations of radioactive material from all sources in the environs of the SRS, including the Barnwell facility and confirms that the doses meet the regulatory limits.

In addition, the NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the SR alternative site. This conclusion is based on data from the radiological environmental monitoring programs conducted around currently operating nuclear power plants.

Based on the information provided by SCE&G and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 plants and other existing and planned projects and actions in the geographic area of interest around the SR alternative site would be SMALL

9.3.6.11 Postulated Accident Impacts

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the SR alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and the projects listed in Table 9-27. As described in Section 9.3.6, SRS is a DOE site. There are no reactors currently operating at the SRS, but there are mothballed reactors and other nuclear facilities on the SRS. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the SR alternative site. Facilities potentially affecting radiological accident risk within this geographic area of interest are existing VCSNS Unit 1, VEGP Units 1 and 2, Hatch Units 1 and 2, facilities throughout the DOE SRS containing radioactive material, the MOX Fuel Fabrication Facility at the SRS, and the Energy Solutions (Barnwell) Low-Level Radioactive Waste Disposal Facility. Also, two AP1000 reactors have been proposed at the Vogtle site. As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the VCSNS site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The AP1000 design is independent of site conditions, and the meteorology of the SR alternative and VCSNS sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the SR alternative site would be minimal. Because the meteorology, population distribution, and land use for the SR alternative site are expected to be similar to the proposed VCSNS site, risks from a severe accident for an AP1000 reactor located at the SR alternative site are expected to be similar to those analyzed for the proposed VCSNS site. The risks for the proposed VCSNS site are presented in Tables 5-17 and 5-19 and are well below the median value for current-generation reactors. In addition, as discussed in Section 5.11.2, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest (VCSNS Unit 1, Hatch Units 1 and 2, and VEGP Units 1 and 2), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1). Finally, according to the Vogtle ESP (NRC 2008a), the risks from this proposed site are also well below current-generation reactors and meet the Commission's safety goals.

There are no reactors currently operating at DOE's SRS; however, there is some severe accident risk associated with the spent nuclear fuel and other high-level radioactive wastes that may be processed or stored at SRS. The severe accident risks associated with stored spent fuel at operating nuclear power plants are lower than the risks for severe accidents involving the reactor core. Likewise, the severe accident risks associated any spent reactor fuel or other high-level radioactive waste processed or stored at SRS would be lower than the risks for severe accidents involving the reactor core. There is no irradiated fuel at the MOX Fuel Fabrication Facility at SRS, and this facility is designed to prevent inadvertent criticalities. Other facilities at SRS and the Barnwell Low-Level Radioactive Waste Disposal Facility may contain substantial amounts of radioactive material, but there is no credible severe accident risk like there is for an operating reactor. Therefore, the additional risk from these facilities is not significant in the evaluation of the cumulative severe accident risk for a nuclear power plant at the SR alternative site. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the SR alternative site would be SMALL.

9.3.7 Comparison of the Impacts of the Proposed Action and the Alternative Sites

This section summarizes the review team's characterization of the cumulative impacts related to locating a two-unit AP1000 nuclear power facility at the proposed VCSNS site and at each alternative site. The four sites selected for detailed review as part of the alternative sites environmental analysis included the FA-1 site located in Fairfield County, South Carolina; the CGS site located in Orangeburg County, South Carolina; the Saluda site located in Saluda County, South Carolina; and the SR alternative site located in Aiken County, South Carolina. Comparisons are made between the proposed site and alternatives to evaluate whether one of the alternative sites is environmentally preferable to the proposed site. The NRC's determination is independent of the USACE's determination under Section 404(b)(1) and its Guidelines at 40 CFR Part 230 of whether this site is the least environmentally damaging practical alternative (LEDPA). The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision. The USACE alternatives evaluation is discussed in Section 9.5. The need to compare the proposed site with alternative sites arises from the requirement in NEPA Section 102(2)(C)(iii) (42 USC 4332) that EISs include an analysis of alternatives to the proposed action. The NRC criterion to be used in assessing whether a proposed site is to be rejected in favor of an alternative site is based on whether the alternative site is "obviously superior" to the site proposed by the applicant (Public Service Company of New Hampshire 1977). An alternative site is "obviously superior" to the proposed site if it is "clearly and substantially" superior to the proposed site (Rochester Gas & Electric Corp. 1978). The standard of obviously superior "...is designed to guarantee that a proposed site will not be rejected in favor of an alternate unless, on the basis of appropriate study, the Commission can be confident that such action is called for" (New England Coalition on Nuclear Pollution 1978).

The "obviously superior" test is appropriate for two reasons. First, the analysis performed by NRC in evaluating alternative sites is necessarily imprecise. Key factors considered in the alternative site analysis, such as population distribution and density, hydrology, air quality, aquatic and terrestrial ecological resources, aesthetics, land use, and socioeconomics, are difficult to quantify in common metrics. Given this difficulty, any evaluation of a particular site must have a wide range of uncertainty. Second, the applicant's proposed site has been analyzed in detail, with the expectation that most of the adverse environmental impacts associated with the site have been identified. The alternative sites have not undergone a comparable level of detailed study. For these reasons, a proposed site may not be rejected in favor of an alternative site when the alternative site is marginally better than the proposed site, but only when it is obviously superior (Rochester Gas & Electric Corp. 1978). NEPA does not require that a nuclear plant be constructed on the single best site for environmental purposes. Rather, "...all that NEPA requires is that alternative sites be considered and that the effects on the environment of building the plant at the alternative sites be carefully studied and factored into the ultimate decision" (New England Coalition on Nuclear Pollution 1978).

Section 9.3.7.1 discusses the process the review team used to compare the alternative sites to the proposed VCSNS site. Cumulative impact levels from Chapter 7 (for the VCSNS), and the four alternative sites (from Sections 9.3.3 through 9.3.6) are listed in Table 9-35. Section 9.3.7.2 and Section 9.3.7.3 discuss the cumulative impacts of the proposed project located at the VCSNS site and at the alternative sites as they relate to a determination of environmental preference or obvious superiority.

9.3.7.1 Comparison of Cumulative Impacts at the Proposed and Alternative Sites

The following section summarizes the review team's independent assessment of the proposed and alternative sites. The team characterized the expected cumulative environmental impacts of building and operating new units at the VCSNS site and alternative sites; these impacts are summarized by category in Table 9-35. Full explanations for the specific impact characterizations are provided cumulatively in Chapter 7 for the proposed site and in Sections 9.3.3, 9.3.4, 9.3.5, and 9.3.6 for each of the alternative sites. The review team's impact category levels are based on professional judgment, experience, and consideration of controls likely to be imposed under Federal, State or local permits that would not be acquired until after the review of a COL application is underway. The considerations and assumptions were similarly applied at each of the alternative sites to provide a common basis for comparison. In the following discussion, the review team compares the impact levels between the proposed site and each alternative site.

Table 9-35. Comparison of Cumulative Impacts at the VCSNS Site and Alternative Sites

Resource Category	VCSNS[(a)]	FA-1	CGS	Saluda	SR
Land use	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Water-related					
Surface-water use	SMALL	SMALL	SMALL	SMALL	SMALL
Groundwater use	SMALL	SMALL	MODERATE	SMALL	SMALL
Surface-water quality	SMALL	SMALL	SMALL	SMALL	SMALL
Groundwater quality	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological					
Terrestrial ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Aquatic ecosystems	SMALL	SMALL	MODERATE	SMALL	SMALL
Socioeconomic					
Physical impacts	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Transportation and housing	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE
Demography	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL
Taxes and economy	SMALL to LARGE and beneficial	SMALL to LARGE and beneficial	SMALL to LARGE and beneficial	SMALL to LARGE and beneficial	SMALL to MODERATE and beneficial
Public services and education	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL
Aesthetics and recreation	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL
Environmental justice	SMALL to MODERATE (localized)	SMALL to MODERATE (localized)	SMALL	SMALL	SMALL

Table 9-35. (contd)

Resource Category	VCSNS[a]	FA-1	CGS	Saluda	SR
Historic and cultural resources	MODERATE	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Nonradiological health	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological impacts of normal operations	SMALL	SMALL	SMALL	SMALL	SMALL
Postulated accidents	SMALL	SMALL	SMALL	SMALL	SMALL

(a) From Chapter 7, Cumulative Impacts Analysis for VCSNS

The cumulative environmental impact areas listed in the table have been evaluated using the NRC's three-level standard of significance: SMALL, MODERATE, or LARGE. These levels were developed using CEQ guidelines and are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

> 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.

9.3.7.2 Environmentally Preferable Sites

The cumulative impacts of building and operating a two-unit nuclear power plant at the VCSNS site and at each alternative site are generally SMALL for many impact categories. The resource categories for which the impact level at an alternative site would be the same as the proposed site would not contribute to the determination that the alternative site is environmentally preferable to the proposed site. Therefore, these categories are not discussed further in determining whether an alternate site is environmentally preferable to the proposed site. Where there is a range of impacts for a resource, the upper range of the resource is used for the comparison. In addition, for those cases in which the cumulative impacts for a resource would be greater than SMALL, consideration is given to those cases in which the impacts of the project at the specific site would not make a significant contribution to the cumulative impact level. As shown in Table 9-35, there would be some differences in impacts among the sites.

Distinguishing cumulative impacts are primarily related to the development of greenfield sites and the impacts from likely transmission-line routing for the alternative sites on terrestrial and aquatic ecology, as well as socioeconomic impacts associated with a sudden influx of workers on existing infrastructure and populations. In addition, distinctions between the VCSNS site and alternative sites are found in the cumulative impacts associated with the consumptive water use and the potential impact on the available resources. Specific variations in cumulative impacts are discussed in the following paragraphs, which compare the VCSNS to each alternative site.

VCSNS and FA-1: Due to the proximity of VCSNS to the FA-1 alternative site, most of the cumulative impacts at the FA-1 site would be expected to be similar to the cumulative impacts described for the VCSNS site in Chapters 4 and 5. The only resource area for which the impact level differs between the VCSNS site and the FA-1 site is historic and cultural resources. The review team evaluated the impact on these resources at the VCSNS site as MODERATE based on impacts on the General Pearson Cemetery and the Daughters of the American Revolution Monument. As discussed in Section 4.6, the South Carolina SHPO has concurred with a finding of no adverse effect to the above historic sites, based on protective and avoidance measures being implemented by SCE&G (SCE&G 2009k). The impacts at the FA-1 site were evaluated as SMALL based on reconnaissance-level information. The review team also recognizes that the VCSNS site is a brownfield site with existing infrastructure and ancillary services, and it is likely that the impacts on ecology of building two new units at the VCSNS site would be somewhat less than the impacts of building the units at a greenfield site, such as the FA-1 site. On balance, the review team concludes that there would be little if any difference in the overall environmental impacts between the two sites. Therefore, the review team determined that the FA-1 site is not an environmentally preferable site to the VCSNS site.

