ENCLOSURE 3
Attachment 2

OCONEE NUCLEAR STATION
Subsequent License Renewal Application, Appendix E, Environmental Report

Appendix E

Applicant's Environmental Report

Subsequent Operating License Renewal Stage

Oconee Nuclear Station Units 1, 2, and 3

Table of Contents

List of Tables

List of Figures

List of Attachments

Abbreviations, Acronyms, and Symbols

§	Section
°C	degrees Celsius
°F	degrees Fahrenheit
AADT	average annual daily traffic
AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
ALWR	advanced light water reactor
APE	area of potential effect
AQCR	air quality control region
ARERR	annual radiological effluent release report
ATWS	anticipated transient without scram
B&W	Babcock and Wilcox Company
BDB	beyond design basis
Bechtel	Bechtel Corporation
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practice
BOD	biological oxygen demand
BOEM	U.S. Bureau of Ocean Energy Management
Btu	British thermal unit
C&D	construction and demolition
CAA	Clean Air Act
CCW	condenser circulating water
CDF	core damage frequency
CDP	census-designated place
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COLA	combined license application
CSP	concentrated solar power

CTP	chemical treatment pond
CWA	Clean Water Act (Federal Water Pollution Control Act)
CZMP	Coastal Zone Management Program
dBA	A-weighted decibels
DCH	designated critical habitat
DDT	dichlorodiphenyltrichloroethane
DECON	dismantling and decontamination, one of three NRC decommissioning strategies
DO	dissolved oxygen
DSM	demand-side management
Duke Energy	Duke Energy Carolinas, LLC
EA	environmental assessment
EAB	exclusion area boundary
ECCS	emergency core cooling system
EFH	essential fish habitat
EIS	environmental impact statement
ENTOMB	permanent entombment on site, one of three NRC decommissioning strategies
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ER	environmental report
ESA	Endangered Species Act
ESV	essential siphon vacuum
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FES	final environmental statement
FPPA	Farmland Protection Policy Act
fps	feet per second
ft^3	cubic feet
FV	Fussell-Vesely (probabilistic risk assessment importance measure)
FY	fiscal year
gal/kWh	gallons per kilowatt hour

GEIS	NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*
GHG	greenhouse gas
GPI	Groundwater Protection Initiative
gpd	gallons per day
gpm	gallons per minute
gpm_a	average gallons per minute for the month
gpy	gallons per year
GWd/MTU	gigawatt-days per metric ton of uranium
GWDT	gaseous waste decay tank
GWR	gaseous waste release
HAP	hazardous air pollutant
HAPC	habitat areas of particular concern
HPSW	high pressure service water
HUC	hydrologic unit code
HVAC	heating, ventilation, and air conditioning
I-85	Interstate 85
IGCC	integrated gasification combined cycle
IPA	integrated plant assessment
IPEEE	individual plant examination of external events
IRB	interim radwaste building
IRP	integrated resource plan
ISFSI	independent spent fuel storage installation
km	Kilometer
kV	kilovolt
LAR	license amendment request
Ldn	day-night 24-hour average (noise)
LDST	let down storage tank
LERF	large early release frequency
LLMW	low-level mixed waste
LLRF	large late release frequency
LLRW	low-level radioactive waste
LLW	low-level waste

LOCA	loss of coolant accident
LOS	level of service
LPSW	low pressure service water
LRA	license renewal application
mA	milliamperes
Mb	body-wave magnitude (earthquakes)
MB	maximum benefit
MBTA	Migratory Bird Treaty Act
MEI	maximum exposed individual
MG	million gallons
mg/L	milligram per liter
MGD	million gallons per day
MGM	million gallons per month
mgy	million gallons of water per year
MM	modified Mercalli intensity (seismic intensity scale)
MMBtu	million British thermal units
mph	miles per hour
mrad	milliradiation absorbed dose
mrem	millirem (milli roentgen equivalent man)
mrem/hour	milli roentgen equivalent man/hour
mrem/year	milli roentgen equivalent man/year
MRLC	Multi-Resolution Land Characteristics Consortium
msl	mean sea level
mSv	millisievert
MUR	measurement uncertainty recapture
MVA	mega-volt amp
MW	megawatt
MWD/MTU	megawatt days per metric ton uranium
MWe	megawatts electric
MWt	megawatts thermal
NA	not available/not applicable
NAAQS	national ambient air quality standards

NAVD88	North American Vertical Datum 1988
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NGCC	natural gas-fired combined-cycle
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NOV	notice of violation
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWS	National Weather Service
OAC	operator aid computer
OCA	owner-controlled area
ODCM	offsite dose calculation manual
OL	operating license
ONS	Oconee Nuclear Station
OSHA	Occupational Safety and Health Administration
Pb	lead
pc/h	passenger cars per hour
PCB	polychlorinated biphenyl
pCi/l	picoCuries per liter
PEO	period of extended operation

PILOT	payment in lieu of taxes
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PM_{10}	particulate matter less than 10 micrometers in diameter
PM	particulate matter
PMF	probable maximum flood
ppm	parts per million
ppt	parts per thousand
PRA	probabilistic risk assessment
psig	pounds per square inch gauge
PSW	protected service water
PV	photovoltaic
PWR	pressurized water reactor
RCRA	Resource Conservation and Recovery Act
RCS	reactor coolant system
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
ROL	renewed operating license
ROW	right-of-way
SAFSTOR	safe storage, one of three NRC decommissioning strategies
SAMA	severe accident mitigation alternative
SBO	station blackout
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCDOT	South Carolina Department of Transportation
SCEPPC	South Carolina Exotic Pest Plant Council
SHPO	state historic preservation officer
SLR	subsequent license renewal
SLRA	subsequent license renewal application
SMP	shoreline management plan
SMITTR	surveillance, monitoring, inspections, testing, trending, and recordkeeping
SMR	small modular reactor

SN	station number
SO_2	sulfur dioxide
SO_x	sulfur oxides
SPCC	spill prevention, control, and countermeasure
SPUT	special purpose utility permit
SQG	small quantity generator
SSA	sole source aquifer
SSC	systems, structures, and components
STC	source term category
SWPPP	stormwater pollution prevention plan
TEDE	total effective dose equivalent
THPO	tribal historic preservation officer
TLD	thermoluminescent dosimetry
TSS	total suspended solids
UFSAR	updated final safety analysis report
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USCB	U.S. Census Bureau
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tanks
VOC	volatile organic compound
WMA	wildlife management area
W.S. Lee Station	William States Lee III

1.0 INTRODUCTION

1.1 Purpose of and Need for Action

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended (AEA), and NRC implementing regulations. Duke Energy Carolinas, LLC (Duke Energy) operates Oconee Nuclear Station (ONS) Units 1, 2, and 3, located on the shore of Lake Keowee in Oconee County, South Carolina, pursuant to NRC operating licenses (OLs) DPR-38, 47, and 55, respectively. Based on a license renewal application (LRA) submitted in 1998, the NRC issued renewed OLs (ROLs) in May 2000, providing authorization to operate for an additional 20 years beyond the original 40-year licensed operating term. The Unit 1 ROL expires on February 6, 2033, the Unit 2 ROL expires October 6, 2033, and the Unit 3 ROL expires on July 19, 2034.

Duke Energy has prepared this environmental report in conjunction with its application to the NRC for a subsequent license renewal of the ONS ROLs, as provided by the following NRC regulations and guidance (NRC 2013a):

- Title 10, Energy, Code of Federal Regulations (CFR), Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Section 54.23, Contents of Application - Environmental Information [10 CFR 54.23]
- Title 10, Energy, CFR, Part 51, Environmental Protection Requirements for Domestic Licensing and Related Regulatory Functions, Section 51.53, Post-construction Environmental Reports, Subsection 51.53(c), Operating License Renewal Stage [10 CFR 51.53(c)]
- NUREG-1555, Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal

The NRC has defined the purpose and need for the proposed action–renewal of the operating licenses for nuclear power plants such as ONS–as follows (NRC 2013b):

> *The purpose and need for the proposed action (issuance of a renewed license) is to provide an option that allows for baseload power generation capability beyond the term of the current nuclear power plant operating license to meet future system generating needs. Such needs may be determined by other energy-planning decision-makers, such as state, utility, and, where authorized, federal agencies (other than the NRC). Unless there are findings in the safety review required by the AEA or the National Environmental Policy Act (NEPA) environmental review that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions of whether a particular nuclear power plant should continue to operate.*

The renewed ROLs would allow an additional 20 years of operation for the ONS units beyond their current licensed operating terms. The subsequent license for ONS Unit 1 renewed license would expire on February 6, 2053, the ONS Unit 2 renewed license would expire October 6, 2053, and the ONS Unit 3 renewed license would expire on July 19, 2054.

Duke Energy has prepared Table 1.1-1 to verify conformance with regulatory requirements. Table 1.1-1 indicates the sections in the ONS subsequent license renewal (SLR) environmental report (ER) that respond to each requirement of 10 CFR 51.53(c) and 10 CFR 51.45.

Table 1.1-1 Environmental Report Compliance with License Renewal Environmental Regulatory Requirements (Sheet 1 of 3)

Description	Requirement	ER Section(s)
Environmental Report—General Requirements [10 CFR 51.45]		
Description of the proposed action	10 CFR 51.45(b)	2.1
Statement of the purposes of the proposed action	10 CFR 51.45(b)	1.0
Description of the environment affected	10 CFR 51.45(b)	3.0
Impact of the proposed action on the environment	10 CFR 51.45(b)(1)	4.0
Adverse environmental effects which cannot be avoided should the proposal be implemented	10 CFR 51.45(b)(2)	6.3
Alternatives to the proposed action.	10 CFR 51.45(b)(3)	2.6, 7.0, 8.0
Relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity	10 CFR 51.45(b)(4)	6.5
Irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented	10 CFR 51.45(b)(5)	6.4
Analysis that considers and balances the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse environmental effects	10 CFR 51.45(c)	2.6, 4.0, 7.0, 8.0
Federal permits, licenses, approvals, and other entitlements which must be obtained in connection with the proposed action and description of the status of compliance with these requirements	10 CFR 51.45(d)	9.0
Status of compliance with applicable environmental quality standards and requirements which have been imposed by federal, state, regional, and local agencies having responsibility for environmental protection, including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements	10 CFR 51.45(d)	9.0
Alternatives in the report including a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements	10 CFR 51.45(d)	9.7
Information submitted pursuant to 10 CFR 51.45(b) through (d) and not confined to information supporting the proposed action but also including adverse information	10 CFR 51.45(e)	4.0, 6.3

Table 1.1-1 Environmental Report Compliance with License Renewal Environmental Regulatory Requirements (Sheet 2 of 3)

Description	Requirement	ER Section(s)
Operating License Renewal Stage [10 CFR 51.53(c)]		
Description of the proposed action including the applicant's plans to modify the facility or its administrative control procedures as described in accordance with §54.21. The report must describe in detail the affected environment around the plant, the modifications directly affecting the environment or any plant effluents, and any planned refurbishment activities	10 CFR 51.53(c)(2)	2.1, 2.3, 2.4, 3.0, 4.0
Analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for applicable Category 2 issues, as discussed below	10 CFR 51.53(c)(3)(ii)	2.3, 4.0
Surface Water Resources		
Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)	10 CFR 51.53(c)(3)(ii)(A)	4.5.1
Groundwater Resources		
Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)	10 CFR 51.53(c)(3)(ii)(A)	4.5.2
Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])	10 CFR 51.53(c)(3)(ii)(C)	4.5.3
Groundwater quality degradation (plants with cooling ponds at inland sites)	10 CFR 51.53(c)(3)(ii)(D)	4.5.4
Radionuclides released to groundwater	10 CFR 51.53(c)(3)(ii)(P)	4.5.5
Aquatic Resources		
Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	10 CFR 51.53(c)(3)(ii)(B)	4.6.1
Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	10 CFR 51.53(c)(3)(ii)(B)	4.6.2
Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river.	10 CFR 51.53(c)(3)(ii)(A)	4.6.3

Table 1.1-1 Environmental Report Compliance with License Renewal Environmental Regulatory Requirements (Sheet 3 of 3)

Description	Requirement	ER Section(s)
Terrestrial Resources		
Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	10 CFR 51.53(c)(3)(ii)(A)	4.6.4
Effects on terrestrial resources (non-cooling system impacts)	10 CFR 51.53(c)(3)(ii)(E)	4.6.5
Special Status Species and Habitats		
Threatened, endangered, and protected species and essential fish habitat	10 CFR 51.53(c)(3)(ii)(E)	4.6.6
Historic and Cultural Resources		
Historic and cultural resources	10 CFR 51.53(c)(3)(ii)(K)	4.7
Human Health		
Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	10 CFR 51.53(c)(3)(ii)(G)	4.9.1
Electric shock hazards	10 CFR 51.53(c)(3)(ii)(H)	4.9.2
Environmental Justice		
Minority and low-income populations	10 CFR 51.53(c)(3)(ii)(N)	3.11.2, 4.10.1
Cumulative Impacts		
Cumulative impacts	10 CFR 51.53(c)(3)(ii)(O)	4.12
Postulated Accidents		
Severe accidents	10 CFR 51.53(c)(3)(ii)(L)	4.15
All Plants		
Consideration of alternatives for reducing adverse impacts for all Category 2 license renewal issues	10 CFR 51.53(c)(3)(iii)	4.0, 6.2
New and significant information regarding the environmental impacts of license renewal of which the applicant is aware	10 CFR 51.53(c)(3)(iv)	4.0, 5.0

1.2 Environmental Report Scope and Methodology

NRC regulations for domestic licensing of nuclear power plants require reviews of environmental impacts from renewing an OL. NRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document entitled "Applicant's Environmental Report – Operating License Renewal Stage." In determining what information to include in the ONS SLR applicant's ER, Duke Energy has relied on NRC regulations and the following supporting documents to provide additional insight into the regulatory requirements:

- *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), Revision 1 (NRC 2013a), and referenced information specific to transportation (NRC 1999a)
- NRC supplemental information in the *Federal Register* notice for the 2013 final rule updating 10 CFR 51 (78 FR 37282)
- *Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses* (NRC 1996a)
- Regulatory Guide 4.2, Supplement 1, Revision 1 *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications* (NRC 2013b)

The NRC included in 10 CFR 51 the list of 78 NEPA issues for license renewal of nuclear power plants that were identified in the 2013 GEIS (Appendix B to Subpart A of 10 CFR 51, Table B-1). Attachment A lists the 78 issues from 10 CFR 51, Subpart A, Appendix B, Table B-1 and identifies the section in this ER in which Duke Energy addresses each applicable issue.

1.3 Oconee Nuclear Station Licensee and Ownership

Duke Energy, headquartered in Charlotte, NC, is a regulated public utility primarily engaged in the generation, transmission, distribution, and sale of electricity in portions of North Carolina and South Carolina. Duke Energy's service area covers approximately 24,000 square miles and supplies electric service to 2.6 million residential, commercial, and industrial customers. Duke Energy is subject to the regulatory provisions of the North Carolina Utility Commission, the Public Service Commission of South Carolina, and the Federal Energy Regulatory Commission (FERC), in addition to the NRC. In its generation portfolio, Duke Energy owns (at least in part) and operates three nuclear plants, four coal plants, eight natural gas plants, and several hydro plants. This includes the ONS Units 1, 2 and 3, of which Duke Energy is the owner and licensed operator. Duke Energy is a wholly-owned subsidiary of Duke Energy Corporation (Duke 2019a).

2.0 PROPOSED ACTION AND DESCRIPTION OF ALTERNATIVES

2.1 The Proposed Action

In accordance with 10 CFR 51.53(c)(2), a license renewal applicant's ER must contain a description of the proposed action. The proposed action is to renew for a second time, and for an additional 20-year period, the ROLs for ONS Units 1, 2, and 3, which would preserve the option for Duke Energy to continue operating ONS and provide reliable baseload power for the 20-year proposed SLR operating term. For ONS Unit 1, the proposed action would extend the ROL from February 6, 2033, to February 6, 2053. For ONS Unit 2, the proposed action would extend the ROL from October 6, 2033, to October 6, 2053. For ONS Unit 3, the proposed action would extend the ROL from July 19, 2034, to July 19, 2054.

Duke Energy does not anticipate any license renewal-related refurbishment as a result of the technical and aging management program information submitted in accordance with the NRC license renewal process. The relationship of refurbishment to SLR is described in Section 2.3.

Changes to surveillance, monitoring, inspections, testing, trending, and recordkeeping (SMITTR) would be implemented as a result of the 10 CFR Part 54 aging management review for ONS. Potential SMITTR activities are described in Section 2.4. No plant upgrades to support extended operations that could directly affect the environment or plant effluents are planned to occur during this period of extended operation (PEO).

2.2 General Plant Information

A license renewal applicant's ER must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures. This report must describe in detail the affected environment around the plant and the modifications directly affecting the environment or any plant effluents. [10 CFR 51.53(c)(2)]

The principal structures at ONS are the reactor containments, auxiliary building, fuel building, and turbine building, which includes the main control room. Main structures outside the power block are the intake structure, discharge structure, office complex, independent spent fuel storage installation (ISFSI), visitor center (World of Energy), steam generator/reactor head retirement building, flex building, radwaste building, service building, operations training center, firing range, warehouses, 525-kilovolt (kV) switchyard, 230-kV switchyard, 100-kV switchyard, and meteorological towers. Figure 3.1-1 illustrates these plant structures and the exclusion area boundary (EAB). As discussed in Section 3.1.2, all the property within the 1-mile radius EAB is owned in fee, including mineral rights, by Duke Energy, except for the small rural church plot belonging to Old Pickens Church, rights-of-way (ROWs) for existing highways, and approximately 9.8 acres of U.S. government property involved with the Lake Hartwell reservoir. Duke Energy, through agreements with the church property owners and the U.S. government, has the authority to control activities within the EAB. In the event of an emergency, local law enforcement will control and limit traffic on public roadways within the EAB. To control development around Lake Keowee, Duke Energy has a property use permit process for construction or maintenance activities, including installation of residential docks along the lake, private facilities construction, modification and maintenance of existing structures, and modification or maintenance of existing shoreline stabilization.

2.2.1 Reactor and Containment Systems

As shown in Figure 3.1-1, ONS is a three-unit (Units 1, 2, and 3) plant. Each unit includes a two-coolant-loop pressurized light water reactor (PWR) nuclear steam supply system supplied by Babcock and Wilcox Company (B&W). In addition, B&W supplied technical direction of erection and consultation for initial fuel loading, testing, and initial startup of the complete nuclear steam supply system with coordination, scheduling, and administrative direction by Duke Energy. The Bechtel Corporation (Bechtel) was retained by Duke Energy as a general consultant to provide such engineering assistance as needed during the design and construction of the station. Layout, engineering, and design of the reactor buildings were assigned to Bechtel.

Units 1, 2, and 3 achieved commercial operation on July 15, 1973; September 9, 1974; and September 16, 1974, respectively. Each reactor unit was originally designed to generate 2,568 megawatts thermal (MWt), with an equivalent gross electrical output of 860 megawatts electric (MWe). In 2011, Duke Energy submitted a license amendment request (LAR) for measurement uncertainty recapture (MUR) power uprated to a core power output of 2,610 MWt. (Duke 2020a) The MUR LAR takes into credit implementation of protected service water (PSW); however, the PSW implementation was delayed, and that paused the uprate. Duke Energy resubmitted the MUR LAR in February 2020 (Duke 2020a) and it is currently under NRC review.

The concrete/steel containment is analyzed as a free-standing structure and is referred to as the reactor building. It is constructed of reinforced concrete and structural liner plate steel with no separation between the two.

The reactor building interior structure consists of (1) the reactor cavity; (2) two steam generator compartments; and (3) a refueling pool located between the steam generator compartments and above the reactor cavity. The reactor cavity houses the reactor vessels and serves as a biological shield wall. The reactor cavity is also designed to contain core flooding water up to the level of the reactor nozzle.

The reactor is a pressurized water reactor and is functionally comprised of the reactor internals, fuel system, and control rod drives. The fuel system consists of the fuel assemblies and control components. The major functions of the reactor internals are to support the core, maintain fuel assembly alignment, and direct the flow of reactor coolant. The fuel system is designed to operate at 2,568 MWt with sufficient design margins to accommodate transient operation and instrument error without damage to the core and without exceeding limits for the reactor coolant system (RCS).

The reactor is controlled by control rod movement and regulation of the boric acid concentration in the reactor coolant. Between 15 percent and 100 percent full power, the integrated control system maintains constant average reactor coolant temperature. Constant steam pressure is maintained over the full power range. The excess reactivity is controlled by a combination of soluble boron, lumped burnable poison, and control rods. Long-term decreases in reactivity caused by fuel burnup are offset by decreases in soluble boron concentration and decreases in burnable poison worth. Short-term reactivity effects are controlled by changes in control rod position.

The core will have sufficient reactivity to produce the design power level and lifetime without exceeding the control capacity or shutdown margin. Fuel assemblies have been designed for the maximum burnups rate of 62,000 megawatt days per metric ton of uranium (MWD/MTU). ONS is currently licensed for maximum enrichment of 5 percent U-235, which is reduced to 4.95 percent to allow for tolerances. Duke Energy does not have any commitments or contracts for higher burnup or enrichment at this time.

Fuel irradiation rates are as follows: first cycle averages are 9,582 MWD/MTU; 14,396 MWD/MTU; and 14,978 MWD/MTU for Units 1, 2, and 3 respectively. The equilibrium cycle averages (Mk-B11 & B11A) are 15,172 MWD/MTU; 15,172 MWD/MTU; and 15,172 MWD/MTU for Units 1, 2, and 3 respectively. The equilibrium cycle averages (Mk-B-HTP) are 14,241/20,854 MWD/MTU; 14,241/20,854 MWD/MTU; and 14,241/20,854 MWD/MTU for 18 months and 24 months corresponding to Units 1, 2, and 3 respectively.

The complete core has 177 fuel assemblies which are arranged in the approximate shape of a cylinder. All fuel assemblies are similar in mechanical construction and are mechanically interchangeable in any core location. The reactivity of the core is controlled by 61 control rod assemblies and 8 axial power shaping rod assemblies, a variable number of burnable poison rod assemblies, and soluble boron in the coolant. Cladding, fuel pellets, end caps, and fuel support components form a “fuel rod.” The basic fuel assembly consists of 208 fuel rods, 16 control rod guide tubes, one instrumentation tube assembly, eight spacer grids, and two end fittings.

Materials testing and actual operation in reactor service with Zircaloy cladding have demonstrated that Zircaloy-4 and M5 materials have sufficient corrosion resistance and mechanical properties to maintain the integrity and serviceability required for design burnup.

The pre-stressed, post-tensioned, steel-lined, concrete reactor building is designed to withstand the maximum internal pressure resulting from an analysis of a spectrum of reactor coolant system and main steam line leaks. Isolation valves are provided on fluid piping penetrating the reactor building to provide containment integrity when required.

The reactor building completely encloses the reactor coolant system to minimize release of radioactive material to the environment should a serious failure of the reactor coolant system occur. The principal design basis for the structure is that it be capable of withstanding the internal pressure resulting from a loss-of-coolant accident or a secondary line rupture with no loss of integrity.

Following a loss of coolant accident (LOCA), the emergency core cooling systems inject borated water into the reactor coolant system to remove core decay heat and to minimize metal-water reactions and the associated release of heat and fission products. Flashed primary coolant, reactor coolant system sensible heat, and core decay heat transferred to reactor building are removed by two engineered safeguards systems: the reactor building spray and/or the reactor building cooling systems. The reactor building spray system removes heat directly from the reactor building atmosphere by cold water quenching of the reactor building steam. The air recirculation and cooling systems remove heat directly from the reactor building atmosphere to the service water system with recirculating fans and cooling coils. The low-pressure injection coolers remove heat from the containment sump liquid to the service water system with heat exchange through tubes.

The reactor building shield is a reinforced, pre-stressed concrete structure with 3.75-foot thick cylindrical walls and a 3.25-foot thick dome. In conjunction with the primary and secondary shields, it limits the radiation level outside the reactor building from all sources inside the reactor building to no more than 0.5 milli roentgen equivalent man/hour (mrem/hour) at full power operation. The shielding is also designed to protect station personnel from radiation sources inside the reactor building following the maximum hypothetical accident (gross release of fission products).

2.2.2 Maintenance, Inspection, and Refueling Activities

Various programs and activities at the site maintain, inspect, test, and monitor the performance of plant equipment and are detailed throughout the updated final safety analysis report (UFSAR). Maintenance of station safety-related structures, systems, and components is performed in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances (for example, skills normally possessed by qualified maintenance personnel may not require detailed step-by-step delineation in a written procedure) which conform to applicable codes, standards, specifications, criteria, etc. When appropriate sections of related vendor manuals, instructions, or approved drawings with acceptable tolerances do not provide adequate guidance to assure the required quality of work, an approved written maintenance procedure is provided.

Maintenance procedures are sufficiently detailed that qualified workers can perform the required functions without direct supervision. Written procedures, however, cannot address all contingencies, and therefore contain a degree of flexibility appropriate to the activities for which each is applicable.

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear power plant. Some of the maintenance activities conducted at ONS include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and public safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as replacement of a major component. (NRC 1999b, Section 2.1.6)

Scheduled refueling outages commonly have a duration of approximately 30 days plus or minus five days for a single unit. An additional 800 to 900 workers are onsite during a typical outage. For ONS, one fall refueling outage is scheduled during odd years, and spring and fall refueling outages are scheduled for even years. All refueling operations will be carried out with the fuel under borated water to provide cooling for fuel assemblies and shielding for personnel.

2.2.3 Cooling and Auxiliary Water Systems

ONS is equipped with a once-through heat dissipation system that withdraws cooling water from the Little River arm of Lake Keowee from underneath a skimmer wall. The discharge for the cooling water is located on the Keowee River arm of the lake just above the Lake Keowee dam. The Keowee River and the Little River watersheds are connected by a canal. (NRC 1999b, Section 2.1.3)

Each generating unit has three separate water loops. The primary coolant loop is a closed piping system: pressurized water in the system is circulated through the reactor and transfers heat from the reactor to the steam generator. The secondary loop is also a closed system: water from this system is converted into steam (in the steam generators) used to drive the turbine. The third loop is an open system: water from the Little River arm of Lake Keowee is used to cool the spent steam in the secondary loop, and then it is returned to the Keowee River arm of Lake Keowee. The principal components of the third cooling loop are the skimmer wall, intake structure, circulating water pumps, condensers, and discharge conduits. (NRC 1999b, Section 2.1.3)

ONS has four sources of water for shutdown and cooldown. These sources are: (1) water from Lake Keowee via the intake canal using the circulating water pumps; (2) gravity flow through the circulating water system; (3) water trapped between the submerged weir in the intake canal and the intake structure in the event of a loss of Lake Keowee and; (4) 8,776,948 gallons of water trapped in the plant's circulating water system (below elevation 791 feet) with appropriate valving, pumping and recirculation as a backup in the event of the loss of all external water supplies.

2.2.3.1 Emergency Core Cooling System

The emergency core cooling system (ECCS) is designed to cool the reactor core and provide shutdown capability following initiation of the following accident conditions:

1. LOCA including a pipe break or a spurious relief or safety valve opening in the RCS, which would result in a discharge larger than that which could be made up by the normal make-up system.

2. Rupture of a control rod drive mechanism causing a rod cluster control assembly ejection accident.
3. Steam or feedwater system break accident including a pipe break or a spurious relief or safety valve opening in the secondary steam system which would result in an uncontrolled steam release or a loss of feedwater.
4. A steam generator tube rupture.

The primary function of the ECCS is to remove the stored and fission product decay heat from the reactor core during accident conditions. The ECCS for one reactor unit is shown in Figure 2.2-1. The overall ECCS is comprised of the following independent subsystems: high pressure injection system, low pressure injection system, and core flooding system.

2.2.3.2 Component Cooling System

The component cooling system is designed to provide cooling water for various components in the reactor building as follows: letdown coolers, reactor coolant pump cooling jacket and seal coolers, quench tank cooler, and control rod drive cooling coils. The design cooling requirement for the system is based on the maximum heat loads from these sources. The system also provides an additional barrier between high pressure reactor coolant and service water to prevent an inadvertent release of activity.

During operation, one component cooling pump and one component cooler recirculate and cool water to accommodate the system heat loads for each reactor unit. The component cooling surge tank accommodates expansion, contraction, and leakage of coolant into or out of the system. The surge tank provides a reservoir of component cooling water until a leaking cooling line can be isolated. Makeup water is added to the system in the surge tank.

The component cooling system performs no emergency functions and is not an engineered safeguard system. Redundancy in active components is provided to improve system reliability. The component cooling system for ONS is shown in Figure 2.2-2.

2.2.3.3 Cooling Water Systems

The cooling water systems for the station are designed to provide redundant cooling water supplies to insure continuous heat removal capability both during normal and accident conditions. The low-pressure service water and portions of the condenser circulating water systems are designed so no single component failure will impair emergency safeguards operation. Redundant pumping capability is provided, heat exchangers and pumps can be isolated, and pressure-reducing valves are provided with bypasses.

2.2.3.3.1 Condenser Circulating Water System

This system provides for cooling of the condensers during normal operation of the plant. The system uses lake water as the ultimate heat sink for decay heat removal during cooldown of the plant.

The Little River arm of Lake Keowee is the source of water for the condenser circulating water (CCW) systems. Each unit has four condenser circulating water pumps supplying water via two 11-foot conduits into a common condenser intake header under the turbine building floor. The discharge from the condenser is returned to the Keowee River arm of Lake Keowee. The suction of the condenser circulating water pumps extends below the maximum drawdown of the lake. The intake structure is provided with screens which can be manually removed for periodic cleaning.

The intake canal that supplies water from Lake Keowee to the suction of the CCW pumps contains a submerged weir. The purpose of this weir is to provide an emergency pond of cooling water if the water supply from Lake Keowee were lost. This emergency pond could be recirculated through the condensers and back to the intake canal for decay heat removal as long as the intake canal level remains sufficient.

Lake Keowee supplies the CCW system and the lake water serves as the ultimate heat sink for ONS.

During an external flood mitigation event, the water sources for alternative low pressure emergency feedwater are the chemical treatment ponds (CTPs) 1 and 2. This will include connecting flex steam generator feedwater from CTP-1 or CTP-2 through preferred injection point 2PSW29 (Unit 2 steam generator fill valve) or alternatively through 1, 2, 3 CCW-528 standby shutdown facility auxiliary service water emergency connection check. CTP-1 and CTP-2 are required to maintain one million gallons of water.

2.2.3.3.2 High Pressure Service Water System

The high pressure service water (HPSW) system provides a source of water for fire protection throughout the station and is used primarily for fire protection throughout ONS. In the event of a loss of the normal low pressure service water (LPSW) supply, HPSW automatically supplies cooling water to the HPI pump motor coolers. For loss of AC power, HPSW automatically supplies cooling water to the turbine-driven emergency feedwater pump oil cooler for all units via the elevated water storage tank. HPSW is also used as a backup supply to the siphon seal water system.

2.2.3.3.3 Low Pressure Service Water System

This system provides cooling water for normal and emergency services throughout the station. Following a design basis event involving loss of the CCW pumps, the emergency condenser circulating water system supplies suction to the LPSW pumps via gravity flow or siphon flow from the CCW system.

2.2.3.3.4 Recirculated Cooling Water System

This is a closed loop system to supply corrosion inhibited cooling water to various components. This system provides inhibited closed cycle cooling water to various components outside the reactor building including RC pump seal return coolers, spent fuel cooling, sample coolers, evaporator systems, and various pumps and coolers in the turbine building. The recirculated cooling water system consists of two parallel loops which are normally isolated from each other. One loop supplies cooling for shared station loads, Units 1 and 2 loads, and secondary loads on Unit 3. The other loop supplies cooling for Unit 3 primary loads. It consists of two motor-driven pumps and two RCW heat exchangers. It contains a 7,700-gallon surge tank and also utilizes condenser circulating water to cool the RCW heat exchangers.

2.2.3.3.5 Essential Siphon Vacuum System

This system supports the CCW system by removing air from the CCW intake header during normal and siphon modes of operation.

2.2.3.3.6 Siphon Seal Water System

This system's nuclear safety-related function is to support the essential siphon vacuum (ESV) system by providing operating liquid to the ESV pumps. The ESV pumps are liquid ring vacuum pumps which require a continuous supply of water to create a vacuum.

2.2.3.4 Protected Service Water System

The PSW system is designed as a standby system for use under emergency conditions. The PSW system is provided as an alternate means to achieve and maintain safe shutdown conditions for one, two, or three units following certain postulated scenarios. The PSW system reduces fire risk by providing a diverse power supply to power safe shutdown equipment in accordance with the National Fire Protection Association (NFPA) 805 safe shutdown analyses. The PSW system requires manual activation and can be activated if normal emergency systems are unavailable.

The function of the PSW system is to provide a diverse means to achieve and maintain safe shutdown by providing secondary side decay heat removal, RCS pump seal cooling, RCS primary inventory control, and RCS boration for reactivity management following plant scenarios that disable the 4,160V essential electrical power distribution system. Following achieving safe shutdown, a plant cooldown is initiated within 72 hours of the start of the event. No credit is taken in the safety analyses for PSW system operation following design basis events. Based on its contribution to the reduction of overall plant risk, the PSW system satisfies Criterion 4 of 10 CFR 50.36 (c)(2)(ii) and is therefore included in the station technical specifications.

2.2.3.5 Thermal Effluent Dispersion

ONS is located on Lake Keowee where an isthmus runs between the former watersheds of the Little and Keowee rivers. The watersheds of the two rivers are connected by a man-made canal approximately 213 feet wide with a maximum depth of 98 feet. To the south of the connecting canal, ONS withdraws cool hypolimnetic water from the Little River arm of Lake Keowee through an intake canal which is approximately 5,860 feet long and ranges in width from 500 to 1,800 feet. Water depths in the canal range from 91 to 100 feet. Heated water from the condenser cooling water system is discharged into the Keowee River watershed from a submerged opening that is 25 to 40 feet deep.

At the entrance to the intake canal, there is a skimmer wall that extends to a depth of 65 feet so that only water from 65- to 88.6-foot depths at full pond is drawn into the intake canal and station. The intake canal has two offshore debris protection barriers. A submerged underwater weir is located about 850 feet downstream of the skimmer wall. The weir has a 2.5:1 slope on both the upstream and downstream sides.

A trash boom was installed across the intake channel in 1999, about 900 feet upstream of the intake structure. The boom is angled to funnel debris to the shoreline.

The intake structure has 24 intake bays with trash racks having 5.5-inch clear spacing between the bars and two 10.75-foot fixed screens with 3/8-inch square mesh for each of 12 circulating pumps. There are four circulating pumps for each unit. Normal operation consists of running all four pumps in the summer, three pumps in the spring and fall, and two pumps in the winter. The maximum design withdrawal rate is 4,732 cubic feet per second (cfs), or 3,058 million gallons per day (MGD). An alarm sounds when the differential pressure at the fixed screens reaches 10 inches. The fixed screens are periodically lifted, as necessary, to clean them of debris using a high-pressure wash.

Water withdrawals and discharges from ONS are dominant influences on the thermal structure of Lake Keowee, along with water exchanges between Lake Jocassee and Lake Keowee via the Jocassee pumped storage station. A distinct but variable-size thermal plume occurs in the vicinity of the ONS discharge, primarily in the Keowee River watershed. The plume is largest in the winter and smallest in the summer.

Currently, ONS has a surface water withdrawal permit to withdraw a maximum of 94,817 million gallons per month (MGM) from the CCW intake and 68 MGM from the B5B intake. The amount to be returned is 93,936 MGM (99 percent). The permitted withdrawal rates for the plant intake structure are based on the design capacity of the pumps at the intake: 12 CCW pumps at 177,000 gpm/pump = 3,085.6 MGD or 94,817 MGM (31-day month) and one B5B pump at 1,500 gpm – 2.2 MGD or 68 MGM. The B5B system intake is "emergency withdrawal" as per NRC Order EA-02-026, Section B.5.b, Extensive Damage Mitigation. Return No. 1 (once-through cooling) is the only significant water return at ONS. Average intake and discharge temperatures, along with groundwater withdrawal rates, are discussed in Section 3.6. ONS also has an industrial pretreatment permit which allows for a maximum industrial wastewater discharge of 80,000 gallons per day (gpd) into the Coneross Creek wastewater treatment facility in accordance with the effluent limitations, monitoring requirements, and other conditions set forth in the permit.

There are two additional insignificant returns that are less than 5 percent of the current total withdrawal. These returns are the conventional wastewater outfall (Outfall 002 in the National Pollutant Discharge Elimination System [NPDES] permit) and the low-level radiological wastewater outfall (Outfall 004 in the NPDES permit). The wastewater flow path is illustrated in Figure 2.2-3.

2.2.3.6 Fire Protection System

The fire protection program is based on NRC requirements and guidelines. With regard to NRC criteria, the fire protection program meets the requirements of 10 CFR 50.48(c), which endorses, with exceptions, the NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 edition. ONS has further used the guidance of NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program under 10 CFR 50.48(c)" as endorsed by the NRC's Regulatory Guide 1.205, *Risk-Informed, Performance Fire Protection for Existing Light-Water Nuclear Power Plants*.

A safety evaluation issued on December 29, 2010, by the NRC transitioned the existing fire protection program to a risk-informed, performance-based program based on NFPA 805, in accordance with 10 CFR 50.48(c).

2.2.4 Meteorological Monitoring Program

Meteorological data have been taken continuously onsite since June 23, 1967. Meteorological measurements include wind direction and speed, horizontal wind direction fluctuation, temperature, and vertical temperature gradient.

There are two meteorological towers at ONS: meteorological tower #1 and meteorological tower #2. Meteorological tower locations are depicted in Figure 3.1-1. Meteorological tower #1 was relocated to approximately 1,750 feet northwest of its original location at the microwave tower on April 23, 1988. Relocating meteorological tower #1 was necessary due to the erection of the new administration building near the microwave tower. The building's proximity to the tower would have significantly influenced air flow near the tower. The new 60-meter high meteorological tower began operation on April 23, 1988, with wind speed and direction measured at the 10-meter and 60-meter levels and delta temperature measured between these intervals. The dew point temperature system was not reinstalled because there are no regulatory requirements for this parameter at ONS.

Instrument specifications at meteorological tower #1 are the same as those given in the 1984–1988 listing, with the exception of discontinued dewpoint measurements. Both upper and lower wind direction sensors for meteorological tower #1 were upgraded from potentiometric sensors to resolver sensors. This improved performance and reliability. A supplemental low-level wind system at the 10-meter level was installed January 30, 1981. The type of rain gauge was changed to a tipping bucket rain gauge and was relocated near the supplemental wind system. Meteorological tower #2 measures wind speed, wind direction, and precipitation data.

Instrumentation signals are processed digitally, transmitted via buried cable to the plant, and processed back to analog for use by the chart recorders and the plant operator aid computer (OAC). One-minute average data collection is available on the OACs in the control room. Near real-time digital outputs of meteorological measurements are summarized for end-to-end 15-minute periods for use in a near real-time puff-advection model to calculate offsite dose during potential radiological emergencies. The OAC system computes the 15-minute quantities from a sampling interval of 60 seconds. It calculates 15-minute average values for high- and low-level wind direction and speed; 15-minute averages are also calculated for delta temperature and ambient temperature. Total water equivalence is computed for precipitation. All 15-minute values are stored with a 24-hour recall. Permanent archiving of data from the digital system is made by combining the 15-minute quantities into one-hour values.

Periodic equipment calibration and maintenance checks are performed in the field for all parameters, as specified by station procedure. Semiannual calibration checks are performed as per associated station procedures.

Based on 5 years of meteorological data from 2014–2018, the recovery rate at ONS has been greater than 90 percent, except for meteorological tower #1 in 2017, when valid data recovery for the upper-level joint frequency of wind direction, wind speed, and stability was only 73.5 percent (mainly due to invalid wind direction data at upper level). However, the lower-level joint frequency was 98.6 percent on meteorological tower #1. Regional and site meteorology and air quality are presented in detail in Section 3.3. Meteorological parameters monitored at ONS are listed in Table 2.2-1.

2.2.5 Power Transmission System

2.2.5.1 In-Scope Transmission Lines

Based on NRC Regulatory Guide 4.2 (NRC 2013b, Section 2.2) and NUREG-1555, Supplement 1, Revision 1, transmission lines subject to evaluation of environmental impacts for license renewal are those that connect the nuclear power plant to the switchyard where electricity is fed into the regional power distribution system, and power lines that feed the plant from the grid during outages.

Transmission lines that connect the plant to the transmission system are only those lines from the ONS turbine building to the 230-kV and the 525-kV switchyards (NRC 1999b, Section 2.1.7). All in-scope transmission lines are located completely within the ONS EAB, as shown in Figure 2.2-4.

Each ONS unit has the following available sources of power to the engineered safeguards systems:

1. The 230-kV transmission system and/or the 525-kV transmission system.
2. Two Keowee Hydro Station units.
3. The 100-kV transmission system.

The onsite power system for each unit consists of the main generator, the unit auxiliary transformer, the startup transformer, the Keowee Hydro Station, the standby shutdown facility, the batteries, CT4 transformer, and the auxiliary power system. Under normal operating conditions, the main generator supplies power through the isolated phase bus to the unit auxiliary transformers. The unit auxiliary transformers are connected to the bus between the generator disconnect link and the associated unit step-up transformer for all three units. During normal operation, station auxiliary power is supplied from the main generator through the unit auxiliary transformer or start up transformers. During startup, during shutdown, and after shutdown, station auxiliary power is supplied from the 230-kV system through the startup transformer or auxiliary transformer via back charge.

Whenever there is inadequate power from the generating units, the 230-kV switching station and the hydroelectric units, power is available to the standby power buses either directly from the 100-kV Central, SC, tie substation or from W.S. Lee Natural Gas Plant via a 100-kV transmission line connected to 12/16/20 mega-volt amp (MVA) transformer CT5 located on the opposite side of the station from the 230-kV facilities. This single 100-kV circuit is connected to the 100-kV transmission system through the tie substation at Central, located 8 miles from ONS. The Central tie substation is connected to W.S. Lee Natural Gas Plant 22 miles away through a similar 100-kV line. If an emergency occurs that would require the use of the 100-kV transmission system, this line can be isolated from the balance of the transmission system to supply emergency power to ONS from W.S. Lee Natural Gas Plant, or emergency power can be supplied directly from the 100-kV system from the Central tie substation.

2.2.5.2 Vegetation Management Practices

The in-scope transmission lines are completely within the ONS EAB as shown in Figure 2.2-4. The in-scope transmission lines cross the ONS industrial area, where vegetation is sparse and need minimal vegetation management.

2.2.5.3 Avian Protection

Duke Energy provides protection to migratory, and threatened and endangered birds through a corporate avian protection plan. This plan adheres to the Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service (USFWS) guidelines regarding birds and electrical energy. The avian protection plan provides the following:

- An introduction to avian interactions including avian risk factors due to structure types, avian biology, behavior, and weather.
- Guidance on state and federal regulatory compliance with laws, regulations, and permit conditions.
- Employee and contractor training for avian awareness.
- Guidance for managing and reducing avian interactions with distribution and transmission lines, generation facilities, equipment, and electrical substations while increasing system reliability and safety.
- Procedures for responding to avian interaction incidents.
- Procedures for avian incident reporting.

- Guidance on the siting of new electric facilities to avoid and minimize impacts to avian resources.
- Avian design standards, tools, and processes.
- Areas of avian concern through the development and implementation of an avian risk assessment.
- Avian enhancement and public awareness measures.
- Key avian resources such as internal subject matter experts, resource agencies by state and region, conservation groups, and wildlife rehabilitation organizations.