VCSNS and CGS: The CGS site is a developed brownfield site with an existing coal-fired power plant. The proposed project would be co-located at the CGS site and would draw on the same resources as the existing plant. The VCSNS site is characterized more favorably than the CGS site in Table 9-27 for the following resource areas: groundwater use, aquatic ecosystems, demography, and education. In all of these resource areas, the differences in ratings are specifically related to higher impacts at the CGS site from building and operating the two new units. The most significant difference relates to groundwater use. The new units would have to withdraw water from both the South Fork Edisto River and from groundwater to meet their needs and the amount of withdrawals would have a noticeable impact on the resource. The amount of surface-water withdrawals from the South Fork Edisto River would also have a noticeable impact on aquatic ecosystems. Impacts on Bamberg County in the area of demography would be noticeable during the building period.

The CGS site is rated more favorably than the VCSNS site for the following resource areas: transportation, environmental justice, and historic and cultural resources. For transportation and environmental justice the impacts are related to traffic near the VCSNS site during the building phase. The transportation and environmental justice issues related to traffic are the result of economic activity from thousands of relatively high-paying construction jobs being created by the building of VCSNS Units 2 and 3, and the traffic impacts would subside once the building phase was completed. The impacts on historic and cultural resources at the CGS site were evaluated as SMALL based on reconnaissance-level information. The review team evaluated the impact on these resources at the VCSNS site as MODERATE based on impacts on the General Pearson Cemetery and the Daughters of the American Revolution Monument. As discussed in Section 4.6, the South Carolina SHPO has concurred with a finding of no adverse effect on the above historic sites, based on protective and avoidance measures being implemented by SCE&G (SCE&G 2009k).

On balance, because of the greater impact on groundwater, aquatic ecosystems, and demography at CGS, the review team concludes that the impacts of building and operating two new nuclear units at the CGS site would be greater than the impacts of the same project at the VCSNS site. Therefore, the review team determined that the CGS site is not an environmentally preferable site to the VCSNS site.

VCSNS and Saluda: The Saluda site is an undeveloped greenfield site located on the Saluda River arm of Lake Murray. Building and operating two new units on a greenfield site generally has greater environmental impacts. As a greenfield site along a river, the impacts on aesthetics and recreation are greater at the Saluda site than at the VCSNS site, which is a developed brownfield site. For both the VCSNS and Saluda sites, the review team identified a MODERATE and adverse cumulative transportation impact during the building phase.

The Saluda site is characterized more favorably than the VCSNS site for environmental justice and for historic and cultural resources. The environmental justice impacts are related to traffic near the VCSNS site during the building phase. The environmental justice issues related to traffic are the result of economic activity from thousands of relatively high-paying construction jobs being created by the building of VCSNS Units 2 and 3, and the traffic impacts would subside once the building phase was completed. For historic and cultural resources, the review team evaluated the impact on these resources at the VCSNS site as MODERATE based on impacts on the General Pearson Cemetery and the Daughters of the American Revolution Monument. As discussed in Section 4.6, the South Carolina SHPO has concurred with a finding of no adverse effect on the above historic sites, based on protective and avoidance measures being implemented by SCE&G (SCE&G 2009k).

On balance, the review team concludes that the Saluda site and the VCSNS site rank closely together. In such a case, the proposed site prevails because the alternative is not environmentally preferable. Therefore, the review team has determined that the Saluda site is not an environmentally preferable site to the VCSNS site.

VCSNS and SR: The SR alternative site, situated within the SRS, is a large geographic site with well-developed existing infrastructure that would be capable of supporting the proposed project such as roads, railways, and site control. The VCSNS site is characterized more favorably than the SR alternative site for taxes and the economy. The taxes and the economic impact would have a greater beneficial impact at the VCSNS site than it would at the SR alternative site. The SR alternative site is characterized more favorably than the VCSNS site in the areas of environmental justice and historic and cultural resources. The environmental justice impacts are related to traffic near the VCSNS site during the building phase. The transportation and environmental justice issues related to traffic are the result of economic activity from thousands of relatively high-paying construction jobs being created by the building of VCSNS units 2 and 3. The transportation and environmental justice issue related to traffic would subside once the building phase was completed. The environmental justice issues related to traffic would subside once the building phase was completed. For historic and cultural resources, the review team evaluated the impact on these resources at the VCSNS site as MODERATE based on impacts to the General Pearson Cemetery and the Daughters of the American Revolution Monument. As discussed in Section 4.6, the South Carolina SHPO has concurred with a finding of no adverse effect to the above historic sites, based on protective and avoidance measures being implemented by SCE&G (SCE&G 2009k). On balance, the review team concludes that there would be little if any overall difference in the environmental impacts between the two sites. Therefore, the review team has determined that the SR alternative site is not an environmentally preferable site to the VCSNS site.

Although there are differences and distinctions between the cumulative environmental impacts of building and operating two new generating units at the VCSNS site and the alternative sites, the review team concludes that none of these differences is sufficient to determine that any one of the alternative sites is environmentally preferable to the VCSNS site.

9.3.7.3 Obviously Superior Sites

None of the alternative sites was determined to be environmentally preferable to the VCSNS site. Therefore, none of the alternative sites is obviously superior to the VCSNS site.

9.4 System Design Alternatives

The review team considered a variety of heat-dissipation systems and circulating-water system (CWS) alternatives. While other heat-dissipation systems and water systems exist in a nuclear power plant, by far the largest and the most likely to dominate the environmental consequences of operation is the CWS that cools and condenses the steam for the turbine generator. Other water systems, such as the service-water system, are much smaller than the CWS. As a result, the review team only considers alternative heat-dissipation and water-treatment systems for the

CWS. The proposed CWS is a closed-cycle system that uses mechanical draft cooling towers for heat dissipation (SCE&G 2010b). The proposed system is discussed in detail in Chapter 3.

9.4.1 Heat-Dissipation Systems

About two-thirds of the heat from a commercial nuclear reactor is rejected as heat to the environment. The remaining one-third of the reactor-generated heat is converted into electricity. Normal heat-sink cooling systems transfer the rejected heat load into the atmosphere and/or nearby waterbodies, primarily as latent heat exchange (evaporating water) or sensible heat exchange (warmer air or water). Different heat-dissipation systems rely on different exchange processes. The following sections describe alternative heat-dissipation systems considered by the review team for proposed VCSNS Units 2 and 3.

In its ER, SCE&G considered a range of heat-dissipation systems, including a once-through cooling system and several closed-cycle cooling systems. In addition to the closed-cycle mechanical draft cooling towers selected, SCE&G considered natural draft cooling towers, once-through cooling into Monticello Reservoir, cooling ponds, spray ponds, dry cooling towers, and a combination wet-dry cooling tower system (SCE&G 2010b). The review team also considered mechanical draft cooling towers with plume abatement.

9.4.1.1 Wet Natural Draft Cooling Towers

Wet natural draft cooling towers, which use about the same amount of water as the proposed design, induce airflow up through large (600 ft tall and 400 ft in diameter) towers by cascading warm water downward in the lower portion of the cooling tower. As heat transfers from the water to the air in the tower, the air becomes more buoyant and rises. This buoyant circulation induces more air to enter the tower through its open base. The environmental aspects of wet natural draft cooling towers and mechanical draft cooling towers are very similar (SCE&G 2010b). Because the water use is similar between natural and mechanical draft cooling towers, the entrainment and impingement of aquatic biota would be similar. Notable differences include that the natural draft cooling towers would be able to be seen from a great distance and the additional height increases the potential for avian collisions. The large size of the natural draft cooling towers has a greater visual and aesthetic impact than a mechanical draft cooling tower. The natural draft cooling towers would use slightly less energy than the mechanical draft cooling towers. The review team concludes that because the impacts of mechanical draft and natural draft cooling towers are similar; wet natural draft cooling towers would not be an environmentally preferable alternative for the VCSNS site.

9.4.1.2 Once-Through Cooling

Once-through cooling systems withdraw water from the source waterbody and return virtually the same volume of water to the receiving waterbody at an elevated temperature. Typically the source waterbody and the receiving waterbody are the same body, and the intake and discharge structures are separated to limit recirculation. While there is essentially no consumptive use of water in a once-through heat-dissipation system, the elevated temperature of the receiving waterbody would result in some induced evaporative loss that decreases the net water supply. The large intake and discharge flows associated with once-through cooling systems require large intake and discharge structures, result in higher levels of impingement and entrainment, and may result in hydrologic alterations in the source/receiving waterbodies. Based on recent changes to implementation plans to meet Section 316(b) of the Clean Water Act, the review team has determined that once-through cooling systems for new nuclear reactors are unlikely to be permitted in the future, except in rare and unique situations.

VCSNS Unit 1 uses a once-through cooling system using Monticello Reservoir as a cooling pond. If VCSNS Units 2 and 3 were to adopt this design to be used with the AP1000 reactors, the water-supply needs for these two units would be 1,700,000 gpm (SCE&G 2010b). SCE&G has determined that this volume of water cannot be practically supplied by the Monticello Reservoir and Broad River. For this reason, in addition to the Clean Water Act considerations, the review team determined that once-through designs were not a feasible alternative design and eliminated it from further consideration as part of the VCSNS Units 2 and 3 cooling system.

9.4.1.3 Cooling Pond

Use of a recirculating cooling pond separate from Monticello Reservoir, Parr Reservoir, and the Broad River was considered as an alternative cooling system design. Previous studies for VCSNS Unit 1 have shown that a recirculating pond would likely need to cover an area of 900 to 1800 ac (SCE&G 2010b) for each of the two additional units. The dedication of an area of this size was weighed against the SMALL thermal impact on Monticello and Parr reservoirs from the current design of the VCSNS Units 2 and 3 cooling system. The other option was to create a 3600-ac cooling pond by isolating part of the Monticello Reservoir and using that as a cooling pond. This option would avoid taking additional land out of use for a cooling pond, but it would have the environmental disadvantage of causing significant aquatic impact on 3600 ac of the reservoirs. The review team determined that due to the impact of the loss of land associated with development of additional cooling ponds or the increase in aquatic impacts if the cooling pond used part of the existing reservoirs, a cooling system using a recirculating cooling pond was not an environmentally preferable alternative to the VCSNS site.

9.4.1.4 Spray Ponds

Spray-pond cooling systems use manufactured ponds to cool water and enhance evaporative cooling by spraying water into the atmosphere. In addition to evaporation, heat transfer from the spray ponds to the atmosphere occurs through black-body radiation and conduction. A spray-pond system alternative was evaluated for cooling VCSNS Units 2 and 3, and it would require a 150-ac pond. Based on the additional land required to build the spray-pond and the impact from spray drift, the review team concludes that use of a spray pond would not be an environmentally preferable alternative for the VCSNS site.

9.4.1.5 Dry Cooling Towers

Dry cooling towers would eliminate virtually all water-related impacts from the cooling system operation. No makeup water would be needed, and no blowdown water would be generated. However, dry cooling systems require much larger cooling systems, result in some loss in electrical generation efficiency because the theoretical approach temperature is limited to the dry-bulb temperature and not the lower wet-bulb temperature, and they result in parasitic energy losses for the large array of fans involved. This loss in generation efficiency translates into increased impacts on the fuel cycle. Dry cooling could reduce water-related impacts. However, the aquatic impacts at the VCSNS site were determined to be SMALL; therefore, the wet cooling towers have only a minimal impact, and any incremental gain by the dry cooling towers would be offset by the increased impacts on the fuel cycle. The review team determined that building and operation of dry cooling towers would not be an environmentally preferable alternative for the VCSNS site because of the availability of cooling water, inefficiencies in energy production associated with dry cooling resulting in higher fuel cycle impacts, and the lack of sensitive biological resources that would be affected by water withdrawn for cooling.

9.4.1.6 Combination Wet/Dry Cooling-Tower System

A combination mechanical draft wet/dry cooling tower system uses both wet and dry cooling cells to limit consumption of cooling water, often with the added benefit of reducing plume visibility. Water used to cool the turbine generators generally passes first through the dry portion of the cooling tower where heat is removed by drawing air at ambient temperature over tubes through which the water is moving. Cooling water leaving the dry portion of the tower then passes through the wet tower where the water is sprayed into a moving air stream and additional heat is removed through evaporation and sensible heat transfer. When ambient air temperatures are low, the dry portion of these cooling towers may be sufficient to meet cooling needs. The use of the dry portion of the system would result in a loss in generating efficiency that would translate into increased impacts on the fuel cycle. As discussed in Chapters 4 and 5, the impacts of the proposed cooling system (mechanical draft tower) for aquatic ecology, water use, and water quality for the building and operation are SMALL. While a combination wet/dry cooling system would reduce these impacts, there would be an increase in fuel cycle impacts because the increased use of resources to generate electricity. Therefore, the review team concludes that the building and operation of a combined wet/dry cooling tower system would not be an environmentally preferable alternative for the VCSNS site.

9.4.1.7 Mechanical Draft with Plume Abatement

Adding additional heat to a saturated cooling tower exhaust, without adding additional water, would result in subsaturated water vapor. Subsaturated water vapor reduces the potential for a visible plume. The concept behind a mechanical draft cooling tower with plume abatement is similar to the wet/dry cooling system described above with the design parameters focused on reducing the visual plume. Such designs may also result in less consumptive water use. However, there is sufficient water at VCSNS site for use of a mechanical draft cooling system without plume abatement. The aesthetic impacts at the VCSNS site with a mechanical draft cooling tower without plume abatement were determined to be SMALL; therefore a mechanical draft tower with plume abatement offers no real advantage. These towers often have a larger footprint and require additional energy to operate, resulting in a net loss of energy available to meet the demand for power. For these reasons, the review team concludes that the building and operation of mechanical draft cooling towers with plume abatement would not be an environmentally preferable alternative for the VCSNS site.

9.4.2 Circulating-Water Systems

The review team evaluated alternatives to the proposed intakes and discharges for the normal heat-sink cooling system, based on the proposed heat-dissipation system water requirements. The capacity requirements of the intake and discharge system are defined by the proposed heat-dissipation system. For proposed VCSNS Units 2 and 3, the proposed heat-dissipation system is a closed-loop system that uses mechanical draft cooling towers for heat dissipation. SCE&G (2010b) indicated that the maximum makeup-water demand for two AP1000 units at the site is estimated to be 58,800 gpm. SCE&G identified two potential sources of makeup-water supply for the VCSNS site: Monticello Reservoir and Parr Reservoir. In addition, the review team considered water reuse and groundwater in its evaluation of alternative water supplies.

9.4.2.1 Intake Alternatives

The proposed intake structures for VCSNS Units 2 and 3 are described in detail in Section 3.2.2.2. SCE&G plans to construct an intake-approach channel, intake structure, water pumps, and biofouling-treatment systems on Monticello Reservoir. The intake structure would be 60 ft long and 75 ft wide, with six pump bays including a pump, trash rack, and traveling screen. The intake structure would be designed to have a through-trash-rack and through-screen-mesh velocity of less than 0.5 fps (SCE&G 2010b).

SCE&G selected the location of the intake structure for the proposed action to avoid the FPSF and the VCSNS Unit 1 discharge. SCE&G considered two alternatives for the intake system in addition to the proposed system: (1) offshore intake with offshore pump and active screening, and (2) onshore pump intake with submerged passive screens. In addition, the review team considered the use of radial collector wells located on the shore of Monticello Reservoir.

The offshore intake alternative has an advantage, if shoreline structures would conflict with a shoreline intake or if bathymetry or vegetation considerations make a shoreline intake less desirable. At the VCSNS site, the conditions that would make a shoreline intake advantageous do not occur. The shoreline option is preferable to an offshore intake with offshore pumps due to the ease of its installation. Offshore intakes with submerged passive screens are more difficult to maintain when ambient currents do not facilitate the removal of debris. For intakes on reservoirs, ambient currents are not typically strong enough to facilitate the removal of debris.

A radial collector-well system was considered by the review team because in many cases it reduces the impact on aquatic resources and, when water is being withdrawn from turbid environments, can reduce the water treatment needed prior to its introduction into the cooling system. A radial collector-well system consists of an excavated central concrete caisson with well screens projected laterally outward in a radial pattern (Riegert 2006). Radial collector wells slowly draw surface water through the subsurface layer and, thereby, filter out some sediment that might have required treatment if the water had been directly withdrawn from the surface waterbody. In general, collecting surface water in this way eliminates most of the direct operational impacts on aquatic ecosystems (e.g., entrainment and impingement) associated with water withdrawal and eliminates some of the construction and preconstruction impacts (e.g., dredging). The review team determined that radial collector wells, which would induce flow through the sediments the Monticello Reservoir into lateral subterranean pipes extending from the shoreline out beneath the reservoir, would require multiple large structures near the shoreline. SCE&G did not consider this alternative water source, but the review team independently determined that a radial collector-well system is not environmentally preferable to the proposed direct withdrawal from the river due to the requirement for multiple new shoreline structures.

Therefore, the review team concludes that there would be no alternative intake designs that would be environmentally preferable to proposed intake design for the VCSNS site.

9.4.2.2 Discharge Alternatives

SCE&G proposes to discharge blowdown from VCSNS Units 2 and 3 to Parr Reservoir through a 36-in. diffuser that extends out into the reservoir. A detailed description of the proposed discharge system is presented in Section 3.2.2.2.

SCE&G considered shoreline discharge and two alternative locations of the diffuser at the selected discharge location, and examined a number of diffuser port designs before arriving at the selected alternative. Shoreline discharge was rejected because of the shallow bathymetry of Parr Reservoir in the possible outfall locations. Water depth was a key consideration in evaluating alternative diffuser locations. Increased depth of placement offers better conditions for mixing prior to the thermal plume rising to the surface. Cornell Mixing Zone Expert System (CORMIX) modeling performed by SCE&G helped to confirm the advantages of the offshore/deeper location. CORMIX was also used to evaluate a number of diffuser options. A 20-port diffuser was found to provide better conditions than the originally proposed 4-port diffuser and was sufficient to meet mixing objectives (SCE&G 2010b).

Alternative paths for the blowdown lines were also considered. The proposed route of these lines is along the eastern shore of Parr Reservoir. An alternative path would have taken the blowdown lines along the existing transmission-line corridor. This alternative would have transected a wetland and therefore was determined to be environmentally less preferable to the proposed route.

The review team also considered the option of discharging blowdown from proposed VCSNS Units 2 and 3 through the Unit 1 discharge canal into Monticello Reservoir. Unit 1 is a once-through cooling plant that currently discharges 534,000 gpm to the reservoir. The total discharge under normal conditions from Units 2 and 3 via the blowdown pipeline would be 9383 gpm; maximum discharge would be 30,547 gpm (SCE&G 2010b). Under normal conditions this would be less than 2 percent of the volume of water discharged from Unit 1 and the impact of discharging this additional water to the reservoir would likely be insignificant. The cooling-tower basins for proposed Units 2 and 3 are at an elevation approximately 25 ft below the elevation of Monticello Reservoir maximum operating level (SCE&G 2010b, c). As a result, discharge from the cooling-tower basins would need to be pumped up to the Unit 1 discharge canal. The energy consumed to operate these pumps would reduce the overall efficiency of the plant without any compensating environmental benefit and would not be environmentally preferable to the proposed design.

The review team determined that the impacts of operation of the proposed discharge system would be SMALL and that there are no alternative discharge designs that would be environmentally preferable to the proposed discharge design at the VCSNS site.

9.4.2.3 Water Supplies

The review team considered alternative sources for the CWS, including water reuse, groundwater, and surface water.

Water Reuse

Sources of water for reuse can come either from the plant itself or from other local water users. Sanitary wastewater-treatment plants are the most ubiquitous sources of water for reuse. Agricultural processing, industrial processing, and oilfield production can also provide significant supplies of water for reuse. Additional treatment (e.g., tertiary treatment, chlorination) may be required to provide water of appropriate quality for the specific plant need. The population is very low, and there is little industry around the VCSNS site, so adequate reliable wastewater sources are not currently available. As a result, no sources of water for reuse at the site were identified. Therefore, the review team determined that water reuse would not be a feasible alternative to SCE&G's proposed water supply and was not evaluated further.

Groundwater

Groundwater is not considered a viable source of cooling water for VCSNS Units 2 and 3 because the geologic formations in the vicinity of the site generally are not pervious enough to sustain well yields greater than a few gallons per minute (SCE&G 2010b). Characterization performed at the proposed site of Units 2 and 3 supports this assertion (SCE&G 2010b), and the review team finds that the groundwater resource could not meet the cooling water demands of proposed VCSNS Units 2 and 3. Therefore, the review team determined that groundwater would not be a feasible alternative to SCE&G's proposed water supply.

Surface Water

The two potential sources of surface water to supply makeup water to VCSNS Units 2 and 3 are the Monticello Reservoir and Parr Reservoir. Both of these reservoirs obtain most of their water from the Broad River. SCE&G has chosen to withdraw water from Monticello Reservoir because it is at a higher elevation and requires less lift to move water from the reservoir to the cooling tower basins for the proposed units, and because water from Monticello Reservoir does not experience the variation in turbidity that Parr Reservoir experiences during periods of high runoff. For these reasons the review team concludes that withdrawing makeup water from Parr Reservoir would not be an environmentally preferable alternative to SCE&G's proposal to withdraw makeup water from Monticello Reservoir.

9.4.2.4 Water Treatment

Both inflow and effluent water may require treatment to ensure that they meet plant water needs and effluent water standards. SCE&G proposes to add chemicals to plant water to meet appropriate water-quality process needs. The chemistry of effluent water is regulated by the EPA through the NPDES permitting process. The largest chemical inputs are required to maintain the appropriate chemistry in the cooling towers to preclude biofouling. The review team identified no environmentally preferable alternative to SCE&G's proposed chemical water treatment. The effluents from cooling-tower blowdown are specifically regulated in 40 CFR Part 423 by the EPA to protect the environment.

9.4.3 Summary

The review team considered alternative systems designs, including five alternative heat-dissipation systems and alternative intake, discharge, and water-supply systems. As discussed in previous sections, the review team identified no alternative that was environmentally preferable to the proposed VCSNS plant systems design.