Utility transmission and distribution structures may pose risks to avian species primarily due to electrocution or collision. Factors that influence these risks relate to the avian species involved, the environment, and the configuration and location of the structures with respect to other structures or topographic and other landscape features. Duke Energy's avian protection plan also provides construction design standards for avian-safe structures and mortality reduction measures.

2.2.5.4 Public

All in-scope transmission lines are located completely within property owned by Duke Energy. The public does not have access to this area; therefore, no induced shock hazards would exist for the public (see Figure 2.2-4).

2.2.5.5 Plant Workers

NUREG-1437 suggests that occupational safety and health hazard issues are generic to all types of electricity generating stations, including nuclear power plants, and are of small significance if the workers adhere to safety standards and use protective equipment (NRC 2013a, Section 3.9.5.1).

Duke Energy maintains safety-specific policies for all work conducted at electrical transmission locations.

2.2.6 Radioactive Waste Management System

ONS uses liquid, gaseous, and solid radioactive waste management systems to collect and process the liquid, gaseous, and solid wastes that are the byproducts of ONS operation. These systems reduce radioactive liquid, gaseous, and solid effluents before they are released to the environment. The ONS waste processing systems meet the design objectives of 10 CFR Part 50, Appendix I, and control the processing, disposal, and release of radioactive liquid, gaseous, and solid wastes. (NRC 1999b, Section 2.1.4)

The liquid and gaseous radioactive waste management systems will be utilized to reduce radioactive liquid and gaseous effluents such that compliance with the dose limitations of the selected licensee commitments is assured. These dose limitations require that:

- The concentration of radioactive liquid effluents released from the site to the unrestricted area will be limited to 10 times the effluent concentration levels of 10 CFR 20, Appendix B, Table 2.
- The exposures to any individual member of the public from radioactive liquid effluents will not result in doses greater than the design objectives of 10 CFR 50, Appendix I.
- The dose rate at any time at the site boundary from radioactive gaseous effluents will be limited to: for noble gases; less than or equal to 500 milli roentgen equivalent man/year (mrem/year) the whole body and less than or equal to 3000 mrem/year to the skin; for iodine-131 and 133, for tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days; less than or equal to 1,500 mrem/year to any organ.
- The exposure to any individual member of the public from radioactive gaseous effluents will not result in doses greater than the design objectives of 10 CFR 50, Appendix I.
- The dose to any individual member of the public from the nuclear fuel cycle will not exceed the limits of 40 CFR 190 and 10CFR 20.

Radioactive material in the reactor coolant is the source of gaseous, liquid, and solid radioactive wastes in light water reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained in the sealed fuel rods, but small quantities escape the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system also is responsible for coolant contamination. (NRC 1999b, Section 2.1.4)

Gaseous waste disposal systems collect, hold as necessary, filter, monitor, release, and record the gaseous effluent from the station. Liquid waste disposal systems provide for collection, holdup, treatment, monitoring, disposal, and recording of liquid wastes. Solid radioactive wastes are stored, packaged, and shipped offsite. Greater than originally anticipated gas and liquid waste volumes led Duke Energy to build an interim radwaste facility. This facility included liquid processing equipment, volume reduction equipment, and associated auxiliary systems. Other than four holdup tanks used for decay of gaseous waste, there is no longer any waste processing done at the interim radwaste facility. A separate radwaste facility has been added to handle increased liquid waste volumes. The systems which make up the facility are resin recovery, liquid processing and recycle, and waste solidification. The facility is capable of processing and packaging for burial these types of waste in optimal fashion.

Non-fuel solid wastes result from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service as well as contaminated protective clothing, paper, rags, and other trash generated from plant design and operations modifications and routine maintenance activities. Solid wastes may be shipped to a waste processor for volume reduction before disposal or may be sent directly to the licensed burial site. Spent resins and filters are dewatered and stored or packaged for shipment to an offsite processing or disposal facility. (NRC 1999b, Section 2.1.4)

Fuel rods that have exhausted a certain percentage of their fuel and are removed from the reactor core for disposal are called spent fuel. ONS currently operates on a 58-month refueling cycle for all three units. Spent fuel is stored onsite either in a spent fuel pool in the auxiliary building or in dry storage at the ONS ISFSI. ONS also temporarily stores mixed waste onsite (mixed wastes are composed of radioactive material and hazardous waste). This storage is governed by the AEA for radioactive material and the Resource Conservation and Recovery Act (RCRA) for hazardous waste, consistent with NRC and U.S. Environmental Protection Agency (EPA) requirements (42 USC 2011-2259 [AEA]; 42 USC 6901 [RCRA]). (NRC 1999b, Section 2.1.4)

The radiation protection manager has the responsibility for conducting the radiation protection program. Duties include the training of personnel in use of equipment, control of radiation exposure of personnel, continuous determination of the radiological status of the station, surveillance of radioactive waste disposal operations, conducting the radiological environmental monitoring program, and maintaining all required records.

Radioactive waste management activities associated with the station's liquid, gaseous, and solid waste systems are performed in accordance with approved written procedures.

2.2.6.1 Liquid Waste Disposal Systems

Based on the water source and process train, radioactive liquid wastes from the operation of ONS are accumulated in storage tanks. These wastes are collected in the auxiliary building and transferred to the radwaste facility for processing by filtration or demineralization or both. The radwaste facility processes high-activity wastes, low-activity wastes, and miscellaneous wastes from the auxiliary building. There is also an interim radwaste building (IRB) that can process liquid wastes, but it is not currently in use. (NRC 1999b, Section 2.1.4.1)

Liquid wastes from the station are disposed of, under continuous radiation monitoring and control, in one of the following three ways depending on the concentration of radioactivity and quantities involved:

1. Collected, sampled, analyzed, and discharged directly to the tailrace of the Keowee Hydro Station if the water is required to be monitored during release. If the water does not require monitoring during release, it is discharged to CTP-3.
2. Processed by filtration and/or demineralization, collected, sampled, and analyzed. The filters and/or spent resins are packaged and shipped offsite to an NRC or approved agreement state-licensed burial ground. The processed water is discharged directly to the tailrace of the Keowee Hydro Station if the water is required to be monitored during release. If the water does not require monitoring during release, it is discharged to CTP-3.
3. Processed by filtration and/or demineralization, collected, sampled, and analyzed. The filters and/or spent resins are packaged and shipped to various offsite vendor waste processors. The processed water is discharged directly to the tailrace of the Keowee

Hydro Station if the water is required to be monitored during release. If the water does not require monitoring during release, it is discharged to CTP-3.

Liquid waste effluent is diluted as necessary in the Keowee Hydro Station tailrace to permissible concentration limits in accordance with selected licensee commitments. Waste releases from the three units are integrated and controlled by process radiation monitors, interlocks, and by the operator so as not to exceed the appropriate station release limits. Where effluents can be released from more than one location, administrative controls are also provided to ensure that station limits are not exceeded.

The offsite dose calculation manual (ODCM) prescribes the effluent release rate that will ensure the concentration of radioactive liquid effluents released from the site to the unrestricted area is less than 10 times the effluent concentrations of 10 CFR Part 20, Appendix B, Table 2. (NRC 1999b, Section 2.1.4.1)

Liquid wastes are accumulated in storage tanks according to the waste source and expected process train. The auxiliary building coolant treatment header has been redesigned to facilitate the processing of liquid wastes from the high activity waste tanks, low activity waste tanks, and the miscellaneous waste holdup tanks in the radwaste facility. The liquid wastes are directed to the radwaste facility for processing by filtration and/or demineralization to segregate impurities for ultimate disposal. Based on the analysis, water is either reprocessed or released.

The IRB has the necessary equipment to process liquid waste. However, current operating practice does not make use of these systems. When the IRB systems are in use, the IRB floor drains and equipment drains are collected in two sumps.

The radwaste facility is designed to process liquid and solid radioactive wastes. The wastes are separated into clean water and concentrated contaminants. The concentrated contaminants are prepared for disposal and the clean water is discarded or recycled for use in the station. The wastes consist of miscellaneous liquid waste (radioactive equipment drains and floor drains, etc.), reactor coolant, powdered resin, and miscellaneous radioactive trash (gloves, paper, etc.).

Liquid wastes are processed by an appropriate combination of equipment (filter, demineralizer, and/or evaporator) in the liquid waste and recycle system. Contaminants collected by the demineralizers and filters are sent to the dewatering system. Boric acid concentrated from reactor coolant by the evaporator are reused or sent to the solidification system, as are the waste concentrates.

2.2.6.1.1 Liquid Waste and Recycle System

The liquid waste and recycle system is designed to appropriately process all excess radioactive water generated at the station. Decontaminated water will be reused by the station as make-up water or released to the environment as appropriate. Generally, chemistry limits control recycling and radioactivity limits control discharge. Contamination removed from processed water will be transferred to the volume reduction and solidification system for packaging and shipment to an approved processor or disposal facility.

Duties concerning radioactive liquid waste disposal are performed by the chemistry section. While the analyses of radioactive liquid waste releases are under the control of the radiation protection section, the records required to characterize the nature of liquid waste releases, both qualitatively and quantitatively, are under the control of the radwaste building.

The actual liquid waste activity released is reported in the ONS annual effluent release report. Duke Energy does not anticipate any increase in liquid waste releases during the proposed SLR operating term.

2.2.6.2 Gaseous Waste Disposal Systems

Radioactive gaseous wastes at ONS are created by the evolution of gases in liquid contained in tanks and piping. Units 1 and 2 share a gaseous waste disposal system, and Unit 3 has a separate system that can be connected to the Unit 1 and 2 system. The purposes of the gaseous waste disposal systems are to (1) maintain a non-oxidizing cover gas of nitrogen in tanks and equipment that may contain radioactive gas; (2) hold up gas for decay; and (3) release the gases under controlled conditions. (NRC 1999b, Section 2.1.4.2)

Gaseous wastes are disposed of at a permissible rate under continuous radiation monitoring or periodic sampling and control by any of the following methods depending on the concentration of radioactivity, quantities, and source of the material involved:

- Release of auxiliary building ventilation air and reactor building purges to the unit vents.
- Release of reactor building purges through high efficiency particulate and charcoal iodine filters to the unit vents.
- Release of waste gas directly or through high-efficiency particulate and charcoal iodine filters to the unit vents.
- Diversion to waste gas tanks with controlled release after sampling and analysis through the waste gas system high efficiency particulate and charcoal iodine filters to the unit vents.
- Release of radwaste facility heating, ventilation, and air conditioning (HVAC) and process exhaust.

The reactor coolant pump motor refurbishment facility ventilation system and ventilation sampling system were abandoned in place in the last quarter of 2004 after completion of the reactor head replacement project.

Waste releases from the three units are integrated and controlled by process radiation monitors, interlocks, and by the operator so as not to exceed the appropriate station release limits. Where effluents can be released from more than one location, administrative controls are also provided to ensure that limits identified in the ODCM are not exceeded.

All components in the auxiliary building and interim radwaste building that can contain potentially radioactive gases are vented to a vent header. The vent gases are subsequently drawn from this vent header by one of two waste gas compressors or a waste gas exhauster. The waste gas compressor discharges through a waste gas separator to one of two waste gas tanks. The waste gas tanks and the waste gas exhauster discharge to the unit vent after passing through a filter bank consisting of a prefilter, an absolute filter, and a charcoal filter.

Most of the gaseous waste disposal system is located in the auxiliary building. Some equipment is located in the interim building, namely interim waste gas decay tanks 1C, 1D, and 3C, and their associated piping and valves. All indication and controls for this system are located in the control room.

Each process radiation monitoring channel is functionally tested and calibrated periodically to verify proper operation of components and to ensure that the desired detector sensitivities are maintained. A signal generator located within the process monitor panel is used to check the alignment of electronic modules. After the electronic alignment is completed, a remote-operated calibration source is actuated to determine proper functioning of the detector. The flow-measuring instrument and controls associated with the gaseous waste effluent lines are calibrated periodically to ensure proper accuracy, measurement, and control of radioactivity releases from the station.

Duties concerning radioactive gaseous and solid waste disposal are performed by the radiation protection section. The detailed analyses and records required to characterize the nature of radioactive gaseous waste releases and solid waste disposal are under the control of the radiation protection section.

The actual gaseous waste activity released is reported in the ONS annual effluent release report. Duke Energy does not anticipate any increase in gaseous waste releases beyond normal operations during the proposed SLR operating term.

2.2.6.3 Solid Waste Disposal Systems

As per selected licensee commitment 16.11-5, radioactive wastes shall be processed and packaged to ensure meeting the requirements of 10 CFR Part 20, 10 CFR Part 71, and federal and state regulations governing the disposal of solid radioactive wastes. The solid waste disposal system provides the capability to package solid wastes for shipment to an offsite NRC or approved agreement state-licensed burial facility.

Solid waste is packaged in containers to meet the applicable requirements of 49 CFR Parts 171 through 177. Disposal and transportation are performed in accordance with the applicable requirements of 10 CFR Part 61 and Part 71, respectively. There are no releases to the environment from radioactive solid wastes created at ONS. (NRC 1999b, Section 2.1.4.1)

The disposal of the powdered resins may be accomplished by backwashing the resins from the filter elements to a sump in the turbine building and then to the resin recovery system for processing. The powdered resin recovery system is designed to collect and sample each sluice (backwash) from the condensate polishing demineralizer backwash sump and to separate water from spent resin. The sump can contain both bead and powdered resins from various demineralizers. In addition, the system can use the spent resin to process liquid from the laundry hot shower tanks and the liquid waste system.

The resin is allowed to settle to the bottom of the backwash receiving tanks in the radwaste facility. The excess water in the backwash receiving tanks is decanted to the decant monitor tank for sampling and release to the environment. The powdered resins may then be used for processing waste. The resins are then prepared for shipment to a processor or directly to either an NRC- or state-licensed disposal facility.

The volume reduction and solidification system is designed to prepare radioactive wastes for shipment and disposal, and to minimize the volume of waste shipped. To prepare wastes for shipment and minimize the volume of waste, wet wastes (e.g., contaminated oil, powdered resins) and dry trash are incinerated and the scrub liquor produced is completely dried. The results of both fluid bed processes are a dry, free-flowing mixture of salt granules and ash. This sand-like material is then packaged to meet federal and state regulations. Resin which is too radioactive to incinerate will be solidified and/or packaged to meet federal and state regulations.

All normal operations of the volume reduction and solidification system involving radioactive material are carried out remotely from the radwaste control room. A remote control crane moves new drums from the clean fill stations to the waste drumming stations, stores, or retrieves drums in the storage pit, and loads truck-mounted shielded casks used to ship solidified waste offsite for disposal.

The process control program manual describes operation of the solid radioactive waste system such that the final product of solidification or dewatering meets all shipping and transportation requirements during transit and meets disposal site requirements when received at the disposal site. Low-level trash such as dry active waste and spent filters are prepared for shipment to a processor or directly to either an NRC- or state-licensed disposal facility.

Duke does not anticipate any increase in solid waste releases beyond normal operations during the proposed SLR operating term.

2.2.6.4 Ultimate Disposal Operations

ONS utilizes the following process to ensure the material is safely processed and packaged for transportation and disposal:

- Sorting and Segregation. This step reduces waste volume by segregating certain metals for recycling and compacting, incinerating, or repackaging the rest for transportation and disposal.
- Compaction. Waste material is compacted to reduce volume up to 20 to 1.
- Incineration. Waste material is incinerated to reduce volume up to 200 to 1. This process also keeps emissions below State of Tennessee requirements.

- Metal Melt (Recycling). Smelter facility is utilized several times a year to melt and recycle metals. The molten metal is then poured into molds forming shield blocks, which are then utilized in the nuclear industry.

ONS also follows an evaluation process that allows for the segregation of potential radiologically contaminated metals found to be clean and releasing them to a recycler for salvage. This also allows segregation of materials that cannot be recycled but are suitable for disposal in a State of Tennessee subtitle D landfill. This process reduces the amount of radiological waste. Any recyclable hazardous, mixed, universal, and solid wastes are recycled according to a Duke Energy procedure.

ONS has a contract with Energy Solutions for the processing and disposal of all radiologically contaminated material. Amounts and types of radioactive waste are reported annually to the NRC via the annual radiological effluent release report (ARERR).

Low-level radioactive waste (LLRW) is classified as Class A, Class B, or Class C (minor volumes are classified as greater than Class C). Class A includes both dry active waste and processed waste (e.g., dewatered resins). Classes B and C normally include processed waste and irradiated components. Classes B and C wastes constitute a low percentage by volume of the total LLRW generated and can be stored onsite in a low-level waste storage facility. No irradiated components were shipped in last 5 years (Duke 2019b). Disposal of greater-than-Class C waste is the responsibility of the federal government.

ONS rarely generates mixed waste. If generated, low-level mixed waste would be managed and transported to an Energy Solutions licensed vendor under the "green is clean" program.

2.2.7 Nonradioactive Waste Management System

The RCRA governs the disposal of solid waste. The South Carolina Department of Health and Environmental Control (SCDHEC) is authorized by the EPA to implement the RCRA in South Carolina. (SCDHEC 2019a)

ONS generates nonradioactive waste as a result of plant maintenance, cleaning, and operational processes that occur at the site. Table 2.2-2 provides the amount of nonradioactive hazardous, nonhazardous, and recycled wastes generated at ONS from 2014–2018. Municipal waste is disposed of at the locally permitted solid waste management facility. Nonradioactive waste commonly generated at ONS includes asbestos insulation and other asbestos-containing materials, batteries (universal waste), lead material, used paints and solvents, expired shelf life chemicals, grout and/or concrete, construction demolition debris, sand blast and metal blasting materials, lamps (universal waste), paper and office debris, water treatment room products such as used resin and used carbon, laboratory waste material, used oil and grease, cafeteria waste, antifreeze liquids, used refrigerants, scrap metal, scrap wood, and used tires.

Liquid waste that is not radioactive typically originates from secondary plant systems in the turbine building, the water treatment room backwash, and other miscellaneous liquid waste streams. This type of wastewater is discharged per the site NPDES permit.

ONS is classified by the EPA and the SCDHEC as a small quantity generator (SQG) of hazardous waste. This means that fewer than 2,200 pounds of any type of hazardous waste is produced in any single month. Duke Energy maintains a list of approved waste vendors for use across the entire company. Duke Energy facilities are required to use an approved waste vendor for both hazardous and nonhazardous waste. The approved waste vendors list is updated as needed by the corporate environmental staff. The process for waste vendor selection is outlined in the corporate environmental compliance manual.

Currently the following vendors are utilized at ONS:

- Hazardous waste: Veolia ES Technical Solutions, LLC
- Non-hazardous and universal waste: Duke Energy Toddville Facility or McGuire Nuclear Station landfill.
- Asbestos waste: Republic Services
- Office waste: Waste Management

Additional non-hazardous and universal waste vendors:

- Raw Materials Company, Inc.
- HazMat Environmental
- Call 2 Recycle (Rechargeable Battery Recycling Group)
- United Scrap Metal, Inc.
- Commercial Metals Corporation Recycling (CMC Recycling)
- Veolia ES Technical Solutions, LLC

Radioactive waste recycle vendor:

- Energy Solutions
- General Trash: Waste Management

Table 2.2-1 Meteorological Parameters Monitored at ONS

Parameter (elevation level)	Meteorological Tower #1	Meteorological Tower #2
Wind speed (10 meters, 60 meters)	10 meters, 60 meters	10 meters
Wind direction (10 meters)	10 meters, 60 meters	10 meters
Vertical temperature difference	(10-60) meters	0–10 meters
Ambient temperature	10 meters	None
Precipitation	None	Yes

Table 2.2-2 Nonradioactive Waste Quantities at ONS

Year	Hazardous Waste (pounds)	Non-Hazardous Waste (pounds)	Recycling Material (tons)
2014	3,355	55,480	1,257
2015	5,953	53,295	1,228
2016	2,199	467,523	1,019
2017	3,663	303,802	1,208
2018	5,745	156,270	713

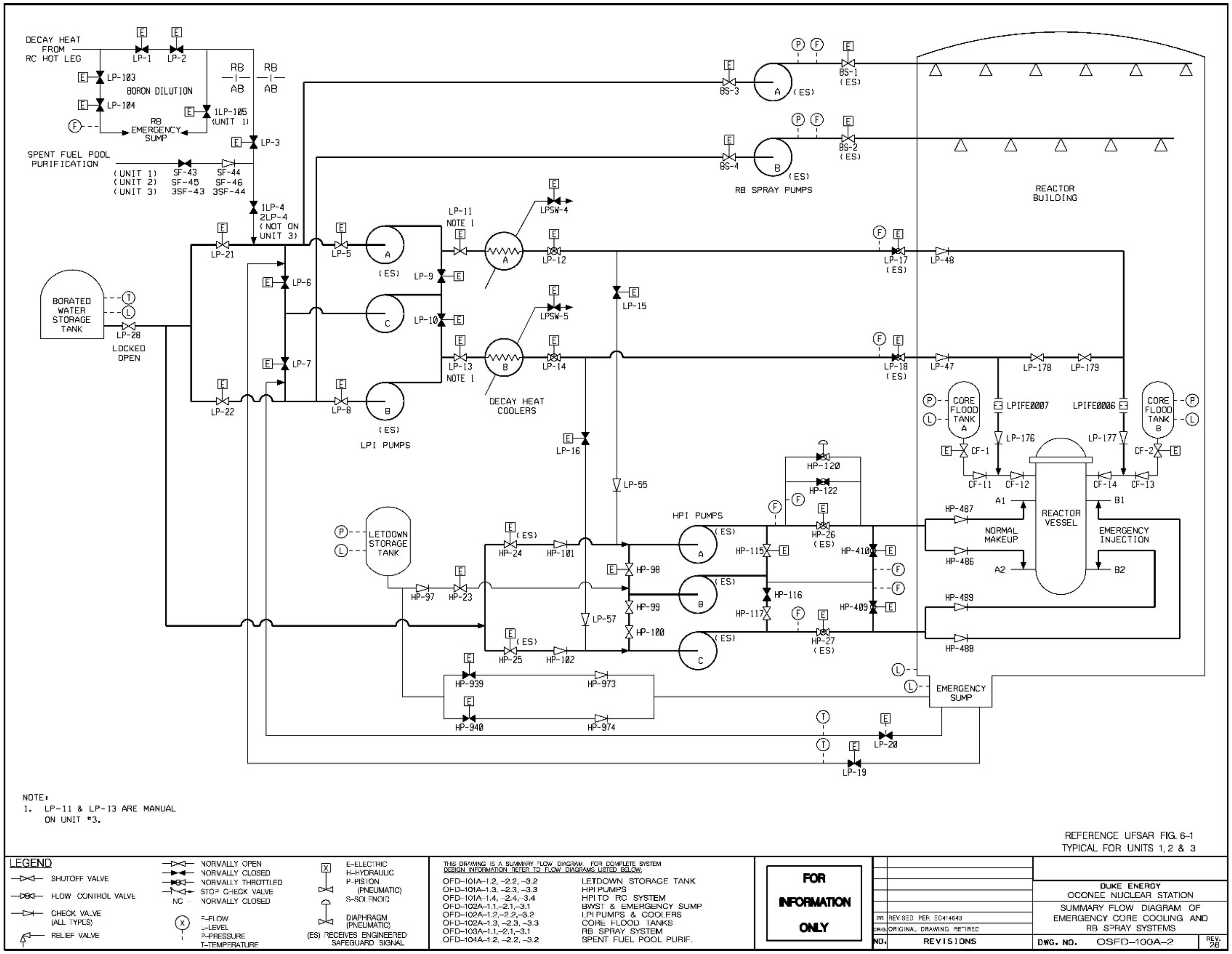


Figure 2.2-1 ECCS System Schematic

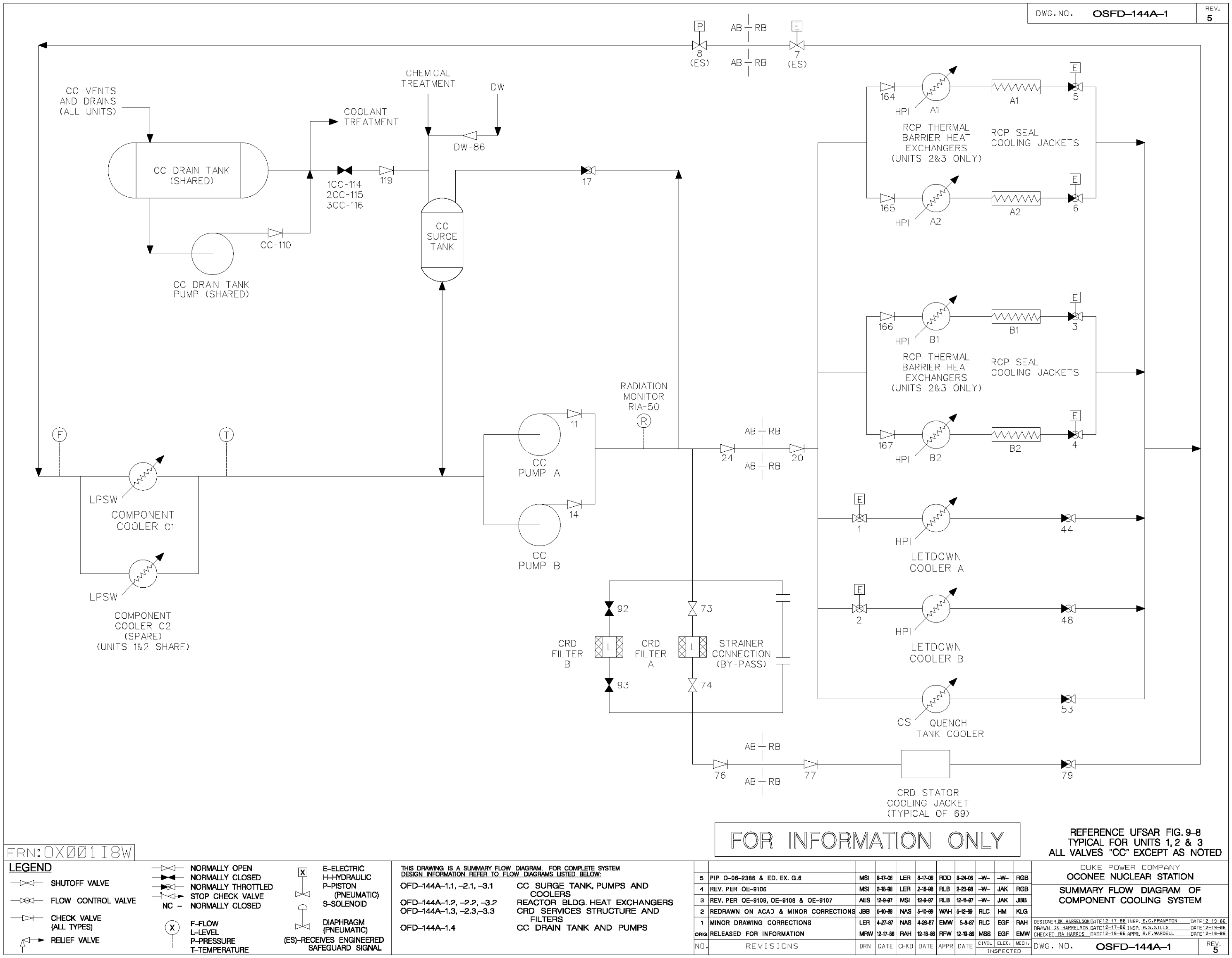


Figure 2.2-2 Component Cooling Water System Schematic

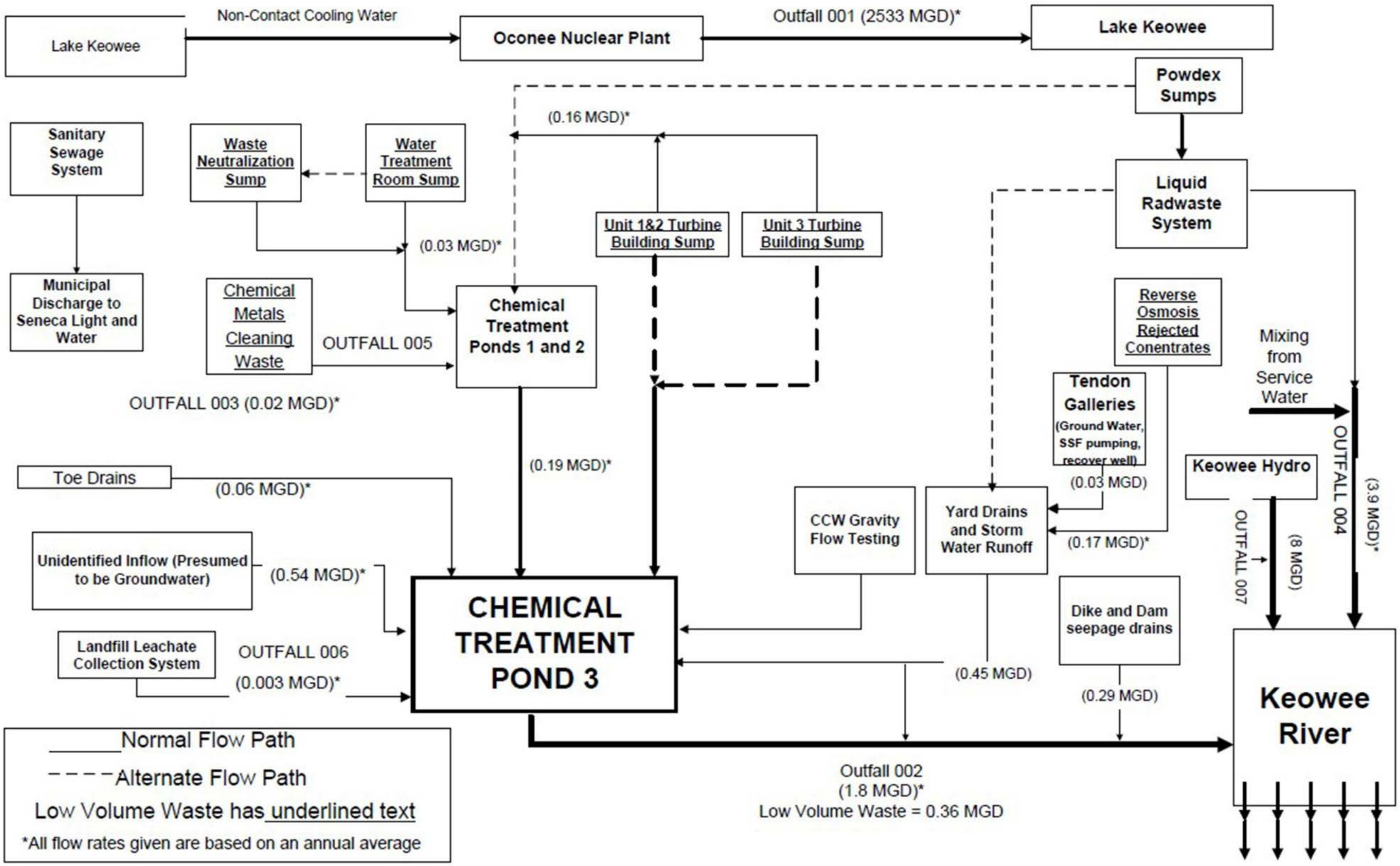


Figure 2.2-3 ONS Wastewater Flow Path

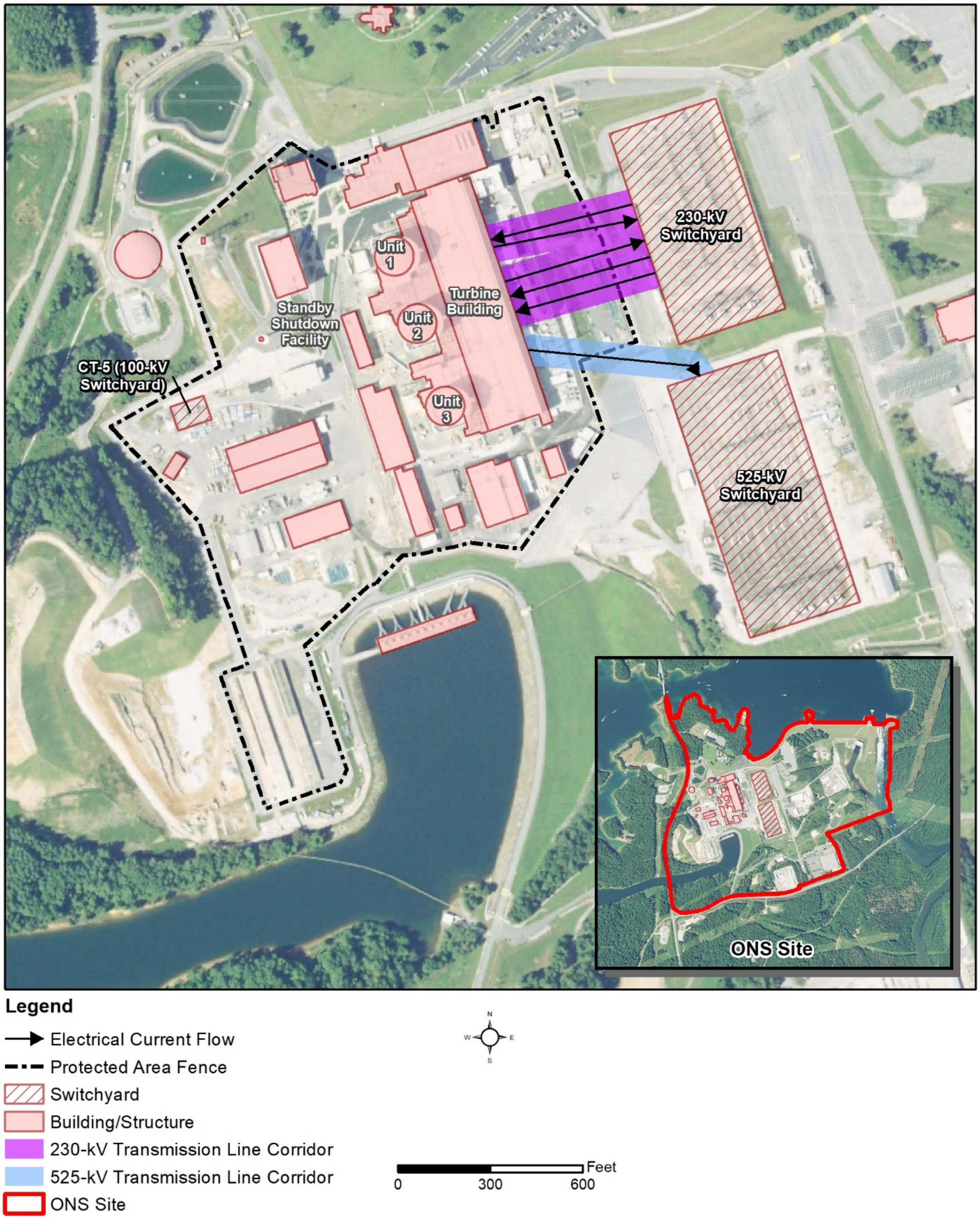


Figure 2.2-4 In-Scope Transmission Lines

2.3 Refurbishment Activities

In accordance with 10 CFR 51.53(c)(2), a license renewal applicant's ER must contain a description of the applicant's plan to modify the facility or its administrative control procedures as described in accordance with § 54.21. If license renewal-related refurbishment is planned at a facility, the applicant's ER would include analysis for environmental impacts of the proposed refurbishment activity. [10 CFR 51.53(c)(3)(ii)].

The incremental aging management activities implemented to allow operation of a nuclear power plant beyond the original 40-year license term were assumed to fall under one of two broad categories. One of these categories involves refurbishment actions, which usually occur infrequently and possibly only once in the life of the plant for any given item. The other category is SMITTR actions, most of which are repeated at regular intervals and schedules. (NRC 2013a, Section 2.1.1)

The NRC requirements for the renewal of OLs for nuclear power plants include preparation of an integrated plant assessment (IPA) [10 CFR 54.21]. The IPA must identify systems, structures, and components (SSCs) subject to an aging management review. The objective of the IPA is to determine whether the detrimental effects of aging could preclude certain SSCs from performing in accordance with the current licensing basis during the additional 20 years of operation requested in the SLR application (SLRA). An example of an SSC subject to aging is the reactor vessel.

The ONS IPA that Duke Energy conducted under 10 CFR 54, which is described in the body of the SLRA, has identified no license renewal-related refurbishment or replacement actions needed to maintain the functionality of SSCs, consistent with the current licensing basis, during the PEO. Duke Energy also does not anticipate the need for any refurbishment for purposes of SLR as a result of the technical and aging management program information submitted in accordance with the NRC license renewal process.

2.4 Programs and Activities for Managing the Effects of Aging

In accordance with 10 CFR 51.53(c)(2), a license renewal applicant's ER must contain a description of the applicant's plans to modify the facility or its administrative control procedures as described in accordance with § 54.21. This report must describe in detail the modifications directly affecting the environment or any plant effluents.

The programs for managing the effects of aging on certain structures and components within the scope of license renewal at the site are described in the body of the SLRA (see Appendix B of the ONS SLRA). The evaluation of structures and components required by 10 CFR 54.21 identified the activities necessary to manage the effects of aging on structures and components during the PEO beyond the initial license renewal term.

2.5 Employment

The 2020 workforce at the ONS site consists of 1,936 persons, including 698 ONS regular full-time employees, listed in Table 2.5-1, and an additional 1,238 persons that include contingent and outage workers. Since the initial license renewal, overall plant staffing levels have been reduced due to increased efficiencies in Duke Energy's operations and departmental reorganizations. There are no plans to add additional regular full-time employees to support plant operations during the proposed SLR operating term, and as noted in Section 2.3, no license renewal-related refurbishment activities have been identified. Neither are there plans to add additional regular full-time operational staff to support any SMITTR activities during the proposed SLR operating term.

During refueling outages, which usually last approximately 30 days plus or minus five days per unit, the workforce typically consists of 800 to 900 contingent workers onsite. Refueling and maintenance outages for the three ONS units are on a staggered schedule, with one fall refueling outage scheduled during odd years and spring and fall outages scheduled for even years.

Table 2.5-1 ONS Regular Full-Time Employee Residence Information, October 2020 (Sheet 1 of 2)

State	County	City/Town	Regular Full-Time Employees
Georgia (20)	Elbert (1)	Elberton	1
	Franklin (5)	Canon	1
		Carnesville	1
		Martin	2
		Royston	1
	Hart (2)	Bowersville	1
		Hartwell	1
	Stephens (11)	Toccoa	11
	White (1)	Sautee Nacoochee	1
North Carolina (8)	Buncombe (1)	Leicester	1
	Cherokee (1)	Murphy	1
	Clay (1)	Hayesville	1
	Haywood (1)	Maggie Valley	1
	Mecklenburg (1)	Charlotte	1
	New Hanover (1)	Kure Beach	1
	Transylvania (2)	Brevard	1
		Lake Toxaway	1
South Carolina (670)	Abbeville (1)	Abbeville	1
	Anderson (68)	Anderson	44
		Belton	5
		Iva	2
		Pendleton	13
		Townville	1
		Williamston	3
	Fairfield (1)	Blair	1
	Greenville (24)	Greenville	12
		Marietta	1
		Piedmont	6
		Simpsonville	2
		Taylors	2
		Travelers Rest	1
	Greenwood (2)	Greenwood	1
		Ninety Six	1

Table 2.5-1 ONS Regular Full-Time Employee Residence Information, October 2020 (Sheet 2 of 2)

State	County	City/Town	Regular Full-Time Employees
South Carolina (continued)	Horry (1)	Myrtle Beach	1
	Laurens (1)	Laurens	1
	Oconee (311)	Fair Play	5
		Long Creek	1
		Mountain Rest	6
		Salem	10
		Seneca	183
		Tamassee	3
		Walhalla	33
		West Union	40
		Westminster	30
	Pickens (254)	Central	47
		Clemson	22
		Easley	79
		Liberty	29
		Pickens	44
		Six Mile	30
		Sunset	3
	Spartanburg (7)	Duncan	1
		Inman	2
		Lyman	1
		Moore	1
		Roebuck	1
		Spartanburg	1
		Total	**698**

Note: ONS employee place of residence information is for Duke Energy permanent staffing and does not include a breakdown for non-outage contract staff nor temporary refueling outage workers. Contract employee settlement patterns are assumed to generally follow the county settlement patterns indicated by permanent ONS staff.

2.6 Alternatives to the Proposed Action

The proposed action as described in Section 2.1 is for the NRC to subsequently renew the ONS ROLs for an additional 20 years. Because the NRC decision is to renew or not renew the existing ONS ROLs, the only fundamental alternative to the proposed action is the no-action alternative, which would result in the NRC not renewing the ONS ROLs. The no-action alternative does not provide a means for meeting current and future regional electricity needs. Because ONS provides baseload generation for the Duke Energy service area, the generation loss would need to be replaced with a reliable source of equivalent baseload power. Therefore, unless replacement for the loss of the ONS baseload generation is considered under the no-action alternative, that alternative would not satisfy the purpose and need for the proposed action. Duke Energy has considered a range of replacement power alternatives from which to select those alternatives to be further analyzed for replacement of ONS baseload power generation.

2.6.1 Alternatives Evaluation Process

Duke Energy developed the following set of evaluation criteria to review ONS replacement alternatives:

- The purpose of the proposed action (SLR) is the baseload generation of 2,610 MWt per unit.
- Alternatives evaluated in this ER would need to provide baseload generation.
- Alternatives considered must be fully operational by 2033 considering development of the technology, permitting, construction of the facilities, and connection to the grid.
- Alternatives must be electricity-generating sources that are technically feasible and commercially viable.

2.6.2 Alternatives Considered

Using a screening process based on the above criteria, Duke Energy considered the full range of alternatives considered in the GEIS in light of the need to meet the criteria as well as federal regulations and South Carolina's Distributed Energy Resource Program (NRC 2013a). Consideration of generation options is also undertaken by Duke Energy annually for preparation of its integrated resource plan (IRP), so this screening and selection of generating options to meet the power demands of Duke Energy's customers was relied upon for evaluating replacement alternatives for ONS.

Duke Energy's 2020 IRP presents the company's long-range strategy to meet customers' energy needs with cost-effective and reliable resources. The 2020 IRP is a planning document that looks at current and future energy needs over a 15-year planning period from 2021 through 2035 and considers both supply- and demand-side opportunities. The IRP's strategies for meeting the power needs of Duke Energy's customers considered compliance with existing and future environmental regulations. (Duke 2020b).

The following generation sources were selected as reasonable replacement alternatives based on capability to provide reliable baseload power:

- Natural gas-fired plant alternative (natural gas-fired combined-cycle [NGCC] turbine) located at the ONS site and adjacent Duke Energy-owned land.
- New advanced light water reactor nuclear plant (the proposed William States Lee III (W.S. Lee Station) Nuclear Station, Units 1 & 2) and new small modular reactor (SMR) cluster located at the ONS site.
- Combination of alternatives consisting of an NGCC plant and solar photovoltaic (PV) with battery storage, offsite wind installations, and demand-side management (DSM). The NGCC plant would be sited at the ONS site and adjacent Duke Energy-owned land, while solar PV and wind installations would be sited at offsite locations with access to Duke Energy's service area transmission system(s).

The alternatives selected as reasonable replacement baseload generation alternatives are presented in Section 7.2.1.

Duke Energy determined the following alternatives were not considered reasonable replacements in comparison to renewal of the ONS ROLs:

- Power purchases
- Conservation
- Other Duke Energy plant reactivation or extended service life
- Wind
- Solar
- Geothermal
- Hydropower
- Biomass
- Coal-fired integrated gasification combined cycle (IGCC) technology
- Fuel cells
- Ocean wave and current energy
- Petroleum liquids
- Coal-fired plants

The alternatives not selected as reliable baseload generation for replacing the ONS generation are presented in Section 7.2.2.