9.5 U.S. Army Corps of Engineers Alternatives Evaluation

The 404(b)(1) Guidelines stipulate that no discharge of dredged or fill material into waters of the United States (including jurisdictional wetlands) shall be permitted if there is a practicable alternative that would have a less adverse impact on the aquatic environment, as long as the alternative does not have other significant adverse environmental consequences. An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered. Thus, this analysis is necessary to determine which alternative is the LEDPA that meets the project purpose and need. Even if an applicant's proposed alternative is determined to be the LEDPA, the USACE must still determine whether the LEDPA is contrary the public interest. The USACE Public Interest Review, described in 33 CFR 320.4, directs the USACE to consider a number of factors in a balancing process. A permit would not be issued for an alternative that is not the LEDPA, nor would a permit be issued for an activity that is determined to be contrary to the public interest.

9.5.1 Onsite Alternatives

As part of its process for evaluating permits, the USACE reviewed SCE&G's application and ER for the proposed VCSNS Units 2 and 3 project, responses to RAIs, data regarding impacts on alternative sites, and SCE&G information addressing onsite alternatives for the VCSNS site to minimize impacts on wetlands and other waters of the United States. Within this documentation, SCE&G provided a detailed description of the steps taken to minimize onsite impacts, including alternative site layouts. According to information provided by SCE&G, the site layout with the least impact on waters of the United States for the proposed VCSNS site has 1.7 ac of permanent open water and wetland fill impacts and 774 linear feet of permanent fill impacts on a single stream (Stream L).

This EIS provides environmental information and analyses upon which the LEDPA judgment will be based. It also considers public feedback received in the form of public comments on the draft EIS. Using this information as well as information in the applicant's federal permit application, the USACE will address whether the LEDPA criterion is met in the Record of Decision.

9.5.2 SCE&G Alternative Sites

As noted previously, the evaluation and comparison of potential impacts on waters of the United States among the proposed and four alternative sites is limited by the lack of detailed data for all but the VCSNS site. SCE&G requested and received a jurisdictional determination from the USACE (valid through June 29, 2014) that identified 44.3 ac of wetlands and 49,288 linear feet of streams subject to Clean Water Act jurisdiction. Waters of the United States were estimated for FA-1, CGS, Saluda, and SR alternative sites using a combination of available data resources, including FWS National Wetlands Inventory mapping, U.S. Department of Agriculture-Natural Resources Conservation Service soils mapping, 2006 infrared aerial imagery, SCDHEC State Navigable Waters mapping, USGS 7.5-minute quadrangle maps, and National Hydrography Dataset. For alternative sites and their associated transmission lines, data were reported as acres of forested and nonforested wetlands, as well as linear distance for streams. It is important to note that transmission-line routes associated with the four alternative sites are not finalized and therefore would be subject to change. Note also that impacts on alternative sites include those areas that would be occupied by principal site component footprints such as the powerblock, cooling towers, and switchyard, as well as impacts resulting from intake and discharge water lines. In the absence of detailed topographic design data, it is not feasible to include impacts from associated fill slopes for these components or from other necessary ancillary facilities. Using this information, Table 9-36 presents the impacts on waters of the United States for each alternative considered, including each site and its associated transmission lines. Impacts for transmission lines are calculated based solely on the total area of permanent clearing that would be required for forested wetlands.

Table 9-36. Comparison of Impacts on Waters of the United States for the Proposed and Four Alternative Sites

	FA-1[(a)]	**CGS**[(a)]	**Saluda**[(a)]	**SR**[(a)]	**VCSNS**[(b)] **(Proposed)**
Sites					
Wetland impacts (fill, ac)	3.1	15.9	7.3	14.6	0.7
Stream impacts (fill, linear feet)	5344	432	6106	1628	774
Open water impacts (fill, ac)	1.4	0	1.3	0.6	1.0
Total wetland and open water impacts (fill, ac)	**4.5**	**15.9**	**8.6**	**15.2**	**1.7**
Transmission Lines					
SCE&G T-lines					
Wetland impacts (clearing forest, ac)[(a)]	238.6	103.5	197.5	168.2	37.4
Santee Cooper lines					
Wetlands impacts (clearing forest, ac)[(a)]	9	126	6	77	6.3
Total wetland impacts for transmission lines (clearing forest, ac)	**248**	**230**	**204**	**245**	**43.7**
Total wetland impacts (fill plus clearing forest, ac)	**252**	**245**	**212**	**260**	**45.4**

(a) Wetland impacts for FA-1, CGS, Saluda, and SR alternatives based on published mapping data, including but not limited to NWI maps.
(b) Wetland impacts for VCSNS alternative (proposed action) based on delineations of waters of the U.S. verified by USACE jurisdictional determinations for the VCSNS site and associated transmission lines.

9.6 References

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

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

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

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10.0 Conclusions and Recommendations

This chapter provides a discussion of the conclusions reached in earlier parts of this environmental impact statement (EIS), as well as the U.S. Nuclear Regulatory Commission (NRC) staff's recommendations. Section 10.1 summarizes the impacts of the proposed action, Section 10.2 summarizes the proposed project's unavoidable adverse impacts with an accompanying table, and Section 10.3 discusses the relationship between the short-term use of resources and long-term productivity of the human environment. Section 10.4 summarizes the irretrievable and irreversible use of resources and Section 10.5 summarizes the alternatives to the proposed action. Section 10.6 discusses benefits and costs. Section 10.7 includes the NRC staff's recommendation.

On March 27, 2008, the NRC received an application from South Carolina Electric and Gas (SCE&G), acting for itself and for Santee Cooper (the State-owned electric and water utility, formally called the South Carolina Public Service Authority), for combined construction permits and operating licenses (COLs) for two new nuclear reactors at the Virgil C. Summer Nuclear Station (VCSNS) in Fairfield County, South Carolina (SCE&G 2008). The proposed VCSNS Units 2 and 3 would be jointly owned by SCE&G (55 percent) and Santee Cooper (45 percent), and operated by SCE&G (SCE&G 2010). VCSNS Unit 1 is also jointly owned by SCE&G (66.7 percent) and Santee Cooper (33.3 percent), and operated by SCE&G (NRC 2004). With the exception of transmission systems needed to route power from the proposed units, all of the construction and operation related to VCSNS Units 2 and 3 would be completely within the confines of the VCSNS site (SCE&G 2010). The reactors specified in the application are Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactors. The application references Revision 17 of the AP1000 certified design. On March 2, 2010, SCE&G submitted an application to the U.S. Army Corps of Engineers (USACE) for a Department of the Army (DA) permit to conduct construction activities that would result in alteration of waters of the United States, including wetlands. The USACE is participating in preparing this EIS as a cooperating agency.

The proposed actions in the COL and USACE joint permit applications are (1) NRC issuance of COLs for construction and operation of two new nuclear power reactors at the VCSNS site in Fairfield County, South Carolina, and (2) USACE issuance of permits pursuant to Section 404 of the Federal Water Pollution Control Act, as amended (33 USC 1251, et. seq. [Clean Water Act]), and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC 403) to perform certain construction activities on the site.

SCE&G submitted the *Combined Application of South Carolina Electric and Gas Company for a Certificate of Environmental Compatibility and Public Convenience and Necessity and for a Base Load Review Order for the Construction and Operation of a Nuclear Facility in*

Jenkinsville, South Carolina, to the Public Service Commission of South Carolina (PSCSC) on May 30, 2008. The final order issued by the PSCSC approving the combined application and Certificate of Environmental Compatibility and Public Convenience and Necessity (CPCN) was issued to SCE&G on March 2, 2009 (PSCSC 2009).

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321) directs that an EIS is required for major Federal actions that significantly affect the quality of the human environment. Section 102(2)(C) of NEPA requires that an EIS include information about the following:

- the environmental impact of the proposed action
- any adverse environmental effects that cannot be avoided should the proposal be implemented
- alternatives to the proposed action
- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity
- any irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented.

The NRC has implemented NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. In 10 CFR 51.20, the NRC requires preparation of an EIS for issuance of COLs. Subpart C of 10 CFR Part 52 contains the NRC regulations related to COLs.

Included in this EIS are (1) the results of the review team's preliminary analyses, which consider and weigh the environmental effects of the proposed action and of constructing and operating two new nuclear units at the VCSNS; (2) mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's recommendation regarding the proposed action based on its environmental review. The USACE will base its evaluation of the DA Individual Permit application on the requirements of USACE regulations, the Clean Water Act Section 404(b)(1) Guidelines, and the USACE public interest review process. The USACE permit decision will be made following issuance of the final EIS.

The environmental review described in this EIS was conducted by a joint NRC/USACE team. The review team was composed of NRC staff, its contractor's staff, and staff from the USACE. During the course of preparing this EIS, the team reviewed the Environmental Reports (ERs) submitted by SCE&G (2009, 2010); consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in Regulatory Guide 4.2, Revision 2 (NRC 1976), NUREG-1555, *Environmental Standard Review Plans* (NRC 2000), and the Staff Memorandum "Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity

Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements" (NRC 2010). In addition, the review team 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 review team also considered public comments received on the draft EIS. Those comments and responses are provided in Appendix E of this final EIS.

As a cooperating agency, the USACE has participated in the environmental review of the proposed action and has participated in the scoping meetings, public meetings, public-comment resolution, and EIS preparation. The proposed action includes impacts on waters of the United States, including wetlands. For action requiring a Section 404 Clean Water Act permit for the discharge of dredged and/or fill material into waters of the United States, regulations promulgated by the U.S. Environmental Protection Agency (EPA) require the USACE to limit its authorization to the least environmentally damaging practicable alternative. The USACE will document its conclusion of the review process, including the requirement for compensatory mitigation, in accordance with 33 CFR Part 332, Compensatory Mitigation for Losses of Aquatic Resources, in its permit-decision document.

Following the practice of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) (NRC 1996) and supplemental license renewal EISs, environmental issues are evaluated using the three-level standard of significance—SMALL, MODERATE, or LARGE—developed by the NRC using guidelines from the Council on Environmental Quality (CEQ) (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

> SMALL – 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.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections. During its environmental review, the review team considered planned activities and actions that SCE&G indicates it and others would likely take should SCE&G receive the COLs. In addition, SCE&G provided estimates of the environmental impacts resulting from building and operation of two new nuclear units on the VCSNS site.

10.1 Impacts of the Proposed Action

In a final rule dated October 9, 2007 (72 FR 57416), the Commission limited the definition of "construction" to those activities that fall within its regulatory authority (10 CFR 51.4). Many of the activities required to construct a nuclear power plant are not part of the NRC action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. Because the "preconstruction" activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. Certain preconstruction activities require permits from the USACE, as well as other Federal, State, and local agencies.

Chapter 4 of this EIS describes the relative magnitude of impacts related to preconstruction and construction activities with a summary of impacts in Table 4-18. Impacts associated with operation of the proposed facilities are discussed in Chapter 5 and are summarized in Table 5-23. Chapter 6 describes the impacts associated with the fuel cycle, transportation, and decommissioning. Chapter 7 describes the impacts associated with preconstruction and construction activities and operation of VCSNS Units 2 and 3 when considered along with the cumulative impacts of other past, present, and reasonably foreseeable future projects in the geographical region around the VCSNS site.

10.2 Unavoidable Adverse Environmental Impacts

Section 102(2)(C)(ii) of NEPA requires that an EIS include information on any adverse environmental effects that cannot be avoided should the proposal be implemented. Unavoidable adverse environmental impacts are those potential impacts of the NRC action and the USACE action that cannot be avoided and for which no practical means of mitigation are available.