3.0 AFFECTED ENVIRONMENT

ONS Units 1, 2, and 3 are owned and operated by Duke Energy and situated on approximately 510 acres of land adjacent to Lake Keowee in eastern Oconee County, SC. The Keowee Hydro Station, also owned by Duke Energy, is located onsite and provides additional power generation and emergency power to ONS as needed.

3.1 Location and Features

ONS is located approximately 8 miles northeast of the city of Seneca, SC, at latitude 34° 47' 38.2" north and longitude 82° 53' 54.4" west. The majority of the ONS site is located within Oconee County; however, the northeastern portion of the ONS site falls within neighboring Pickens County, SC. Duke Energy's Lake Keowee occupies the area immediately north and west of ONS. The U.S. Army Corps of Engineers' (USACE)'s Lake Hartwell reservoir is located south of ONS. Figure 3.1-1 shows the ONS property boundary, facility structures, switchyard, EAB, and the Keowee Hydro Station. Topographic features adjacent to ONS and within the property boundary are shown on Figure 3.1-2.

3.1.1 Vicinity and Region

The vicinity of ONS is defined as the area within a 6-mile radius of a center point established on the Unit 2 containment structure. As seen in Figure 3.1-3, the vicinity includes portions of Oconee and Pickens counties. A discussion of county and regional demography, with information on population projections through the ONS PEO, is provided in Section 3.11. Table 3.11-1 provides a list of cities and towns located within a 50-mile radius of ONS.

Oconee County, SC, is described as a medium-sized (population) county in the Seneca, SC, micropolitan area (NACo 2019). As presented in Table 3.11-2, Oconee County's 2017 population was 75,926 persons, an increase from 74,273 in 2010 and 66,215 in 2000. Approximately 5 miles south of ONS is the community of Newry, with an estimated population of 137 persons in 2017, down from 172 persons in 2010 (see Table 3.11-1). The largest community in Oconee County is the city of Seneca, SC, located approximately 8 miles south-southwest of ONS. Seneca's population was 8,199 in 2017, an increase from 8,102 persons in 2010 and 7,652 persons in 2000. (USCB 2019a; USCB 2019b).

Pickens County is described as a medium-sized (population) county in the Greenville-Anderson-Mauldin, SC, metropolitan area (NACo 2019). In 2017, the population of Pickens County was 121,449 persons, an increase from 119,224 in 2010 and 110,757 in 2000. The town nearest to ONS is Six Mile, SC, located approximately 5 miles east. In 2017, Six Mile had an estimated population of 800 persons, an increase from 675 persons in 2010 and 553 in 2000. The largest city in Pickens County is Clemson, located approximately 8 miles south-southeast of ONS. Clemson's reported population in 2017 was 15,375 persons, an increase from 13,905 in 2010 and 11,939 persons in 2000. (USCB 2019a; USCB 2019b)

The ONS site is located within the westernmost component of the Piedmont physiographic province. The topography of the area is undulating to rolling, and the surface elevations range from about 700 to 900 feet. Lake Keowee's primary purpose is to provide cooling water for ONS and water to turn the turbines of the Keowee Hydro Station. The main sources of inflow into Lake Keowee are the Little River and Lake Jocassee. The Jocassee Hydroelectric Station is located approximately 11 miles north of ONS. The Lake Jocassee and Lake Keowee reservoirs and the hydroelectric stations located at these reservoirs are owned and operated by Duke Energy.

Forest covers the majority of the land area in the vicinity, with pasture, cropland, and residential development each contributing significant proportions of total land use (see Section 3.2). The shoreline of Lake Keowee is developed with both vacation and permanent residences, along with campgrounds, boat launch areas, marinas, golf courses, and small retail establishments. (Duke 1998, Sections 2.1 and 2.2).

The region of ONS is defined as the area within a 50-mile radius of a center point established on the Unit 2 containment structure. As seen in Figure 3.1-4 and described in Table 3.11-2, all or parts of 29 counties are located within the 50-mile radius of ONS. Twelve counties are located in the state of Georgia; nine counties are located in the state of North Carolina; and eight counties are located in the state of South Carolina. The most populous county in the region is Greenville County, SC, which increased in size to 490,332 in 2017 from 451,225 persons in 2010 and 379,616 persons in 2000. There are no communities within a 50-mile radius of ONS with a population greater than 100,000. A total of four communities, including Asheville, NC, and Anderson, Greenville, and Greer, SC, have populations greater than 25,000 as of 2017 (see Table 3.11-1). (USCB 2019a; USCB 2019b)

As seen in Figure 3.1-3 and Figure 3.1-4, Lake Jocassee, Lake Keowee, and Lake Hartwell are predominant physical features within the region. Interstate 85 (I-85) runs southwest to northeast across Georgia and South Carolina, providing access to communities along the transportation corridor and through Greenville County, SC. Access to ONS is via local roads and state highways, including SC-183 south of the plant and SC-130 west of the plant. While several communities in Oconee and Pickens counties have public transportation, there is no public bus service or rail system providing access to ONS (CAT 2019; USDOT 2019a). Amtrak rail passenger service is available in the region; the closest station to ONS is located in the city of Clemson, SC (Amtrak 2019).

Along with the ONS helipad (private), there are eight additional airfields within approximately 10 miles of ONS. These include Oakview Airport (private); Hawks Nest Farm Airport (private), Oconee County Regional Airport (public), Eagle Ridge Airport (private), USAR Center, Clemson Heliport (private), Pickens County Airport (public), Anna's Airport (private), and David Field Ultralight Flightpark (private). The nearest full-service airport to ONS is Greenville-Spartanburg International Airport, located east of Greenville, SC. (AirNav 2019)

The general area within the ONS vicinity is not industrial in nature. There are no pipelines within 5 miles of ONS, except for natural gas distribution pipelines. The nearest gas distribution pipeline is located approximately 2.5 miles from the site.

3.1.2 Station Features

The principal structures at ONS are identified in Section 2.2. The ONS site boundary, the EAB (defined as a 1-mile radius from the ONS station center), the ONS owner-controlled area (OCA), the protected area fence perimeter, and ONS site facilities are depicted in Figure 3.1-1. There are no industrial, commercial, institutional, recreational, or residential structures within the site boundary. All the property within the 1-mile radius EAB is owned in fee, including mineral rights, by Duke Energy, except for the small rural church plot belonging to Old Pickens Church, ROWs for existing highways, and approximately 9.8 acres of U.S. government property involved with Lake Hartwell. (Duke 1998, Section 4.8.4) Duke Energy, through agreements with the church property owners and the U.S. government, has the authority to control activities within the EAB. In the event of an emergency, local law enforcement will control and limit traffic on public roadways within the EAB.

The only commercial enterprises within the EAB are the Keowee Hydro Station, ONS, and individual properties managed in partnership by Duke Energy's real estate and water strategy organizations. To control development around Lake Keowee, Duke Energy has a property use permit process for construction or maintenance activities, including installation of residential docks along the lake, private facilities construction, modification and maintenance of existing structures, and modification or maintenance of existing shoreline stabilization. The nearest residence to ONS is located approximately 1.03 miles north-northwest from the center point of Unit 2 reactor containment.

3.1.3 Federal, Native American, State, and Local Lands

As shown in Figure 3.1-5 and Figure 3.1-6, there are a variety of national, state, and local parks; historical sites; national and state wildlife refuges and management areas; and conservation and recreational areas located in the ONS 6-mile vicinity and 50-mile region. As described in Table 3.1-1, there are nine public lands located within the 6-mile vicinity of ONS. The closest to ONS are the Old Pickens Church, located approximately 1 mile east-southeast, and Clemson University Forest, located approximately 1 mile southeast in Pickens County. (NPS 2019; Oconee County 2019a; Pickens County 2019a; SCDNR 2019a; USCB 2019c; USDA 2019a).

No military installations were identified in the ONS region. Recognized by both the federal government and state of North Carolina, the Eastern Band of the Cherokee has tribal lands located in Jackson and Swain counties, NC, that fall within the ONS region (see Figure 3.1-6). The Eastern Band of the Cherokee tribal lands are also located in Graham and Cherokee counties, NC; however, these lands are outside of the 50-mile region. Recognized by the state of South Carolina (but not recognized by the federal government), the Piedmont American Indian Association Lower Eastern Cherokee Nation of SC is located in the town of Gray Court, in Laurens County, SC. No other state or federally recognized tribal locations fall within the 50-mile region. (EBCI 2019; NCSL 2019; NCDOA 2019; PAIA 2019; SCCMA 2019; USCB 2019c; USDA 2019a; USDOI 2019)

3.1.4 Federal and Non-Federal Related Project Activities

No major changes to ONS Units 1, 2, and 3 or plans for future expansion of plant infrastructure during the SLR term are anticipated. As discussed in Section 4.12, near future changes currently planned for ONS include the following (Duke 2020a).

- Thermal margin recapture uprates of 1.64 percent (15 MWe) per unit in 2021 and 2022.
- Installation of five new security towers.
- Installation of a watercraft barrier below Keowee Hydro Dam.
- The onsite ISFSI configuration was expanded to host additional storage units. It is anticipated that the ONS ISFSI may need to be expanded during the SLR PEO. It is expected that there is enough land area available for this expansion within the site boundary.

Two FERC-approved projects were identified in Oconee County. The first was Duke Energy's Bad Creek pumped storage hydro station, where FERC issued an order approving a non-capacity license amendment to add about 335 megawatts to the facility by installing more efficient and powerful pump turbines, new transformers, generators, and circuit breakers. The second was the city of Walhalla, which filed with FERC for the installation of a water intake on Lake Keowee, which is under construction.

Currently, Duke Energy is developing plans for construction of additional public safety features (installation of new shoreline rock barrier and fencing) to control recreational access at the Lake Keowee Fall Creek Landing site in Oconee County. Upon securing necessary approvals from the USACE, the South Carolina Department of Natural Resources (SCDNR), and the USFWS, Duke Energy proposes to complete the work in 2020. (Greenville News 2019)

In 2019, Oconee County announced that Horton Holding will construct a new 100,000 square-foot manufacturing facility in the county, with completion in 2020 (125 new jobs expected). In 2018, RBC Aerostructures announced expansion of its Oconee County facility in Westminster, SC, by 13,500 square feet, creating 22 new jobs. Pickens County announced in 2019 that a new frozen food processing facility will relocate to a 310,000 square-foot facility, creating 114 new jobs. (UA 2019)

Table 3.1-1 Federal, State, and Local[(a)] Lands Totally or Partially within a 6-Mile Radius of ONS

Name	Management	Distance[(b)]	Direction	Nearest Place	County
Old Pickens Presbyterian Church[(d)]	Local	1	ESE	Six Mile	Oconee
Clemson University Forest[(c)]	State	1	SE	Newry	Pickens
High Falls County Park	Local	2	West	Newry	Oconee
Alexander-Hill House[(d)]	Local	2	West	Newry	Oconee
Lake Keowee Conservation Easement	Local	3	NNE	Six Mile	Pickens
Mile Creek Park	Local	4	North	Six Mile	Pickens
Keowee Wildlife Management Area	State	4	South	Newry	Oconee
Newry Historic District	Local	5	South	Newry	Oconee
Ponderosa Park	Local	5	ENE	Six Mile	Pickens

(NPS 2019; Oconee County 2019a; Pickens County 2019a; SCDNR 2019a; USCB 2019c; USDA 2019a)

a. List is based on best available public information and includes lands that are totally or partially located within a 6-mile radius of ONS.

b. Distances are approximate miles (rounded to the nearest mile and calculated based on the ONS center point and land centroid data).

c. The distance reported for the Clemson University Forest is based on the closest point of the property boundary to the ONS center point.

d. The distances reported for Old Pickens Presbyterian Church and Alexander-Hill House are based on locations provided by the National Register of Historic Places (NRHP).

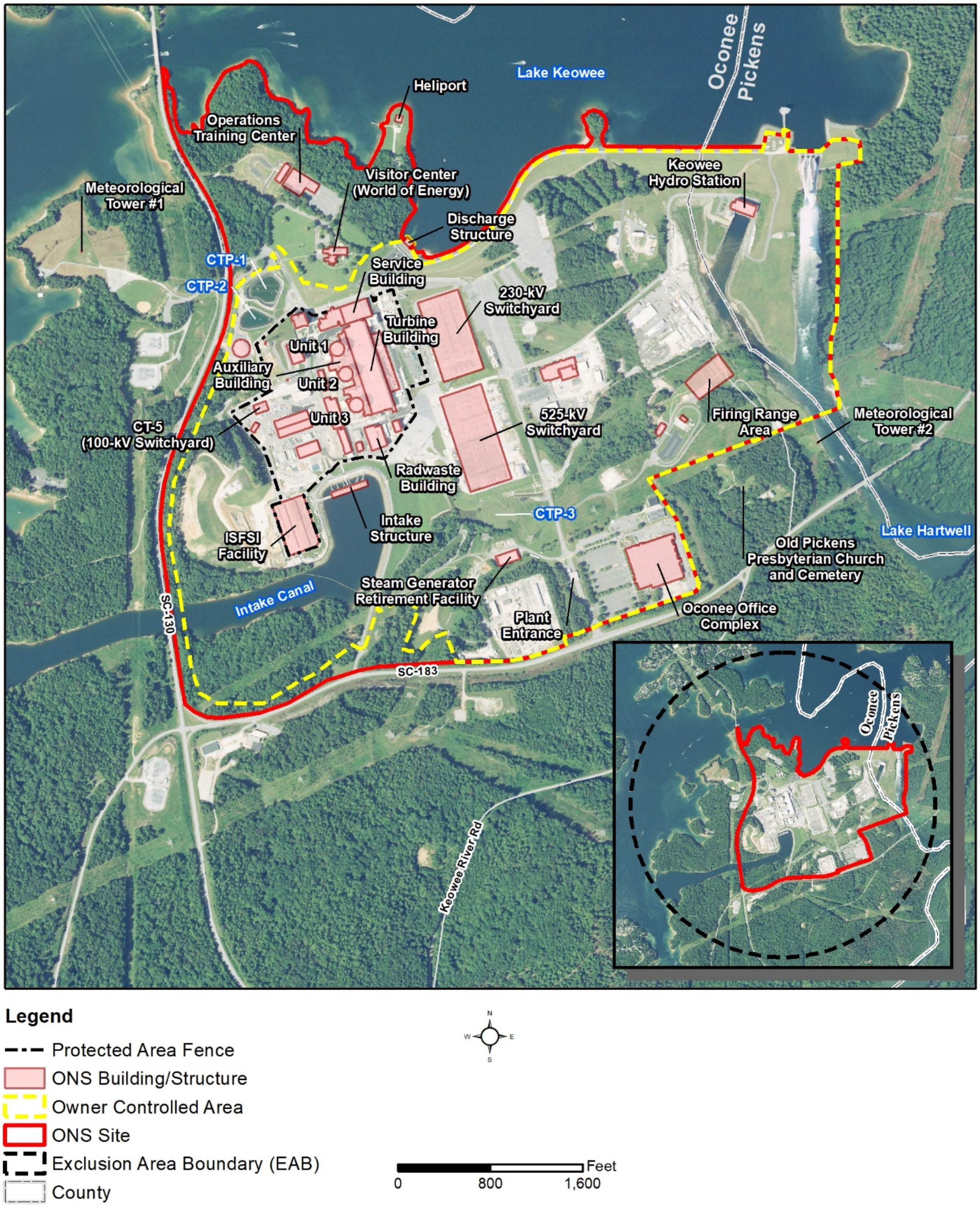


Figure 3.1-1 ONS Plant Layout

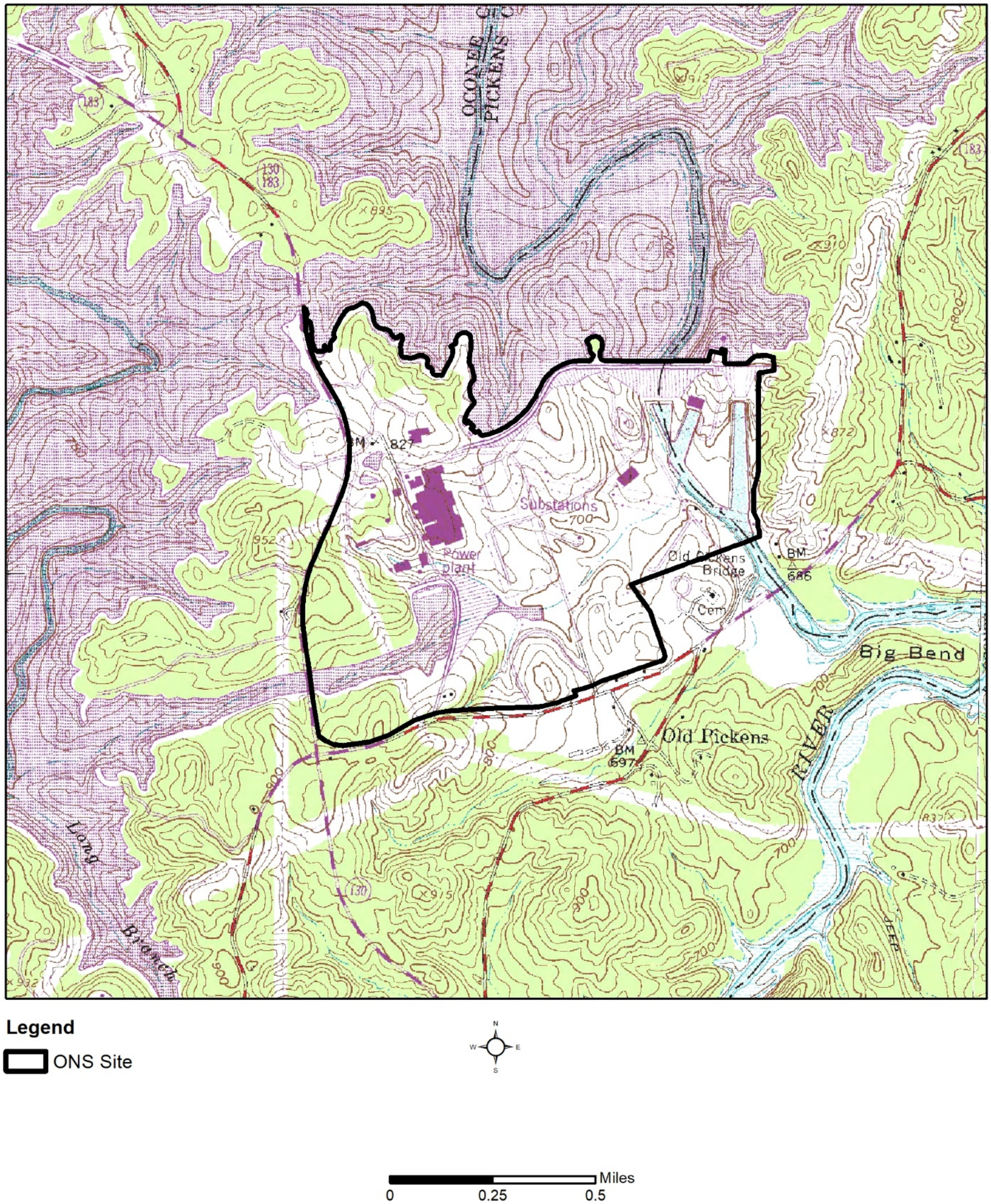


Figure 3.1-2 ONS Property and Area Topography

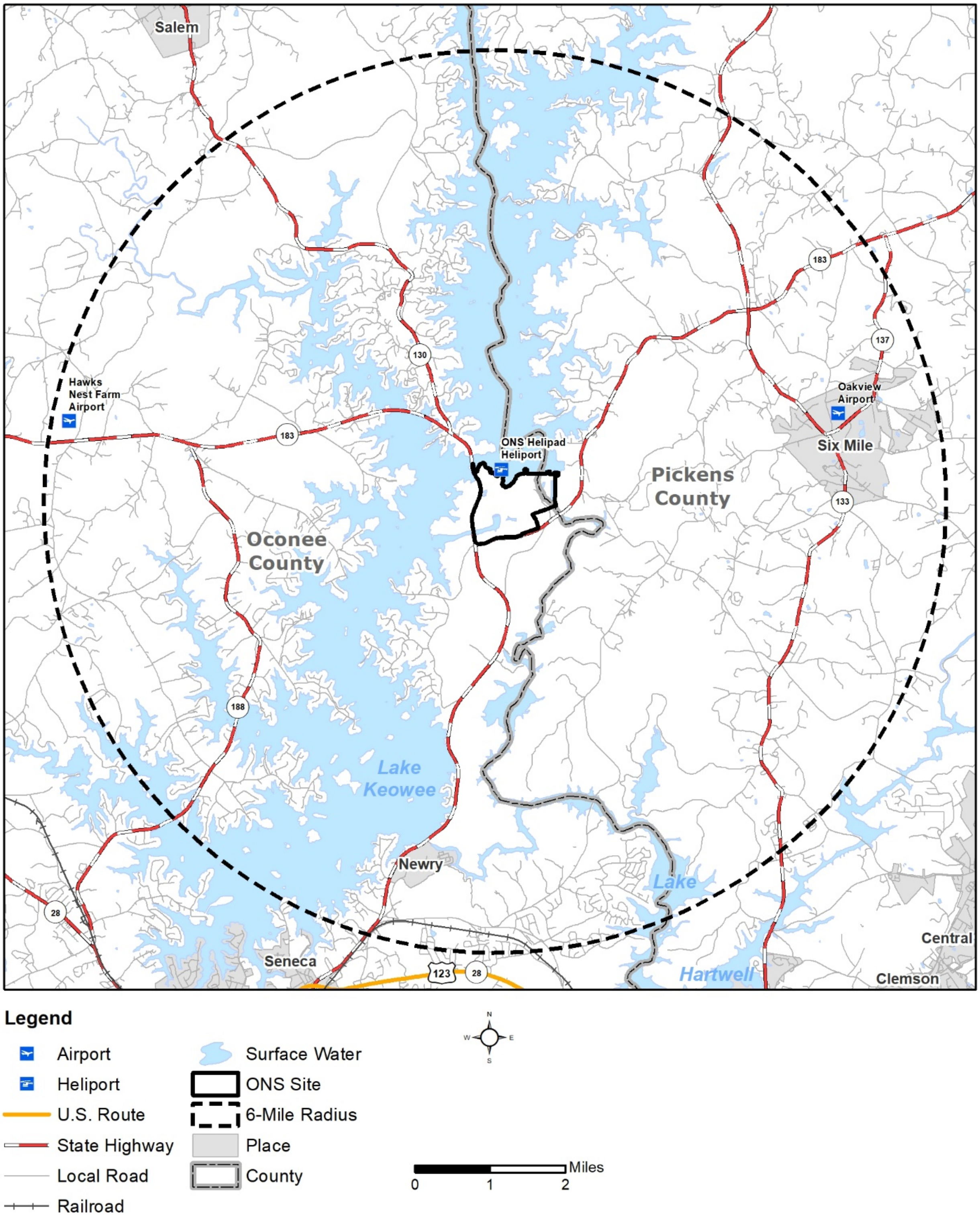


Figure 3.1-3 ONS Site and 6-Mile Radius of ONS

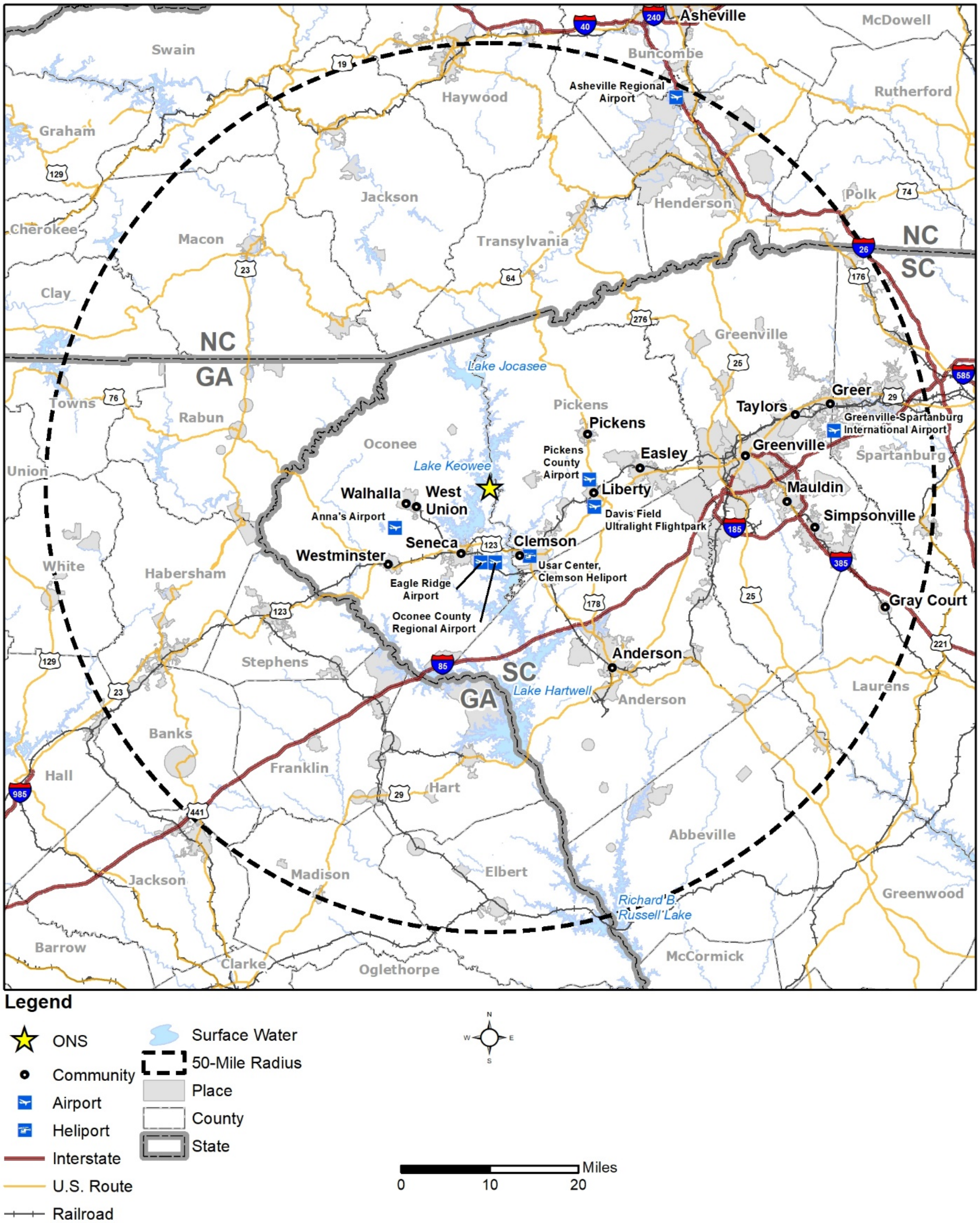


Figure 3.1-4 ONS Site and 50-Mile Radius of ONS

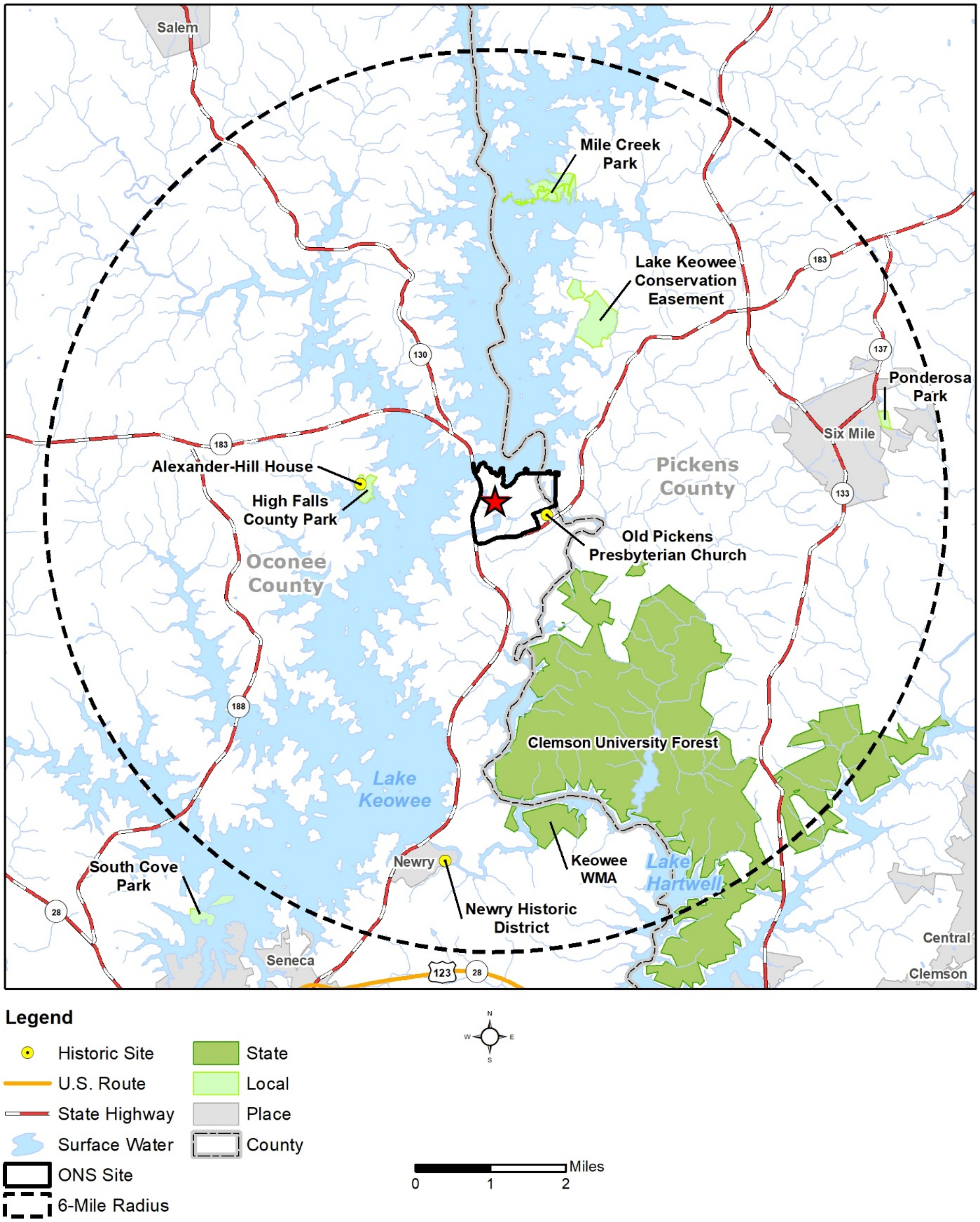


Figure 3.1-5 Federal, State, and Local Lands within a 6-Mile Radius of ONS

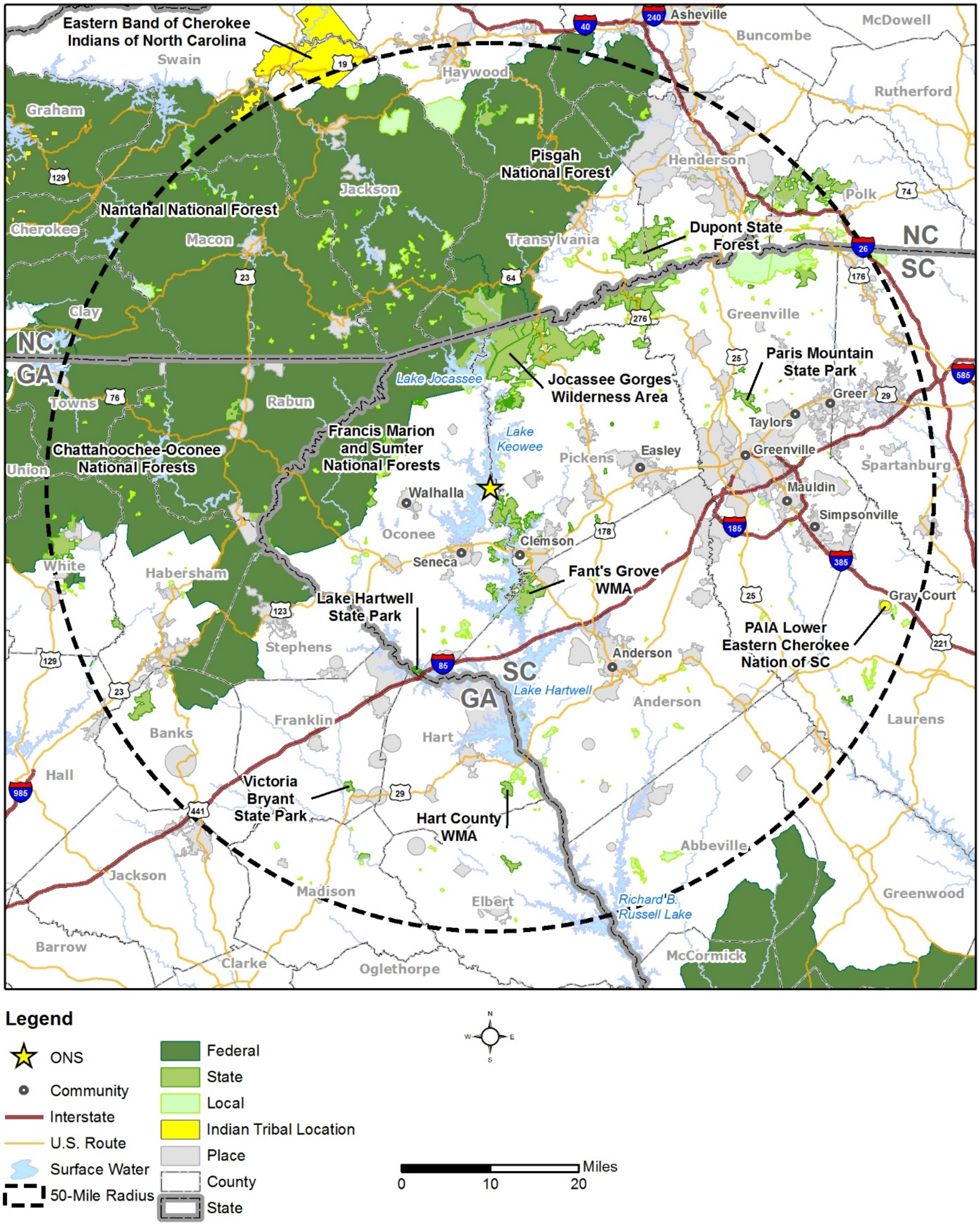


Figure 3.1-6 Federal, State, and Local Lands within a 50-Mile Radius of ONS

3.2 Land Use and Visual Resources

Land use descriptions focus on Oconee and Pickens counties, SC, because approximately 78 percent of the ONS regular full-time employees live in these counties and because ONS pays property taxes to Oconee County. For additional information concerning the ONS workforce, see Section 2.5.

3.2.1 Onsite Land Use

ONS is located in eastern Oconee County, SC, approximately 8 miles northeast of Seneca, SC. Lake Keowee occupies the area immediately north and west of the site. The Lake Hartwell reservoir is south and downstream of the site. The 510-acre site includes the dam that forms Lake Keowee and extends westward to SC-130. The towns of Six Mile and Newry are approximately 5 miles from the site. As shown in Table 3.11-1, the city of Anderson, SC, is the closest population center in the region, and is approximately 25 miles southeast of ONS.

As shown in Table 3.2-1 and illustrated in Figure 3.2-1, "developed" is the largest land use/land cover category within the ONS property boundary, covering approximately 60.8 percent of the site. These onsite developed areas are classified primarily as "developed, open space" (13.5 percent), "developed, low intensity" (13.2 percent), "developed, medium intensity" (15.5 percent), and "developed, high intensity" (18.6 percent). The onsite forested areas within the ONS property boundary comprise approximately 17.4 percent. The remaining six land use/land cover categories found onsite comprise approximately 21.9 percent. (MRLC 2019)

The ONS site is in a control-free zone of Oconee County, SC. The site also falls within the Keowee-Jocassee overlay. (Oconee County 2019b) The Keowee-Jocassee overlay depicts an area surrounding the reservoirs that Duke Energy is responsible for supervising and managing (Duke 2014a). All property within the EAB is owned in fee, including mineral rights, by Duke Energy except for the small rural church plot belonging to Old Pickens Church, ROWs for existing highways, and approximately 9.8 acres of U. S. government property involved with Lake Hartwell reservoir (see Figure 3.1-1).

The Hartwell property is either a portion of the Lake Hartwell reservoir or subject to flooding and not suitable for other uses. Duke Energy has obtained from the owners of the church plot and from the U.S. government the right to restrict activities on these properties and to evacuate them of all persons at any time without prior notice if, in its opinion, such evacuation is necessary or desirable in the interest of public health and safety.

3.2.2 Offsite Land Use

As shown in Table 3.11-2 and Table 3.11-3, total county population for Oconee and Pickens counties has increased between 2010 and 2017. The population for Oconee County is expected to increase until 2025, and Pickens County's population is projected to increase through 2054. As described in Section 3.1, the vicinity (6-mile radius) surrounding ONS includes portions of Oconee and Pickens counties. The land use/land cover categories located within the vicinity of

ONS are illustrated in Figure 3.2-2. Lake Keowee is the predominant geographic feature in the vicinity, and as noted in Table 3.2-2, forest is the largest land use/land cover category at approximately (52.7 percent), divided among deciduous forest (28.8 percent), evergreen forest (12.9 percent), and mixed forest (11.0 percent). The next largest land use land cover category in the vicinity is open water as 18.3 percent. Developed land is the third largest land use and land cover category identified in the 6-mile vicinity, at approximately 14.3 percent. The remaining six land use and land cover categories found within the vicinity comprise approximately 14.7 percent. (MRLC 2019)

Oconee County occupies approximately 400,850 acres of land, of which 62,499 acres (15.6 percent) are proportioned to farmland. The 2017 census of agriculture reports that the county had a total of 815 farms, with an average farm size of 77 acres. Approximately 551 farms produced crops, with primary crops reported as corn for grain (601 acres), wheat (1,344 acres), soybeans (1,892 acres), and forage (11,240 acres). Livestock is also an important agricultural product in the county, with livestock commodities such as cattle and calves (394 farms), hogs and pigs (45 farms), layers (120 farms), broilers and other meat-type chickens (58 farms), and sheep and lambs (35 farms) reported. Other agricultural uses of farmland within the county included woodlands (18,759 acres on 569 farms), permanent pasture and rangeland (20,944 acres on 550 farms), and pastureland (26,664 acres on 597 farms). (USDA 2019b)

Pickens County occupies approximately 317,663 acres of land, of which 39,331 acres (12 percent) are proportioned to farmland. In 2017, it was reported that the county had a total of 740 farms, with an average farm size of 53 acres. Approximately 462 farms produced crops, with primary crops reported as corn for grain (462 acres), soybeans (253 acres), and forage (7,477 acres). Livestock is also an important agricultural product in the county, with livestock commodities such as cattle and calves (247 farms), hogs and pigs (28 farms), layers (141 farms), broilers and other meat-type chickens (6 farms), and sheep and lambs (36 farms) reported. Other agricultural uses of farmland within the county included woodlands (10,381 acres on 454 farms), permanent pasture and rangeland (12,634 acres on 486 farms), and pastureland (15,361 acres on 522 farms). (USDA 2019b)

The State of South Carolina allows cities and counties to have comprehensive land use plans. As specified in South Carolina Local Government Comprehensive Planning Enabling Act of 1994 Title 6 Chapter 29, local planning commissions may undertake a continuing planning program for the physical, social, and economic growth, development, and redevelopment of the area within its jurisdiction. The comprehensive plan shows the locality's long-range recommendations for the general development of the territory covered by the plan. It may include, but is not limited to, the following (SCL 2019):

- Prepare and revise periodically plans and programs.
- Prepare and recommend for adoption to the appropriate governing authority or authorities:

- Zoning ordinances to include zoning district maps and appropriate revisions thereof, as provided in this chapter.
- Regulations for the subdivision or development of land and appropriate revisions thereof.
- An official map and appropriate revision on it showing the exact location of existing or proposed public street, highway, and utility rights-of-way, and public building sites.
- A landscaping ordinance setting forth required planting, tree preservation, and other aesthetic considerations for land and structures.
- A capital improvements program setting forth projects required to implement plans which have been prepared and adopted.
- Policies or procedures to facilitate implementation of planning elements.

Comprehensive plans are in place for Oconee and Pickens counties, SC, and reflect planning efforts and public involvement in the planning process (Oconee County 2019c; Pickens County 2016).

Oconee County has increased in both industrialization and commercialization, but has traditionally relied on agriculture and textiles. In the twentieth century, industry evolved into high-tech, services, and tourism. The creation of major lakes and energy projects permanently altered the landscape. Many historical sites have survived from the early years of European settlement. There are currently 20 sites on the National Register of Historical Places (NRHP) in Oconee County. Land use in the past centered on the exploitation of natural resources. Currently about 23.72 percent of the county is preserved as state and federal forest lands. However, private forest land is the largest land use in the county at 29.13 percent. The third largest is agriculture at 23.71 percent, then residential. Future development will be managed by zoning and other land use regulations; creating wildlife sanctuaries; providing incentives for landowners to preserve and create natural areas; preserving lakes and rivers; retaining small town and rural characteristics; preserving farms; protecting and expanding green spaces; and funding an agriculture conservation bank. (Oconee County 2019c)

Pickens County was mostly agricultural and rural until the 1940s. By the end of World War II, the county had transitioned into mainly manufacturing. Pickens County has been able to attract other types of industry to diversify the economy. In addition to manufacturing, tourism and education have contributed to Pickens County's growth. The most common use of land in Pickens County is residential, followed by agricultural, then institutional/recreational. Because of the terrain and location of infrastructure and services, most of the growth will occur in the southern portion of the county. Pickens County's comprehensive plan goals is to mitigate the impact of development by encouraging the conservation of the agricultural character and natural resources of Pickens County while protecting the rights of landowners. (Pickens County 2016)

3.2.3 Visual Resources

As presented in Section 3.1, ONS is adjacent to Lake Keowee in eastern Oconee County, SC. Figure 3.1-1 shows the building site layout and the property boundary in association with Lake Keowee. As discussed in Section 3.2.1, the largest land use categories on the ONS site property are "developed" at approximately 60.8 percent and "forested" at approximately 17.3 percent.

The tallest structures on the ONS site are the reactor containment buildings, which are approximately 191 feet in height. Predominant visual features at ONS are the reactor containment buildings, the turbine buildings, and transmission lines. The site structures located within the protected area of the plant are set back from the lake, adjacent to the Keowee Dam and surrounded by forest, offering limited offsite viewing opportunities. Because of the wooded setting, shape of the lake, remote location, and absence of refurbishment plans for purposes of SLR, ONS would continue to have minimal visual impact on neighboring properties or from the viewpoint of the Lake Keowee (see Section 3.1.3).

Table 3.2-1 Land Use/Land Cover, ONS Site

Category	**Acres**	**Percent**
Open Water	34.69	6.8
Developed, Open Space	68.94	13.5
Developed, Low Intensity	67.61	13.2
Developed, Medium Intensity	79.39	15.5
Developed, High Intensity	95.41	18.6
Barren Land (Rock/Sand/Clay)	1.33	0.3
Deciduous Forest	50.48	9.9
Evergreen Forest	21.79	4.3
Mixed Forest	16.23	3.2
Grassland/Herbaceous	32.91	6.4
Pasture/Hay	40.03	7.8
Woody Wetlands	1.56	0.3
Emergent Herbaceous Wetlands	1.56	0.3
Total	**511.93**[a]	**100**

(MRLC 2019)

a. The acreages presented in this table are based on the Multi-Resolution Land Characteristics Consortium (MRLC) land use/land cover data. These data are presented in a raster (pixel-based) format and because of their square geography, they do not exactly match the ONS site boundary. This geographic variation creates a small difference between total acreage reported compared to the ONS property acreage stated throughout the ER.