The unavoidable adverse environmental impacts associated with the granting of the COLs for VCSNS Units 2 and 3 would include impacts of both construction and operation.

10.2.1 Unavoidable Adverse Impacts During Construction and Preconstruction Activities

Chapter 4 discusses in detail the potential impacts from construction and preconstruction of the proposed Units 2 and 3 at the VCSNS site. Table 10-1 presents the adverse impacts associated with construction and preconstruction activities to each of the resource areas evaluated in this EIS and the mitigation measures that would reduce impacts. All building activities for VCSNS Units 2 and 3, including ground-disturbing activities, would occur within the existing VCSNS site boundary. Unavoidable adverse impacts are the result of both construction and preconstruction activities, unless otherwise noted.

The impact determinations in Table 10-1 are for the combined impacts of construction and preconstruction, but the impact determinations for NRC-regulated construction are the same for water use, water quality, aquatic ecology, socioeconomic and environmental justice, air quality, and nonradiological and radiological health resource areas. The impact determinations for building and NRC-related construction are different for land use, terrestrial and wetland ecosystems, and historic and cultural resources. For the impact determinations that differ for the NRC-regulated activities, the impacts from the NRC-regulated activities are discussed below the table.

Table 10-1. Unavoidable Adverse Environmental Impacts from Construction and Preconstruction Activities

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land Use	MODERATE for transmission lines SMALL for other offsite areas; SMALL for NRC-authorized construction activities	Follow best management practices (BMPs); use flexibility in transmission-line corridor routing	Use of roughly 556 ac of land throughout period of construction and preconstruction. New transmission-line routing would convert 426 ac over 45 mi to utility corridor use, of which 204 ac are currently forested.
Water-Related Impacts			
Water Use	SMALL	Implement BMPs to control erosion; use of turbidity curtain to control sediment from dredge operations	Temporary degradation of surface water quality because of sediment loading.
Water Quality	SMALL		
Ecology (Terrestrial)	MODERATE; SMALL for NRC-authorized construction activities	Implement wetland mitigation as required by USACE; implement BMPs during construction and preconstruction; use flexibility in transmission-line corridor routing to avoid adverse impacts on important species and habitats.	Approximately 0.66 ac of wetlands would be filled; vegetation would be cleared and up to 592 ac of wetlands traversed by new transmission lines; permanent loss of terrestrial habitat onsite and in proposed new transmission-line corridors; increased habitat fragmentation from transmission lines; and potential impacts on important species in proposed transmission-line corridors.

Table 10-1. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Ecology (Aquatic)	SMALL	Comply with Federal permits and State 401 water-quality certification. Prepare and implement SWPPP and use appropriate BMPs to control erosion and sedimentation.	774 linear feet of Stream L would be filled. Temporary benthic habitat disturbance associated with the installation of cooling-water intake, water-treatment plant intake, discharge pipeline and diffuser, and temporary sanitary waste-treatment plant discharge. Loss of river bottom habitat associated with the installation of concrete pile foundations in Parr Reservoir for the VCSNS-Varnville line. Localized, temporary site-preparation impacts on onsite streams include the widening of an existing rail spur right-of-way adjacent to a seasonal stream, and the construction of a new bridge at Mayo Creek. Installation of new transmission-line corridors and clearing unmaintained transmission-line corridors would result in disturbance of riparian buffers adjacent to streams and other waterways.
Socioeconomics			
Infrastructure and Community Services	MODERATE for traffic impacts, SMALL for other infrastructure and community service impacts; MODERATE for traffic impacts SMALL for other infrastructure and community service impacts for NRC-authorized construction activities	Implement traffic-management plan during site development.	Temporary highly localized periodic traffic impacts.

Table 10-1. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Physical Impacts	SMALL		
Demography	SMALL		
Economic Impacts on the Community	SMALL		
Environmental Justice			
Health and Environmental	SMALL		
Socioeconomic	MODERATE; MODERATE for NRC-authorized construction activities	Implement traffic management plan during site development.	Temporary highly localized traffic impacts would occur in an environmental justice community.
Subsistence and Special Conditions	SMALL		
Historic and Cultural	MODERATE; SMALL for NRC-authorized construction activities	Implement management agreement with SHPO. Develop resource-specific mitigation plans if significant cultural resources are located within transmission-line corridors.	Cultural resources would be permanently altered by the proposed action and from the installation of transmission lines. Cultural resource attributes that would be affected include the context and landscape of the surrounding area, the relationship of these resources with regional history, settlement patterns, and the historical use of the land. Visual impacts (alteration of the historic landscape) would affect the integrity of the resources.
Air Quality	SMALL	Development of a dust-control plan prior to construction that would include specific dust-mitigation measures. Air quality permits would be obtained from the SCDHEC (as required).	Temporary degradation of local air quality due to dust particle emissions during ground clearing, grading excavation activities, and operation of concrete batch plant.

Table 10-1. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Nonradiological Health	SMALL	Train all workers in appropriate safety requirements.	Occupational injuries to personnel
		Noise-limiting devices on vehicles and equipment. Restrict noise-related activities to daylight hours.	Noise from construction activities
Radiological Health	SMALL	Doses to construction workers would be maintained below NRC public dose limits.	Small doses to construction workers that would be less than NRC public dose limits.

BMPs = best management practices
SCDHEC = South Carolina Department of Health and Environmental Control
SHPO = State Historic Preservation Office
SWPPP = Stormwater Pollution Prevention Plan
USACE = U.S. Army Corps of Engineers

The NRC staff concludes that the potential unavoidable adverse impacts on land use, terrestrial and wetland ecosystems, and historic and cultural resources from NRC-authorized construction activities would be SMALL. Nearly all such unavoidable adverse impacts would be attributable to preconstruction activities due mainly to the conversion of about 1171 ac from undeveloped or forested uses to utility corridor use.

The NRC staff concludes that the potential unavoidable adverse impacts for infrastructure and community services from NRC-authorized construction activities would be MODERATE for traffic impacts and SMALL for other infrastructure and community service impacts. The South Carolina Department of Transportation road-capacity standards would not be exceeded, but the increase in traffic would be noticeable to local residents in the Jenkinsville area for the worker commuting hours during the limited period of peak building employment. Impacts would be largely temporary and of short duration, based on the size of the workforce during any one period, and would abate as construction and preconstruction activities wind down.

Construction and preconstruction traffic-related unavoidable adverse impacts would be noticeable but not destabilizing to the Jenkinsville community. The Socioeconomic Environmental Justice impacts from NRC-authorized construction is estimated to be 80 percent of combined construction and preconstruction.

The primary unavoidable adverse environmental impacts during building activities would be related to land use and terrestrial habitat loss, because approximately 500 ac would be permanently disturbed.

10.2.2 Unavoidable Adverse Impacts During Operation

Chapter 5 provides a detailed discussion of the potential impacts from operation of the proposed Units 2 and 3 at the VCSNS site. The unavoidable adverse impacts related to operation are listed in Table 10-2 and are summarized below.

Table 10-2. Unavoidable Adverse Environmental Impacts from Operation

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land Use	SMALL	None	Long-term dedication of 290 ac of land.
Water-Related Impacts			
Water Use	SMALL	Comply with Federal and State permits	Increased water use because of the addition of Units 2 and 3
Water Quality	SMALL	Comply with SCDHEC NPDES permit	Increased temperature and concentrations of chemicals in discharge
Ecology (Terrestrial)	SMALL	Implement BMPs during vegetation maintenance on transmission-line rights-of-way	Vegetation maintenance on transmission-line rights-of-way
Ecology (Aquatic)	SMALL	Comply with SCDHEC NPDES permit.	Cooling-water withdrawal results in impingement and entrainment of aquatic biota from Monticello Reservoir.
		Comply with SCDHEC NPDES permit	Thermal, chemical, and physical effects associated with station blowdown into Parr Reservoir have the potential to affect the distribution and abundance of some aquatic species.

Table 10-2. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
		Comply with SWPPP and implement BMPs.	Lack of stormwater management could introduce sediments and pollutants into onsite waterbodies and waterways crossed by transmission-line corridors and injure aquatic biota.
		Use EPA-approved herbicides adjacent to streams and waterbodies.	Maintenance and operation activities (e.g., application of chemicals for vegetation management) along transmission-line corridor could harm aquatic species.
Socioeconomics	SMALL	Traffic mitigation would have been performed during the construction phase.	Increased traffic; increased use of services.
Environmental Justice	SMALL		None
Historic and Cultural	SMALL	Finalize and implement management agreement with SHPO.	Potential for inadvertent discoveries during maintenance and operational activities.
Air Quality	SMALL	Cooling towers are operated with drift eliminators to limit salt deposition. Operation of generators is regulated by SCDHEC.	Impact on local aesthetic due to cooling tower plumes, increased salt deposition in and near the site due to operation of the cooling towers. Emissions associated with intermittent operation of standby and ancillary generators.
Nonradiological Health	SMALL	Strict adherence to NRC and Occupational Safety and Health Administration safety standards.	Occupational injuries such as falls, noise and inhalation of air contaminants.

Table 10-2. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Radiological Health	SMALL	Doses to members of the public would be maintained below NRC and EPA standards; worker doses would be maintained below NRC limits and ALARA; and doses to biota other than humans would be maintained below NCRP and IAEA guidelines.	Small radiation doses to members of the public, below NRC and EPA standards; ALARA doses to workers; and biota doses less than NCRP and IAEA guidelines.

BMPs = best management practices
EAB = exclusion area boundary
NPDES = National Pollutant Discharge Elimination System
SCDHEC = South Carolina Department of Health and Environmental Control
SHPO = State Historic Preservation Office
SWPPP = Stormwater Pollution Prevention Plan

Increased water use is an unavoidable adverse impact due to operation of the proposed plant. Stormwater would be managed with a site-specific Stormwater Pollution Prevention Plan and operations-related monitoring would be performed to ensure compliance with South Carolina Department of Health and Environmental Control requirements.

Unavoidable adverse impacts to terrestrial resources would include herbicide use, mowing, and similar activities for vegetation maintenance on transmission-line rights-of-way. Assuming that best management practices are followed, terrestrial impacts during operation would be minor. Within transmission-line corridors, low-growing vegetated buffer zones would be maintained adjacent to streams and waterbodies to minimize soil erosion and sedimentation. Only EPA-approved and registered herbicides would be used.

Unavoidable adverse aquatic impacts would be minimal during operation because the design of the intake structures on Monticello Reservoir would have minimal effects to aquatic organisms from impingement and entrainment. Aquatic impacts from station blowdown to Parr Reservoir would also have minimal effects to aquatic organisms due to design of the diffuser. Operation of the intake and discharge structures would comply with any NPDES permit.

Adverse socioeconomic impacts likely would be similar in character to those during the building phase but much smaller due to the smaller project-related population and the fact that much of the mitigation of housing and infrastructure shortages would have occurred in response to the larger impacts during the building period. Socioeconomic impacts would primarily be increased traffic, some damage to roads, an increase in the demand for housing and public services, along with increased employment opportunities and an increase in tax revenue to support the increase in service-demand.

Unavoidable adverse air-quality impacts would be negligible and that pollutants emitted during operations would be insignificant. Nonradiological and radiological health impacts would be minimal. Nonradiological health impacts to members of the public from operation, including etiological agents, noise, electromagnetic fields, occupational health and transportation of materials and personal, would be minimal through controls and measures by SCE&G associated with compliance to Federal and State regulations.

10.3 Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

Section 102(2)(C)(iv) of NEPA requires that an EIS include information on the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

The local use of the human environment by the proposed project can be summarized in terms of the unavoidable adverse environmental impacts of preconstruction, construction, and operation and the irreversible and irretrievable commitments of resources. With the exception of the consumption of depletable resources as a result of plant construction and operation, these uses may be classed as short term. The principal short-term benefit of the plant is represented by the production of electrical energy; and the economic productivity of the site, when used for this purpose, would be extremely large compared to the productivity from agriculture or from other probable uses for the site.

The maximum long-term impact on productivity would result if the plant were not immediately dismantled at the end of the period of plant operation, and consequently the land occupied by the plant structures would not be available for any other use. However, the enhancement of regional productivity resulting from the electrical energy produced by the plant is expected to result in a correspondingly large increase in regional long-term productivity that would not be equaled by any other long-term use of the site. In addition, most long-term impacts resulting from land-use preemption by plant structures can be eliminated by removing these structures or by converting them to other productive uses. Once the plants are shut down, they would be decommissioned according to NRC regulations. Once decommissioning is complete and the NRC license is terminated, the site would be available for other uses.

The review team concludes that the negative aspects of plant construction, preconstruction, and operation as they affect the human environment are outweighed by the positive long-term enhancement of regional productivity through the generation of electrical energy.

10.4 Irreversible and Irretrievable Commitments of Resources

Section 102(2)(C)(v) of NEPA requires that an EIS include information on any irreversible and irretrievable commitments of resources that would occur if the proposed actions are implemented. The term “irreversible commitments of resources” refers to environmental resources that would be irreparably changed by the new units and that could not be restored at some later time to the resource’s state before the relevant activities. “Irretrievable commitments of resources” refers to materials that would be used for or consumed by the new units in such a way that they could not, by practical means, be recycled or restored for other uses. The irreversible commitment of resources are the environmental resources discussed in Chapters 4, 5, and 6 of this EIS.

10.4.1 Irreversible Commitments of Resources

Irreversible commitments of environmental resources resulting from Units 2 and 3, in addition to the materials used for the nuclear fuel, include those described in the following sections.

10.4.1.1 Land Use

Land committed to the disposal of radioactive and nonradioactive wastes is committed to that use, and cannot be used for other purposes. The land used for Units 2 and 3, with the exception of any filled wetlands, would not be irreversibly committed because once Units 2 and 3 cease operations and the plant is decommissioned in accordance with NRC requirements, the land supporting the facilities could be returned to most other industrial or nonindustrial uses.

10.4.1.2 Water Use

Under average conditions, 27,160 gpm of cooling water would be lost through consumptive use (evaporation) during operation.

10.4.1.3 Aquatic and Terrestrial Biota

Construction and preconstruction would temporarily adversely affect the abundance and distribution of local flora and fauna on the VCSNS site and transmission-line corridors. However, the staff expects that minimal adverse impacts on shoreline, stream, reservoir benthic habitat, terrestrial habitat, or on individual species are expected to occur at the VCSNS site. Similar impacts could occur during the installation and maintenance of transmission-line corridors. Once construction and preconstruction are complete, the staff expects that flora and fauna would recover in areas that are not directly adjacent to or part of operations. Also, impacts on biota would cease post-operations. The staff considers that the 0.66 ac of wetlands and 774 linear feet of Stream L that would be filled during preconstruction of Units 2 and 3 would be irreversible.

10.4.1.4 Socioeconomic Resources

The staff expects that no irreversible socioeconomic commitments would be made to socioeconomic resources because they would be reallocated for other purposes once the plant is decommissioned.

10.4.1.5 Historic and Cultural Resources

Cultural resource attributes would be permanently altered by the construction, preconstruction and operation of the proposed plant and transmission lines. Nearly all impacts would be attributable to preconstruction activities, particularly transmission lines. Cultural resource attributes that could be impacted include the context and landscape of the surrounding area, the relationship of these resources with regional history, settlement patterns, and the historical use of the land. Visual impacts (alteration of the historic landscape) could affect the integrity of the resources.

10.4.1.6 Air and Water

Air pollutants would be released to the environment during routine operations. Because these releases would conform to applicable Federal and State regulations, their impact to the public health and the environment would be limited.

Dust and other emissions such as vehicle exhaust would be released to the air during construction. During operations, vehicle exhaust emissions would continue and other air pollutants and chemicals including very low concentrations of radioactive gases and particulates would be released from the facility to the air and surface water. The staff expects no irreversible commitment to air or water resources because all Unit 2 and 3 releases would be made in accordance with duly issued permits.

10.4.2 Irretrievable Commitments of Resources

Irretrievable commitments of resources during construction of the proposed new units generally would be similar to that of any major construction project. A study by the U.S. Department of Energy (DOE 2004) of new reactor construction estimated that the following quantities of materials would be required for the reactor building of a typical new 1300-MW(e) nuclear power plant: 12,239 yd^3 of concrete, 3107 tons of rebar, and 2,500,000 ft of cable. An estimated additional 6,500,000 ft of cable and 275,000 ft of piping would be required for each unit. A total of approximately 182,900 yd^3 of concrete and 20,512 tons of structural steel would be required to construct the reactor building, major auxiliary buildings, the turbine-generator building, and the turbine-generator pedestal. Therefore, about twice these amounts would be needed for the construction of two units at the VCSNS site. Hazardous materials such as asbestos would not be used, if possible. Use of materials such as asbestos would be in accordance with applicable safety regulations and practices.

The review team expects that the use of construction materials in the quantities associated with those expected for VCSNS Units 2 and 3, while irretrievable, would be of small consequence with respect to the availability of such resources.

The main resource that would be irretrievably committed during operation of the new nuclear units would be uranium. The availability of uranium ore and existing stockpiles of highly enriched uranium in the United States and Russia that could be processed into fuel is sufficient (OECD NEA and IAEA 2008) so that the irreversible and irretrievable commitment of this resource would be negligible.

10.5 Alternatives to the Proposed Action

Alternatives to the proposed action are discussed in Chapter 9 of this EIS. Alternatives considered are the no-action alternative, energy-production alternative, system-design alternatives, and alternative sites. For the purposes of the USACE's evaluation, onsite alternatives are also addressed.

The no-action alternative, described in Section 9.1, refers to a scenario in which the NRC would deny the request for COLs. Upon such a denial, the construction and operation of two new nuclear units at the VCSNS site would not occur and the predicted environmental impacts associated with the project would not occur. The USACE could deny SCE&G's permit request. If the permit were denied, SCE&G's construction of the two new units would not go forward as proposed. If no other power plant were built or electrical power supply strategy implemented to take its place, the electrical capacity to be provided by the project would not become available, and the benefits (electricity generation) associated with the proposed action would not occur and the need for power would not be met. Failure to supply the needed electricity would have significant adverse impacts within the region of interest and the staff expects that the PSCSC would take steps to confirm that the need for power would be met.

Alternative energy sources are described in Section 9.2 of this EIS. Alternatives not requiring additional generating capacity are described in Section 9.2.1. Detailed analyses of coal- and natural-gas-fired alternatives are provided in Section 9.2.2. Other energy sources are discussed in Section 9.2.3 and a combination of energy alternatives is discussed in Section 9.2.4. The staff concluded that none of the alternative power production options were both practical and environmentally preferable to the proposed action.

Alternative sites are discussed in Section 9.3 of this EIS, and the cumulative impacts in the VCSNS site vicinity, including the proposed VCSNS Units 2 and 3 increment, are compared with the impacts of the same physical facilities at each of the alternative sites in Chapter 9 of this EIS. Table 9-35 contains the staff's characterization of cumulative impacts at the proposed and alternative sites. Based on this review, the NRC staff concludes that while there are differences in cumulative impacts at the proposed and alternative sites, none of the alternative sites is environmentally preferable or obviously superior to the proposed VCSNS site. The NRC's determination is independent of the USACE's determination of a Least Environmentally Damaging Practicable Alternative pursuant to Section 404(b)(1) Guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

Alternative system designs are discussed in Section 9.4 of this EIS, focusing on alternative cooling-system designs. The staff determined none of the alternative system designs were environmentally preferable to the proposed design.

10.6 Benefit-Cost Balance

NEPA (42 USC 4321, et seq.) requires that all agencies of the Federal Government prepare detailed EISs on proposed major Federal actions that can significantly affect the quality of the human environment. A principal objective of NEPA is to require each Federal agency to consider, in its decision-making process, the environmental impacts of each proposed major action and the available alternative actions. In particular, Section 102 of NEPA requires all Federal agencies to the fullest extent possible:

> (B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by Title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations. (42 USC 4321)

However, neither NEPA nor CEQ requires the costs and benefits of a proposed action be quantified in dollars or any other common metric.

The intent of this section is not to identify and quantify all of the potential societal benefits of the proposed actions and compare these to the potential costs of the proposed actions. Instead, this section will focus on only those the benefits and costs of such magnitude or importance that their inclusion in this analysis can inform the decision-making process. This section compiles and compares the pertinent analytical conclusions reached in earlier chapters of this EIS. It gathers all of the expected impacts from building and operations of the proposed VCSNS Units 2 and 3 and aggregates them into two final categories; the expected costs and the expected benefits. The benefit-cost balancing for the NRC action will be based on a balancing of the benefits and costs of construction and operation.

Although the analysis in this section is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the analysis identifies the important potential societal benefits of the proposed action and compares them to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed actions. In this section, the benefits assessment provides the insight to determine if the benefits of the proposed actions outweigh the aggregate costs.

General issues related to SCE&G's financial viability and those of its parent organizations are outside NRC's mission and authority and, thus, would not be considered in this EIS. Issues related to the financial qualifications of SCE&G's will be addressed in the NRC staff's safety evaluation report. It is not possible to quantify and assign a value to all benefits and costs associated with the proposed action. This analysis, however, attempts to identify, quantify, and provide monetary values for benefits and costs when reasonable estimates are available.

Section 10.6.1 discusses the benefits associated with the proposed action. Section 10.6.2 discusses the costs associated with the proposed action. A summary of benefits are shown in Table 10-3. Section 10.6.3 provides a summary of the impact assessments by integrating information from previous sections to frame the relative magnitude of the proposed actions' benefits and costs.

10.6.1 Benefits

The most apparent benefit from a power plant is that it generates power and provides thousands of residential, commercial, and industrial consumers with electricity. Maintaining an adequate supply of electricity in any given region has social and economic importance, because the resource is the foundation for economic stability and growth and is fundamental to maintaining the current standard of living. In addition to nuclear power, however, a number of different power-generation technology options could meet the need for baseload power, including natural-gas-fired, coal-fired plants, or a combination of alternatives. Because the focus of this EIS is on the proposed expansion of the VCSNS site generating capacity, this section focuses primarily on the relative benefits of the VCSNS option rather than the broader, more generic benefits of electricity supply.