Table 3.2-2 Land Use/Land Cover, 6-Mile Radius of ONS

Category	Acres	Percent
Open Water	13,464.44	18.3
Developed, Open Space	7,802.72	10.6
Developed, Low Intensity	2,130.32	2.9
Developed, Medium Intensity	462.36	0.6
Developed, High Intensity	164.35	0.2
Barren Land (Rock/Sand/Clay)	119.20	0.2
Deciduous Forest	21,160.85	28.8
Evergreen Forest	9,467.56	12.9
Mixed Forest	8,118.96	11.0
Shrub/Scrub	902.70	1.2
Grassland/Herbaceous	2,354.49	3.2
Pasture/Hay	7,315.89	9.9
Woody Wetlands	110.75	0.2
Emergent Herbaceous Wetlands	24.69	0.0
Total	**73,599.28**	**100.0**

(MRLC 2019)

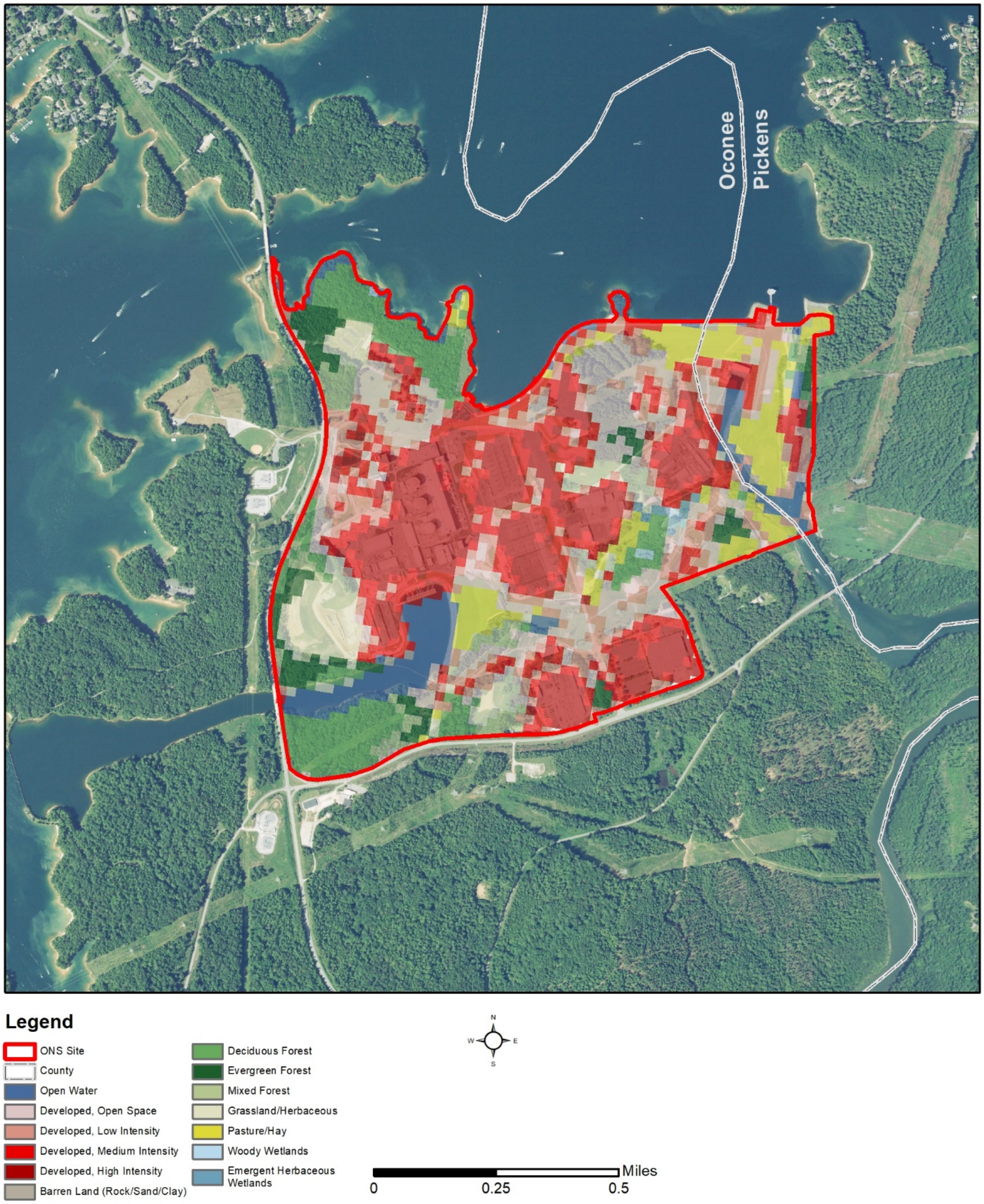


Figure 3.2-1 Land Use/Land Cover, ONS Site

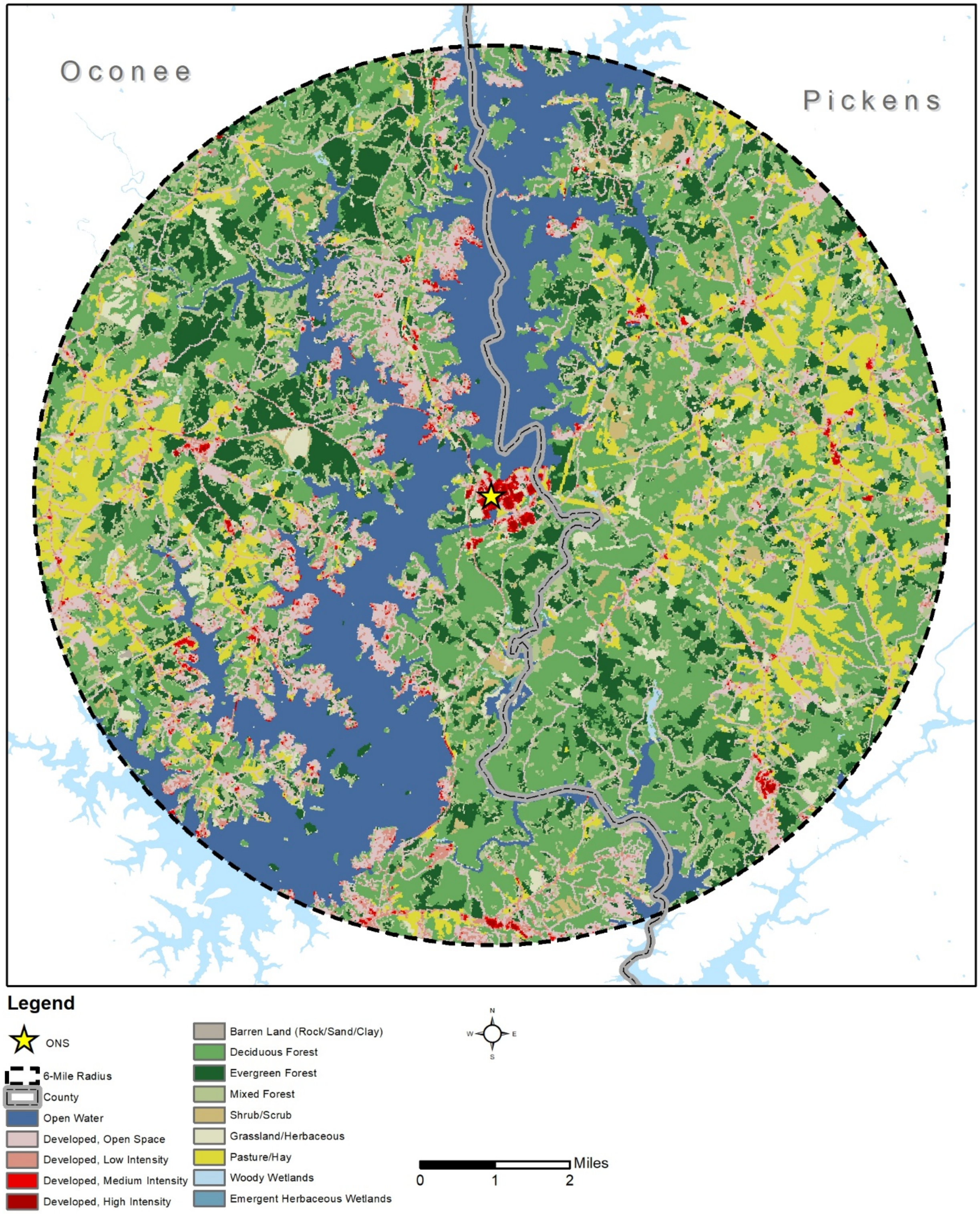


Figure 3.2-2 Land Use/Land Cover, 6-Mile Radius of ONS

3.3 Meteorology and Air Quality

The meteorology, climate, and air quality of ONS were previously evaluated during the ONS Units 1, 2, and 3 license renewal approval processes (NRC 1999b, Section 2.2.4). ONS is located on the eastern slope of the Appalachian Mountains near Greenville, SC. The climate of the region is generally mild with wind directions influenced by the mountains. (NRC 1999b, Section 2.2.4). A high-level overview of the plant layout is provided in Figure 3.1-1.

The climatological data presented below have been provided to represent a range of meteorological conditions considered typical for the ONS site region. The Greenville-Spartanburg weather station, also known as the Greer weather station, is the closest first-order National Weather Service (NWS) data collection station to ONS with a significant period of meteorological data, and thus has been used to describe the representative climatic conditions. Greenville-Spartanburg climatological information has been used in previous ONS licensing environmental reviews, making its continued use appropriate for comparison. (NRC 1999b, Section 2.2.4)

3.3.1 General Climate

The Greenville-Spartanburg station located 3 miles south of Greer, SC, is situated in northwestern South Carolina on the eastern slope of the southern Appalachian Mountains. The terrain consists of rolling hills with the mountains starting about 20 miles to the northwest and the main ridge about 55 miles farther. The mountains protect this area from the full force of the cold air masses which move southeastward from central Canada during the winter months. The station is level with, or slightly higher than, most of the surrounding countryside. The elevation ranges from 800 to 1,100 feet. No bodies of water are nearby. The coldest weather in Greenville-Spartanburg normally occurs in late December and January, when low temperatures (°F) usually average in the lower 30s and the high temperatures in the 50s. Temperatures seldom lower to 0°F, but there have been occurrences of below zero temperatures. Summertime high temperatures range in the 80s, but there have been occurrences of temperatures above 100°F. Temperatures taken at the station are consistent with those in Greer, Greenville, and Spartanburg. Winter temperatures remain above freezing throughout the daylight hours except for a few times during a normal year. There are usually two freezing rainstorms and two or three small snowstorms each winter. Rainfall in the region is usually abundant and spread quite evenly throughout the months. Droughts can occur, but are usually of short duration. (NCDC 2019)

The mountain ridges, which lie in a northeast-southwest direction, have an overall influence on wind direction. The prevailing directions are northeast and southwest, divided almost evenly, with fall and winter favoring northeast and spring and summer favoring southwest. (NCDC 2019) Destructive winds can occur, but tornados are infrequent and generally small (NRC 1999b). The average latest freeze occurs in late March and the average first freeze is early November, giving an average growing season of 225 days. In higher elevations of the region, the growing season begins about one month later and ends about one month earlier. (NCDC 2019)

Like the Greenville-Spartanburg weather station, the ONS site is situated on the eastern slope of the southern Appalachian Mountains at an elevation of about 800 feet mean sea level. The mountains influence wind direction, resulting in bimodal prevailing wind directions of north-northeast to east-northeast and southwest to west. The normal average temperature is consistently above freezing in winter and in the upper 70s in summer. Normal precipitation is about 4 to 5 inches per month. (NRC 1999b; NCDC 2019) For detailed meteorological information about ONS, please see Section 3.3.2.

3.3.2 Meteorology

3.3.2.1 Wind Direction and Speed

The prevailing wind at the ONS site is from the west-southwest and from the northeast. Wind speeds are influenced by the Bermuda high off the eastern coast of the United States during the summer season. The average annual wind speed is 4.5 mph. Mean monthly wind speeds at the ONS site are provided in Table 3.3-2, based on a 30-year record (1989–2018) of measurements from the lower level (32.8 feet above ground level) of the onsite meteorological monitoring system. Similar to the Greenville-Spartanburg station, the average onsite summer wind speed (3.9 mph) is also lower than those during other seasons (see Table 3.3-2) (NRC 1999b). Annual wind rose diagrams for the period 2014–2018 are provided in Figures 3.3-1, 3.3-2, 3.3-3, 3.3-4, and 3.3-5.

For Greenville-Spartanburg, the 39-year period of record data show the annual prevailing wind direction (i.e., the direction from which the wind blows most often) is from 30 degrees (i.e., from the north-northeast). Monthly prevailing winds are from the south-southwest during the end of winter through early summer. In late summer through early winter, the mean prevailing wind is northerly. As listed in Table 3.3-1, the mean wind speed over the past 35-year period of record was 6.6 miles per hours (mph). A maximum 3-second wind speed of 76 mph was recorded in June 2009. (NCDC 2019)

3.3.2.2 Temperature

Representative regional temperature averages and extremes are available from the Greenville-Spartanburg monitoring station. Monthly and annual daily mean temperature data and temperature extremes for the Greenville-Spartanburg area are summarized in Table 3.3-3. The local climate data summary for the Greenville-Spartanburg area indicates that the mean daily maximum temperature is highest during July (89.0°F) and decreases to the seasonal low in January (51.2°F). The Greenville-Spartanburg area experiences normal temperatures above 90°F approximately 46 days per year from April through October. The highest temperature of record (107°F) occurred in July 2012. The mean daily minimum temperature is above 50°F from May through September and is at its lowest in January, when the mean daily minimum decreases to 31.2°F. Record low temperatures less than 0°F have been recorded in January, with below freezing temperatures normally occurring approximately 52 days per year from October through April. The lowest temperature of record by the Greenville-Spartanburg station is -6°F, occurring in January 1966. (NCDC 2019)

Average temperatures in the area of ONS are 44°F in January and 79°F in July, with annual extremes of approximately 7°F as the low and 101°F as the high. Monthly and annual daily mean temperature data and temperature extremes for the ONS area are summarized in Table 3.3-4. On average, ONS has slightly higher temperatures than Greenville-Spartanburg. However, the deviation between the ONS average temperatures and the Greenville-Spartanburg average temperatures does not exceed 3°F (NCDC 2019)

For comparison of regional temperatures over the past several decades, Table 3.3-5 presents monthly and annual temperature averages from Clemson for the period between 1929 and 1958, the Greenville-Spartanburg station for the period between 1962 to 2018, the most recent 30-year period for the ONS site, and the most recent data available for Clemson. The Greenville-Spartanburg monthly temperatures have a similar temperature pattern with the other sites throughout the year. The annual temperature for Greenville-Spartanburg is slightly cooler than the temperatures listed at the other sites. The annual temperature differential between the Clemson data and the ONS data is less than two degrees. (NCDC 2019)

3.3.2.3 Precipitation

As noted in Table 3.3-7, precipitation at ONS is generally evenly distributed throughout the year with normal monthly precipitation amounts ranging from 3.81 inches (October) to 5.18 inches (December). For about two-thirds of the year, the region is under the influence of the Bermuda high pressure system (NRC 1999b). There is a potential for tropical storms in the fall months of the year, which could result in high precipitation events.

The precipitation records of normal rainfall totals for the Greenville-Spartanburg area indicate that precipitation of 0.01 inches or more occurs on average for 114 days per year, with seven or more days per month receiving at least some precipitation. The annual average precipitation at the Greenville-Spartanburg station is 47.19 inches per year. Precipitation recorded at the station is relatively well-distributed throughout the year, with a mean of approximately 3 or more inches falling during most months. The highest seasonal precipitation occurs in the summer (approximately 20 percent falling in July and August), which also coincides with record events where more than 12 inches have occurred in a 24-hour period. There is considerable variability in total monthly amounts from year to year. While the summer months may experience significant rainfall events, those months can also be very dry. Droughts have been experienced, but are usually of short duration. Normal regional precipitation and extremes are presented in Table 3.3-6. The maximum 24-hour precipitation total recorded at Greenville-Spartanburg, 12.32 inches, occurred in August 1995. Greenville-Spartanburg received a record minimum monthly rainfall total (0.00 inches) in October 2000. (NCDC 2019)

Precipitation measurements are collected at ground level at the ONS meteorology monitoring station on an hourly basis. Review of data collected for the period from 1989–2018 indicates that the average monthly precipitation is highest in March (5.14 inches) and lowest in October (3.81 inches) (Table 3.3-7). The ONS data also indicate that while significant rainfall may occur in some years during June to September, these months can also receive very little precipitation.

Based on data collected over the 30-year period, the ONS site receives approximately 6 inches of precipitation per year, which is more than Greenville-Spartanburg.

3.3.2.4 Snow and Glaze

In the Greenville-Spartanburg area, winters are mild with daytime temperatures only going below freezing a few times during a normal year. Ice storms (freezing rain or glaze) usually occur twice a year. Greenville-Spartanburg receives on average approximately 4.7 inches of snow per year. Since 1990, annual snowfall has ranged from as little as a trace in 3 years to 10.2 inches (1992–1993). (NCDC 2019) Snowfall at the site is not recorded by ONS.

3.3.2.5 Relative Humidity and Fog

The closest available fog data for the ONS region are from the NWS Greenville-Spartanburg observation station. The local climatological data for Greenville-Spartanburg indicate an average of 27.2 days per year of heavy fog. Heavy fog is defined by the NWS as fog which reduces visibility to 0.25 mile or less. (NCDC 2019) Fog at the site is not recorded by ONS.

3.3.2.6 Severe Weather

3.3.2.6.1 Thunderstorms

Climatological records show that the area is subject to occasional storms, including destructive winds. (NRC 1999b, Section 2.2.4) Thunderstorms are frequent during the late spring and summer months, with the greatest occurrence during the month of July. The mean number of days with thunderstorms in each month for Greenville-Spartanburg is provided in Table 3.3-8. Based on National Centers for Environmental Information (NCEI) records, Oconee County, SC, has recorded 281 thunderstorm events since 1959, with most of the thunderstorms occurring in June, July, and August. (NCEI 2019)

3.3.2.6.2 Tornados

Tornados are infrequent in this region and are generally small when they occur. (NRC 1999b, Section 2.2.4) Based on NCEI records, a total of 27 tornados have been recorded in Oconee County, SC, since 1973. The records show that the intensity of the storms was limited to EF0, F0, F1, and F2 with one exception of an F3 that occurred on March 27, 1994. (NCEI 2019)

3.3.2.6.3 Hurricanes

Most years, one or more tropical storms affect the site; however, ONS is sufficiently far inland that the winds associated with these storms are below hurricane force. (NRC 1999b, Section 2.2.4) The NCEI does not have any record of a hurricane in Oconee County, SC, since 1950. (NCEI 2019)

3.3.2.7 Atmospheric Stability

Atmospheric stability is a meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined by the difference in temperature between two heights. The seven-category Pasquill atmospheric stability classification scheme (ranging from A for extremely unstable to G for extremely stable) based on temperature differences is recommended by the NRC to determine atmospheric dispersion characteristics per the NRC's Regulatory Guide 1.23, Revision 1 (NRC 2007). When the temperature decreases rapidly with height (typically during the day when the sun is heating the ground), the atmosphere is unstable and atmospheric dispersion is greater. Conversely, when temperature increases with height (typically during the night as a result of the radiative cooling of the ground), the atmosphere is stable, and dispersion is more limited. The stability category between unstable and stable conditions is D (neutral), which would occur typically with higher wind speeds and/or higher cloud cover, irrespective of day or night. (NRC 2013c, Section 2.9.1.4).

Based on a 5-year average (2014–2018), onsite temperature difference data recorded at ONS indicate that stable atmospheric conditions (E to G) occurred about 45.1 percent of the time and unstable conditions (A to C) occurred about 17.6 percent of the time. The remaining observations (about 37.3 percent) fell into the neutral (D) category. Stability class distributions at ONS covering the period 2014–2018 are presented in Table 3.3-9.

3.3.3 Air Quality

3.3.3.1 Clean Air Act Non-Attainment Maintenance Areas

The Clean Air Act (CAA) was established in 1970 [42 USC § 7401 et seq.] to reduce air pollution nationwide. The EPA has developed primary and secondary national ambient air quality standards (NAAQS) under the provisions of the CAA. The EPA classifies air quality within an air quality control region (AQCR) according to whether the region meets or exceeds federal primary and secondary NAAQS. An AQCR or a portion of an AQCR may be classified as being in attainment or non-attainment, or it may be unclassified for each of the six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter ($PM_{2.5}$, fine particulates; and PM_{10}, coarse particulates), ozone, and sulfur dioxide (SO_2).

Emissions from nonradiological air pollution sources, including the criteria pollutants, are controlled through compliance with federal, state, and local regulations. Non-attainment areas are areas where the ambient levels of criteria air pollutants in the air are designated as not exceeding the criteria set forth in federal, state, and local regulations. Attainment areas are areas that exceed the criteria or cannot be classified (depending on the pollutant and other factors). A maintenance area is an area that formerly did not exceed the attainment criteria but currently exceeds the attainment criteria. (EPA 2019a)

The ONS site is within 62 miles of the Great Smoky Mountains National Park and Shining Rock Wilderness Area. These areas are designated in 40 CFR, Part 81, Subpart D, as mandatory Class I federal areas in which visibility is an important value. As a result of the proximity of the ONS site to these Class I areas, future industrial development at the site will be subject to strict federal standards for pollution control. (NRC 1999b, Section 2.2.4) The boundary of the Great Smoky Mountains National Park is northwest of the ONS site outside of the 50-mile region. The Shining Rock Wilderness Area is located to the north within the 50-mile region.

There are three intrastate AQCRs within 50 miles of ONS. These are the Greenville-Spartanburg Intrastate AQCR (40 CFR 81.106), the Northeast Georgia Intrastate AQCR (40 CFR 81.237), and the Western Mountain Intrastate AQCR (40 CFR 81.153). As of July 2019, all the counties within 50 miles of the site are now in attainment. Hall County, GA, in the Northeast Georgia Intrastate AQCR, is the only county designated as a maintenance area. The county is designated as a maintenance area for the $PM_{2.5}$ annual (1997) and the ozone 8-hour (1997) criteria. The nearest non-attainment area is outside of the 50-mile region (Figure 3.3-6).

3.3.3.2 Air Emissions

ONS holds a conditional major operating permit to operate an auxiliary boiler in accordance with the provisions of the Pollution Control Act, Sections 48-1-50(5), 48-1-100(A), and 48-1-110(a), the 1976 Code of Laws of South Carolina. Although ONS may periodically utilize a portable auxiliary boiler or generator(s) during outages, nonradioactive gaseous effluents result primarily from the testing of emergency generators and diesel pumps. Because ONS utilizes a once-through cooling system for condenser cooling purposes, there are no cooling towers or associated particulate emissions. (NRC 1999b, Section 2.0)

To protect South Carolina's ambient air quality standards and ensure that impacts from facilities that generate air emissions are maintained at acceptable levels, the SCDHEC governs the discharge of regulated pollutants by establishing specific conditions in the air permit. ONS is permitted under the 2018 air permit No. CM-1820-0041. Duke Energy is not aware of any issues that will significantly change the permit compliance of ONS. Permitted emission sources and conditions established in air permit No. CM-1820-0041 for ONS are shown in Table 3.3-10. The emission unit numbers identified in Table 3.3-10 are those cited in the 2018 air permit.

The permitted emission sources at ONS are regulated by the applicable regulations cited in the emissions permit. In addition, annual updates and emission statement reports are submitted to the SCDHEC each year. These reports contain tabular summary information related to each permitted emissions unit. Criteria pollutants and applicable hazardous air pollutants are summed and reported for each emission unit. Annual emissions for the 5 years from 2014–2018 are shown in Table 3.3-11.

As presented in Chapter 9, there have been no notices of violation or non-compliances associated with ONS air emissions over the 5 years from 2014–2018.

As presented in Section 2.3, no license renewal-related refurbishment or other license renewal-related construction activities have been identified. In addition, Duke Energy's review did not identify any future upgrades or replacement activities necessary for plant operations (e.g., diesel generators, diesel pumps) that would affect ONS's current air emissions program. Therefore, no increase or decrease of air emissions is expected over the proposed SLR operating term.

Studies have shown that the amount of ozone generated by even the largest industry transmission lines in operation (765 kV) would be insignificant (NRC 2013c, Section 4.3.1.1). As presented in Section 2.2.5, the in-scope transmission lines at ONS are 230-kV and 525-kV.

Therefore, the amount of ozone generated from in-scope transmission lines is anticipated to be minimal.

3.3.4 Greenhouse Gas Emissions and Climate Change

No data exist for mobile emission sources at ONS such as visitors and delivery vehicles. Therefore, Duke Energy calculated greenhouse gas (GHG) emissions on those direct plant activities (stationary and portable combustion sources in Table 3.3-11 reported in Duke Energy's annual updates and air emissions statements) and indirect plant activities (workforce commuting) where information was readily available. GHG emissions generated at ONS are presented in Table 3.3-12. As presented in Section 9.5.2.3, Duke Energy maintains a program to manage stationary refrigeration appliances at ONS to recycle, recapture, and reduce emissions of ozone-depleting substances and is in compliance with Section 608 of the CAA. Therefore, Duke Energy did not include potential emissions as the result of leakage, servicing, repair, and disposal of refrigerant equipment in Table 3.3-11.

Table 3.3-1 Regional Wind Conditions, Greer, SC

Measurement	Period of Record (years)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean speed (mph)	35	7.2	7.5	8	7.9	6.8	6.1	5.7	5.3	5.9	6	6.3	6.6	6.6
Prevailing direction (degrees from)	39	240	230	30	230	240	240	240	30	30	40	30	230	30
Max 3-second speed (mph)	22	49	58	51	54	58	76	56	64	48	41	41	46	76
Max speed year of occurrence		2009	2009	2017	1998	2003	2009	2012	2008	2003	2004	2010	2009	Jun 2009

(NCDC 2019)

Table 3.3-2 ONS Wind Conditions (1989–2018)

Measurement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean speed (mph)	5.3	5.5	5.5	5.0	4.3	3.8	3.8	3.7	4.0	4.2	4.4	5.0	4.5
Prevailing direction (degrees from)	220	210	220	210	220	220	230	60	60	60	230	230	220

Table 3.3-3 Regional Temperatures, Greer, SC

Measurement	Period of Record (years)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean daily maximum (˚F)	56	51.2	55.2	63.8	72.6	79.5	86.2	89	87.4	81.6	72.1	62.5	53.8	71.2
Highest daily maximum (˚F)	56	79	81	89	93	97	105	107	105	98	92	85	79	107
Year of occurrence		1975	2018	1995	1986	1967	2012	2012	2007	2011	1986	1974	2007	Jul 2012
Mean daily minimum (˚F)	56	31.2	33.6	40.6	48.5	57.1	65	68.9	68.1	61.9	49.8	40.5	34.3	50
Lowest daily minimum (˚F)	56	-6	8	11	24	31	40	54	52	36	25	12	5	-6
Year of occurrence		1966	1996	1993	2007	1989	1972	1979	1968	1967	1976	1970	1985	Jan 1966

(NCDC 2019)

Table 3.3-4 ONS Site Temperatures 1989–2018

Measurement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly average (˚F)[a]	43.88	46.94	53.42	61.52	69.08	75.2	78.98	77.54	72.68	62.96	53.24	46.4	61.88
Highest daily maximum (˚F)	76.64	77.18	84.56	88.7	92.48	99.5	101.12	98.42	95.36	88.34	80.24	75.74	101.12
Year of occurrence	2002	1996	2015	1989	2011	2012	2012	2011	2011	2018	2000	1998	2012
Lowest daily minimum (˚F)	6.98	12.2	16.88	30.74	40.1	52.88	59.36	60.8	49.28	35.78	24.08	11.66	6.98
Year of occurrence	1994	2015	1996	2007	1989	2000	2013	1992	1990	2017	2014	1989	1994

a. Calculated average of all temperature measurements for each month and of all measurements for the period 1989–2018.

Table 3.3-5 Regional Temperature Historic Comparison (°F)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
ONS (1989–2018)	43.9	46.9	53.4	61.5	69.1	75.2	79	77.5	72.7	63	53.2	46.4	61.9
Clemson, SC (1929–1958)	43.6	45.5	52.2	60.5	68.9	76.2	78.6	77.8	73.1	62.2	51.4	44	61.2
Greer (1962–2018)	41.2	44.4	52.2	60.5	68.3	75.7	79	77.8	71.8	61	51.5	44.1	60.6
Clemson, SC (2006–2018)	44.2	47.7	55.6	63.9	71.1	78.5	80	79.5	74.3	63.7	53.2	48	63.4

(NCDC 2019)

Table 3.3-6 Regional Precipitation

Greer														
Measurement	**Period of Record (years)**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Normal monthly precipitation (inches)	30	3.82	3.97	4.52	3.36	3.76	3.8	4.8	4.48	3.43	3.44	3.7	4.11	47.19
Maximum monthly precipitation (inches)	56	7.19	7.43	11.37	11.3	8.89	10.12	14.45	17.37	11.65	10.24	9.13	11.46	17.37
Year occurred		1993	1971	1980	1964	1972	1994	2013	1995	1975	1964	2015	2018	Aug 1995
Maximum 24 hour (inches)	56	3.3	3.57	4.45	3.76	3.79	4.8	4.68	12.32	6.21	4.93	4.23	3.54	12.32
Year occurred		1982	1984	1963	1963	1996	1980	2005	1995	1973	1990	2009	2004	Aug 1995
Minimum monthly precipitation (inches)	56	0.29	0.53	1.13	0.69	1.09	0.13	0.75	0.79	0.16	0	0.73	0.37	0
Year occurred		1981	1978	1985	1976	1965	2008	1993	1999	2005	2000	2017	1965	Oct 2000

(NCDC 2019)

Table 3.3-7 ONS Precipitation Records (1989–2018)

Measurement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Normal monthly precipitation (inches)	5.04	4.36	5.14	3.91	4.1	4.25	4.42	4.98	4.33	3.81	4.08	5.18	53.6
Maximum monthly precipitation (inches)	9.86	8.35	9.58	9.22	11.77	11	17.9	14.6	8.66	9.88	10.1	13	79.8
Year occurred	1998	1998	2011	1998	2018	2005	2013	1995	2002	2017	2015	2018	2013
Minimum monthly precipitation (inches)	1.77	1.41	1.35	0.93	0.50	0.00	0.24	0.06	0.47	0.01	0.00	1.44	32.4
Year occurred	2003	2017	2016	2001	2000	2004	2004	2011	2008	2000	2005	2010	2007

Table 3.3-8 Regional Thunderstorms, Mean Days per Month[a]

Greer												
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
0.8	0.9	2.5	3.2	5.9	7.7	9.7	7	3.2	0.8	0.7	0.6	43

(NCDC 2019)

a. The period of record is 56 years.

Table 3.3-9 ONS Stability Class Distributions

Percent Frequency of Occurrence by Stability Class Pasquill Stability Class[a]							
Year	**A**	**B**	**C**	**D**	**E**	**F**	**G**
2014	11.21	5.36	6.86	39.49	31.35	4.42	1.31
2015	2.37	3.96	5.45	38.86	44.91	3.91	0.54
2016	8.38	5.68	6.39	36.42	37.53	4.64	0.95
2017	4.62	5.05	5.21	35.73	43.38	5.04	0.97
2018	5.82	5.45	6.04	36.23	41.69	4.09	0.68
2014-2018	6.47	5.1	5.99	37.35	39.79	4.42	0.89

a. Classes are as follows (NRC 2007, Regulatory Guide 1.23, Table 1):

Class A: Extremely unstable

Class B: Moderately unstable

Class C: Slightly unstable

Class D: Neutral

Class E: Slightly stable

Class F: Moderately stable

Class G: Extremely stable

Table 3.3-10 ONS Permitted Air Emission Sources

Emission Source[(a)]	Description	Capacity Rating	Permit Conditions[(b)]
AB-01[(c)]	auxiliary boiler	172 mmBtu/hour	PM: 0.6 lbs/hr (3-hour block average)
			SO_2: 2.3 lbs/MMBtu (24-hour block average)
			Fuel oil sulfur content shall be less than or equal to 0.0015 percent by weight.
			Opacity: <40 percent, except during one 6-minute period per hour of not more than 60 percent opacity for no more than 24 minutes in a 24-hour period.
All[(b, d)]			Less than 100 tons NO_x per year

a. Emission source unit reference.

b. Stationary combustion sources also subject to 40 CFR Part 63, Subpart ZZZZ—National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.

c. Also subject to 40 CFR Part 63, Subpart JJJJJJ - National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources.

d. SCDHEC does not require reports to be submitted for generators; however, their emissions are included in the "All" category.

Table 3.3-11 ONS Reported Annual Air Emissions Summary, 2015–2019

Annual Emissions (tons/year)			
Year	**NO_x**	**CO**	**HAPs**
2015[(a)]	8.44	1.86	0.27
2016[(a)]	5.74	1.27	0.25
2017[(a)]	10.27	2.41	0.21
2018[(b)]	7.09	N/A	N/A
2019[(b)]	9.75	N/A	N/A

a. Emissions comply with the previous version of the air emissions permit dated August 13, 2012.

b. Emissions comply with the current version of the air emissions permit dated November 13, 2017.

Table 3.3-12 ONS Annual Greenhouse Gas Emissions Inventory Summary, 2015–2019

Emission Source	2015	2016	2017	2018	2019
Combustion sources[a]	2,281.3	1,550.9	2,777.0	1,916.1	2,634.8
Workforce commuting[b]	8,770.0	8,770.0	8,770.0	8,770.0	8,770.0
TOTAL	11,051.3	10,320.9	11,547.0	10,686.1	11,404.8

a. GHG calculated emissions are based on fuel usage for combustion sources as shown in Duke Energy's annual updates and emissions statements for 2015–2019 and as indicated by the referenced sources of Table 3.3-11 and 40 CFR 98 Table A-1 to Subpart A Global Warming Potentials.

b. Workforce commuting calculations are based on:

1. Statistical information from U.S. Census Bureau indicates that 3.6 percent of South Carolina workers in the transportation and warehouse and utilities industry carpool to work (USCB 2019d). The number of ONS employees as stated in Section 2.5 was 1,936. Utilizing the 3.6 percent USCB carpool statistic, a value of "1,866" passenger vehicles per day was utilized.
2. The EPA's greenhouse gas equivalencies calculator estimated the carbon dioxide equivalent (CO_2e)/year to be 8,770 metric tons for 1,866 vehicles (EPA 2019a).
3. Carbon dioxide has a global warming potential (100-year time horizon) of "1" based on Table A-1 to Subpart A of 40 CFR Part 98.
4. 8,770 metric tons CO_2e/year × 1 (global warming potential).

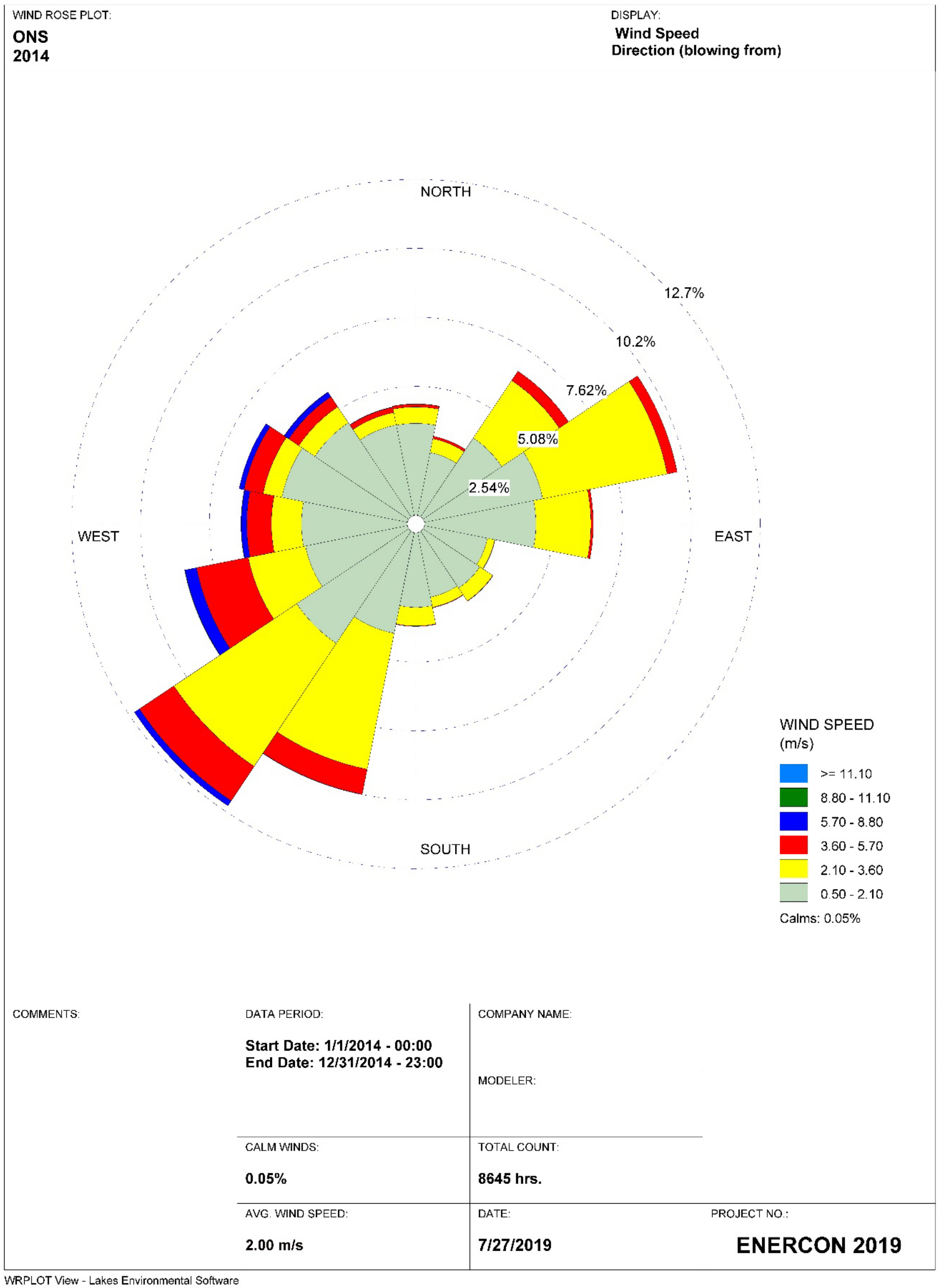


Figure 3.3-1 2014 ONS Wind Rose

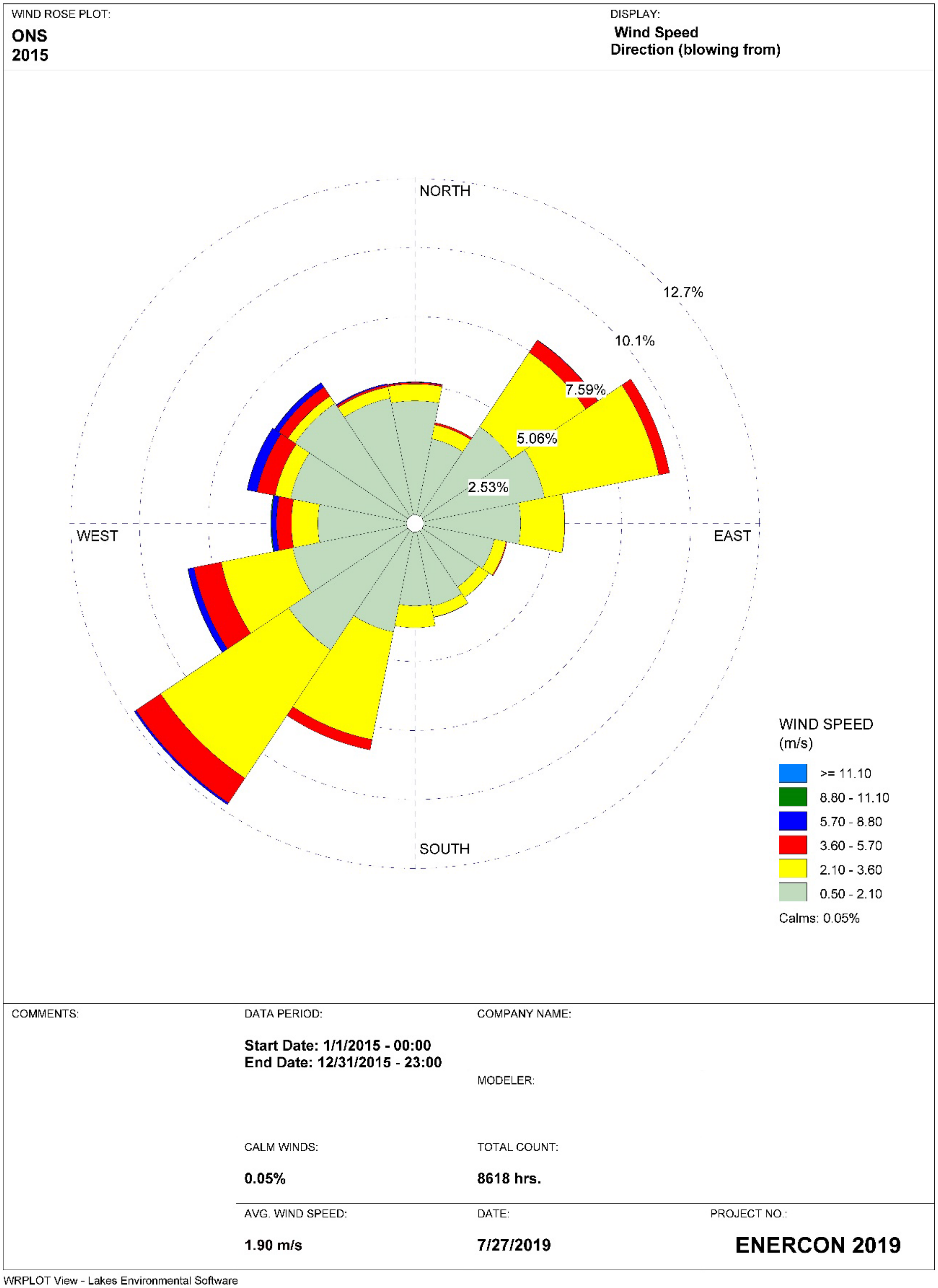
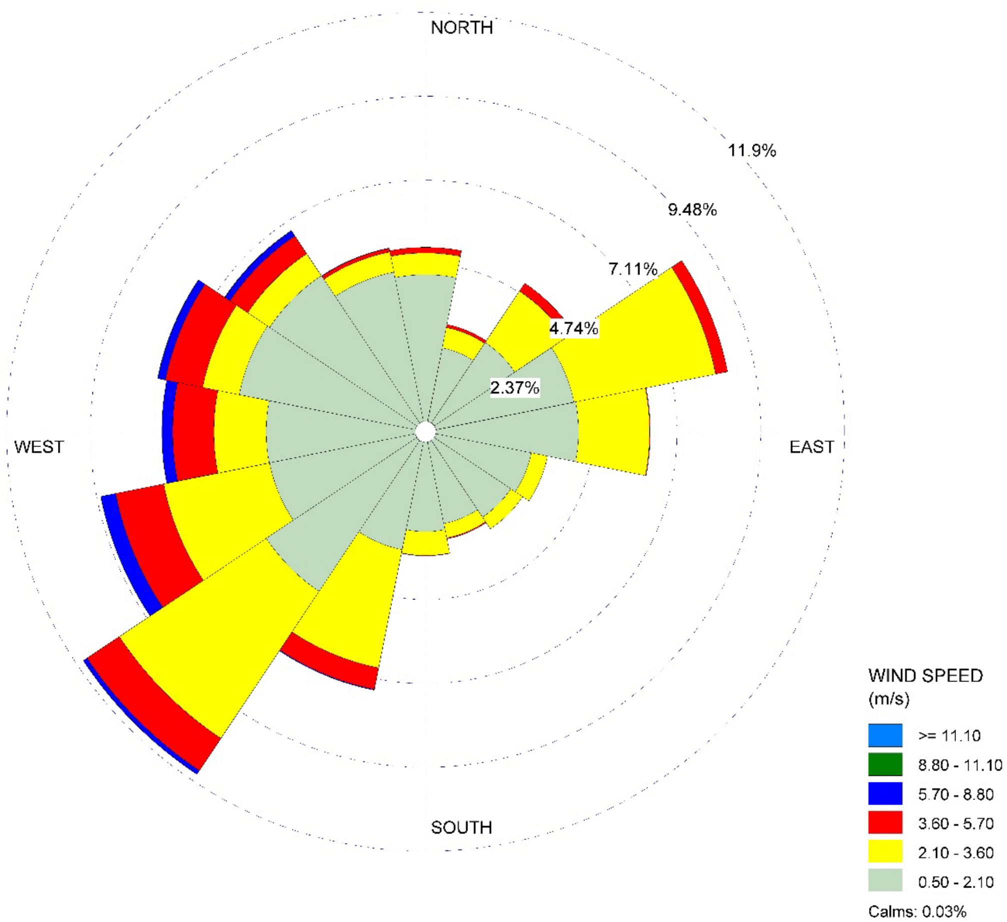


Figure 3.3-2 2015 ONS Wind Rose

WIND ROSE PLOT:
ONS
2016

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2016 - 00:00 **End Date: 12/31/2016 - 23:00**	MODELER:	
	CALM WINDS: **0.03%**	TOTAL COUNT: **8555 hrs.**	
	AVG. WIND SPEED: **1.94 m/s**	DATE: **7/27/2019**	PROJECT NO.: **ENERCON 2019**

WRPLOT View - Lakes Environmental Software

Figure 3.3-3 2016 ONS Wind Rose

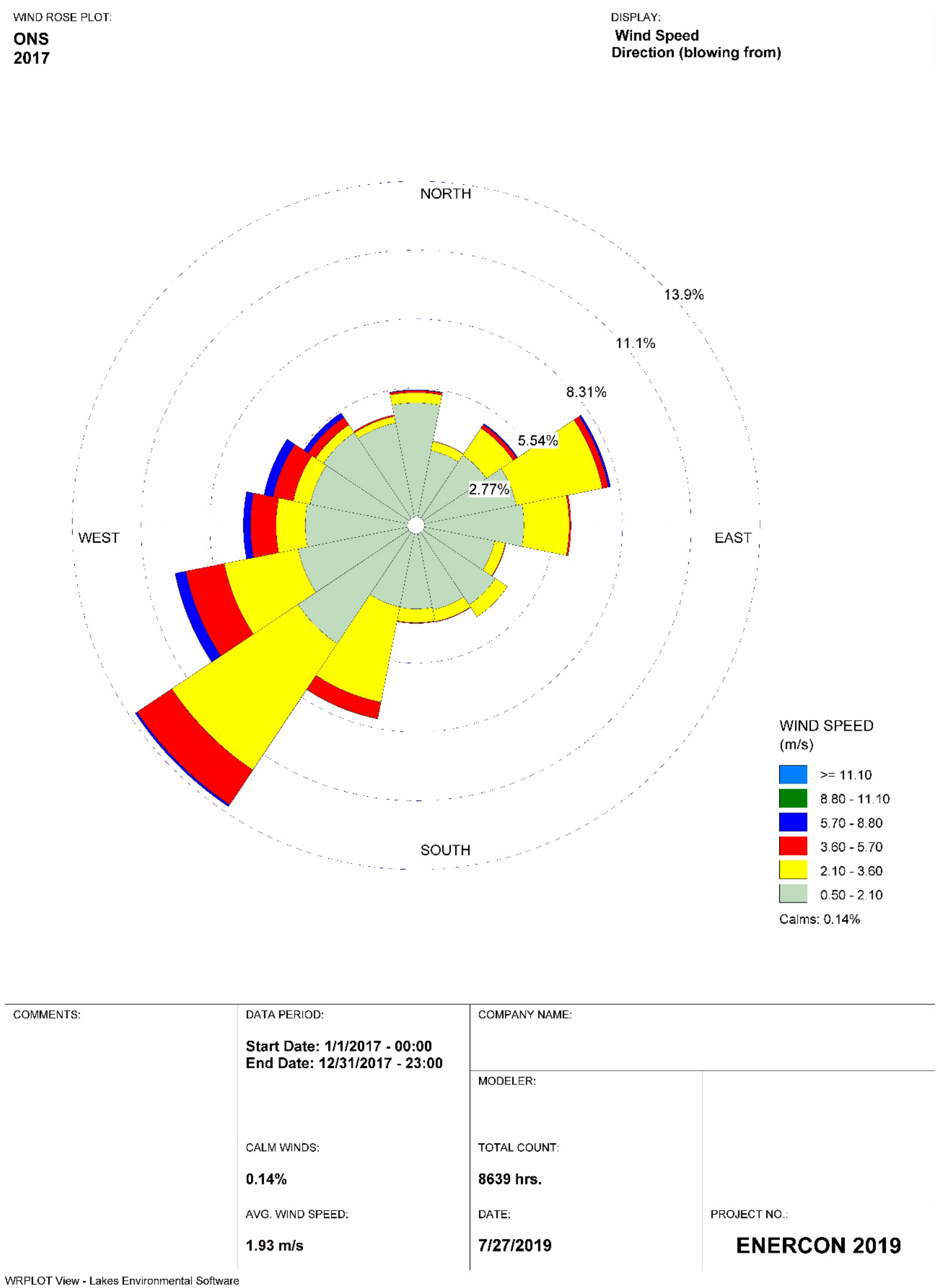
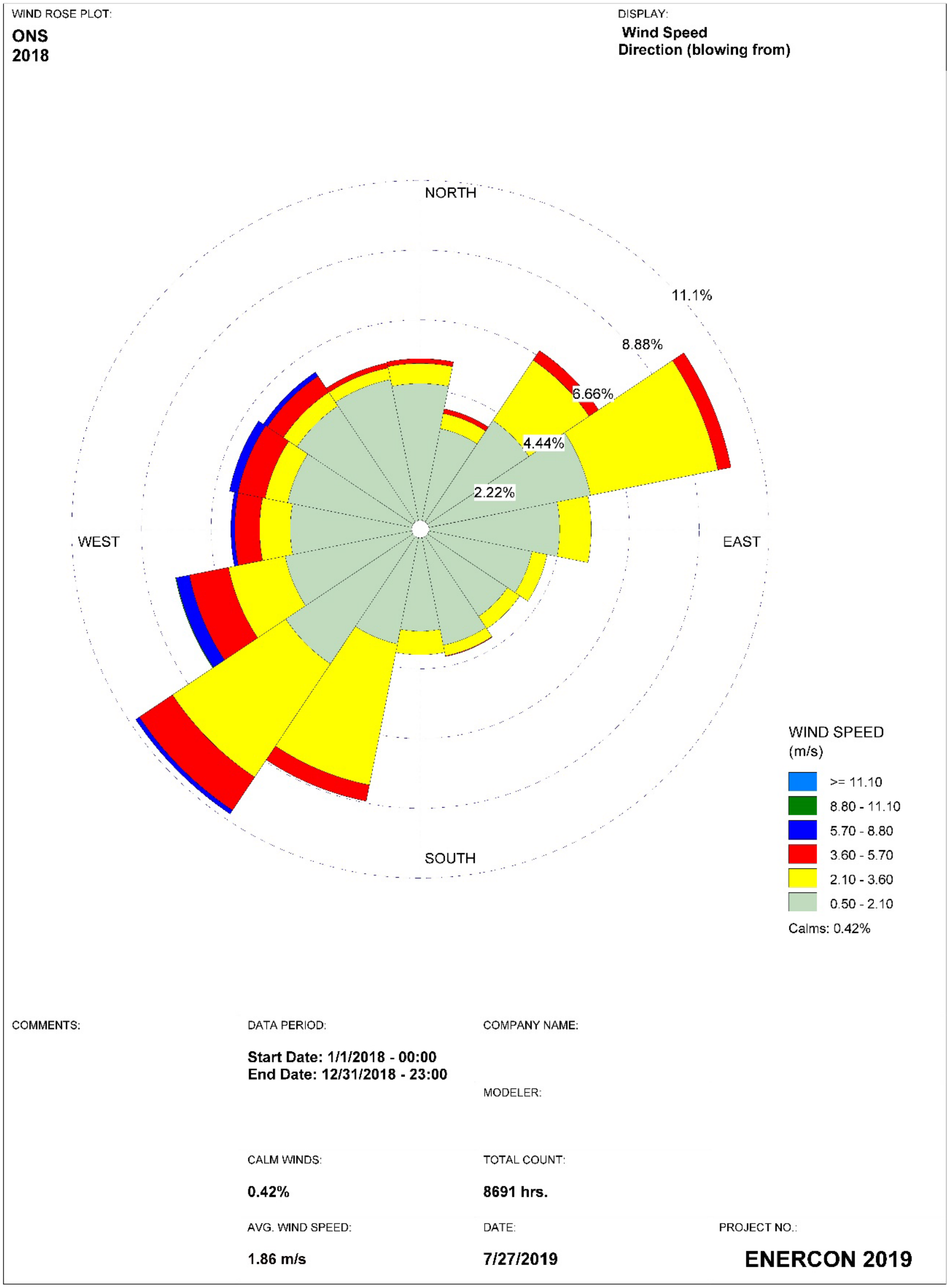


Figure 3.3-4 2017 ONS Wind Rose



WRPLOT View - Lakes Environmental Software

Figure 3.3-5 2018 ONS Wind Rose

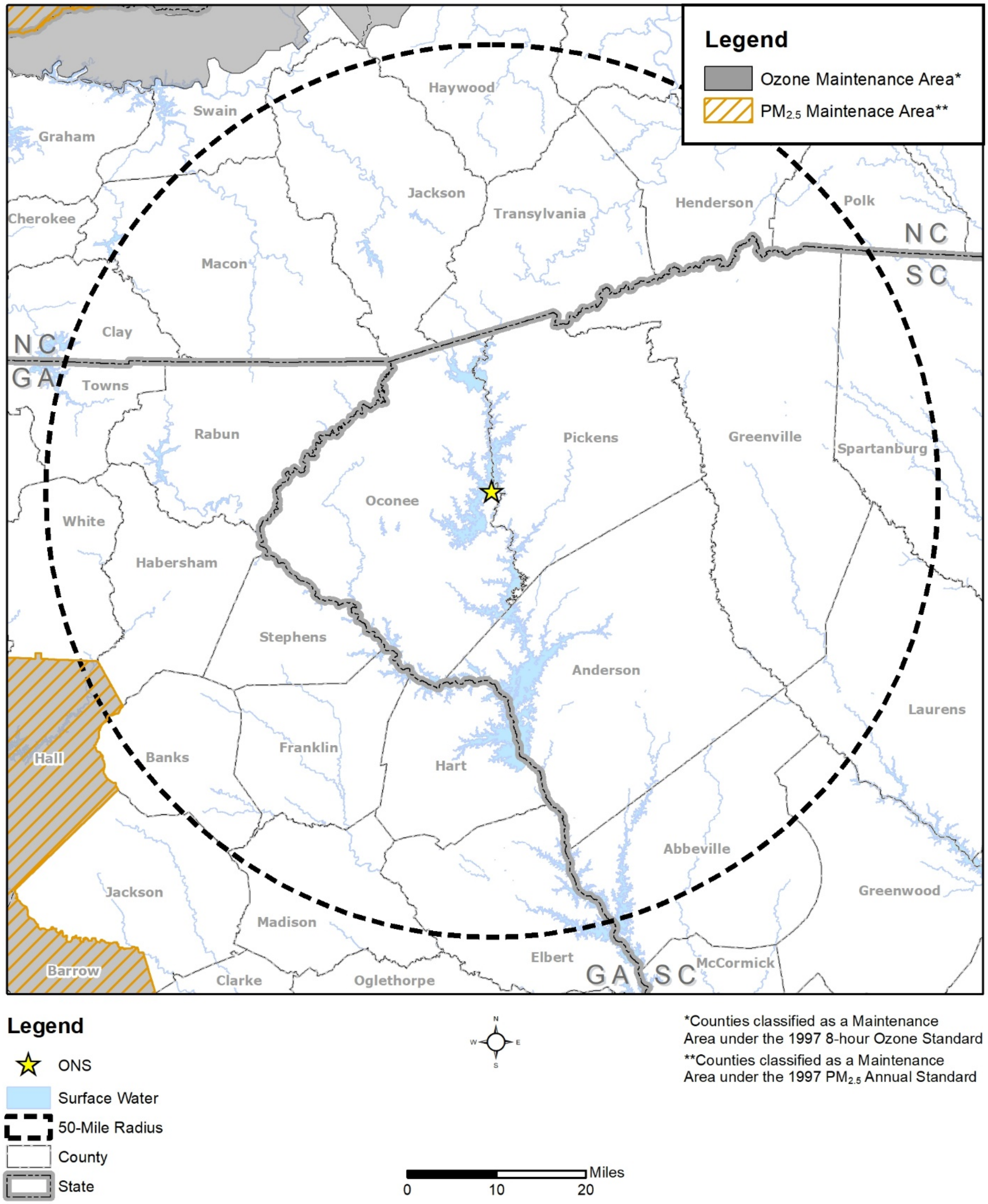


Figure 3.3-6 Non-Attainment and Maintenance Areas, 50-Mile Radius of ONS

3.4 Noise

Noise is produced at ONS from industrial plant operations and site activities. The Oconee County noise ordinance identifies specific sound levels of 70 A-weighted decibels (dBA) as a daytime (between 7:00 AM and 9:59 PM) level and 60 dBA as a nighttime (between 10:00 PM and 6:59 AM) level, measured 100 feet from the point which the sound is emanating. It further indicates that industrial facilities, including sirens and loudspeakers, are exempt from these requirements (Oconee County 2019d).

Industrial background noise at ONS is generally from turbine generators, transformers, loudspeakers, transmission lines, the ONS firing range, and the main steam safety valves. The loudest sound emitted from ONS plant systems would be from a limited-duration steam release to the atmosphere through the main steam safety valves or steam generator power-operated relief valves. The steam safety valves and relief valves are generally located adjacent to their unit's reactor containment building.

Sound from a main steam safety valve is observed only when steam pressure is released from the valve on an intermittent basis. ONS Unit 1 is located closest to the property boundary. ONS Unit 1 main steam valves are located approximately 990 feet from the closest point of the site boundary in the northeast direction. Periodic use of the firing range is another onsite activity that creates occasional noise. The firing range is approximately 490 feet from the closest point of the site boundary in the southeast direction. The nearest residence is located approximately 1.03 miles north-northwest from the center point of the Unit 2 reactor containment (ONS 2020).

Because ONS is located in a rural area (away from urban areas), it is unlikely that noise levels from ONS would affect offsite residences. This is further substantiated by the fact that during the most recent 5 years (2014–2018), there have been no noise complaints received by Duke Energy as it relates to ONS plant operational and outage activities). Therefore, no noise issues affecting offsite residences are anticipated during the proposed SLR operating term because noise levels at ONS are expected to remain the same as under current operating conditions and future land use designations surrounding the ONS site are not expected to change.

ONS may make a public announcement via local media beforehand for emergency warning siren tests and in case of emergency, so the public is aware of what is taking place at the plant. If an unplanned noise generation activity takes place, members of the public can contact the local radio and television stations or the plant with questions. (Duke 2020c)

ONS monitors noise at and around the plant site for occupational and ambient effects on an as-needed basis. This includes scheduled activities such as outages or systems testing. ONS or its subcontractors perform noise surveys or monitoring for these scheduled activities. Noise levels at ONS are anticipated to remain the same as under current operating conditions during the proposed SLR operating term.

3.5 Geologic Environment

3.5.1 Regional Geology

The ONS site is in northwestern South Carolina, which falls within the Piedmont physiographic province (Figure 3.5-1). The Piedmont and Blue Ridge physiographic provinces of the southeastern United States form a narrow ridge along the Appalachian Mountains approximately 1,375 kilometers (km) long by 100 to 300 km wide. Features of the present landscape were caused by uplift, erosion, and rock resistance since the formation of the Appalachian Mountains ended in Paleozoic (and possibly early Mesozoic) times. Bedrock in the Blue Ridge and Piedmont physiographic provinces is significantly fractured (FERC 2016a, Section 3.3.1.1). Bedrock is overlain by saprolite, which is a layer of decomposed rock resulting from bedrock weathering (FERC 2016a, Section 3.3.1.1). Saprolite is overlain by soil and alluvium from stream valleys, where present (Miller 1990).

The regional structure is typical of the southern Piedmont and Blue Ridge. The region was subjected to compression in the northwest-southeast direction, which produced a complex assortment of more or less parallel folds whose axes lie in a northeast-southwest direction. The Blue Ridge uplift was the climax of the folding, and it was accompanied by major faulting along a line stretching northeast through Atlanta and Gainesville, GA, and across South Carolina, 11 miles northwest of the ONS site. This has been termed the Brevard Fault.

The age of these uplifts has not been agreed upon by geologists. The consensus of geologic opinion seems to require a period of severe deformation followed by at least one additional period of less severity. Probably all occurred during the Paleozoic Era, but it has been suggested that the last major uplift was as late as the Triassic (180 million years ago) when the Coastal Plain to the east was downwarped. A number of investigators have maintained that the major deformative movements occurred at least 225 million years ago. However, all the resulting stresses have not yet been fully dissipated.

There is no evidence of any displacement along these faults during either historic times or during the geologic recent era as indicated in displacements in the residual soils that blanket the region. While the well-known Brevard Fault passes 11 miles northwest of the ONS site, there is no indication of a major fault in the immediate vicinity of the site. Furthermore, the major faults of the region are ancient and dormant, except for minor adjustments at considerable depth. Therefore, there is no indication of any structural hazard to foundations.

The site is underlain by crystalline rocks that are a part of the southeastern Piedmont physiographic province. The Piedmont province is characterized by rolling, well-rounded hills, low ridges, and river-cut valleys (FERC 2016a, Section 3.3.1.1). This northeastward-trending belt of ancient metamorphic rocks extends northward from Alabama east of the Appalachians, and in South Carolina crosses the state from the fall line on the east to the Blue Ridge Mountains and Appalachian Mountains on the west. These rocks represent some of the oldest on the continent. New techniques of dating by radioactive decay have placed the age of the metamorphic episodes that produced these rocks as occurring from 1,100 million years to 260 million years ago. In summary, the regional geology of the ONS site can be accepted as typical of the southeastern Piedmont—narrow belts of metamorphic rocks trending northeast with the foliation dipping generally to the southeast.

3.5.2 Site Geology

The rock present at the ONS site is metamorphic. It is believed to be Precambrian in age; thus, it was formed over 600 million years ago. The complete history of this region is quite complex. However, geologic opinion concludes that the formation consisted of thick strata of sedimentary rocks that were later downwarped and altered by heat and pressure. This first rock formed is termed the country rock. Since the formation of the country rock, most of the mass has been altered or replaced by the injection of granite gneiss, biotite hornblende gneiss, and one or possibly more pegmatite dikes. It is not definite which is the younger: the granite gneiss injection or the biotite hornblende gneiss injection. The limited evidence points to the granite gneiss as the younger of the two. The pegmatite dikes are the youngest rock known at the site. One such dike is exposed in the road cut on the eastern side of the state highway passing through the site. It clearly shows the pegmatite cutting through the older rocks, and thus demonstrates that it is the youngest. Regional metamorphism, folding, and some minor faulting occurred concurrently much of this early time.

The geology of the ONS site is typical of the southeastern inner Piedmont belt. The foundation rock is biotite and hornblende gneiss, striking generally northeast, with the foliation dipping southeast. The rock is overlain by residual soils, which vary from silty clays at the surface, where the rock decomposition has completed its cycle, to partially weathered rock, and finally to sound rock. The three dominant rock types, listing in decreasing abundance, are granite gneiss, biotite hornblende gneiss, and quartz pegmatite, described in further detail in the list below. Columnar geologic cross sections for the site area are shown in Figures 3.5-3a, 3.5-3b, 3.5-3c, 3.5-3d, and 3.5-3e.

- Granite gneiss encountered on the site is light to medium gray, moderately hard and hard, with iron-stained joints in the upper layer and unstained joints in deeper, harder rock.
- Biotite hornblende gneiss encountered on the site is softer in the upper areas and harder with depth. The weathered, softer area of this rock is deeper than in the granite gneiss, possibly due to a higher percentage of biotite mica. Iron in biotite causes a more rapid rate of decomposition.
- Quartz pegmatite was encountered in an approximately 3.5-foot-wide dike on a nearby road cut. Dikes are sheet-like bodies of igneous rock that, when molten, fill in fissures in older rocks. Pegmatite is a hard, sound, and durable material.

The U.S. Geological Survey (USGS) online map of the geology of South Carolina maps the Cambrian or Precambrian Walhalla metamorphic suite underlying soils on the ONS site. The major lithologic constituents include amphibolite and hornblende gneiss, and the minor lithologic constituent is biotite-quartz-feldspar gneiss. (USGS 2019a) Figure 3.5-4 depicts the geological map of the subject property and surrounding areas.

3.5.3 Soils

3.5.3.1 Onsite Soils and Geology

Soil units that occur within the ONS property boundary are described in detail in Table 3.5-1 and shown in Figure 3.5-4. They are also summarized below (USDA 2019c).

- Cecil sandy loam, 6-10 percent slopes
- Cecil sandy loam, 25-35 percent slopes
- Congaree fine sandy loam
- Grover fine sandy loam, 40-80 percent slopes
- Gullied land, hilly
- Hayesville and Cecil fine sandy loams, 2-6 percent slopes
- Hayesville and Cecil fine sandy loams, 6-10 percent slopes
- Hayesville and Cecil fine sandy loams, 10-15 percent slopes
- Hayesville and Cecil fine sandy loams, 15-25 percent slopes
- Hayesville and Cecil fine sandy loams, 25-45 percent slopes
- Hiwassee clay loam, 10-15 percent slopes
- Hiwassee clay loam, 6-10 percent slopes
- Hiwassee clay loam, 10-25 percent slopes
- Lloyd clay loam, 15-35 percent slopes
- Riverview-Chewacla complex, 0-2 percent slopes
- Pacolet clay loam, 15-25 percent slopes
- Pacolet fine sandy loam, 25-40 percent slopes
- Pacolet clay loam, 10-25 percent slopes
- State fine sandy loam
- Toccoa soils
- Wickham sandy loam, 2-6 percent slopes

During construction, the ONS site was excavated to a generally level grade at an elevation of 796 feet above mean sea level (msl). Man-made dikes and dams forming the Keowee Reservoir are at an elevation of 815 feet above msl. The crest of the submerged weir in the intake canal is at 770 feet above msl.

3.5.3.2 Erosion Potential

Because ONS has been operational since the early 1970s, stabilization measures are already in place to prevent erosion and sedimentation impacts to the site and vicinity. Based on information from the U.S. Department of Agriculture (USDA), all soil units listed in Table 3.5-1 subject to erosion have a slight to moderate erosion potential, except for the Grover complex soils (40-80 percent slopes), which were rated very severe for slope erodibility (USDA 2019c). The Grover complex soils (40-80 percent slopes) are in areas of steep slopes adjacent to the Keowee River on the northwestern corner of the site and do not extend beneath any plant structures.

ONS maintains and implements a stormwater pollution prevention plan (SWPPP) that identifies potential sources of pollution reasonably expected to affect the quality of stormwater, such as erosion, and identifies best management practices (BMPs) that will be used to prevent or reduce the pollutants in stormwater discharges. These practices, as they relate to erosion, include nonstructural preventive measures and source controls, as well as structural controls to prevent erosion or treat stormwater containing pollutants caused by erosion. In addition, any ground disturbance of one or more acres requires a construction stormwater permit to be obtained from the SCDHEC. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Although no license renewal-related refurbishment or construction activities are planned, any such activities would continue to be managed in adherence to the ONS SWPPP.

3.5.3.3 Prime Farmland Soils

The USDA's Natural Resources Conservation Service maps show areas of prime farmland surrounding and within the developed portion of the ONS property. Locations designated as prime farmland are small, isolated patches on the eastern side of ONS near the Keowee River and in isolated patches at the southern parking area and the ONS office complex (USDA 2019c). These areas would most likely still be considered prime farmland even though they are part of the property owned by Duke Energy. Even if areas of the property are designated prime farmland, ONS would not be subject to the Farmland Protection Policy Act (FPPA) because the act does not include federal permitting or licensing for activities on private or nonfederal lands. Soil units designated as prime farmland are identified in Table 3.5-1.

3.5.4 Seismic History

The ONS site is situated in a region that has experienced only infrequent minor earthquake activity. The magnitude of an earthquake is described by two methods: the modified Mercalli (MM) intensity scale and the Richter magnitude scale. The MM intensity is an estimate of the amount of damage caused at a site by an earthquake. The Richter magnitude scale is an approximate measure of the total amount of energy released by an earthquake. Accurate locations for earthquake epicenters have been available since the installation of modern seismographs in the region. Without seismographs, earthquakes were described using the MM intensity.

Epicentral locations of earthquakes greater than magnitude 3 within a 400-km radius of the site from 1970 through August 8, 2020 are listed in Table 3.5-2 and shown in Figure 3.5-5 (USGS 2019a).

There have been two earthquakes with magnitudes great than 3 on the Richter magnitude scale in the immediate vicinity of the plant since construction began:

- On July 13, 1971, an earthquake occurred near Seneca, SC. An MM intensity VI was assigned to the event by the USGS based on the report of a cracked chimney near Newry, approximately 10 kilometers south of the present epicentral area. It was preceded by a felt shock earlier in the morning and followed by at least one felt aftershock. MM VI intensity is characterized by slight structural damage with some heavy furniture moved.
- On August 25, 1979, a magnitude 3.7 earthquake occurred near Lake Jocassee, SC. It was an MM intensity VI event felt within an area of approximately 15,000 square kilometers. It was recorded locally on the three-seismograph network. From August 26 to September 15, 1979, 26 aftershocks were recorded ranging from 0.6 to 2.0 in magnitude.

There are three major seismic areas in South Carolina: the overthrust zone and Blue Ridge metamorphic belt, the crystalline-metamorphic zone, exclusive of the Blue Ridge belt, and the coastal plain. The most recorded shocks occurred within the overthrust zone and the Blue Ridge metamorphic belt. The epicenters in this area were scattered. There have been few earthquakes within the crystalline-metamorphic zone, exclusive of the Blue Ridge metamorphic belt. There have also been a few earthquakes in the coastal plain.

There are 11 faults within 200 miles of ONS, the closest of which is located 11 miles to the northwest. Most of the faults are associated with the last metamorphic period. There is no surface indication that any of the faults have been active since the Triassic Period.

The USGS's national seismic hazard map shows that the ONS site is in a region with a 2 percent in 50 years (once in 2,500 years) probability of exceeding a peak ground acceleration between 0.28 and 0.4g.

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 1 of 10)

Map Unit Symbol[(a)]	Soil Unit Name	Description	Farmland Designation
CdC2	Cecil sandy loam, 6-10% slopes, moderately eroded	The Cecil component makes up 2.7% of the map unit. Slopes are 6-10%. This component found on interfluves on side slopes, shoulders, and summits. The parent material consists of residuum weathered from granite and/or residuum weathered from gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 9 inches is high. Runoff class is not reported. This soil is not flooded. It is not ponded. The frost-free period is 180-280 days. The depth to water table is greater than 80 inches. Non-irrigated land capability classification is 3e. This soil does not meet hydric criteria.	Farmland of statewide importance
CdF2	Cecil sandy loam, 25-35% slopes, eroded	The Cecil component makes up 2.7% of the map unit. Slopes are 25-35%. This component found on interfluves on side slopes and backslopes. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.7 inches is moderate. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. The depth to water table is greater than 80 inches. Non-irrigated land capability classification is 7e. This soil does not meet hydric criteria.	Not prime farmland
CeC3	Cecil clay loam, 6-10% slopes, severely eroded	The Cecil component makes up 2.7% of the map unit. Slope are 6-10%. This component is on backslope, shoulder, and side slope interfluves. The parent material consists of residuum weathered from granite and/or residuum weathered from gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.8 inches is moderate. Runoff class is not reported. This soil is not flooded. It is not ponded. The frost-free period is 180-280 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 4e. The soil does not meet hydric criteria.	Not prime farmland

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 2 of 10)

Map Unit Symbol[(a)]	Soil Unit Name	Description	Farmland Designation
Co	Congaree fine sandy loam	The Congaree component makes up 0.1% of the map unit. Slopes are 2-4%. This component is on flood plains. The parent material consists of loamy alluvium. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 9 inches is high. The depth to the water table is approximately 30-48 inches. Runoff class is low. This soil is occasionally flooded. It is not ponded. The frost-free period is 151-227 days. Non-irrigated land capability classification is 2w. This soil does not meet hydric criteria.	Prime farmland if protected from flooding or not frequently flooded during the growing season
Gh	Gullied land, hilly	Gullied land makes up 1.9% of the map unit. Slopes are 15-25%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is more than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.8 inches is moderate. This soil is not flooded. Runoff class is high. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland
GrG	Grover fine sandy loam, 40-80% slopes	The Grover component makes up 0.7% of the map unit. Slope are 40-80%. This component is on backslope and mountain flank interfluves. The parent material consists of loamy residuum weathered from hornblende gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 9.6 inches is high. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 184-239 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 3 of 10)

Map Unit Symbol[(a)]	Soil Unit Name	Description	Farmland Designation
HcB	Hayesville and Cecil fine sandy loams, 2-6%, eroded	The Hayesville and Cecil components make up 70.9% of the map unit. Slopes are 2-6%. This component is on summit interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.8 inches is moderate. Runoff class is low. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 3e. The soil does not meet hydric criteria.	Prime farmland
HcC2	Hayesville and Cecil fine sandy loams, 6-10%, eroded	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 6-10%. This component is on shoulder and nose slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.8 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 3e. The soil does not meet hydric criteria.	Farmland of statewide importance
HcD2	Hayesville and Cecil fine sandy loams, 10-15% slopes, eroded	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 10-15%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.5 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 4e. The soil does not meet hydric criteria.	Not prime farmland

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 4 of 10)

Map Unit Symbol[(a)]	Soil Unit Name	Description	Farmland Designation
HcE	Hayesville and Cecil fine sandy loams, 15-25% slopes	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 15-25%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.5 inches is moderate. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 6e. The soil does not meet hydric criteria.	Not prime farmland
HcE2	Hayesville and Cecil fine sandy loams, 15-25% slopes, eroded	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 15-25%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.5 inches is moderate. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 6e. The soil does not meet hydric criteria.	Not prime farmland
HcF	Hayesville and Cecil fine sandy loams, 25-45% slopes	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 25-45%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.5 inches is moderate. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 5 of 10)

Map Unit Symbol(a)	Soil Unit Name	Description	Farmland Designation
HcF2	Hayesville and Cecil fine sandy loams, 25-45% slopes, eroded	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 25-45%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.8 inches is moderate. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 6e. The soil does not meet hydric criteria.	Not prime farmland
HdC3	Hayesville and Cecil loams, 6-10% slopes, severely eroded	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 6-10%. This component is on shoulder and nose slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.4 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 4e. The soil does not meet hydric criteria.	Not prime farmland
HdD3	Hayesville and Cecil loams, 10-15% slopes, severely eroded	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 10-15%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.4 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 4e. The soil does not meet hydric criteria.	Not prime farmland

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 6 of 10)

Map Unit Symbol[(a)]	Soil Unit Name	Description	Farmland Designation
HdF3	Hayesville and Cecil loams, 15-45% slopes, severely eroded	The Hayesville and Cecil components make up 70.9% of the map unit. Slope are 15-45%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.4 inches is moderate. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland
HmD3	Hiwassee clay loam, 10-15% slopes, severely eroded	The Hiwassee component make up 1.9% of the map unit. Slope are 10-15%. This component is on stream terraces. The parent material consists of clayey ancient alluvium. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.2 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 4e. The soil does not meet hydric criteria.	Not prime farmland
HyC3	Hiwassee clay loam, 6-10% slopes, severely eroded	The Hiwassee component makes up 1.9% of the map unit. Slope are 6-10%. This component is on shoulder and nose slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.3 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 184-239 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 4e. The soil does not meet hydric criteria.	Not prime farmland

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 7 of 10)

Map Unit Symbol[(a)]	Soil Unit Name	Description	Farmland Designation
HyE3	Hiwassee clay loam, 10-25% slopes, severely eroded	The Hiwassee component makes up 1.9% of the map unit. Slope are 10-25%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.1 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 184-239 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland
LcE3	Lloyd clay loam, 15-35% slopes, severely eroded	The Lloyd component makes up 1.6% of the map unit. Slope are 15-35%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.8 inches is moderate. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland
LdC2	Lloyd sandy loam, 6-10% slopes, eroded	The Lloyd component makes up 1.6% of the map unit. Slope are 6-10%. This component is on shoulder and nose slope interfluves. The parent material consists of ancient clayey alluvium. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.1 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 3e. The soil does not meet hydric criteria.	Farmland of statewide importance

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 8 of 10)

Map Unit Symbol[(a)]	Soil Unit Name	Description	Farmland Designation
Mv	Riverview-Chewacla complex, 0-2% slopes, frequently flooded	The Riverview-Chewacla complex component makes up 1.9% of the map unit. Slope are 0-2%. This component is on toe slopes of floodplains. The parent material consists of loamy alluvium derived from igneous and metamorphic rock. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 10.4 inches is high. Runoff class is not reported. This soil is frequently flooded. It is not ponded. The frost-free period is 200-260 days. Depth to the water table is approximately 39-60 inches. Non-irrigated land capacity classification is 3w. The soil does not meet hydric criteria.	Not prime farmland
PaE3	Pacolet clay loam, 15-25% slopes, severely eroded	The Pacolet component makes up 13.2% of the map unit. Slope are 15-25%. This component is on backslope and side slope interfluves. The parent material consists of residuum weathered from granite and/or residuum weathered from gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.1 inches is moderate. Runoff class is not reported. This soil is not flooded. It is not ponded. The frost-free period is 180-280 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland
PaF	Pacolet fine sandy loam, 25-40% slopes	The Pacolet component makes up 13.2% of the map unit. Slope are 25-40%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 6.9 inches is moderate. Runoff class is high. This soil is not flooded. It is not ponded. The frost-free period is 184-239 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 9 of 10)

Map Unit Symbol[(a)]	Soil Unit Name	Description	Farmland Designation
PcE3	Pacolet clay loam, 10-25% slopes, severely eroded	The Pacolet component makes up 13.2% of the map unit. Slope are 10-25%. This component is on backslope and side slope interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.1 inches is moderate. Runoff class is medium. This soil is not flooded. It is not ponded. The frost-free period is 184-239 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 7e. The soil does not meet hydric criteria.	Not prime farmland
Sf	State fine sandy loam	The State component makes up 1.8% of the map unit. Slope are 0-2%. This component is on stream terraces. The parent material consists of loamy alluvium. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 8.2 inches is moderate. Runoff class is low. This soil is rarely flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is approximately 48-72 inches. Non-irrigated land capacity classification is 1. The soil does not meet hydric criteria.	Prime farmland
To	Toccoa soils	The Toccoa component makes up 1.3% of the map unit. Slope are 0-2%. This component is on floodplains. The parent material consists of loamy alluvium. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is high. Available water to a depth of 6.6 inches is moderate. Runoff class is very low. This soil is not occasionally flooded. It is not ponded. The frost-free period is 184-239 days. Depth to the water table is approximately 30-60 inches. Non-irrigated land capacity classification is 2w. The soil does not meet hydric criteria.	Prime farmland if protected from flooding or not frequently flooded during the growing season

Table 3.5-1 Onsite Soil Unit Descriptions (Sheet 10 of 10)

Map Unit Symbol[a]	Soil Unit Name	Description	Farmland Designation
WkB2	Wickham sandy loam, 2-6% slopes, eroded	The Wickham component makes up 0.8% of the map unit. Slope are 2-6%. This component is on summit interfluves. The parent material consists of clayey residuum weathered from granite and gneiss. Depth to a restrictive layer is greater than 80 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 7.8 inches is moderate. Runoff class is low. This soil is not flooded. It is not ponded. The frost-free period is 151-227 days. Depth to the water table is more than 80 inches. Non-irrigated land capacity classification is 2e. The soil does not meet hydric criteria.	Prime farmland

(USDA 2019c)

a. See Figure 3.5-4 for map unit symbols.