10.6.1.1 Societal Benefits

For the production of electricity to be beneficial to a society, there must be a corresponding demand, or "need for power," in the region. Chapter 8 defines and discusses the need for power in more detail. From a societal perspective, price stability and longevity and energy security and fuel diversity are the primary benefits associated with nuclear power generation relative to most other alternative generating options. These benefits are described in this section.

Table 10-3. Monetary and Nonmonetary Benefits of the Proposed VCSNS Units 2 and 3

Category of Benefit	Description of Benefit	Value of Benefit Over License Period
Net Electrical Generating Benefits		
Net generating capacity	~2200 MW(e)	
Electricity generated (operating at 85-percent to 93-percent capacity)	16,000,000 – 18,000,000 MWh per year	
Taxes and Other Revenue During Plant Construction and Operation Period (transfer payments – not independent benefits)		
Annual property taxes from operating plant (paid to Fairfield County)	Proposed Unit 2 and Unit 3 could pay on average $21.5 million in property taxes annually	$860 million over the 40-year license period
Local direct income generated during construction	$133.2 million annual direct worker regional income during peak employment	$256.5 million total annual regional income impact
Local direct income generated during operation	$121 million per year during 40-year life of plant	$220 million total annual regional income impact
Effects on Regional Productivity		
Construction workers	Direct Impact: Approximately 3600 workers at project peak.	3762 additional indirect regional employment supported by peak direct employment
Operational workers	Direct Impact: 800 operations workers added over 40-year life of plant	1704 additional indirect regional employment supported by the direct employment
Socioeconomics	Increased tax revenue supports improvements to public infrastructure and social services. The increased revenue spurs future growth and development	
Technical and other non-monetary benefits	Fuel diversity reduces exposure to supply and price risks associated with reliance on any single fuel source	
Price volatility	Dampens potential for fuel price volatility.	
Electrical reliability	Enhances reliability of the electricity supply.	

Source: SCE&G 2010 unless otherwise indicated.

Price Stability and Longevity

Because of the relatively low and nonvolatile cost of nuclear power (approximately 0.5 cents/kWh) and the reactor's projected availability rate of 85 to 93 percent, nuclear energy is a dependable source of electricity that can be provided at relatively stable prices. Nuclear power plants are generally not subject to fuel-price volatility as are natural-gas-fired and oil-fired power plants; there is less price volatility with coal than the other fossil fuels. In addition, uranium fuel constitutes only 3 to 5 percent of the cost of a kilowatt-hour of nuclear-generated electricity. Doubling the price of uranium increases the cost of electricity by about 7 percent, while doubling the price of natural gas would add about 70 percent to the cost of gas-fired electricity generation, and doubling the cost of coal would add about 36 percent to the cost of coal-fired electricity generation (WNA 2010).

Energy Security and Fuel Diversity

Currently, more than 70 percent of the electricity generated in the United States is from fossil-based technologies. Nuclear power contributes to the diverse U.S. energy mix, thereby hedging the risk of shortages and price fluctuations for any one type of power-generation system.

In Chapter 8 of this EIS the NRC staff analyzed the relevant load forecasts, which revealed a need for an additional 2214 MW(e) of baseload power capacity in the region of interest by the year 2020. The proposed VCSNS Units 2 and 3 would generate approximately 2200 MW(e) net, which would help meet this baseload need in the region. Assuming a reasonably low capacity factor of 85 percent, the plant's average annual electrical energy generation would be about 16,400,000 MWh. A reasonably high-capacity factor of 93 percent would result in slightly more than 17,900,000 MWh of electricity.

10.6.1.2 Regional Benefits

The region would benefit from additional VCSNS-related tax revenues, regional productivity, and community impacts.

Tax Revenue Benefits

In recent years, SCE&G's property tax payments to Fairfield County for Unit 1 on the VCSNS site have been between $12.2 million to $14.3 million, annually. On average, 37 to 45 percent of the Fairfield County property tax revenue comes from real property taxes generated by Unit 1 operations (see Table 2-33). With the completion of VCSNS Units 2 and 3, Fairfield County would receive additional property tax revenue.

Upon completion and operation of Units 2 and 3, based on information provided by SCE&G (SCE&G 2010), the staff expects SCE&G will enter an agreement with Fairfield County to pay from $13 to $31 million annually in property taxes over the 40-year operating life of the new units (see Table 5-5). Taxes on the new units would be in addition to existing taxes being collected by Fairfield County on Unit 1 operations.

In addition to property taxes, the construction-related and preconstruction jobs and salaries would generate State income tax revenue. The review team assumed that 50 percent of the skilled crafts workforce would relocate into the region while the plant is being built. However, impacts in the state would occur only to the degree that construction and operations workers would be relocating from out of state or when in-state workers significantly upgrading their disposable income compared to previous in-state employment. The review team concludes, when viewed in the context of total sales tax revenue to the State of South Carolina, the net impact on sales tax revenue caused by potential relocations to South Carolina, or from the effect of upgrading disposable income through better employment, would be minimal.

Once the plant is operational, it would be subject to corporate income tax, which in South Carolina is 5.533 percent of net taxable income. Sales taxes would be levied on materials purchased in-state to construct VCSNS Units 2 and 3. Retail sales of tangible personal property are subject to general State sales or use taxes of 6.0 percent. In addition, the local counties collect an additional 1.0 percent in sales and use taxes bringing the total rate to 7 percent (SCE&G 2010).

Regional Productivity and Community Impacts

The new units would require a peak-level workforce of approximately 3600 workers and an operating workforce of about 800. The long-term impact would be realized from the operations employment multiplier effect, which suggests that 1704 additional indirect and induced jobs would be created to support the 800 jobs during the operation period. In total, approximately 2504 jobs (apart from outage employment impacts) within the economic impact area affected by the site would be supported by the startup of the new units and would be maintained throughout the life of the plant. The economic multiplier effect of the increased spending by the direct and indirect workforce created as a result of two new units would increase the economic activity in the region. The final demand economic multiplier effect means that every dollar spent by nuclear plants results in the creation of an additional $0.33 of induced income in the community. Sections 4.5.4 and 5.5.4 provide additional information about the economic impacts of constructing and operating Units 2 and 3 on the VCSNS site.

10.6.2 Costs

Internal costs to SCE&G and external costs to the surrounding region and environment would be incurred during the preconstruction, construction, and operation of proposed VCSNS Units 2 and 3. Internal costs include the costs to physically construct the power plant (capital costs), as well as operating and maintenance costs, fuel costs, waste disposal costs, and decommissioning costs. External costs include all costs imposed on the environment and region surrounding the plant that are not internalized by the company and may include such things as a loss of regional productivity, environmental degradation, or loss of wildlife habitat. The external costs listed in Table 10-4 summarize environmental impacts to resources that could result from preconstruction, construction, and operation of the proposed VCSNS Units 2 and 3. The external costs listed in Table 10-4 summarize environmental impacts on resources that could result from construction, preconstruction, and operation of Units 2 and 3. Because Table 10-4 includes costs for pre-construction activities as well as for NRC-authorized construction and operation, the costs presented for an individual resource may be greater than the costs solely for the NRC-authorized portion of the project.

10.6.2.1 Internal Costs

The most substantial monetary cost associated with nuclear energy is the cost of capital. Nuclear power plants typically have relatively high capital costs for building the plant, but very low fuel costs relative to alternative power-generation systems. Because of the large capital costs for nuclear power plants, and the relatively long construction period before return on capital investment, servicing the capital costs of a nuclear power plant is one of the most important factors in determining the economic competitiveness of nuclear energy. Construction delays can add significantly to the cost of a plant. Because no new nuclear plants have been built in the United States in many years to establish an empirical cost basis, there is some uncertainty regarding the actual costs of constructing a new unit and how it would relate to construction costs for similarly large industrial facilities.

Table 10-4. Internal and External Costs of Proposed VCSNS Units 2 and 3

Category of Cost	Description of Cost	Impact Assessment[a]
Internal Costs		
Construction (overnight cost) for both units (including preconstruction costs)	$7.0 billion (about $3182 per installed kW(e)) (SCE&G 2010)	
Transmission, distribution, and general plant costs	$576 million (about $262 per installed kW(e)) (SCE&G 2010)	
Levelized cost of operation (includes fuel costs, decommissioning, and waste disposal)	$37 to $42 per MWh (SCE&G 2010)	
Fuel costs	$4.50 MWh (calculated based on WNA 2010)	
Decommissioning (NRC minimum)	Approximately $1–$2 per MWh	

Table 10-4. (contd)

Category of Cost	Description of Cost	Impact Assessment[a]
External Costs		
Land use	Project impacts including site and transmission lines would convert land use on about 556 acres of land at the site and about 426 ac of land for transmission lines. (See Sections 4.1 and 5.1.)	MODERATE for transmission lines; SMALL for NRC-authorized construction activities
Water use and water quality	There are some costs associated with providing water for various needs during construction and operation. Cooling water is taken from Monticello Reservoir. Impact on water quality would be regulated by the South Carolina Department of Health and Environmental Control (SCDHEC) and the South Carolina Department of Natural Resources (SCDNR). (See Sections 4.2 and 5.2.)	SMALL
Terrestrial and wetlands ecosystems	Some impacts on wildlife due to mortality during construction operations are anticipated. However, these impacts do not affect long-term wildlife populations. Wildlife mortality during operations is expected to be minimal. (See Sections 4.3 and 5.3.)	SMALL
Aquatic ecosystems	Filling in of the headwaters for Stream L, which flows into Mayo Creek, would result in a noticeable change for that immediate area. However, water-quality impacts are likely to be negligible with the use of BMPs to control sedimentation. (See Sections 4.3 and 5.3.)	SMALL
Radioactive effluents and emissions	Radioactive waste is generated. The plant produces radioactive air emissions. Relatively small levels of radioactive effluents are introduced into the Broad River. (See Sections 4.9 and 5.9.)	SMALL
Hazardous and radioactive waste	Storage, treatment, and disposal of high-level radioactive spent nuclear fuel. Commitment of underground geological resources for disposal of radioactive spent fuel. (See Sections 4.9 and 5.9.)	SMALL

Table 10-4. (contd)

Category of Cost	Description of Cost	Impact Assessment[a]
Air quality	Air emissions from diesel generators, auxiliary boilers, equipment, and vehicles that have a small impact on workers and local residents. Emission sources would be operated intermittently and emissions would be within Federal, State, and local air quality limits. Avoidance of sulfur dioxide, nitrogen oxide, carbon monoxide, carbon dioxide, and particulate emissions (relative to other baseload fossil-fired generation). (See Sections 4.7 and 5.7.)	SMALL
Materials, energy, and uranium	Irreversible and irretrievable commitments of materials and energy, including depletion of uranium. Construction materials include concrete, aggregate, rebar, conduit, cable, piping, building supplies, tools. Equipment needs include cranes, cement trucks, excavation equipment, dump trucks, and graders.	SMALL
Socioeconomics	The external costs of building and operating Units 2 and 3 have been discussed in detail in Chapters 4 and 5. The review team determined all of these external costs would be SMALL, with the exception of building-related traffic impacts, which were identified as MODERATE for each preconstruction and construction. (See Sections 4.4 and 5.4)	MODERATE for traffic impacts, SMALL for other infrastructure and community service impacts; MODERATE for traffic impacts, SMALL for other infrastructure and community service impacts for NRC-authorized construction activities
Cultural Resources	SCE&G and Santee Cooper have signed management agreements to be protective of cultural resources in the event of inadvertent discovery. (See Sections 4.6 and 5.6.)	MODERATE; SMALL for NRC-authorized construction activities
Health impacts (nonradiological and radiological)	Small estimated temperature increases would not significantly increase the abundance of thermophilic microorganisms. Radiological doses and nonradiological health hazards to the public and occupational workers would be monitored and controlled in accordance with regulatory limits. (See Sections 4.8, 4.9, 5.8, and 5.9.)	SMALL

(a) Impact assessments are listed for all impacts evaluated in detail as part of this EIS. The details on impact assessments are found in the indicated sections of this EIS.