Table 3.5-2 Historic Earthquakes > 3.0 Mb, 1970–2020[(a)] (Sheet 1 of 6)

Earthquake Date	Time	Latitude	Longitude	Magnitude	Distance from ONS (miles)	Approximate Location
7/13/1971	6:42	34.7600	-82.9800	3.7	5	South Carolina
2/3/1972	18:11	33.3060	-80.5820	4.36	168	South Carolina
10/30/1973	17:58	35.7500	-84.0000	3.4	91	Eastern Tennessee
11/30/1973	2:48	35.7990	-83.9620	4.7	92	Eastern Tennessee
5/30/1974	16:28	37.3820	-80.4190	3.6	226	West Virginia
8/2/1974	3:52	33.8720	-82.4880	4.3	68	Georgia, USA
10/28/1974	6:33	33.7900	-81.9200	3	89	South Carolina
11/4/1974	22:00	33.7300	-82.2200	3.7	83	Georgia, USA
11/22/1974	0:25	32.9000	-80.1450	4.7	205	South Carolina
12/3/1974	3:25	33.9500	-82.5000	3.6	62	Georgia, USA
8/28/1975	23:22	33.8200	-86.6000	3.5	222	Alabama
11/11/1975	3:10	37.1930	-80.8390	3.2	202	West Virginia
11/25/1975	10:17	34.8730	-82.9580	3.2	6	South Carolina
1/19/1976	1:20	36.8830	-83.8250	4	153	Eastern Kentucky
6/19/1976	0:54	37.3620	-81.6240	4.7	191	West Virginia
9/13/1976	13:54	36.6040	-80.8100	3.3	171	Virginia-North Carolina border region
12/27/1976	1:57	32.2230	-82.4630	3.7	179	Georgia, USA
1/18/1977	13:29	33.0690	-80.1990	3	195	South Carolina
7/27/1977	17:03	35.4200	-84.4170	3.5	96	Eastern Tennessee
8/24/1977	23:20	33.3920	-80.6920	3.1	159	South Carolina
12/15/1977	14:16	32.9230	-80.2200	3	201	South Carolina
8/13/1979	0:18	35.2430	-84.3750	3.7	89	Eastern Tennessee
8/25/1979	20:31	34.9290	-82.9710	3.7	10	South Carolina

Table 3.5-2 Historic Earthquakes > 3.0 Mb, 1970–2020[(a)] (Sheet 2 of 6)

Earthquake Date	Time	Latitude	Longitude	Magnitude	Distance from ONS (miles)	Approximate Location
9/12/1979	1:24	35.5870	-83.9010	3.2	79	Eastern Tennessee
6/10/1980	18:47	35.4470	-82.8790	3	45	North Carolina
6/25/1980	13:02	35.7790	-84.0460	3.3	94	Eastern Tennessee
7/27/1980	13:52	38.1740	-83.9070	5.1	240	14 km N of Mount Sterling, KY
8/22/1980	22:49	37.9950	-84.9220	3.1	248	Eastern Kentucky
4/9/1981	2:10	35.4760	-82.0730	3	66	North Carolina
5/5/1981	16:21	35.3300	-82.4300	3.5	45	North Carolina
2/28/1982	22:33	32.9360	-80.1380	3	204	South Carolina
10/30/1982	22:12	32.6550	-84.8670	3.1	186	Georgia, USA
1/26/1983	9:07	32.7280	-83.3750	3.5	145	Georgia, USA
3/24/1983	21:47	35.3450	-82.4620	3.2	45	North Carolina
7/8/1983	14:29	35.5440	-84.1520	3.3	88	Eastern Tennessee
8/28/1983	17:45	36.7000	-83.8370	3.1	142	Eastern Kentucky
11/6/1983	4:02	32.9370	-80.1590	3.3	203	South Carolina
2/14/1984	15:54	36.1210	-83.7350	3.7	103	Eastern Tennessee
3/17/1984	18:26	35.8140	-84.0330	3	95	Eastern Tennessee
8/8/1984	21:42	34.5640	-86.3080	3	195	Alabama
8/30/1984	11:26	35.5600	-84.3400	3.2	97	Eastern Tennessee
10/9/1984	6:54	34.7400	-85.1600	4.2	129	11 km ENE of LaFayette, GA
10/22/1984	13:58	36.3600	-81.6720	3.1	128	Virginia-North Carolina border region
7/12/1985	13:20	35.1920	-85.1450	3	130	Eastern Tennessee
1/6/1986	20:26	35.6060	-84.7590	3.2	119	Eastern Tennessee
2/13/1986	6:35	34.8100	-82.9400	3	3	12 km ENE of Walhalla, SC
7/11/1986	9:26	35.1100	-84.9800	3.3	120	8 km NE of Collegedale, TN

Table 3.5-2 Historic Earthquakes > 3.0 Mb, 1970–2020[(a)] (Sheet 3 of 6)

Earthquake Date	Time	Latitude	Longitude	Magnitude	Distance from ONS (miles)	Approximate Location
3/27/1987	2:29	35.5700	-84.2100	4.2	92	3 km SE of Vonore, TN
7/10/1987	19:04	36.1030	-83.8170	3.6	104	Eastern Tennessee
7/10/1987	21:48	36.1000	-83.8200	3.3	104	Eastern Tennessee
9/22/1987	12:23	35.6230	-84.3110	3.3	98	Eastern Tennessee
12/11/1987	22:53	34.2440	-82.6280	3	41	South Carolina
1/8/1988	20:07	35.2750	-84.2010	3.3	81	Eastern Tennessee
1/22/1988	20:57	32.9350	-80.1570	3.3	203	South Carolina
2/16/1988	10:26	36.5610	-82.3040	3.3	126	Eastern Tennessee
2/17/1988	19:37	35.3660	-83.8530	3.5	67	Tennessee-North Carolina border region
4/14/1988	18:37	37.2380	-81.9870	4.1	176	West Virginia
9/6/1988	21:28	38.1430	-83.8780	4.5	237	8 km E of Mount Sterling, KY
4/10/1989	13:12	37.1360	-82.0680	4.3	168	West Virginia
8/17/1990	16:01	36.7940	-83.3400	4	140	Eastern Kentucky
9/7/1990	19:03	38.0610	-83.7310	3.3	230	Eastern Kentucky
11/13/1990	10:22	32.9470	-80.1360	3.2	203	South Carolina
9/24/1991	2:21	35.7110	-84.0950	3.3	93	Eastern Tennessee
1/2/1992	23:21	33.9460	-82.4650	3.2	63	Georgia, USA
8/21/1992	11:31	33.0500	-80.1160	4.1	200	South Carolina
1/1/1993	0:08	35.8770	-82.0900	3	88	North Carolina
1/14/1993	21:02	35.0750	-84.9740	3.2	119	Eastern Tennessee
8/8/1993	4:24	33.6330	-81.5950	3.2	109	South Carolina
2/11/1994	21:40	36.8000	-82.0000	3.4	147	Virginia-North Carolina border region
4/5/1994	17:21	34.9610	-85.4930	3.2	148	Alabama
3/18/1995	17:06	35.4250	-84.9220	3.3	123	Eastern Tennessee

Table 3.5-2 Historic Earthquakes > 3.0 Mb, 1970–2020[(a)] (Sheet 4 of 6)

Earthquake Date	Time	Latitude	Longitude	Magnitude	Distance from ONS (miles)	Approximate Location
4/17/1995	8:45	32.9470	-80.0680	3.9	207	South Carolina
6/25/1995	19:36	36.7470	-81.4520	3.1	157	Virginia-North Carolina border region
7/5/1995	9:16	35.3660	-84.2120	3.7	84	Eastern Tennessee
7/7/1995	16:01	36.5150	-81.8730	3.1	132	Eastern Tennessee
7/19/1997	12:06	35.0560	-84.8080	3.5	110	Eastern Tennessee
7/30/1997	7:29	36.4360	-83.5090	3.8	118	Eastern Tennessee
4/13/1998	4:56	34.6100	-80.4660	3.5	139	South Carolina
6/4/1998	21:31	35.4790	-80.8210	3.2	127	North Carolina
6/17/1998	3:00	35.9260	-84.4050	3.3	115	Eastern Tennessee
1/17/1999	13:38	36.8540	-83.6910	3	149	Eastern Kentucky
1/18/2000	17:19	32.9930	-83.2140	3.5	125	Georgia, USA
3/7/2001	12:12	35.5302	-84.8432	3.2	121	5 km WNW of Decatur, TN
3/21/2001	18:35	34.8570	-85.4390	3.2	145	Alabama
4/13/2001	11:36	36.5300	-83.3400	3	122	Eastern Tennessee
7/26/2001	0:26	36.0008	-83.5537	3.2	91	11 km S of New Market, TN
12/7/2001	20:08	34.7350	-86.2450	3.9	191	Alabama
11/8/2002	8:29	32.4220	-79.9500	3.5	236	South Carolina
11/11/2002	18:39	32.4040	-79.9360	4	237	South Carolina
3/18/2003	1:04	33.6890	-82.8880	3.5	76	Georgia, USA
4/29/2003	3:59	34.4938	-85.6298	4.6	157	9 km NE of Fort Payne, AL
4/29/2003	4:45	34.4423	-85.6402	3.1	158	7 km E of Fort Payne, AL
5/2/2003	5:48	34.4932	-85.6067	3.1	156	11 km ENE of Fort Payne, AL
5/5/2003	5:53	33.0550	-80.1900	3.1	196	4 km NNW of Summerville, SC
7/13/2003	15:15	32.3350	-82.1440	3.6	175	Georgia, USA

Table 3.5-2 Historic Earthquakes > 3.0 Mb, 1970–2020[(a)] (Sheet 5 of 6)

Earthquake Date	Time	Latitude	Longitude	Magnitude	Distance from ONS (miles)	Approximate Location
12/22/2003	18:50	32.9240	-80.1570	3	204	8 km SSW of Ladson, SC
7/20/2004	4:13	32.9720	-80.2480	3.1	197	7 km WSW of Centerville, SC
9/17/2004	10:21	36.9328	-84.0040	3.7	160	8 km ESE of Corbin, KY
12/23/2004	1:54	35.4293	-84.2042	3	86	17 km SE of Madisonville, TN
8/24/2005	22:09	35.8795	-82.7952	3.7	75	13 km NW of Marshall, NC
10/12/2005	1:27	35.5093	-84.5443	3.3	105	8 km NNE of Athens, TN
4/10/2006	22:29	35.3623	-84.4802	3.3	98	5 km NE of Etowah, TN
5/10/2006	7:17	35.5330	-84.3960	3.2	99	3 km WNW of Madisonville, TN
6/15/2006	19:57	35.5122	-83.2033	3.4	52	9 km W of Maggie Valley, NC
9/22/2006	6:22	34.4923	-79.6920	3.4	184	13 km S of Bennettsville, SC
9/25/2006	0:44	34.5402	-79.3748	3.7	201	7 km W of Rowland, NC
11/2/2006	12:53	37.2000	-81.9200	4.3	175	West Virginia
11/23/2006	5:42	37.1570	-81.9750	4.3	171	West Virginia
12/18/2006	3:34	35.3560	-84.3508	3.3	91	14 km ESE of Englewood, TN
6/19/2007	13:16	35.7925	-85.3617	3.5	155	10 km ENE of Spencer, TN
8/4/2007	5:04	35.4865	-82.0873	3	66	12 km ENE of Lake Lure, ND
6/23/2008	18:30	34.9250	-84.8410	3.1	111	12km ENE of Varnell, GA
12/16/2008	7:42	33.0882	-80.1347	3.6	197	5 km N of Sangaree, SC
12/17/2008	19:05	36.0502	-83.5918	3.3	95	6 km SSW of New Market, TN
1/27/2009	6:20	36.7733	-84.1312	3.2	153	4 km NE of Williamsburg, KY
4/4/2009	15:45	33.2147	-83.2023	3.1	110	15 km N of Milledgeville, GA
5/16/2009	3:08	37.2485	-80.0020	3	234	2 km NNE of Cave Spring, VA
8/1/2009	8:38	35.0635	-84.2923	3.2	81	11 km NE of McCaysville, GA
8/29/2009	5:37	33.0330	-80.1587	3.2	199	2 km NE of Summerville, SC

Table 3.5-2 Historic Earthquakes > 3.0 Mb, 1970–2020[(a)] (Sheet 6 of 6)

Earthquake Date	Time	Latitude	Longitude	Magnitude	Distance from ONS (miles)	Approximate Location
8/31/2009	9:07	35.7780	-84.1238	3.3	97	8 km SW of Louisville, TN
11/1/2009	12:01	35.1368	-84.8543	3	114	1 km ESE of South Cleveland, TN
12/6/2009	19:27	33.0293	-83.0108	3.2	122	19 km WNW of Sandersville, GA
4/20/2010	4:28	35.7252	-84.0010	3.3	89	4 km SW of Maryville, TN
5/6/2010	9:04	34.1870	-85.9480	3.2	179	Alabama
9/13/2011	17:59	33.5600	-86.5540	3	226	1 km NNW of Leeds, AL
11/10/2012	12:08	37.1387	-83.0537	4.2	162	17 km SE of Hazard, KY
11/24/2012	6:03	35.9187	-83.5012	3	85	7 km NE of Sevierville, TN
2/14/2014	22:23	33.8167	-82.0920	4.1	82	15 km WNW of Edgefield, SC
2/16/2014	15:23	33.8302	-82.0657	3	82	13 km WNW of Edgefield, SC
3/19/2014	17:38	32.9978	-80.1778	3	199	0 km S of Centerville, SC
12/15/2014	1:44	36.0590	-81.5195	3	117	16 km N of Lenoir, NC
6/20/2017	10:14	33.4275	-82.0168	3.2	107	6 km SW of Augusta, GA
9/13/2017	12:33	37.4728	-80.7030	3.2	222	16 km N of Pearisburg, VA
4/29/2018	17:32	36.2968	-83.3895	3.1	107	10 km WSW of Bean Station, TN
12/12/2018	4:14	35.6123	-84.7320	4.4	118	12 km NNE of Decatur, TN
12/15/2018	23:12	36.0383	-83.6955	3.01	97	5 km ESE of Mascot, TN
3/5/2019	15:56	36.2955	-83.7357	3.37	114	7 km NE of Maynardville, TN
1/20/2020	14:12	36.4305	-84.0268	3.8	129	3km ENE of Fincastle, TN
5/10/2020	3:33	35.1405	-85.8918	3.13	172	7km SSE of Sewanee, TN
8/9/2020	7:07	36.4743	-81.0865	5.1	154	Virginia-North Carolina border region

a. All earthquakes within 400 km with a magnitude of greater than 3.0.

(USGS 2020a)

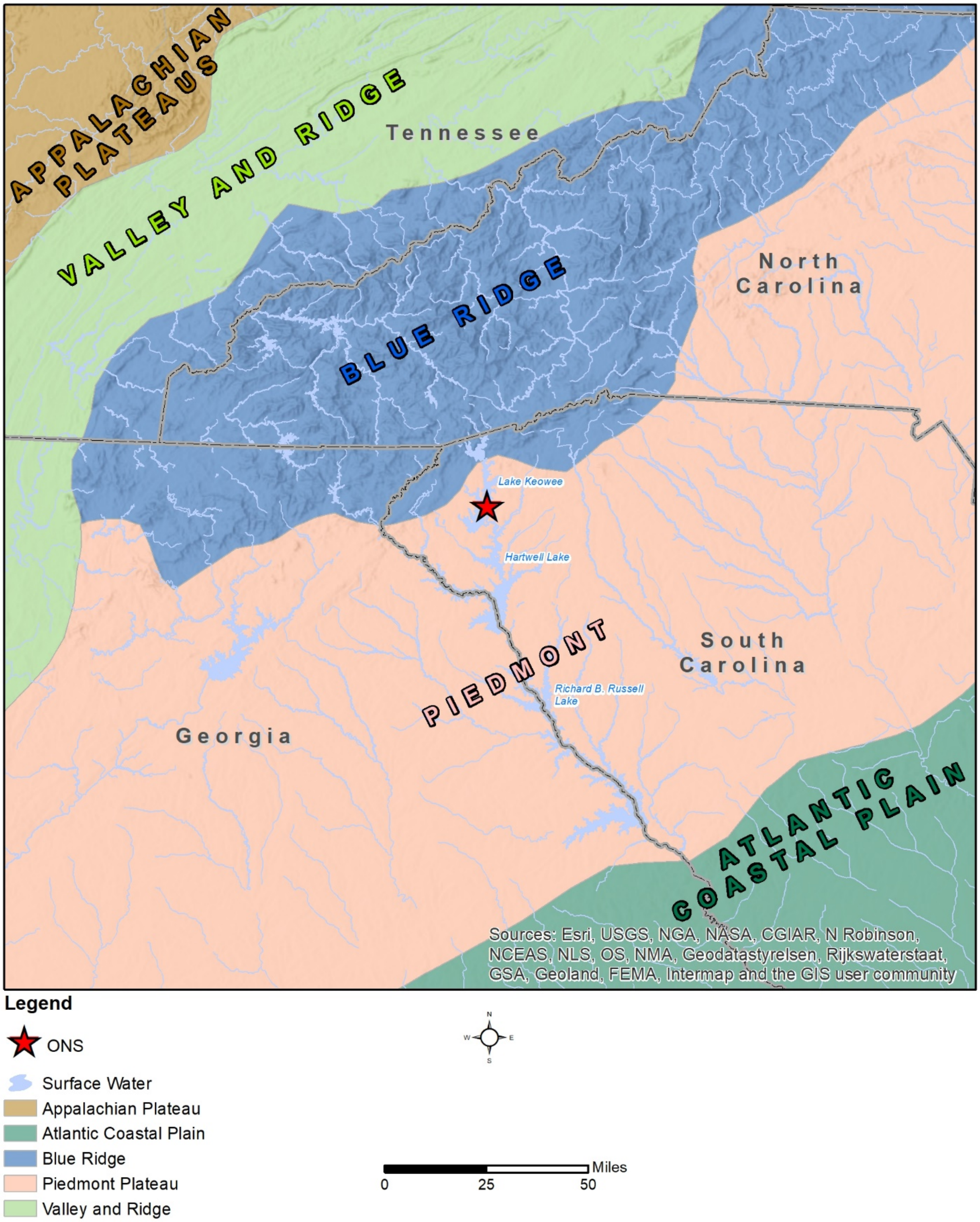


Figure 3.5-1 Physiographic Provinces Associated with the ONS Site

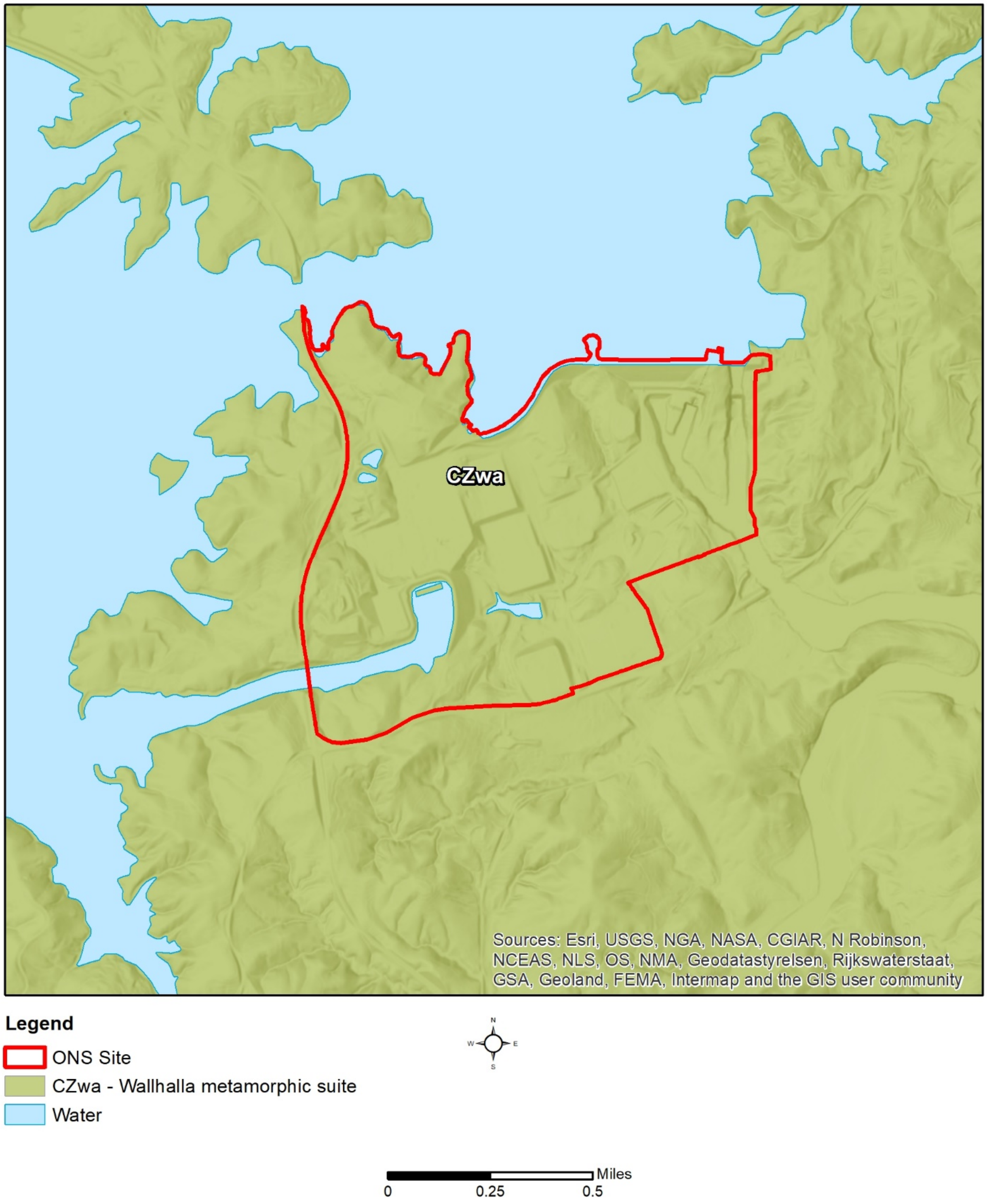


Figure 3.5-2 Surficial Geology Map, ONS Property

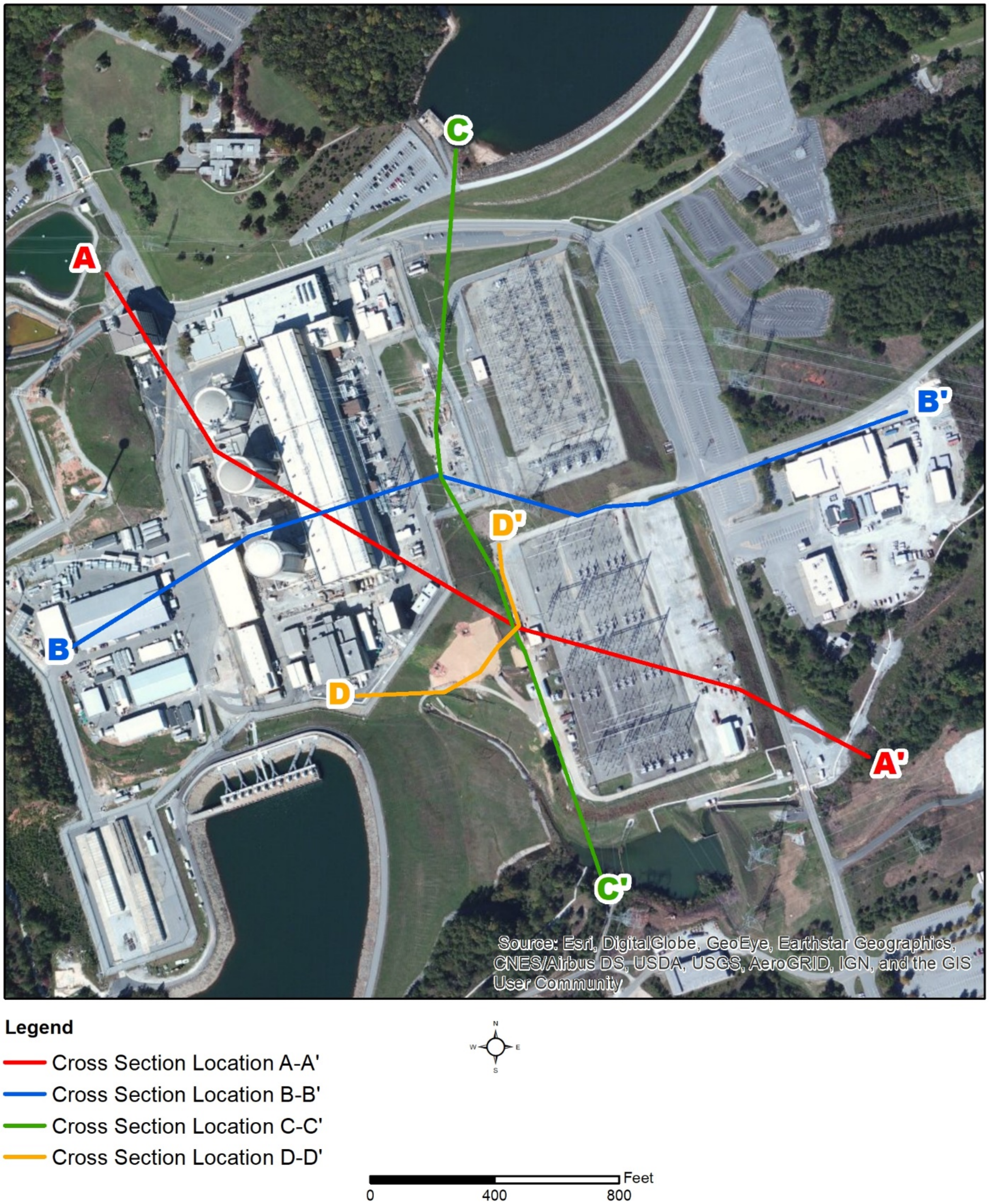


Figure 3.5-3a Hydrological Cross-Section Locations on ONS Site

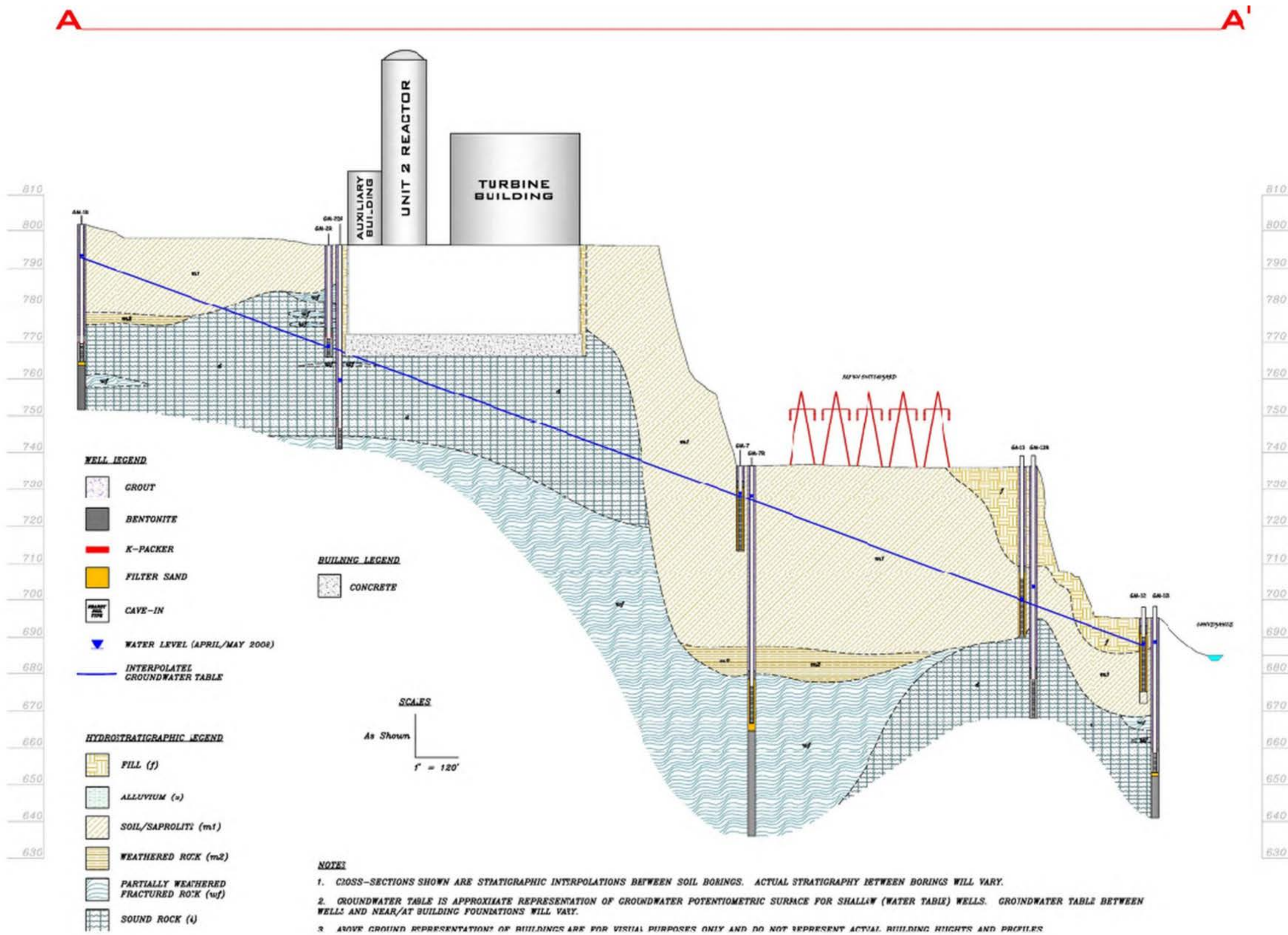


Figure 3.5-3b Cross-Section A-A'

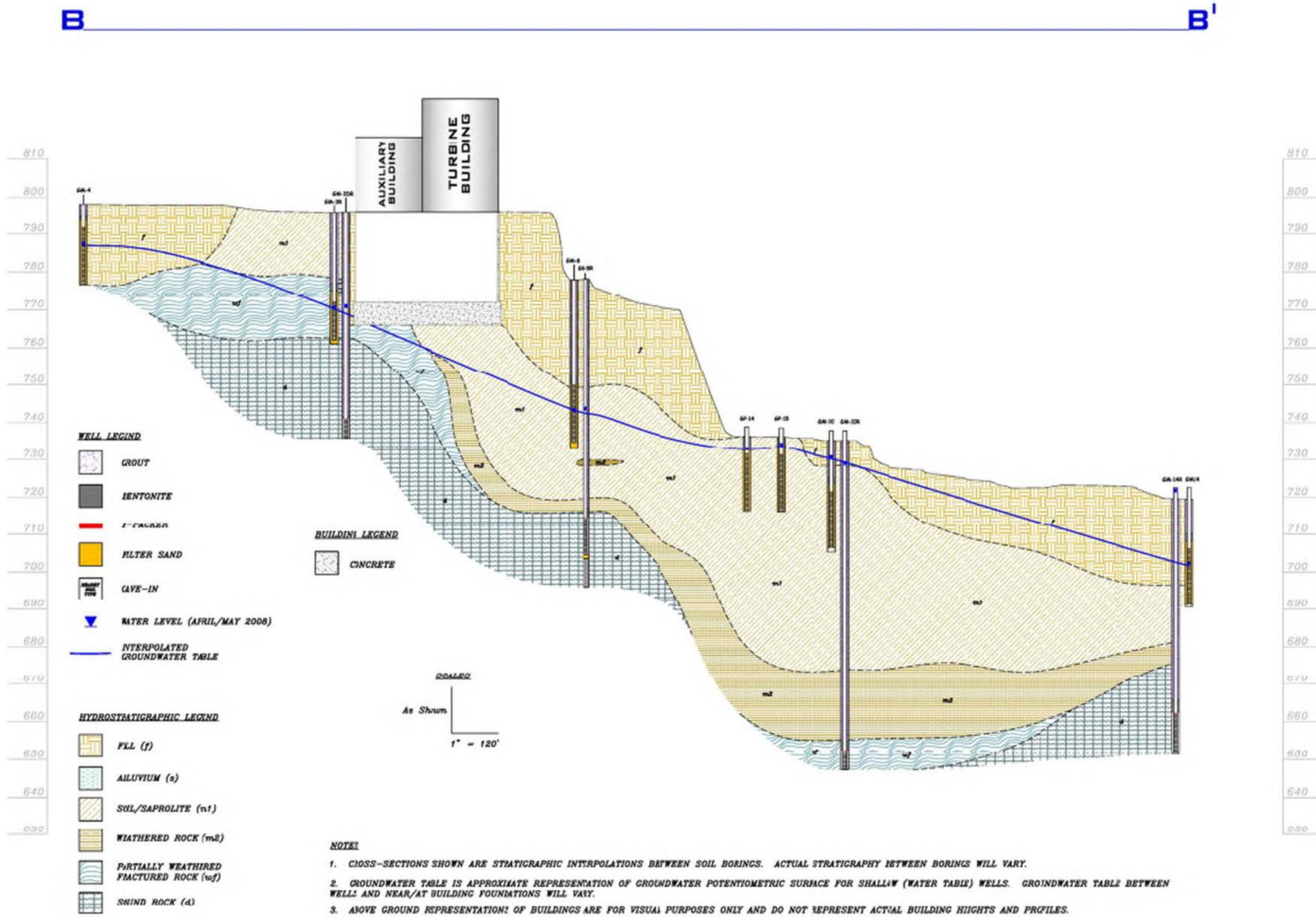


Figure 3.5-3c Cross-Section B-B'

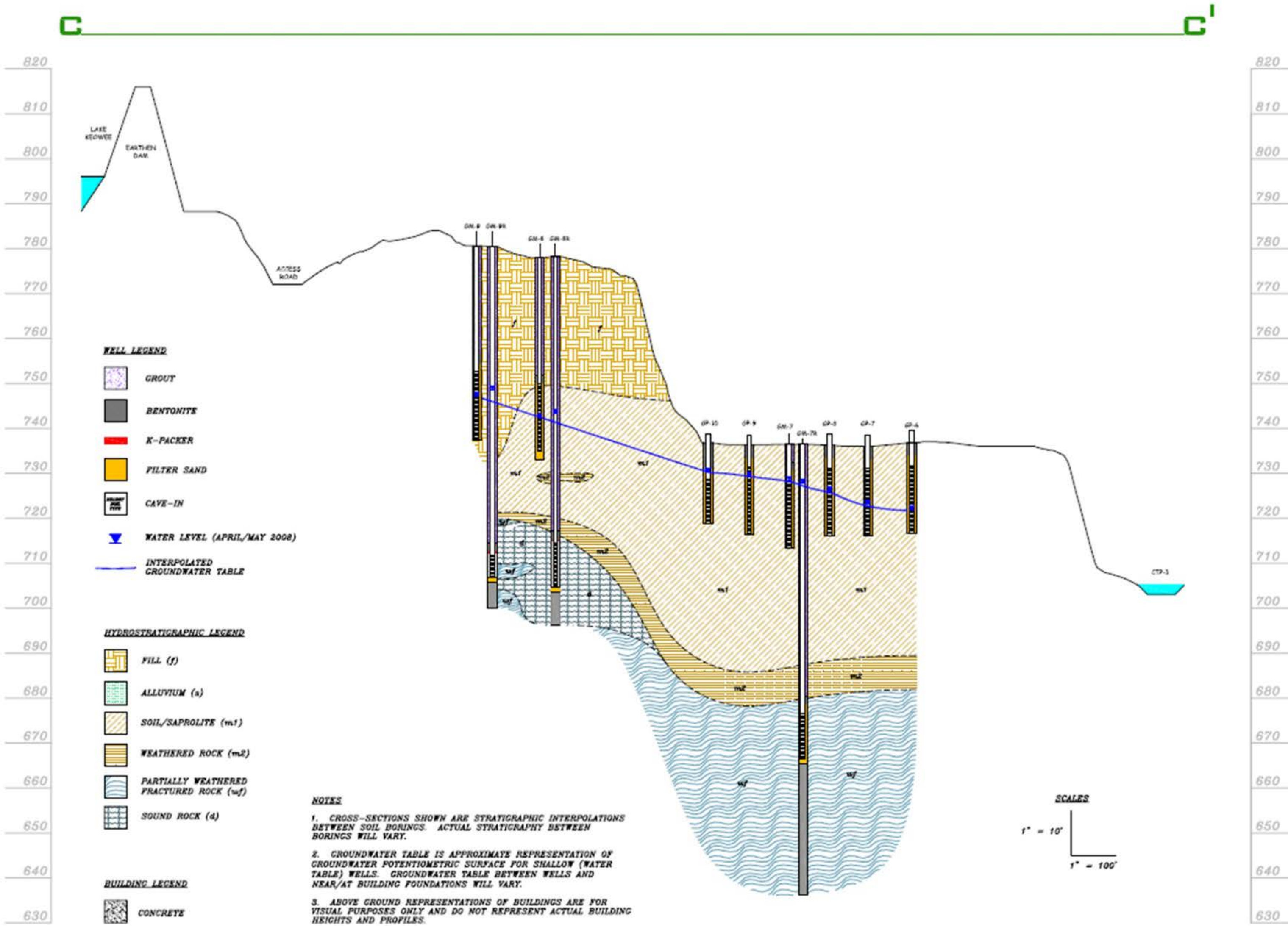


Figure 3.5-3d Cross-Section C-C'

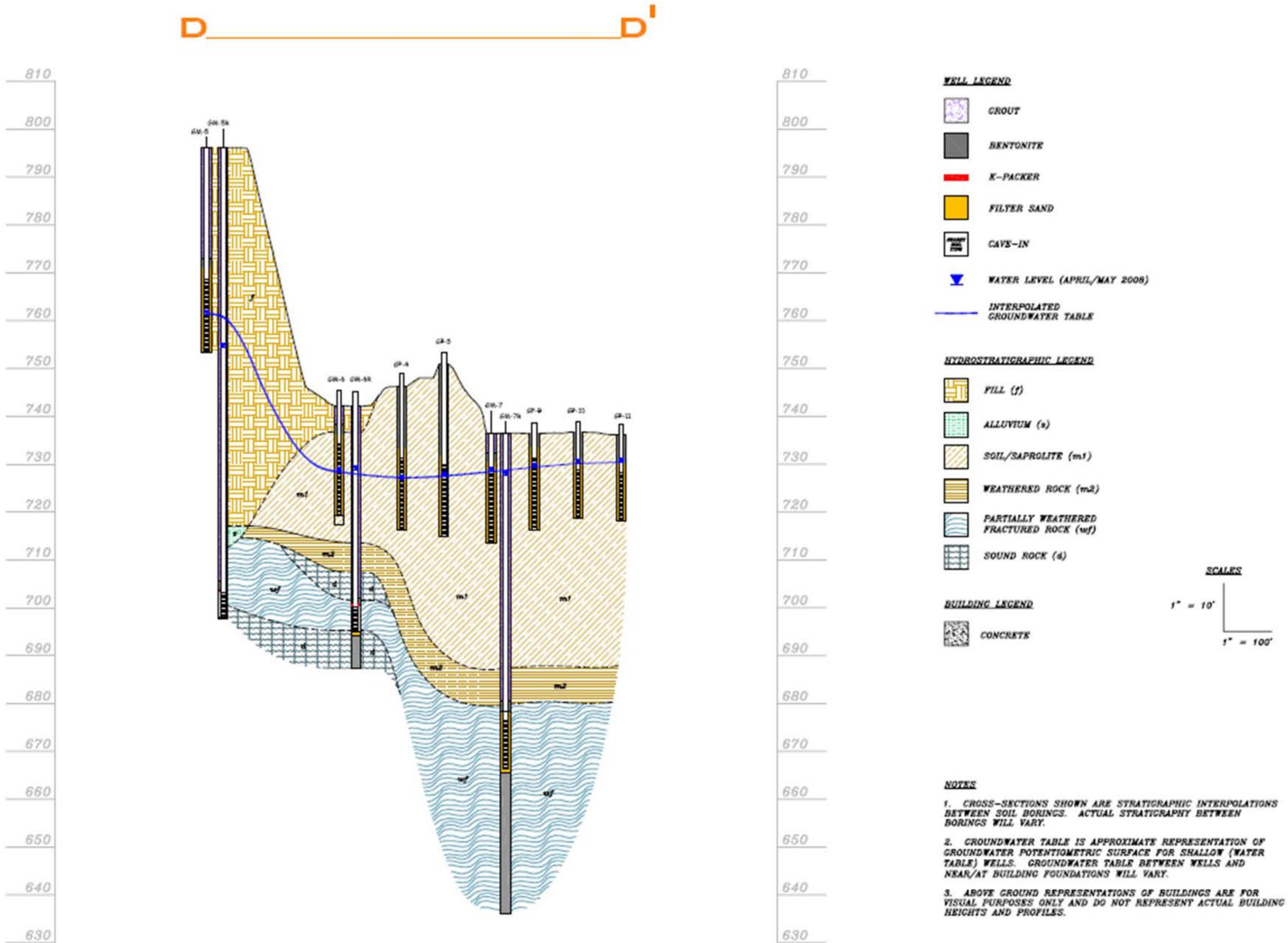


Figure 3.5-3e Cross-Section D-D'

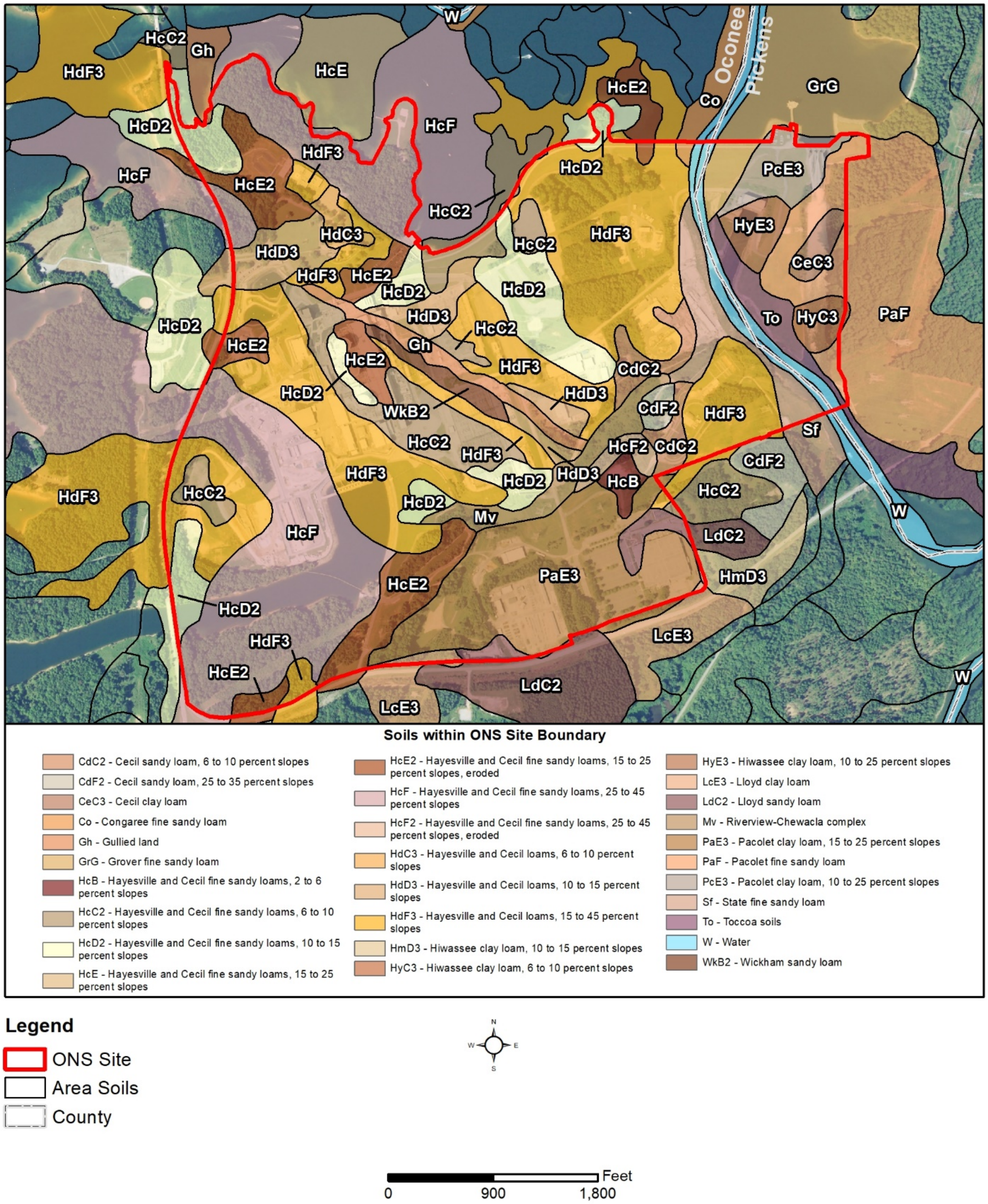


Figure 3.5-4 Distribution of Soil Units, ONS Property

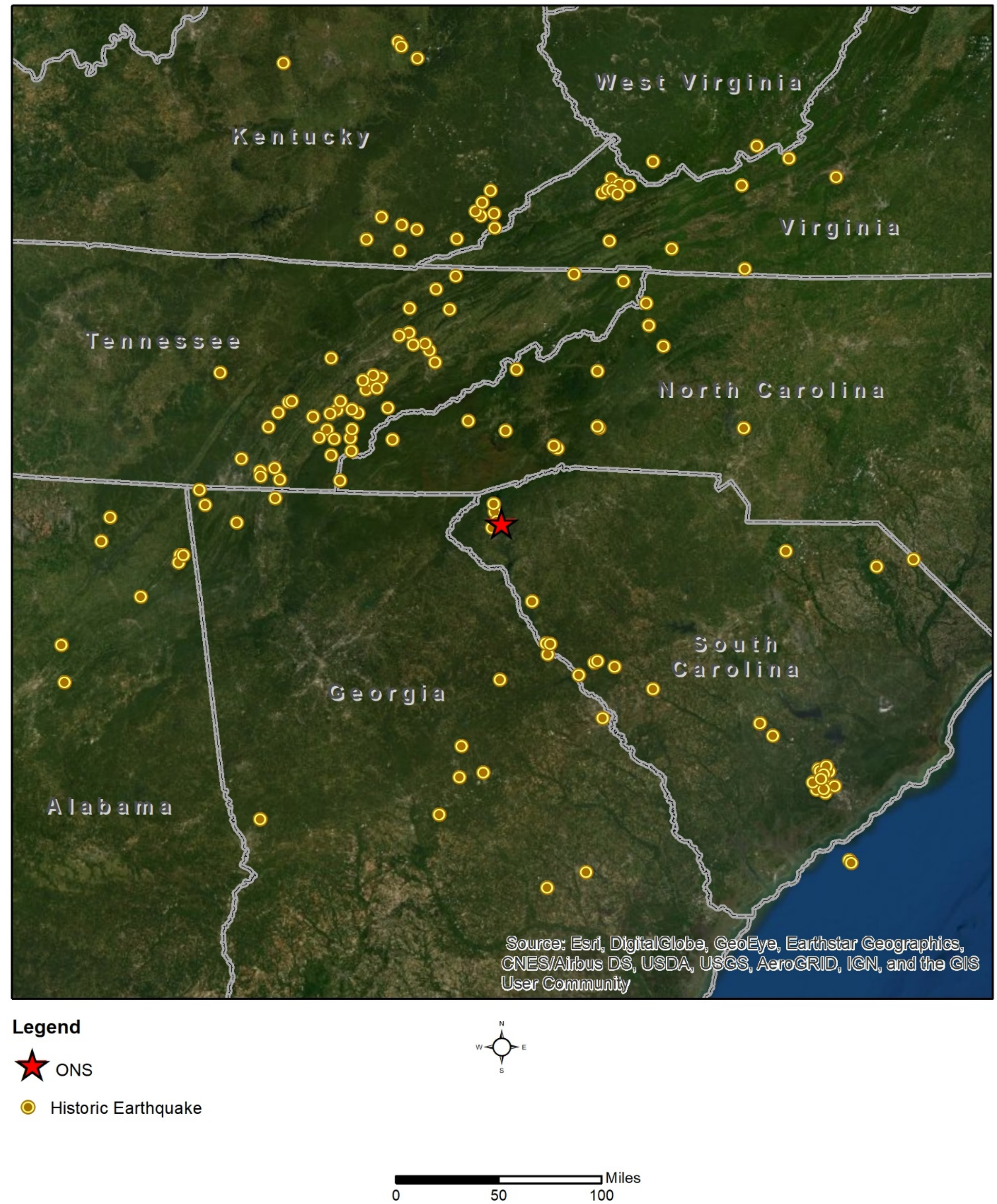


Figure 3.5-5 Historic Earthquakes, 1774–2016

3.6 Water Resources

3.6.1 Surface Water Resources

The main hydrologic features influencing the plant are the Lake Jocassee and Lake Keowee reservoirs (Figure 3.6-1). The Lake Jocassee and Lake Keowee reservoirs and the hydroelectric stations located at these reservoirs are owned and operated by Duke Energy.

Lake Keowee was created in 1971 with the construction of the Keowee Dam on the Keowee River and the Little River Dam on the Little River. Its explicit purpose is to provide cooling water for ONS and water to turn the turbines of the Keowee Hydro Station. Lake Keowee is an 18,357-acre multipurpose impoundment which serves as a source for public drinking water, cooling water, hydroelectric production, pumped-storage operation, and water-based recreation. The reservoir is moderately dendritic with approximately 388 miles of shoreline at full pond (800 feet msl). Storage capacity at full pond is 952,300 acre-feet with 56 percent of that contained within the Little River watershed and 44 percent within the Keowee River watershed. As discussed further in Section 3.7.1, ONS is located on Lake Keowee between the Little River watershed and Keowee River watershed. The Little River watershed is slightly larger in terms of surface area than the Keowee River watershed, but also somewhat shallower. These two watersheds (total drainage area of 439 square miles) are connected by a narrow (approximately 213 feet wide) man-made canal (maximum depth of approximately 98 feet) which allows for water accessibility by ONS within the two watersheds. A summary of Lake Keowee data is included in Table 3.6-1.

Keowee Hydro Station, a two-unit conventional hydroelectric facility located at the lower end of the Keowee River watershed, controls the flow from Lake Keowee downstream into Lake Hartwell. The operation of the Keowee Hydro Station was designed to provide power during peak demand for electricity and backup power for ONS in the case of a station shutdown. Flows range from 50 cfs at leakage to 20,000 cfs at maximum electrical output. The opening of the Keowee Hydro Station intake structure is between 41 to 65 feet below full pond elevation. Due to a submerged coffer dam in front of the intake tower of the hydroelectric facility, only water above elevation 765 feet msl (34.45 feet deep) is released into Lake Hartwell. Fifty-five percent of the water in Lake Keowee is above the crest of the submerged weir and is hydraulically accessible by Keowee Hydro Station. Retention time calculations based on outflow information from Keowee Hydro Station ranged from 13 to 465 days, depending on actual flow values and water volumes used.

Lake Jocassee was created in 1973 with the construction of the Jocassee Dam on the Keowee River. The lake provides pump storage capacity to the reversible turbine-generators of the Jocassee Hydroelectric Station, located approximately 11 miles north of the plant. At full pond, elevation 1,110 feet msl, Lake Jocassee has a surface area of 7,565 acres, a shoreline of approximately 75 miles, a volume of 1,160,298 acre-feet, and a total drainage area of about 148 square miles. The Jocassee Hydroelectric Station is located at the extreme northern end of the Keowee River watershed approximately 13.67 miles from the Keowee Hydro Station. During the generation cycle, the twin intake towers in Lake Jocassee remove water from an elevation of 1,043.0 to 1,066.9 feet msl, and once it passes through the turbines, release it into Lake Keowee. Conversely, during pump-back mode, the turbines are reversed and employed as pumps to withdraw water from Lake Keowee. The 44.3-foot depth of the old Keowee River channel, however, precludes access of Lake Keowee water below that depth. This morphometric restriction results in the Jocassee Hydroelectric Station having pumping access to approximately 65 percent of the volume of Lake Keowee. The number of hours of operation (either generation or pumping) is highly variable both seasonally and annually, and depends on system load and allocation of demand, but usually is less than full capacity. The interchanges of water between Lake Jocassee and Lake Keowee are planned with the intent of conserving water within the system for electrical generation.

The CCW intake system for ONS is located just south of the man-made canal within the Little River watershed and consists of a concrete skimmer wall, and a 4,921-foot intake canal. The skimmer wall extends from elevation 802 feet msl (2 feet above full pool) to 732.91 feet msl and allows for hydraulic access to 94 percent of the total lake volume. The main CCW pumps (four per unit, 12 total) withdraw water at a maximum capacity of 4,767 cfs from the intake canal through the main condenser where the latent heat from the spent steam is transferred across the condenser tubing to the lake water. This "non-contact" cooling water is discharged into the Keowee River watershed from an opening 24.9 feet to 40.0 feet below full pond elevation. The ONS circulates approximately 2.5 reservoir volumes through the CCW system at mean flow each year, based on retention time calculations, and slightly greater than 3.6 reservoir volumes at maximum flow. Since ONS has access to 94 percent of the water in the reservoir, retention time calculations based on mean and maximum flow were similar for "accessible water," and that based on total reservoir volume.

The ONS conventional wastewater treatment system consists of three CTPs labeled CTP-1, CTP-2, and CTP-3. CTP-1 and CTP-2 are parallel ponds with one pond receiving wastewater and the other pond providing treatment or discharging. Pumps are provided for recirculation or controlled discharge via the west yard drain system to CTP-3. The conventional wastewater treatment system receives input primarily from the turbine building sump or the water treatment room. In 2007, both CTP-1 and CTP-2 were lined with a synthetic liner. Treated water from CTP-3 proceeds through the wastewater conveyance to NPDES Outfall 002 at the headwaters of Lake Hartwell at a rate of approximately 1.8 MGD, dependent on rainfall. In addition to the treated water passing through CTP-3, an additional volume of groundwater collects there and is discharged through the wastewater conveyance. Groundwater seepage flows into CTP 3 on the northern, western, and southern sides. Approximately 5 to 50 gpm (7,200 to 72,000 gpd) of unaccounted for seepage (not designed as part of the conventional wastewater treatment system) enters CTP 3.

3.6.1.1 Potential for Flooding

ONS is located near the ridgeline between the Keowee and Little River valleys, or more than 100 feet above the maximum known flood in either valley.

Statistical analyses have shown design reservoir inflows for both Lake Keowee and Lake Jocassee equal to respective design discharge capacities outlined above to have recurrence intervals less frequent than once in 10,000 years. The surcharge on full pond during the probable maximum flood (PMF) is 8.9 feet and 12 feet for Keowee and Jocassee, respectively. The spillway discharge capacity is 140,000 cfs and 74,000 cfs for Keowee and Jocassee respectively. The dependable flood flow through units is 0 cfs for Keowee and 26,600 cfs for Jocassee. The total discharge capacity is 140,000 cfs for Keowee. The total combined discharge capacity is 100,600 cfs for Jocassee, although only 85,405 cfs is assumed in the PMF analysis of record.

While spillway capacities at Lake Keowee and Lake Jocassee have been designed to pass the design flood with no surcharge on full pond, the dams and other hydraulic structures have been designed with adequate freeboard and structural safety factors to safely accommodate the effects of maximum hypothetical precipitation. Because of the time-lag characteristics of the runoff hydrograph after a storm, it is not considered credible that the maximum reservoir elevation due to maximum hypothetical precipitation would occur simultaneously with winds causing maximum wave heights and run-ups.

3.6.1.2 Surface Water Discharges

3.6.1.2.1 NPDES-Permitted Outfalls

Non-contact cooling water, process wastewaters, and hydroelectric wastewaters are monitored and discharged to Lake Keowee and the Keowee River via NPDES Outfalls 001, 002, 004, and 007 in accordance with the ONS NPDES Permit No. SC0000515 (Attachment B). The current NPDES permit authorizes discharges from six outfalls (four external outfalls and two internal outfalls). The outfalls are depicted in Figure 3.6-3, and their associated effluent limits are listed in Table 3.6-2. Chemical additives approved by the SCDHEC are used to control pH, scale, and corrosion in the circulating water system, and to control biofouling of plant equipment. Chemical additives are not used in the non-contact cooling water or hydroelectric waste waters discharged at Outfalls 001 and 007, respectively.

Certain low-volume and chemical wastewaters from the ONS facility with liquids treated to NRC effluent release criteria (10 CFR Part 20) as defined by the NRC plant effluent release limits, may be comingled and treated with similar waste and controlled under the terms of NPDES Permit No. SC0000515. These discharges are treated, monitored, and directed to the discharge canal which drains via external Outfall 004 to the Keowee River. (Attachment B)

3.6.1.2.2 Stormwater Runoff

Stormwater from improved areas of the ONS site is collected in a system of roof drains, a yard drain system, and ditches arranged around the plant in such a way as to direct runoff away from the plant to natural drainage channels. The yard drain system is made up of metal, plastic and concrete piping and culverts. The yard drain system, ditches, and graded areas are all arranged to primarily direct stormwater to CTP-3 or the wastewater conveyance area between CTP-3 and NPDES Outfall 002.

ONS also maintains and implements a SWPPP that identifies potential sources of pollution, such as erosion, that would reasonably be expected to affect the quality of stormwater, and identifies BMPs that will be used to prevent or reduce the pollutants in stormwater discharges. Both structural and non-structural BMPs are employed at the ONS site to minimize exposure of industrial activities to stormwater. Structural BMPs at the facility include buildings, shelters, enclosures, dedicated secondary containments, paved loading/unloading locations, sumps and oi/water separators. Non-structural BMPs include personnel training, facility policy and procedures, environmental awareness, good housekeeping practices, security, preventative maintenance, and spill and emergency response. These BMPs include erosion and sediment controls by placing flow velocity-dissipation devices at discharge locations and within outfall channels where necessary to reduce erosion and/or settle out pollutants, management runoff and stormwater management of runoff where ONS must divert, infiltrate, reuse, contain, or otherwise reduce stormwater runoff to minimize pollutants in their discharge. ONS collects stormwater runoff samples on a quarterly basis (when there is a flow) at stormwater outfalls SW001 through SW005, SW010, and SW-011, which receive runoff from the entire industrial area, and analyzes the samples for pollutants as specified in the permit.

3.6.1.2.3 Sanitary Wastewaters

All sanitary wastewater is now routed offsite to Seneca Light and Water. This wastewater is treated at the Coneross treatment plant by the Oconee Joint Regional Sewer Authority. All sanitary wastewater has been routed offsite since February 2010.

3.6.1.2.4 Dredging

According to ONS personnel, no dredging has occurred at ONS since 1998 and none is anticipated during the proposed SLR operating term.

3.6.1.2.5 Compliance History

As discussed in Chapter 9, over the 2014–October 2020 period, there have been no notices of violation or non-compliances associated with ONS wastewater discharges to receiving surface waters.

3.6.1.2.6 River Water Temperatures Reporting

Cooling water intake and discharge water temperatures for each unit are measured by ONS and the raw data averaged for each month. The averaged values for 2013 to 2018 are plotted in Figures 3.6-4 (intake) and Figure 3.6-5 (discharge).

3.6.2 Groundwater Resources

3.6.2.1 Groundwater Aquifers

The ONS site lies within the drainage area of the Little and Keowee rivers which flow southerly into the Seneca River and subsequently discharge into the main drainage course of the Savannah River. The average annual rainfall at the site area is approximately 53 inches.

The deposits of the Little and Keowee drainage basins are generally of low permeability, which results in nearly total runoff to the two rivers and their numerous tributary creeks. Runoff occurs soon after precipitation, particularly during the spring and summer months when the soil percolation rates are exceeded by the short term but higher yielding rainfall periods. The area is characterized by youthful narrow streams and creeks which discharge into the mature Little and Keowee rivers.

Throughout the area, groundwater occurs at shallow depths within the saprolite (residual soil which is a weathering product of the underlying parent rock) soil mantle overlying the metamorphic and igneous rock complex. This saprolite soil, which ranges in thickness from a few feet to over 100 feet, is the aquifer for most of the groundwater supply. Wells are shallow with few exceeding a total depth of 100 feet. Depths to water commonly range from 5 to 40 feet below the land surface. Seasonal fluctuation is wholly dependent on rainfall and the magnitude of change may vary considerably from well to well due to the limited areas of available recharge. Average fluctuation is about 3 to 5 feet. Both surface water and groundwater in this area are of low mineral content and generally of good quality for all uses.

3.6.2.2 Hydraulic Properties

Local subsurface drainage generally travels down the topographic slopes within the more permeable saprolite soil zones toward the nearby surface creek or stream. Gross drainage is southward to the Little and Keowee rivers, which act as a base for the gradient. Because the topography and thickness of the residual soil, overlying bedrock control the hydraulic gradient throughout the area, and further, the relief is highly variable within short distances. The groundwater hydraulic gradient is steep and conforms to the topographic slope. Water released on the surface will percolate downward and move toward the main drainage channels at an estimated rate of 150 to 250 feet per year.

The gradient throughout the area represents the upper surface of unconfined groundwater and therefore is subject to atmospheric conditions. Confined groundwater occurs only locally as evidenced by the existence of isolated springs and a few exploratory drill holes which encountered artesian conditions. These examples do not reflect general conditions covering large areas but merely represent isolated local strata within the saprolite soil which contain water under a semi-perched condition and/or permeable strata overlain by impermeable clay lenses which have been breached by erosion at its exit and recharged short distances upslope by vertical percolation.

The site area is on a moderately sloping, northwest trending topographic ridge which forms a drainage divide between the Little and Keowee rivers located approximately 0.5 mile to the west and east, respectively. Groundwater levels at the site, measured during the 1966 drilling program and subsequently in four piezometer holes drilled for pre-construction monitoring purposes, ranged from elevation 792 feet msl to 696 feet msl. The slope of this apparently free water surface is predominantly southeasterly toward the Keowee River and its tributary drainage channels. An average hydraulic gradient to the southeast of approximately 8.0 percent was plotted along a line of measured wells. This closely conforms to the existing topography as expected.

Field permeability tests conducted during the 1966 exploratory program within the saprolite soil yielded values ranging from 100 to 250 feet per year. The permeability tests were performed in holes of varying depths to determine if the zoned typed weathering of the saprolite soil affects vertical permeability. Based on the test results, inspection of nearby road cuts, and a study of the exploratory drill logs, it is tentatively concluded that the surficial saprolite possesses lower permeability values than that found in the deeper strata. This correlates with the general profile of the saprolite in that the later stages of weathering produce a soil having a higher clay content than the more coarse-grained silty sand sediments below. This natural process of weathering results in the formation of a partial barrier to downward movement of surface water.

3.6.2.3 Potentiometric Surfaces

During ONS site development, groundwater was generally encountered under water table conditions in the residual soil/saprolite and weathered rock that overlie less weathered rock. Local subsurface drainage generally traveled down the topographic slopes within the more permeable saprolite soil zones toward the nearby surface creek or stream. Gross drainage was southward to the Little and Keowee rivers which acted as a base for the gradient.

Contour maps of the shallow and deep groundwater based on water level data collected in 2016 as part of the Nuclear Energy Institute's (NEI) groundwater protection initiative (GPI) program are provided as Figures 3.6-6a and 3.6-6b. Groundwater generally flows from northwest toward the southeast. A groundwater flow component also exists from the Lake Keowee intake to the east towards CTP-3 and the wastewater conveyance. An additional groundwater flow component exists from Lake Keowee (at the cooling water discharge structure) to the south toward CTP-3 and the wastewater conveyance.

3.6.2.4 Groundwater Protection Program

In May 2006, the NEI implemented the GPI, an industry-wide voluntary effort to enhance nuclear power plant operators' management of groundwater protection (NEI 2007).

Industry implementation of the GPI identifies actions to improve licensee management and response to instances where the inadvertent release of radioactive substances may result in detectable levels of plant-related materials in subsurface soils and water, and also describes communication of those instances to external stakeholders. Aspects addressed by the initiative include site hydrology and geology, site risk assessment, onsite groundwater monitoring, and remediation. In August 2007, NEI published updated guidance on implementing the GPI as NEI 07-07, Industry Ground Water Protection Initiative—Final Guidance Document (NEI 2007). The goal of the GPI is to identify leaks of licensed material as soon as possible.

Duke Energy implemented a groundwater protection program in 2007. This initiative was developed to ensure timely and effective management of situations involving inadvertent releases of licensed material to groundwater. As part of this program, ONS monitored 61 wells in 2020. No gamma or difficult-to-detect radionuclides, other than naturally occurring radionuclides, were identified in well samples between 2014 and October 2020. (Duke 2015a; Duke 2016; Duke 2017; Duke 2018; Duke 2019b; Duke 2020d) The low levels of tritium detected in groundwater are discussed further under the onsite groundwater use subsection of Sections 3.6.3.2 and 3.6.4.2.

In conjunction with the GPI, ONS performs groundwater monitoring from a total of 63 onsite GPI sampling locations to monitor for potential radioactive releases to groundwater, environmental conditions, and groundwater elevation in accordance with site procedures. Figure 3.6-7 shows locations of these groundwater monitoring wells with construction details presented in Table 3.6-3.

3.6.2.5 Sole Source Aquifers

A sole source aquifer (SSA), as defined by the EPA, is an aquifer which supplies at least 50 percent of the drinking water consumed by the area overlying the aquifer, and there is no reasonably available alternative drinking water source should the aquifer become contaminated. The SSA program was created by the U.S. Congress as part of the Safe Drinking Water Act and allows for the protection of these resources. (EPA 2019b)

ONS is located in EPA Region 4, which has oversight responsibilities for the public water supply in Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, and six tribes (EPA 2019c). The EPA has designated three aquifers in EPA Region 4 as SSAs. None of these SSAs are located in or adjoining the State of South Carolina; therefore, the ONS site is not situated over any of these designated SSAs (EPA 2019b).

3.6.3 Water Use

3.6.3.1 Surface Water Use

Two municipal water withdrawals are located on the Lake Keowee. The City of Greenville, SC, withdraws water from the Keowee River watershed at a maximum capacity of 90 million gpd. The City of Seneca, SC, withdraws water from the Little River watershed at a maximum rate of 30 million gpd. No major permitted municipal point-source discharges flow into the lake.

Besides serving the needs of the nuclear and hydroelectric power plants, Lake Keowee is used as a source of municipal drinking water by the cities of Greenville and Seneca. Lake Keowee experiences extensive recreational use by fishermen, boaters, skiers, and swimmers. Concentrations of all minerals and nutrients are very low, with total dissolved solids of less than of 25 milligrams per liter (mg/l). Water clarity is generally very high. Dissolved oxygen (DO) concentrations in surface waters are adequate, and algae are not known to be present in nuisance concentrations. Due to the low nutrient content of its waters, Lake Keowee has a relatively low standing crop (pounds per acre) of fish. The species composition and general health of the fish are normal for the region. (Duke 1998, Section 2.2)

The ONS intake system withdraws once-through cooling water from the Little River arm of Lake Keowee, pulling it from underneath a skimmer wall. The discharge for this cooling water is located on the Keowee arm of the lake. (Duke 1998, Section 2.2) The average surface water withdrawal rate by ONS in 2018 was reported as 2,578.21 MGD and averaged 2,619.15 MGD between 2014 and 2018 (Table 3.6-4a). A summary of monthly surface water withdrawals reported by ONS between 2014 and 2018 is included as Table 3.6-4b.

In 2015, total surface water withdrawals in Oconee County were reported as 2,605.59 MGD, of which 2,589.73 MGD were used for power generation. The total surface water withdrawals in Pickens County were reported as 35.02 MGD, of which 32.98 MGD were used for public supply with no reported power generation uses. Excluding power generation, surface water use for Oconee County in 2015 was reported as 15.86 MGD. (USGS 2019b) A summary of surface water use in Oconee and Pickens counties is presented in Table 3.6-5.

3.6.3.2 Groundwater Use

Offsite Groundwater Use

In 2015, groundwater withdrawals in Oconee and Pickens counties were each reported as 1.94 MGD with no withdrawal for power generation. Domestic, self-supplied withdrawals are reported as the largest consumption of groundwater, reported at 1.67 MGD in Oconee County and 1.85 MGD in Pickens County. The remaining water use was for public supply and mining purposes. (USGS 2019b) A summary of groundwater use in Oconee and Pickens counties is presented in Table 3.6-6.

Two public supply water wells are located within a 2-mile band around the ONS property boundary (USGS 2019c). The water wells are listed on the SCDHEC database with limited information, but are not listed on the EPA or USGS databases. Both water supply wells are associated with an RV park across Lake Keowee from ONS, approximately 1.3 miles west of the center point of the plant. No other water supply wells were identified through publicly available data. (SCDHEC 2020a; USGS 2020b)

Onsite Groundwater Use

ONS operates a groundwater drawdown system around its standby shutdown facility comprising three pumping wells: DMW-1, DMW-2, and DMW-3. These wells include automated pumps that turn on when groundwater reaches an approximate elevation of 747 feet (50 feet below surrounding grade of 797 feet). This system pumps an approximate average of 20 gpm of groundwater into the yard drainage system. This yard drainage system discharges into CTP-3 (see Section 3.6.1).

Recovery well RW-1 was installed November 2010 and groundwater extraction began February 2011. Duke Energy recorded extraction flow rates and tritium activity monthly from February 2011 through April 2016. Given the reductions in tritium activity over this period, Duke Energy reduced tritium measurements from RW-1 to quarterly and ceased monitoring/recording extraction flow rates; however, RW-1 continues to operate. As of April 2016, just over 25 million gallons of groundwater had been extracted from RW-1. Since July 2015 through the third quarter of 2020, tritium activity has averaged only 1,280 picoCuries per liter (pCi/L) in groundwater monitoring well GM-7R, the well most proximate to RW-1 (shown in Figure 3.6-7) and historically exhibiting the more persistent and elevated tritium activity, > 20,000 pCi/L.

ONS states that all potable groundwater supply wells installed on the ONS property were originally intended for irrigation use and are not required to be permitted or collect withdrawal data. None have been used within the last 10 years; they have all been abandoned or are being assessed for abandonment.

3.6.4 Water Quality

3.6.4.1 Surface Water Quality

The known permitted discharges to Lake Keowee are limited to those from the existing units. These sources and permitted discharge limits are described in the NPDES permit (Attachment B). ONS is in compliance with its NPDES permit, as discussed in Section 3.6.1.2, and does not contribute to the impairments listed on the SCDHEC's draft 2018 303(d) list of impaired waters.

Lake Keowee, Lake Jocassee, and several tributaries within hydrologic unit codes (HUCs) 0306010101, 0306010102, and 0306010103 (HUC 10 drainage basins to Lake Keowee and Lake Jocassee) appear on the SCDHEC's draft 2018 303(d) list of impaired waters:

- Lake Jocassee, Toxaway River Arm – Mercury in fish tissue
- Lake Jocassee at end of State Highway 25 – Mercury in fish tissue
- Lake Jocassee approximately 1.6 miles south of station SV-335 at big turn in lake around large land point – Nitrogen impact to aquatic life
- Lake Keowee at nuclear plant near dam – Mercury in fish tissue
- Lake Keowee at State Highway 44 (Fall Creek access) – Mercury in fish tissue
- Lake Keowee at State Highway 188 (Cane Creek Arm) – Mercury in fish tissue
- North Fork Little River at S-37-73, Crestwood Drive, west-northwest of Salem – *e. Coli*

Development of total maximum daily load implementation plans for Little Eastatoe Creek, Colonels Fork Creek, Coneross Creek, Burgess Creek, and a culvert over White Fork at Stribling Shoals were approved in 2001 and 2010 (SCDHEC 2019b).

Additionally, fish consumption advisories have been issued for Lake Keowee and Lake Jocassee, recommending only one meal a week from largemouth and spotted bass due to mercury levels found in tissue samples of those fish (SCDHEC 2020b; SCDHEC 2020c).

3.6.4.2 Groundwater Quality

The surface water and groundwater of the area is generally of good quality with no pre-treatment required. The temperature of well water was reported from a low of 46 to a high of 59°F. The majority ranges from 50 to 53°F.

As part of the ONS radiological groundwater monitoring program, groundwater samples are collected from selected onsite monitoring wells and analyzed for radionuclides to detect potential impacts to groundwater from inadvertent leaks or spills. Wells are typically sampled quarterly, semi-annually, or annually. Groundwater samples are regularly analyzed for tritium and gamma emitters, with select wells being analyzed for difficult-to-detect radionuclides (Duke 2019b). Tritium concentrations have been detected in GMR-7 and GMR-7R since 2010. Tritium activity in wells GM-7R and GM-7DR was reported according to NEI 07-07 in February 2010. The probable source of this activity was determined to be discharges from the turbine building sumps to CTP-3 through the east yard drain. Discharges from the turbine building sump through this pathway were discontinued in 2008. Installation of a recovery well, currently RW-1, in 2011 has resulted in decreased tritium concentrations in well GM-7DR to below the minimum detectable activity. (Duke 2020d)

Industrial practices at ONS that involve the use of chemicals are those activities typically associated with painting, cleaning of parts/equipment, refueling of onsite vehicles/generators, fuel oil and gasoline storage, and the storage and use of water treatment additives. The use and storage of chemicals at ONS are controlled in accordance with Duke Energy procedures and site-specific spill prevention plans. In addition, as presented in Section 2.2.7, nonradioactive waste is managed in accordance with Duke Energy's waste management procedure, which contains preparedness and prevention control measures.

3.6.4.2.1 History of Radioactive Releases

No unplanned radioactive liquid releases were reported between 2014 and October 2020 (Duke 2015a; Duke 2016; Duke 2017; Duke 2018; Duke 2019b; Duke 2020d).

One event meeting the criteria for voluntary notification per NEI 07-07 occurred at ONS in 2014 as documented in the corrective action program entry PIP 0-14-5180. On May 6, 2014, while transferring water from CTP-1 to CTP-3, water was observed seeping from the ground at a location near the transfer piping between the ponds. The transfer was terminated and the ground seepage subsided. The leakage path was identified as a 3-inch hole drilled in the side of the yard drain catch basin. The hole had been drilled over 2 years earlier per an engineering change for the installation of security cables. The as-found orientation of the catch basin lid contributed to the amount of leakage that occurred. The 3-inch hole was repaired and the catch basin lid was reoriented. Tritium concentration in CTP-1 at the time was approximately 4E+03 pCi/l. Total estimated tritium activity released over the lifetime of the leak was 2.4E-06 curies and represents a small fraction of total tritium activity released in liquid effluents. Monitoring wells A-13 and A-14 are down-gradient from the leak location. The wells were sampled on May 15, 2014, to detect any changes to the tritium concentration in groundwater.

The results did not indicate any significant changes to tritium concentration in groundwater, as both wells exhibited typical values. (Duke 2015a)

Two unplanned gaseous releases were reported, one in 2014 and one in 2015. There were no unplanned gaseous offsite releases of radioactive effluents in 2016–October 2020 (Duke 2017; Duke 2018; Duke 2019b; Duke 2020d). Release of "3C" gaseous waste decay tank (GWDT) began at 16:22 on June 1, 2014, as gaseous waste release (GWR) 2014-047. The rate of release was slowly increased until stable counts were observed on radiation monitor 3RIA-37. The "3C" GWDT release was terminated at 18:53 on June 1, 2014, when an unexpected decrease in "3A" GWDT pressure was observed. The "3A" GWDT pressure decreased from 16.2 pounds per square inch gauge (psig) to 15.5 psig during GWR 2014-047. When the GWR 2014-047 was stopped, the "3A" GWDT pressure stopped decreasing. Investigation identified two GWDT system valves that were leaking past the seat during the release. The two GWDT valves were repaired to prevent future occurrences. (Duke 2015a)

A separate "3A" GWDT release permit, 2014-056, was created to account for the release activity and related dose. Based on the GWDT volume chart in OP/0/A/1 108/001, Curves and General Information, a 0.7 psig decrease corresponds to a release volume of 100 cubic feet. The concentrations of the radionuclides during the unplanned release were estimated to be the sampled concentrations identified during the "3C" GWD release 2014-047, which occurred on June 1, 2014. The total activity of the unplanned release was 1.29E-06 curies. (Duke 2015a)

On January 27, 2015, during venting of U3 let down storage tank (LDST) to the 3B GWDT, an increase in counts was observed on the unit vent normal range radiation monitor, 3 RIA 45, at 23:26 hours. The LDST venting was terminated and the 3B GWDT was isolated. Once isolated, the 3B GWDT pressure was observed to be decreasing and the GWDT radiation monitor, 3 RIA 37, had increased counts, indicating the contents were being released to the unit vent. Radiation monitor 3RIA-45 exhibited increased count rates due to the release, but no setpoints or instantaneous release rate limits were exceeded. The unplanned release was terminated when 3B GWDT reached 0 psig at 07:00 on January 28, 2015. Investigation identified that a 3B GWDT relief valve failed to seat, causing the 3B GWDT to lose pressure. The GWDT valve was repaired and an additional test was added to the preventative maintenance procedure to prevent recurrence. (Duke 2016)

A separate release permit, 2015004, was created to account for the release activity and related dose. The release volume and activity were determined using count rates and flow rates for 3RIA-37. The release volume from the 3B tank was 4,500 cubic feet based on the initial tank pressure of 45 psig and tank volume chart in OP/O/A/1108/001, Curves and General Information. The total activity of the unplanned release was 0.735 curies. (Duke 2016)

3.6.4.2.2 History of Nonradioactive Releases

Based on the review of site records from the 5 years from 2014–2018, there has been no inadvertent nonradioactive release that would not be classified as an incidental spill.

Table 3.6-1 Lake Keowee Summary Data

Full pond elevation	800 feet msl
Maximum drawdown	25 feet
Full pond surface area	18,357 acres
Full pond volume	952,300 acre-feet
Shoreline length	388 miles
Mean depth	51.9 feet
Maximum depth	140.7 feet
Drainage area	439 square miles
Mean flow (at Keowee Dam)	830 cfs
Minimum average daily flow (FERC)	125 cfs

Table 3.6-2 NPDES Water Quality Monitoring Program (Sheet 1 of 2)

Outfall	Description	Parameter	Permit Requirement	Frequency
001	Once-through cooling water	Flow (effluent)	No limit, monitor and report	hourly
		Temperature (intake)	No limit, monitor and report	hourly
		Temperature (effluent)	Monthly average: No limit, monitor and report. Daily maximum 100-103°F	hourly
		Temperature (difference)	22°F when intake temperature exceeds 68°F	hourly
002	Low volume waste sources Treated chemical metal cleaning waste (see internal Outfall 005) Landfill leachate (see internal Outfall 006) Intake dam underdrain Indigenous springs Gravity drain system	Flow	No limit, monitor and report	1/week
		pH	6.0–8.5 SU	1/week
		Total Suspended Solids (TSS)	21.7 mg/L monthly average, daily maximum 43.8 mg/L.	1/month
		Oil and Grease (O&G)	3.07 mg/L monthly average, daily maximum 4.09 mg/L.	1/month
		TRC	0.011 mg/L monthly average, daily maximum 0.019 mg/L.	1/month
		Ceriodaphnia dubia acute whole effluent toxicity @ATC = 100%	0 (pass/fail)	1/quarter
		Ceriodaphnia dubia chronic whole effluent toxicity @CTC = 19.4%	25% monthly average 40% daily maximum	1/quarter
004	Low level radiological wastes Treated chemical metal cleaning waste (see internal Outfall 005)	Flow	No limit, monitor and report	1/month
		pH (service water intake)	No limit, monitor and report	1/month
		pH (effluent)	6.0–8.5 SU	1/month
		pH (difference)	Daily maximum ≤ 0.1 SU if effluent pH is < 6.0 SU	1/month

Table 3.6-2 NPDES Water Quality Monitoring Program (Sheet 2 of 2)

Outfall	Description	Parameter	Permit Requirement	Frequency
005	Treated chemical metal cleaning waste (final discharge through either Outfall 002 or Outfall 004)	Flow	No limit, monitor and report	1/batch
		TSS	30 mg/L monthly average, daily maximum 100 mg/L.	1/batch
		Oil and Grease (O&G)	15 mg/L monthly average, daily maximum 20 mg/L.	1/batch
		Total Recoverable Iron (TRI)	1.0 mg/L monthly average, daily maximum 1.0 mg/L.	1/batch
		Total Recoverable Copper (TRC)	1.0 mg/L monthly average, daily maximum 1.0 mg/L.	1/batch
006	Landfill leachate (final discharge through Outfall 002)	Flow	No limit, monitor and report	1/quarter
		Biochemical Oxygen Demand (BOD)	No limit, monitor and report	1/quarter
		Nitrite and Nitrate, total as N^2	No limit, monitor and report	1/quarter
		Total Organic Carbon (TOC)	No limit, monitor and report	1/quarter
		Total recoverable Selenium	No limit, monitor and report	1/quarter
		Total recoverable Zinc	No limit, monitor and report	1/quarter
		TRC	No limit, monitor and report	1/quarter
007	Hydroelectric wastewaters	O&G	No sheen observed	1/month

(Attachment B)

Table 3.6-3 ONS Groundwater Monitor Well Details (Sheet 1 of 4)

Well	Well Diameter[(a)]	Elevations (feet msl)					Well Construction Material
		Top of Casing	Top of Filter[(b)]	Top of Screen[(b)]	Bottom of Screen[(b)]	Bottom of Filter[(b)]	
A-1	--	803.28	--	--	--	--	--
A-2	--	806.68	--	--	--	--	--
A-8	--	830.08	--	--	--	--	--
A-9	--	850.57	--	--	--	--	--
A-10	--	698.03	--	--	--	--	--
A-11	--	702.92	--	--	--	--	--
A-12	--	715.19	--	--	--	--	--
A-13	--	796.34	--	--	--	--	--
A-14	--	796.64	--	--	--	--	--
A-17	--	800.95	--	--	--	--	--
A-18	--	804.02	--	--	--	--	--
BG-4	--	848.80	--	--	--	--	--
DMW-1	6	795.29	--	760.29	695.29	--	PVC casing to open rock
DMW-2	6	795.38	--	754.38	695.38	--	PVC casing to open rock
DMW-3	6	795.81	--	755.81	695.81	--	PVC casing to open rock
SMW-1	2	795.38	--	780.38	770.38	--	PVC
SMW-2	2	795.47	--	779.47	759.47	--	PVC
SMW-3	2	795.42	--	785.42	775.42	--	PVC
SMW-5	2	796.12	--	774.12	764.12	--	PVC
GM-1R	--	801.40	--	769.53	764.53	--	--
GM-2DR	--	795.96	--	746.20	741.20	--	--
GM-2R	--	795.84	--	770.82	765.82	--	--
GM-3DR	--	795.89	--	740.89	735.89	--	--
GM-3R	--	795.83	--	772.04	762.04	--	--

Table 3.6-3 ONS Groundwater Monitor Well Details (Sheet 2 of 4)

Well	Well Diameter[(a)]	Elevations (feet msl)					Well Construction Material
		Top of Casing	Top of Filter[(b)]	Top of Screen[(b)]	Bottom of Screen[(b)]	Bottom of Filter[(b)]	
GM-4	--	797.95	--	791.66	776.66	--	--
GM-5	--	795.79	--	768.30	753.30	--	--
GM-5R	--	795.87	--	703.09	698.09	--	--
GM-6	--	745.46	--	734.27	719.27	--	--
GM-6R	--	745.16	--	700.05	695.05	--	--
GM-7	--	739.18	--	728.44	713.44	--	--
GM-7R	--	739.20	--	676.47	666.47	--	--
GM-7DR	2	739.20	NR	591.50	586.50	NR	Schedule 40 PVC
GM-8	--	777.73	--	749.88	734.88	--	--
GM-8R	--	777.99	--	714.57	704.57	--	--
GM-9	--	780.36	--	752.60	737.60	--	--
GM-9R	--	780.19	--	711.72	706.72	--	--
GM-10	--	737.89	--	721.47	706.47	--	--
GM-10R	--	737.91	--	652.29	647.29	--	--
GM-11	--	723.31	--	691.87	681.87	--	--
GM-11R	--	723.48	--	658.99	653.99	--	--
GM-12	--	698.02	--	690.09	675.09	--	--
GM-12R	--	698.18	--	658.22	653.22	--	--
GM-13	--	739.10	--	705.45	690.45	--	--
GM-13R	--	739.18	--	678.18	668.18	--	--
GM-14	--	722.62	--	706.13	691.13	--	--
GM-14R	--	722.59	--	662.13	652.13	--	--
GM-15	2	735.48	731.48	729.48	719.48	717.48	Schedule 40 PVC
GM-15R	2	735.59	677.59	675.59	665.59	661.59	Schedule 40 PVC

Table 3.6-3 ONS Groundwater Monitor Well Details (Sheet 3 of 4)

Well	Well Diameter[a]	Elevations (feet msl)					Well Construction Material
		Top of Casing	Top of Filter[b]	Top of Screen[b]	Bottom of Screen[b]	Bottom of Filter[b]	
GM-16DDR	2	795.98	NR	671.38	651.38	NR	Schedule 40 PVC
GM-16DR	2	796.37	715.07	720.07	715.07	710.07	Schedule 40 PVC
GM-16R	2	796.34	746.74	752.94	747.94	745.14	Schedule 40 PVC
GM-17DR	2	795.71	697.61	702.61	697.61	692.71	Schedule 40 PVC
GM-17R	2	795.57	719.27	729.27	719.27	715.27	Schedule 40 PVC
GM-18R	2	796.05	NR	721.25	716.25	NR	Schedule 40 PVC
GM-19	2	738.38	715.38	713.38	698.38	696.88	Schedule 40 PVC
GM-19R	2	738.54	NR	662.04	657.04	NR	Schedule 40 PVC
GM-20	2	721.54	704.94	702.94	692.94	692.94	Schedule 40 PVC
GM-20R	2	721.45	626.95	631.95	626.95	625.95	Schedule 40 PVC
GM-21	2	719.32	NR	685.02	680.02	NR	Schedule 40 PVC
GM-22	2	695.27	691.27	689.27	679.27	679.27	Schedule 40 PVC
GM-23	1	741.46	737.46	735.96	725.96	725.96	Schedule 40 PVC
GM-24R	2	796.15	NR	754.85	744.85	NR	Schedule 40 PVC
GM-25R	2	795.45	NR	739.25	734.25	NR	Schedule 40 PVC
RP-01	--	784.05	--	--	--	--	--
RP-02	--	771.51	--	--	--	--	--
RP-03	--	770.91	--	--	--	--	--
MW-3	2	806.92	NR	776.13	786.13	NR	PVC
MW-3R	2	806.92	NR	771.92	757.42	NR	4 in PVC casing to 2 in open rock
MW-4	2	808.46	NR	746.28	756.28	NR	PVC
MW-5	2	809.19	NR	738.51	748.51	NR	PVC
MW-6D	2	794.02	NR	--	--	NR	4 in PVC casing to 2 in open rock

Table 3.6-3 ONS Groundwater Monitor Well Details (Sheet 4 of 4)

Well	Well Diameter(a)	Elevations (feet msl)					
		Top of Casing	Top of Filter(b)	Top of Screen(b)	Bottom of Screen(b)	Bottom of Filter(b)	Well Construction Material
MW-9	2	791.38	NR	736.06	746.06	NR	PVC
MW-10	2	763.49	NR	731.47	741.47	NR	PVC
MW-11	2	749.42	NR	722.14	732.14	NR	PVC
MW-11D	2	750.27	NR	674.47	663.97	NR	4 in PVC casing to 2 in open rock
MW-12	2	777.93	NR	735.91	745.91	NR	PVC
MW-13	2	738.50	NR	714.81	724.81	NR	PVC
MW-16	2	743.57	NR	729.79	738.49	NR	PVC

a. Measured in inches.
b. Approximate measurement.
c. Dashed cells indicate data was not reported.