Construction Costs

In evaluating the monetary costs related to constructing VCSNS Units 2 and 3, SCE&G reviewed recently published literature and internally generated, site-specific information. Construction cost estimates are provided below in Table 10-4. These estimates are based on a number of studies that were conducted by government agencies, universities, and other entities; the estimates include a significant contingency to account for uncertainty. In its ER, SCE&G expressed the construction-cost estimate in terms of “overnight capital cost,” which is a commonly used approach in the construction industry. “Overnight capital cost” is a term used to describe the monetary cost of constructing large capital projects such as a power plant, where costs are exclusive of interest and escalation, but include engineering, procurement, and construction costs, as well as owner's costs and contingencies. The owner’s costs include such things as site work and preparation, cooling-water intake structures and cooling towers, import duties on components, insurance, spare parts, transmission interconnection, development costs, project management costs, owner’s engineering, State and local permitting, legal fees, and staffing-related training.

SCE&G’s initial cost analysis was primarily based on the four following studies:

- Massachusetts Institute of Technology (MIT). 2003. *The Future of Nuclear Power: An Interdisciplinary MIT Study*.
- University of Chicago. 2004. *The Economic Future of Nuclear Power*.
- U.S. Department of Energy (DOE). 2004. *Study of Construction Technologies and Schedules, O&M Staffing and Cost, Decommissioning Costs and Funding Requirements for Advanced Reactor Designs.*
- Organization for Economic Co-Operation and Development and International Energy Agency (OECD/IEA). 2005. *Projected Costs of Generating Electricity, 2005 Update*.

In addition to the four studies referenced by SCE&G, the NRC staff reviewed two additional reports, one published by The Keystone Center entitled *Nuclear Power Joint Fact-Finding* (The Keystone Center 2007), which concluded, based upon alternative discount rates and construction times, overnight construction costs range between $3600 and $4200 per kW(e). The second study is a 2009 update to the MIT study (2003) that revised capital cost estimates to $4000 per kW(e).

In its revised ER, SCE&G estimated an overnight capital cost of $7.0 billion to construct both units (SCE&G 2010), which amounts to about $3182 per kW(e) in 2007 dollars. An additional $576 million would be required to connect Units 2 and 3 to the grid. That estimate more closely reflects estimates reported in the 2007 Keystone study (The Keystone Center 2007) and by MIT (2009).

Operation Costs

Operation costs are frequently expressed as levelized cost of electricity, which is the lowest price per kWh of producing electricity, including the amounts needed to cover operating costs and annualized capital costs. Overnight capital costs account for one-third of the levelized cost, and interest costs on the overnight costs account for another 25 percent (University of Chicago 2004). Levelized cost estimates based on the MIT study (2009) range from $66 to $84 per MWh (6.6 to 8.4 cents per kWh). A number of factors can affect the range, such as the choice of discount rate, construction duration, plant lifespan, capacity factor, tax rates, and premium for uncertainty. Estimates include decommissioning, but because of the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little effect on the levelized cost. In its revised ER, SCE&G estimated that operating costs for Units 2 and 3 would be in the range of $37 to $42 per MWh (3.7 to 4.2 cents per kWh) (SCE&G 2010). Considering the more recent information provided by SCE&G, the review team did not find SCE&G's estimates to be unreasonable approximations, based on expected costs.

Fuel Costs

The cost of fuel is included in the calculation of levelized cost. Based on the recent World Nuclear Association's study (WNA 2010), the review team estimates nuclear fuel costs to be less than half a cent (0.45 cents) per kWh.

Waste Disposal

The back-end costs of nuclear power contribute a very small share of total cost, both because of the long lifetime of a nuclear reactor and the fact that provisions for waste-related costs can be accumulated over that time. It also should be recognized, however, that radioactive nuclear waste poses unique disposal challenges for long-term management. While spent fuel and radioactive nuclear waste are being stored successfully in onsite facilities, the United States and other countries have yet to implement final disposition of spent fuel or high-level radioactive waste streams created at various stages of the nuclear fuel cycle.

Decommissioning

In accordance with 10 CFR 50.75, the NRC requires that licensees provide reasonable assurance that funds will be available for the decommissioning process. Because of the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little effect on the levelized cost of electricity generated by a nuclear power plant. Decommissioning costs are about 9 to 15 percent of the initial capital cost of a nuclear power plant. However, when discounted, decommissioning costs contribute only a few percent to the investment cost and even less to the generation cost. In the United States, they account for 0.1 to 0.2 cents per kWh, which is no more than 5 percent of the cost of the electricity produced (WNA 2010).

10.6.2.2 External Costs

External costs are social and/or environmental effects that would be caused by the building of and generation of power by two new reactors at the VCSNS site.

Environmental and Social Costs

The impacts of building and operating the VCSNS Units 2 and 3 have been identified and analyzed in Chapters 4 and 5, and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned. Such impacts cannot be universally monetized. Chapter 6 similarly addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of nuclear units at the VCSNS site. A summary of project internal and external costs is shown in Table 10-4.

Unlike generation of electricity from coal and natural gas, normal operation of a nuclear power plant does not result in significant emissions of criteria air pollutants (e.g., oxides of nitrogen or sulfur dioxide), methyl mercury, or greenhouse gases associated with global warming and climate change. Whereas combustion-based power plants are responsible for at least 70 percent of the sulfur dioxide, at least 21 percent of nitrogen oxides, and 51 percent of the mercury emissions from industrial sources in the United States (EPA 2009), and 40 percent of the carbon dioxide (DOE/EIA 2008a). Eighty-two percent of the electric power industry's emissions are from coal-fired plants (DOE/EIA 2008b). Chapter 9 of this EIS analyzes coal- and natural-gas-fired alternatives to the construction and operation of VCSNS Units 2 and 3. Air emissions from these alternatives and nuclear power are summarized in Chapters 4, 5, and 9.

As discussed previously, Table 10-4 summarizes the external costs (i.e., environmental impacts) associated with the building and operation of the proposed VCSNS Units 2 and 3. Impacts to air quality, aquatic ecology, housing, public services, aesthetics and recreation, cultural resources, and radiological and nonradiological health all would be SMALL. Because the overall impact to these resources from the proposed project in its entirety would be SMALL, the impacts from the NRC action (i.e., construction as defined in 10 CFR 51.4, and operation of the proposed new units) accordingly would also be SMALL. For land use, the impact from the total project would be MODERATE, the impact from the NRC portion of the project would be SMALL. For terrestrial ecology the impact from the total project would be MODERATE, the impact from the NRC portion of the project would be SMALL. For traffic near the VCSNS site, the review team determined the total impact would be MODERATE and the NRC portion of the project would be MODERATE.

10.6.3 Summary of Benefits and Costs

SCE&G's business decision to pursue expansion of VCSNS generating capacity by adding two additional nuclear reactors is an economic decision, based on private financial factors subject to regulation by the PSCSC. The internal costs to construct additional units appear to be substantial; however, SCE&G's decision to pursue this expansion is an indication that the company has already concluded that the private, or internal, benefits of the proposed facility outweigh the internal costs. Although the identified societal benefits are not specifically monetized, the review team determined that the potential societal benefits of the proposed expansion of the VCSNS site are substantial. In comparison, the external socio-environmental costs imposed on the region appear to be relatively small. The external costs listed in Table 10-4 summarize environmental impacts on resources that could result from construction, preconstruction, and operation of Units 2 and 3. Because Table 10-4 includes costs for pre-construction activities as well as for NRC-authorized construction and operation, the costs presented for an individual resource may be greater than the costs solely for the NRC-authorized portion of the project.

Table 10-3 and Table 10-4 include summaries of the internal and external costs of the proposed activities at the VCSNS site, as well as the identified benefits. The tables include references to other sections of this EIS when impact assessments or more detailed analyses are available for specific topics.

On the basis of the assessments summarized in this EIS, the construction and operation of the proposed VCSNS Units 2 and 3, with the mitigation measures identified by the staff, would have accrued benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (NRC-authorized construction and operation) the accrued benefits would also outweigh the costs of construction and operation of Units 2 and 3.

10.7 Staff Recommendation

The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs should be issued. The staff's evaluation of the safety and emergency preparedness aspects of the proposed action will be addressed in the staff's safety evaluation report that is anticipated to be published in 2011.

This recommendation is based on (1) the ER submitted by SCE&G (2010), (2) consultation with Federal, State, Tribal, and local agencies, (3) the review team's independent review, (4) the NRC staff's consideration of comments related to the environmental review that were received during the public scoping process, (5) the NRC staff's consideration of comments on the draft EIS, and (6) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and in the EIS.

The NRC's determination is independent of the USACE's determination of whether the VCSNS site is the Least Environmentally Damaging Practicable Alternative pursuant to Clean Water Act Section 404(b)(1) Guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

10.8 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."

33 CFR Part 332. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Part 332, "Compensatory Mitigation for Losses of Aquatic Resources."

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

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10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

The Environmental Impact Statement (EIS) has been prepared to satisfy the requirements of the National Environmental Policy Act of 1969, as amendeed (NEPA). The EIS was prepared in response to an application submitted to the U.S. NRC by South Carolina Electric and Gas (SDE&G), acting for itself and for Santee Cooper (aka the South Carolina Public Service Authority) for combined construction permits and operating licenses (COLs). The proposed actions related to the SCE&G application are (1) NRC issuance of COLs for two new nuclear power reactor units (Units 2 and 3) at the V.C. Summer Nuclear Station (VCSNS) site in Fairfield County, SC, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army (DA) Individual Permit application to perform certain activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team. This EIS includes the analysis by the NRC and USACE staff that considers and weighs the environmental impacts fo building and operating two new nuclear units at the VCSNS site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. The EIS also addresses Federally listed species, cultural resources, and essential fish habitat issues.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Environmental Impact Statement, EIS, National Environmental Policy Act of 1969, NEPA, U.S. NRC, South Carolina Electric and Gas , Santee Cooper, South Carolina Public Service Authority, combined construction permits and operating licenses, COLs, proposed actions, SCE&G, application, new nuclear power reactor units, Units 2 and 3, V.C. Summer Nuclear Station, VCSNS, Fairfield County, SC, U.S. Army Corps of Engineers, USACE, permit, Department of the Army, DA, Individual Permit application, participating, cooperating agency, review team, environmental impacts, building, operating, two new nuclear units, alterantive sites, mtigation measures, reducing or avoiding adverse impacts, Federally listed species, cultural resources, fish habitat issues.

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