Table 3.6-4a ONS Yearly Surface Water Withdrawal Summary for Years 2014–2018

Year		2014	2015	2016	2017	2018	2014-2018
Monthly Maximum	MGM	94,817.00	94,817.00	94,817.00	94,817.02	94,817.00	94,817.02
	gpm_a	2,124,036.74	2,124,036.74	2,124,036.74	2,124,037.19	2,124,036.74	2,124,037.19
Monthly Average	MGM	76,382.58	78,818.67	80,745.67	82,571.68	78,694.18	79,442.56
	gpm_a	1,740,920.99	1,827,836.36	1,836,731.32	1,883,172.18	1,794,015.80	1,816,535.33
Monthly Minimum	MGM	53,919.00	57,210.00	62,902.00	65,377.00	56,910.00	53,919.00
	gpm_a	1,418,898.81	1,399,440.41	1,506,273.95	1,544,861.57	1,399,440.41	1,399,440.41
Yearly Total	MG	916,591.00	961,874.00	968,948.00	990,860.19	944,330.18	956,520.67
	MGD	2,511.21	2,635.27	2,647.40	2,714.69	2,587.21	2,619.15

MG = million gallons

gpm_a = average gallons per minute for the month

Table 3.6-4b ONS Monthly Surface Water Withdrawal Summary (Sheet 1 of 2)

Month	CCW Intake (MGM)	B5B Emergency Intake Structure (MGM)	Total (MGM)	Total (gpm_a)
January-14	63,590	0.00	63,590.00	1,424,507.17
February-14	57,142	0.00	57,142.00	1,417,212.30
March-14	63,975	0.00	63,975.00	1,433,131.72
April-14	53,919	0.00	53,919.00	1,248,125.00
May-14	75,203	0.00	75,203.00	1,684,655.02
June-14	82,200	0.00	82,200.00	1,902,777.78
July-14	92,191	0.00	92,191.00	2,065,210.57
August-14	94,817	0.00	94,817.00	2,124,036.74
September-14	91,758	0.00	91,758.00	2,124,027.78
October-14	94,287	0.00	94,287.00	2,112,163.98
November-14	68,019	0.00	68,019.00	1,574,513.89
December-14	79,490	0.00	79,490.00	1,780,689.96
January-15	68,792	0.00	68,792.00	1,541,039.43
February-15	57,210	0.00	57,210.00	1,418,898.81
March-15	64,155	0.00	64,155.00	1,437,163.98
April-15	70,845	0.00	70,845.00	1,639,930.56
May-15	81,558	0.00	81,558.00	1,827,016.13
June-15	83,427	0.00	83,427.00	1,931,180.56
July-15	94,817	0.00	94,817.00	2,124,036.74
August-15	94,810	0.00	94,810.00	2,123,879.93
September-15	90,993	0.00	90,993.00	2,106,319.44
October-15	76,111	0.00	76,111.00	1,704,995.52
November-15	81,483	0.00	81,483.00	1,886,180.56
December-15	81,623	0.00	81,623.00	1,828,472.22
January-16	76,961	0.00	76,961.00	1,724,036.74
February-16	62,902	0.00	62,902.00	1,506,273.95
March-16	73,194	0.00	73,194.00	1,639,650.54
April-16	71,751	0.00	71,751.00	1,660,902.78
May-16	72,788	0.00	72,788.00	1,630,555.56
June-16	84,441	0.00	84,441.00	1,954,652.78
July-16	94,810	0.00	94,810.00	2,123,879.93
August-16	94,817	0.00	94,817.00	2,124,036.74
September-16	91,757	0.00	91,757.00	2,124,004.63
October-16	93,487	0.00	93,487.00	2,094,242.83

Table 3.6-4b ONS Monthly Surface Water Withdrawal Summary (Sheet 2 of 2)

Month	CCW Intake (MGM)	B5B Emergency Intake Structure (MGM)	Total (MGM)	Total (gpm$_a$)
November-16	70,476	0.00	70,476.00	1,631,388.89
December-16	81,564	0.00	81,564.00	1,827,150.54
January-17	76,520	0.01	76,520.01	1,714,157.93
February-17	65,377	0.00	65,377.00	1,621,453.37
March-17	80,448	0.02	80,448.02	1,802,150.99
April-17	78,972	0.03	78,972.03	1,828,056.25
May-17	81,831	0.03	81,831.03	1,833,132.39
June-17	89,916	0.01	89,916.01	2,081,389.12
July-17	94,817	0.01	94,817.01	2,124,036.96
August-17	94,817	0.02	94,817.02	2,124,037.19
September-17	91,758	0.01	91,758.01	2,124,028.01
October-17	88,108	0.02	88,108.02	1,973,745.97
November-17	66,738	0.02	66,738.02	1,544,861.57
December-17	81,558	0.01	81,558.01	1,827,016.35
January-18	71,963	0.01	71,963.01	1,612,074.60
February-18	56,910	0.00	56,910.00	1,411,458.33
March-18	62,471	0.02	62,471.02	1,399,440.41
April-18	69,462	0.01	69,462.01	1,607,916.90
May-18	71,573	0.03	71,573.03	1,603,338.49
June-18	79,506	0.01	79,506.01	1,840,416.90
July-18	94,125	0.02	94,125.02	2,108,535.39
August-18	94,810	0.00	94,810.00	2,123,879.93
September-18	91,758	0.02	91,758.02	2,124,028.24
October-18	94,817	0.00	94,817.00	2,124,036.74
November-18	76,995	0.04	76,995.04	1,782,292.59
December-18	79,940	0.02	79,940.02	1,790,771.06

Table 3.6-5 Surface Water Usage Summary in MGD, 2015

Category	Oconee County	Pickens County
Public Supply	10.58	32.98
Domestic, Self-Supplied	0.00	0.00
Industrial	0.00	1.63
Irrigation	0.42	0.30
Livestock	0.67	0.09
Aquaculture	4.18	0.00
Mining	0.01	0.02
Power Generation	2589.73	0.00
Total	**2605.59**	**35.02**

(USGS 2019b)

Table 3.6-6 Groundwater Usage Summary in MGD, 2015

Category	Oconee County	Pickens County
Public Supply	0.24	0.03
Domestic, Self-Supplied	1.67	1.85
Industrial	0.00	0.00
Irrigation	0.00	0.00
Livestock	0.00	0.00
Aquaculture	0.00	0.00
Mining	0.03	0.06
Power Generation	0.00	0.00
Total	**1.94**	**1.94**

(USGS 2019b)

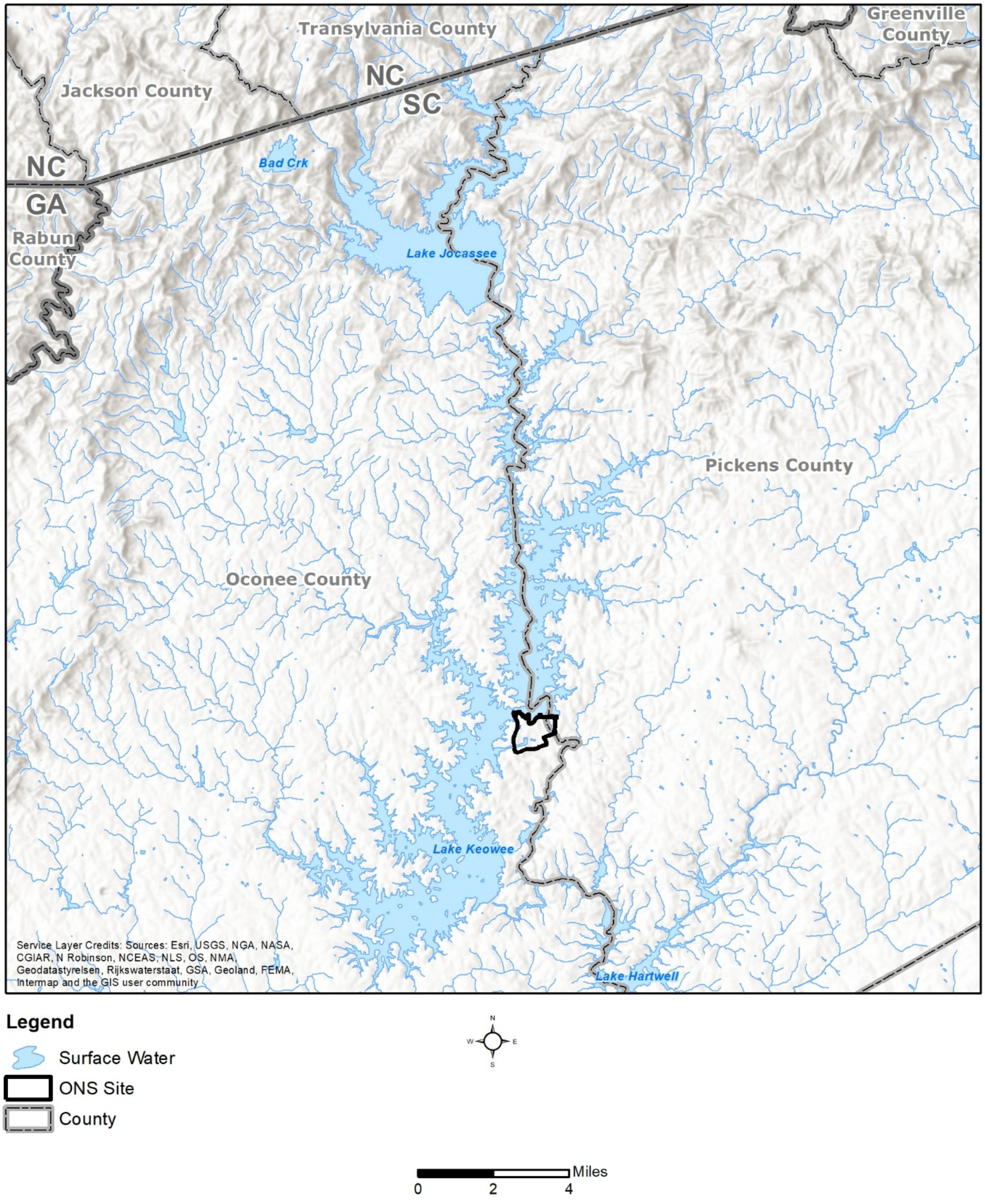


Figure 3.6-1 Regional Hydrological Features

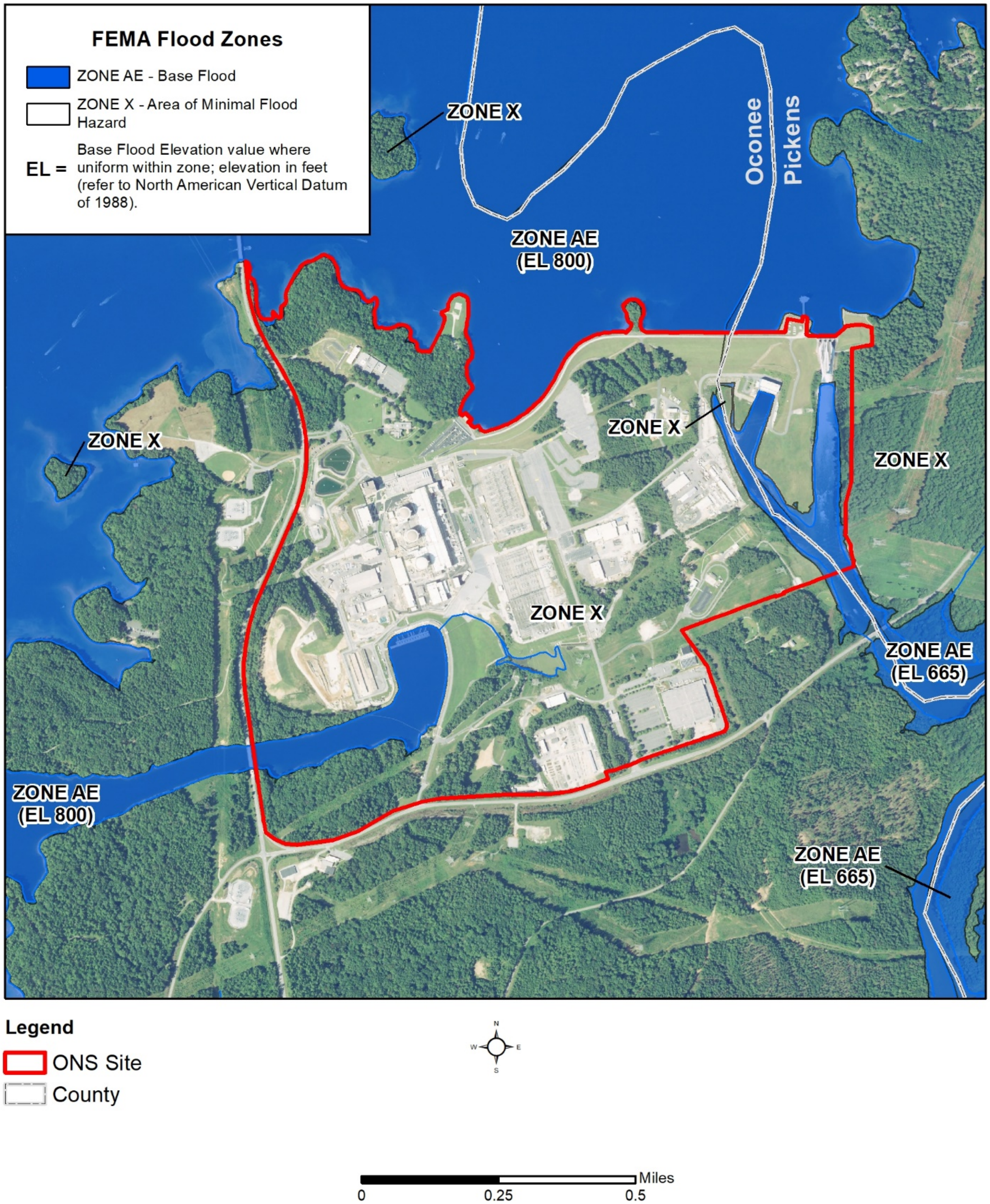


Figure 3.6-2 FEMA Flood Zones, ONS Property

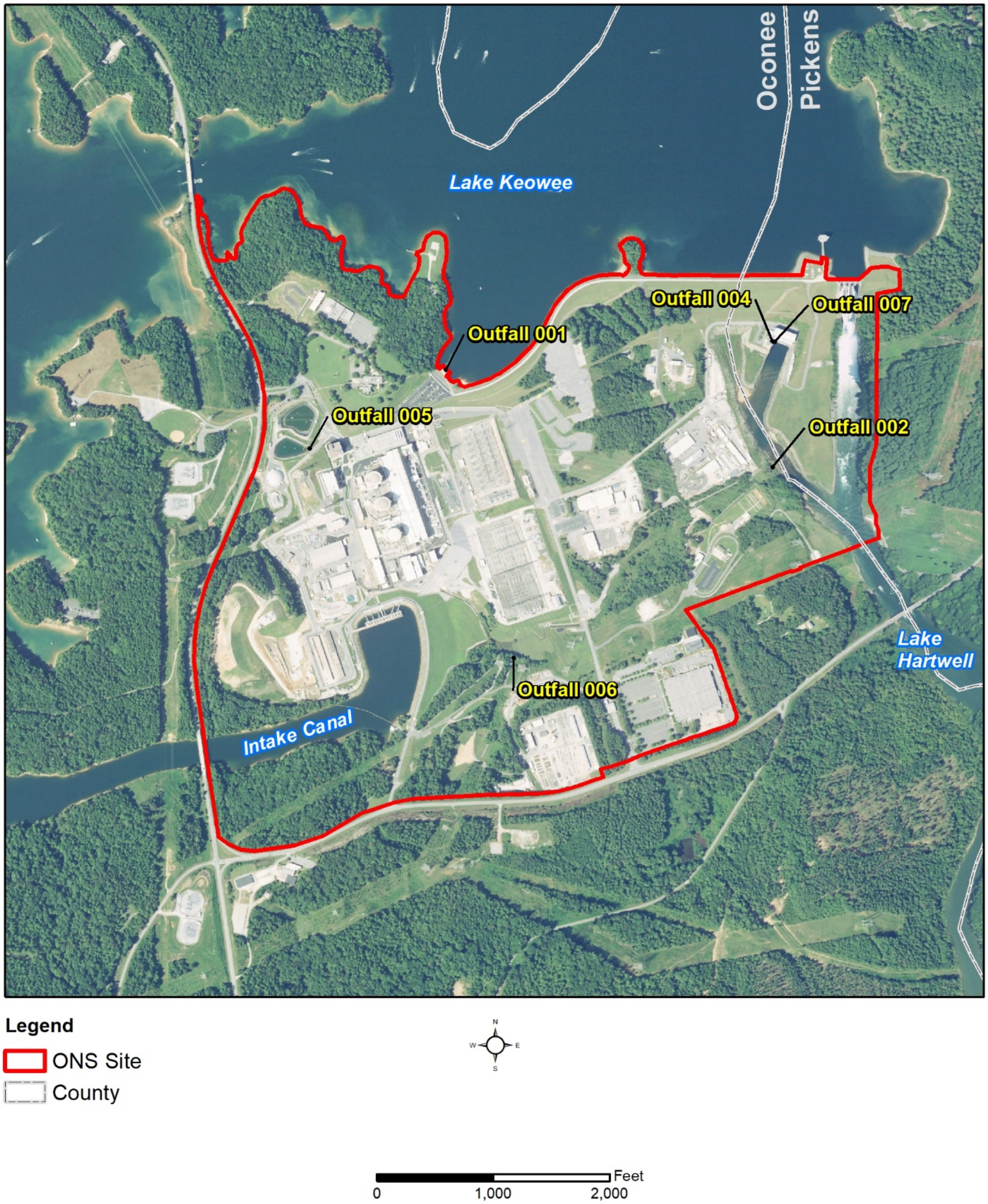


Figure 3.6-3 NPDES Permitted Outfalls at ONS

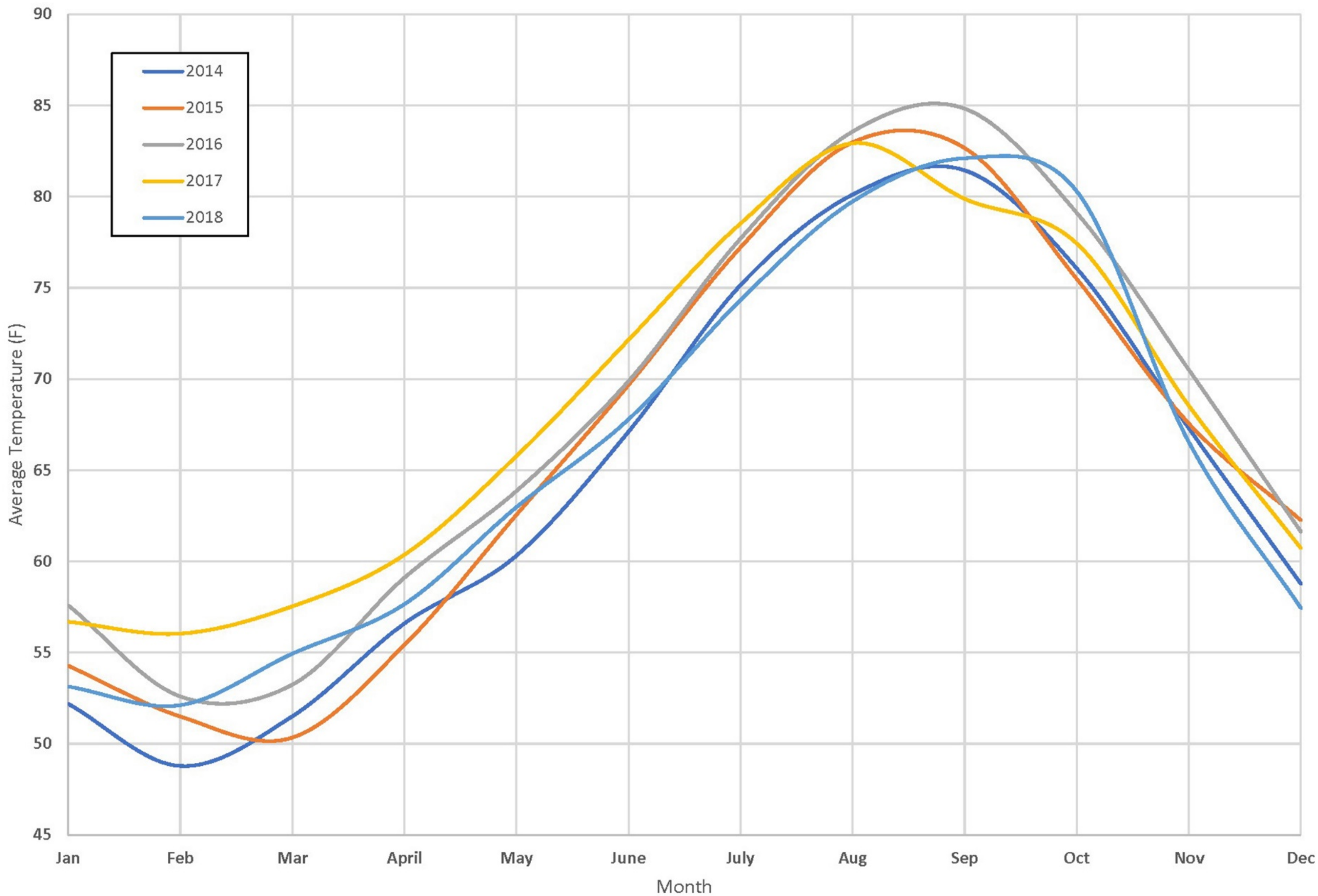


Figure 3.6-4 Average Intake Temperature at ONS, 2014–2018

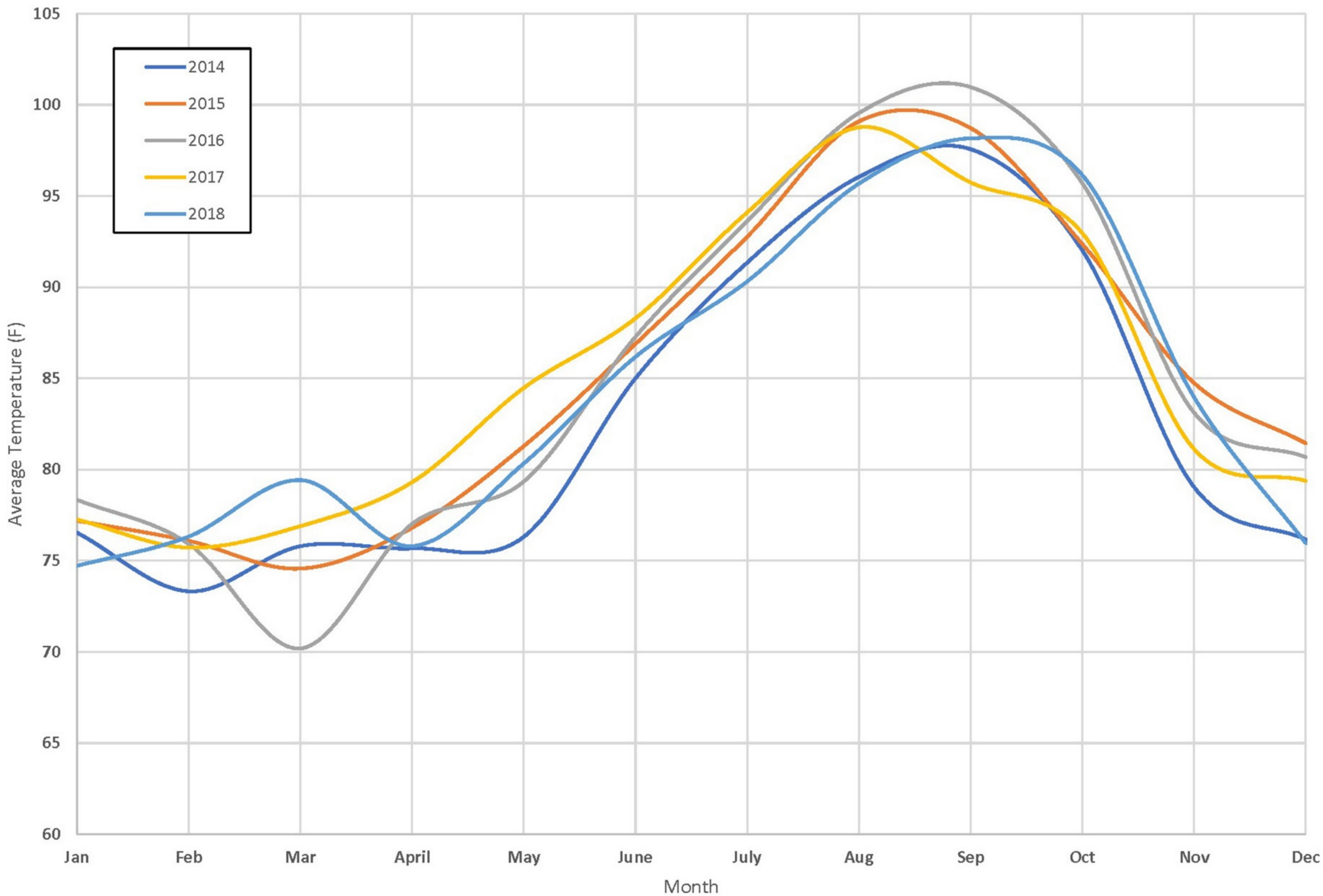


Figure 3.6-5 Average Discharge Temperature at ONS, 2014–2018

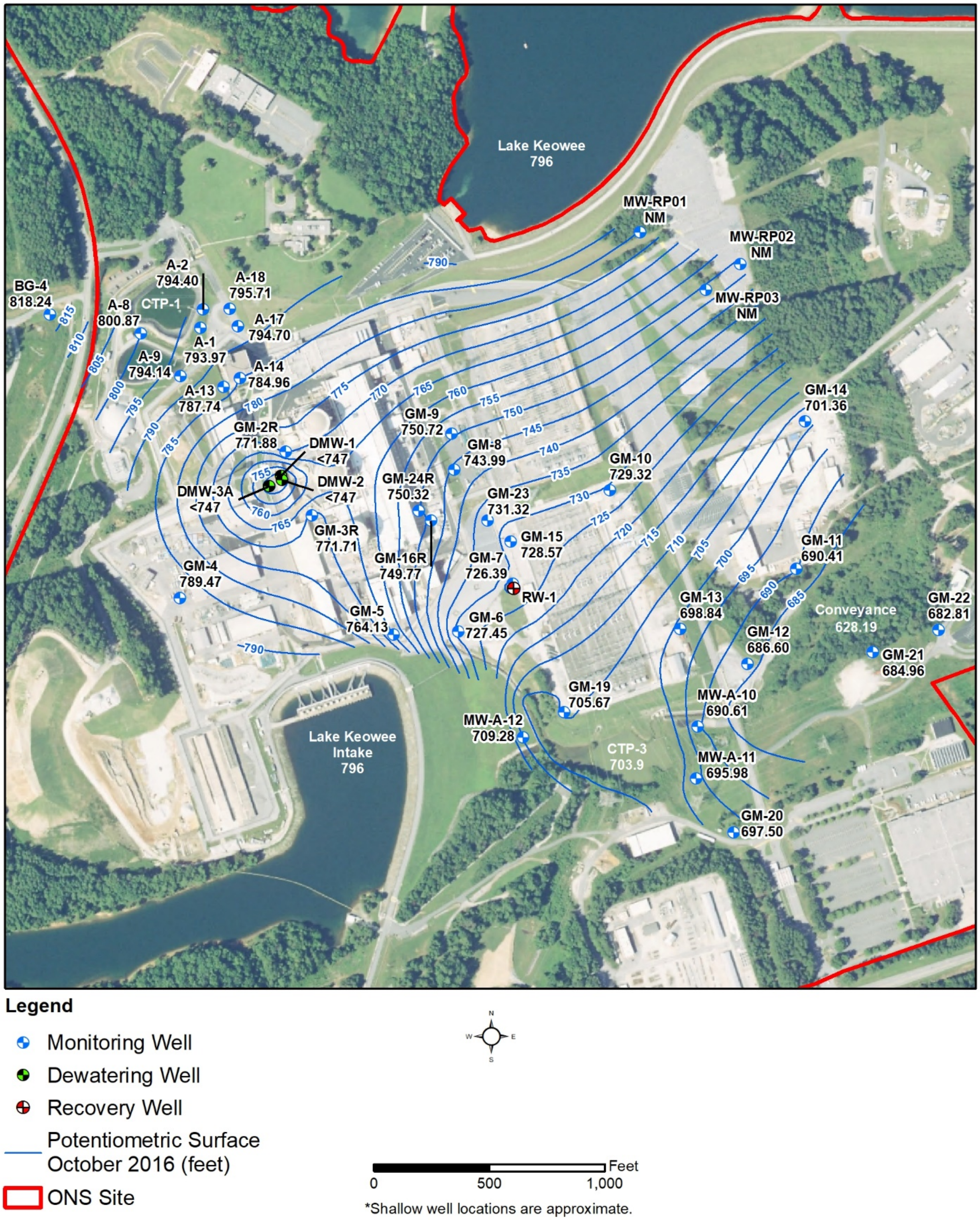


Figure 3.6-6a ONS Potentiometric Surface, Shallow Groundwater Elevation

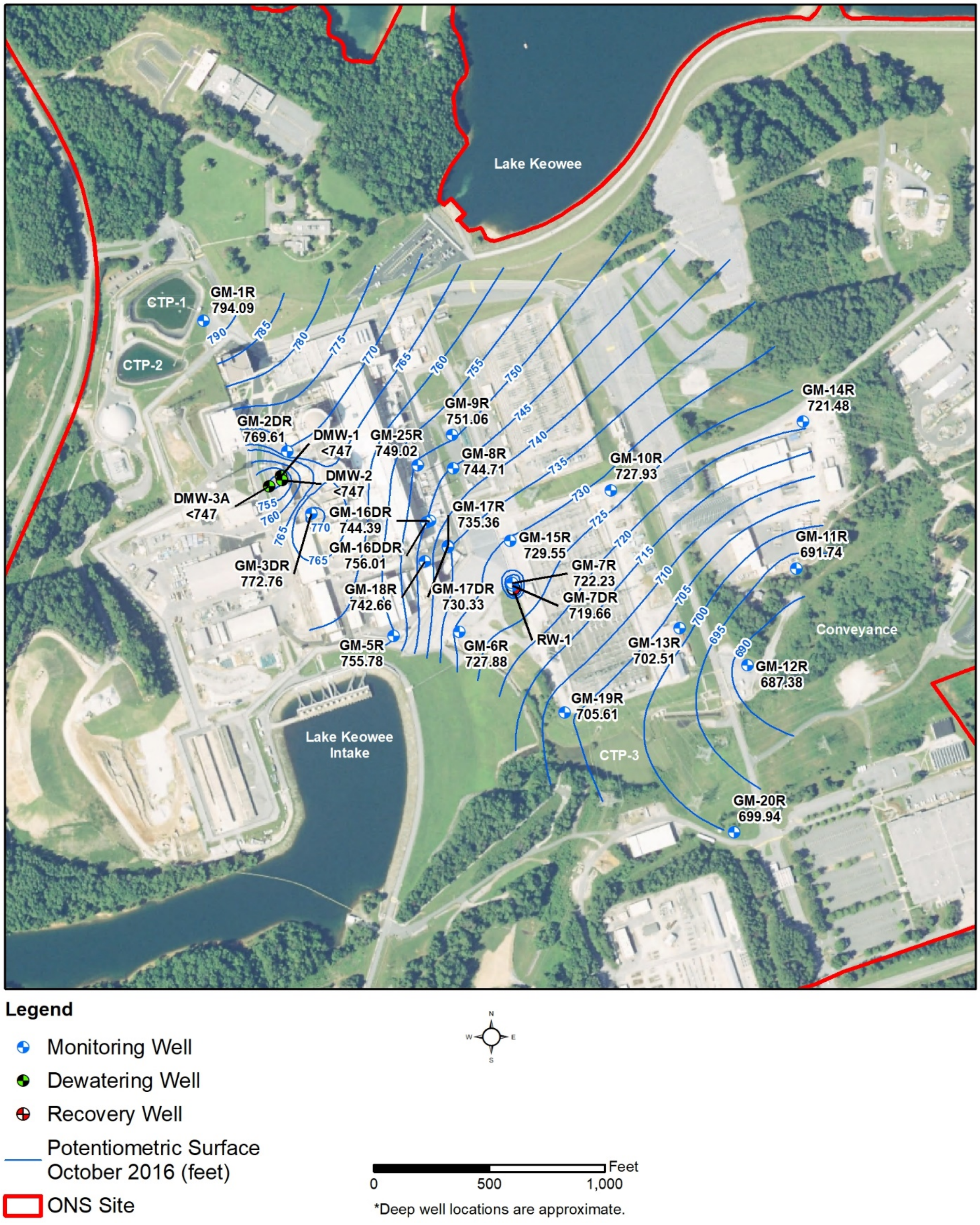


Figure 3.6-6b ONS Potentiometric Surface, Deep Groundwater Elevation

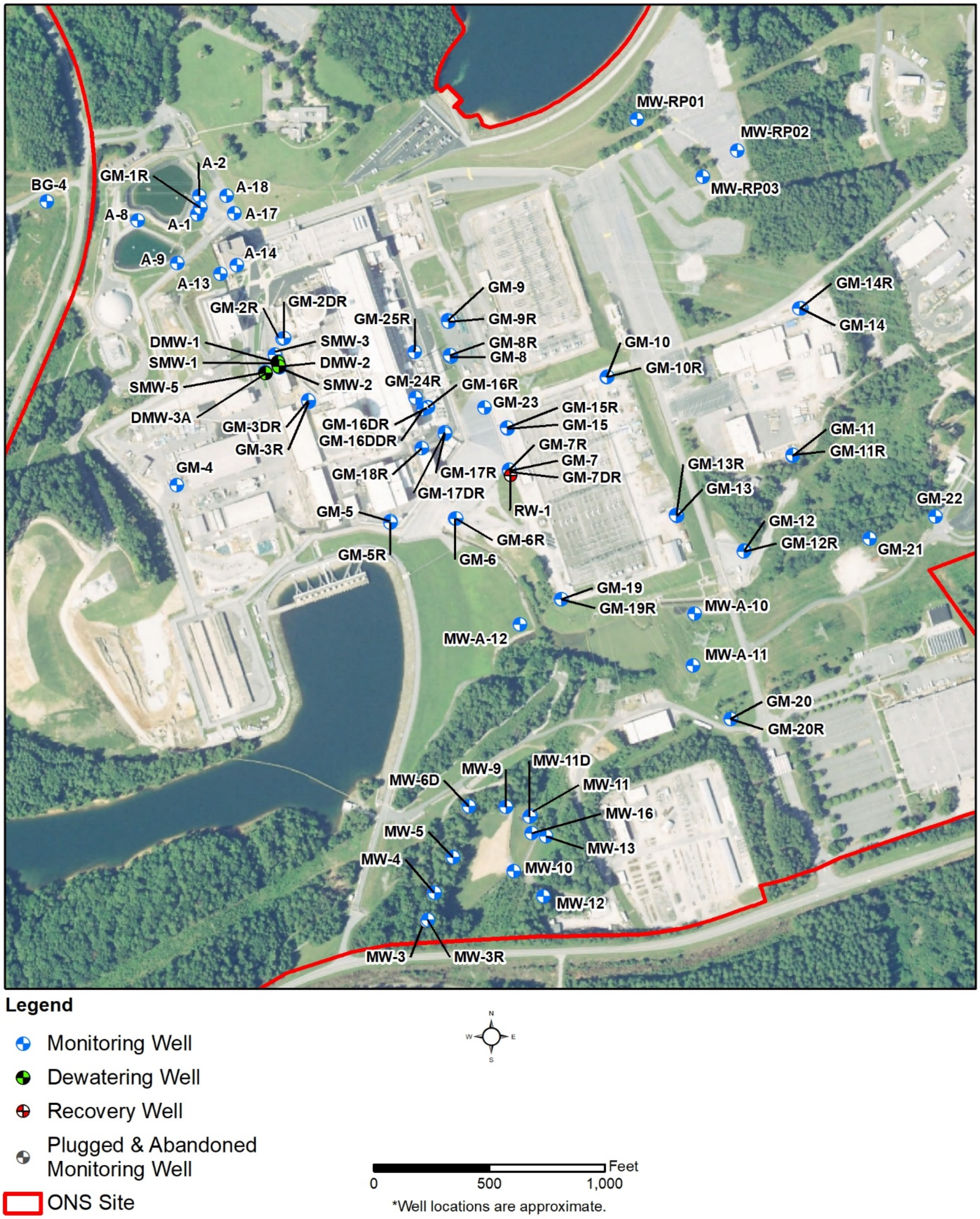


Figure 3.6-7 ONS Onsite Groundwater Monitoring Wells

3.7 Ecological Resources

3.7.1 Aquatic Communities

This section describes the aquatic environment and biota near the ONS site and other areas potentially affected by the continued operation of ONS. It includes a description of the aquatic ecosystems at or near the site, a description of representative important species that are present or are expected to occur, and the location of state parks, critical habitats, or other areas carrying special designations.

The aquatic resources in the vicinity of the ONS site are associated with Lake Keowee and Lake Jocassee. Lake Keowee was created to provide ONS cooling water and hydroelectric generation by impounding the Little River and Keowee River (Figure 3.1-4).

Lake Keowee, near Seneca, SC, was purpose built in 1971 and is an 18,357-acre reservoir with approximately 388 miles of shoreline. Lake Keowee lies within the upper Savannah basin (HUC 030601) in the Seneca sub-basin (HUC 03060101) (USGS 2019c). The lake is owned and managed by Duke Energy. ONS is located between two basins, Little River and Keowee River, that have a total drainage area of 439 square miles. The two basins are connected by a man-made canal which allows for water availability by ONS within the two basins. Water entering the Keowee watershed comes from Lake Jocassee to the north. Water from the lake drains into the Keowee River, travelling south until eventually entering the Lake Hartwell reservoir. The cooling water intake system for ONS is located downstream of the canal in the Little River watershed and withdraws water from under a skimmer wall. Heated water is discharged north of the ONS site at a subsurface depth into the Keowee River watershed. The reservoir serves as a source of cooling water, hydroelectric production, and pumped storage operation. The lake fully supports aquatic life, wildlife, and recreational activities. Additionally, the lake provides drinking water to Greenville, Seneca, and surrounding communities. (SCDNR 2019b)

Lake Jocassee serves as the upper pool for the Jocassee Hydroelectric Station and lower pool for the Bad Creek pumped storage hydroelectric station. These facilities are owned and operated by Duke Energy. The reservoir is in the upper Savannah River basin and is 7,560 acres in size with a maximum depth of 361 feet. The immense depth of lake provides cooler water temperatures and suitable habitat for cool water species.

3.7.1.1 Aquatic Resources of Lake Keowee

Lake Keowee does not provide for commercial fishing but has become a resource for recreational fishing and other aquatic activities. The lake offers many sport fish that anglers enjoy catching and eating. Recreational species include largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), spotted bass (*M. punctulatus*), redeye bass (*M. coosae*), bluegill (*Lepomis macrochirus*), redear sunfish (*L. microlophus*), redbreast sunfish (*L. auritus*), channel catfish (*Ictalurus punctatus*), and flathead catfish (*Pylodictis olivaris*). Forage species include threadfin shad (*Dorosoma petenense*), gizzard shad (*D. cepedianum*), and blueback herring (*Alosa aestivalis*) (FERC 2016a). Stocking of some sport fish such as largemouth and smallmouth bass and the creation of fish attractors have provided greater fishing opportunities around the lake. Although unrelated to ONS operations, consumption of fish from the lake, such as largemouth bass and spotted bass, is recommended to be limited to one meal per week due to high mercury levels in the fish tissue (SCDHEC 2020b).

The Keowee-Toxaway State Park was built on the north end of the lake through a partnership between Duke Energy and the State of South Carolina. The state park provides 1,000 acres that include three separate parks where the public can enjoy camping, fishing, boating, and other recreational amenities. In addition, a 373-acre wildlife preserve is managed by the SCDNR. Real estate around the lake has expanded significantly over the years to include residential neighborhoods, homes along the shoreline, restaurants, and other amenities such as golf courses. Lake Keowee is a valuable resource and important revenue source to the State of South Carolina. (SCDNR 2019b; SCSP 2019a)

Lake Keowee is a relatively deep reservoir in the southeastern United States and has been classified as monomictic. The reservoir is characterized by an annual warming period (spring-summer) when vertical thermal stratification develops and an annual cooling period (fall-winter) that leads to a single homogeneous mixing period. This variability in the reservoir helps to support numerous phytoplankton, zooplankton, benthic macroinvertebrate, and fish communities. Thermal and water quality studies on Lake Keowee, which were completed from the initial impoundment of the lake through 2006, have been done to assess temporal and spatial patterns of temperature and water quality changes and to identify factors that influence these patterns. Several sites around the lake are used to monitor surface water temperatures. On average, surface water temperatures range from 11.3–32.6° Celsius (C). Temperatures nearest the heated water discharge are expectedly higher ranging from 14.1–34.9°C, whereas water temperatures farthest from the discharge range from 8–31.8°C. DO concentrations across the lake are typically similar, with only the discharge location generally being slightly less, likely due to the withdrawal point from Lake Keowee. The minimum surface DO value recorded for the lake as a whole over the last 6-year period was 5.6 mg/L, which is better than South Carolina's water quality standards. Lake Keowee water surface temperatures and DO are similar to other comparable southeastern reservoirs.

Phytoplankton and zooplankton studies in Lake Keowee began in mid-1973 by Duke Energy biologists in accordance with the NRC's technical specifications for ONS. Studies were halted for a period and began again in 1989. Information in this section is from data collected from 2006 to 2011. Identified factors that influence phytoplankton populations in Lake Keowee are solar radiation, temperature, nutrient concentrations, dilution from low level water pumped through the station, and mixing related to ONS and Jocassee Hydroelectric Station pumping rates. Nine phytoplankton taxonomic classes comprising 207 species and varieties have been identified from samples collected in Lake Keowee (Table 3.7-1). More than two-thirds of the taxa are green algae (Chlorophyta) and diatoms (Bacillariophyta). The studies did not identify any large populations of thermally tolerant or nuisance algae species. Phytoplankton are susceptible to entrainment; however, this is unlikely to have any significant impacts on the community. Entrainment of phytoplankton is unlikely to have a significant impact on the population because the numbers of phytoplankton entrained are a very small proportion of the populations present in Lake Keowee and are not anticipated to affect the overall numbers or diversity present. Toxic impacts from thermal inputs to the phytoplankton community in Lake Keowee have not been observed. Phytoplankton communities in Lake Keowee are small but highly diverse and viable. The phytoplankton community plays a vital role in the well-being of the lake, serving as an importance food source, carbon capture, and indicator of aquatic health. Phytoplankton are the foundation of the aquatic food web. Having a diverse phytoplankton population helps ensure healthy aquatic system function. (Agar 2018)

The zooplankton community in Lake Keowee consists entirely of microcrustaceans (copepods and cladocerans) and rotifers. Rotifers are the most diverse of the zooplankton observed, followed by copepods and cladocerans, which were the least abundant. Studies were conducted between 2006 and 2011 and results indicated a decline in zooplankton species during this period. Four zooplankton taxonomic classes and 47 species were identified: Rotifera has 26 species, Cladocera has 11 species, Copepoda has nine species, and Chaoboridae has one species (Table 3.7-2). Changes in the zooplankton communities were associated primarily with normal lake aging. Zooplankton are susceptible to entrainment; however, impacts to the community are likely to be to a very small number of individuals relative to the total population of Lake Keowee and it is not anticipated to affect the diversity of species present in the lake. Lake Keowee provides support for a highly diverse and viable zooplankton communities. The diversity, abundance, and tolerances of zooplankton are indicators of the health of an aquatic system. Zooplankton play an important role in the aquatic food web as they act to regulate productivity by working as secondary producers. They are the primary food source of small fish that occur in aquatic systems, thereby feeding a majority of the food web.

Between 2005 and 2008, macroinvertebrate studies in Lake Keowee identified the following freshwater mussel species occurring in the lake: paper pondshell (*Utterbackia imbecillis*), eastern floater (*Anodonta cataracta*), and Florida pondhorn (*Uniomerus carolinianus*). The eastern floater is the most abundant, followed by the paper pondshell and Florida pondhorn (FERC 2016a).

Freshwater mussels are an important indicator of the health of an aquatic system. The lack of diversity of freshwater mussels may be because Lake Keowee is a reservoir with limited habitat types rather than a free-flowing river with greater habitat heterogeneity. Freshwater mussels are in decline throughout the United States, especially in the southeast. Of the nearly 300 species found in the United States, 70 percent are of conservation concern. Declines in mussel species populations are the result of multiple factors such as habitat destruction, water quality degradation, hydrologic change, and loss of host fish. Native mussels are also impacted by invasive mussels.

One invasive mussel species, the Asian clam (*Corbicula fluminea)* (Section 3.7.5.2.1), has been studied to determine its population densities in ONS condenser cooling water system intake structures. This species has a high susceptibility to entrainment, which can lead to water pump issues. Monitoring has been ongoing since 1990. *Corbicula* can lead to biofouling in raw water systems that can reduce water flow, clog screens, and other narrow passages. Samples are collected from multiple pump pits using a Peterson grab sampler. Clams are then counted, measured, and classified as adults or juveniles. A comparison of biofouling index values for all stations sampled during 2017 showed that ONS Unit 2 pump pits averaged the lowest of any statons sampled. All pump pits were in the low to moderate range.

Fish populations in Lake Keowee have been monitored by several agencies and organizations since 1971. Duke Energy's most current fish studies from Lake Keowee occurred in 2006 and 2013. Standard sampling protocols were used to determine fish abundance and species composition of both littoral and pelagic species. A variety of methods (e.g., electrofishing, hydroacoustic sampling, and purse seine sampling) were employed to reduce gear bias when sampling. Results from the electrofishing sampling determined that Lake Keowee has a diverse littoral fish population. For example, 18 species and two hybrid fish species were identified. Centrarchids, bluegill and sunfish, were the most abundant species. Largemouth and redeye bass populations have decreased slightly, which may be due to the increase in spotted bass numbers. Flathead catfish, which are an introduced species, may also be contributing to the decrease in largemouth and redeye bass populations.

The pelagic fish community stabilized around 2002 at approximately 10 million fish, which was primarily composed of threadfin shad and blueback herring. Threadfin shad and blueback herring were the most common fish identified in this survey. They are also the species which are most likely to be influenced by the levels of chlorophyll a, phytoplankton, and zooplankton in the lake.

Analysis of the collected data indicate the Lake Keowee fish community to be healthy, balanced, and diverse. The fish community structure indicates a healthy aquatic system. Changes in species richness, abundance of species, and trophic composition indicate no long-term trends that can be attributed to the operation of ONS. Between the studies, 30 fish species were identified as occurring in the lake (Table 3.7-3). Two hybrid species were found: hybrid black bass and hybrid sunfish. Six species are listed as state species of concern: blueback herring, notchlip redhorse, snail bullhead, flat bullhead, striped bass, and redeye bass.

Impingement occurs when organisms are held against the intake screen or netting placed within intake canals. Most impingement involves fish and shellfish. Entrainment occurs when organisms pass through the intake screens and travel through the condenser cooling system. Aquatic organisms typically entrained include ichthyoplankton (fish eggs and larvae), larval stages of shellfish and other macroinvertebrates, zooplankton, and phytoplankton. Mortality from entrainment is dependent on several factors such as the characteristics of the intakes, the size and age of fish, and seasonal movement patterns. Impingement studies from 2006–2007 and entrainment studies from 2016–2017 determined that both impingement and entrainment rates were low at ONS due to the use of a curtain wall. The levels are considered low or small compared to the size of the representative fish populations of Lake Keowee. The curtain wall allows intake water to be pulled from depths greater than 65 feet below normal lake elevation. This eliminates many species due to the depth and location and therefore reduces entrainment and impingement.

The impingement study determined that 29 fish species were representative of the entrained species at ONS. Impinged fish were primarily forage species such as threadfin shad and blueback herring. The total number of the most abundant species, threadfin shad and blueback herring, amount to less than 0.7 percent of the population of these species in Lake Keowee. The entrainment study found that most entrained egg and larvae species were Clupeids, with the remainder either sunfish or unidentifiable. ONS operations have little impact on sportfish populations and operations have not impaired the fish community. The amount of fish lost to impingement equals less than one fish per day for all but three species. For the species that result in additional loss, it was still less than four individuals per day, which is less than what a recreational sport fisherman might take. Impingement results from the most recent study were significantly lower than results from a similar study conducted in 1990. This indicates that the intake at ONS is currently not impacting fish levels and that the study is representative of current Lake Keowee populations. Impacts from the thermal plume have been determined to be minimal and to not negatively impact the aquatic biological community of Lake Keowee (FERC 2016a)

3.7.1.2 Other Aquatic Resources

Lake Jocassee is upstream of the ONS facility and is owned and operated by Duke Energy. The spillway of the lake flows into the Keowee River and Lake Keowee. The lake serves as the upper pool for the Jocassee Hydroelectric Station and lower pool for the Bad Creek pumped storage hydroelectric station. The lake was initially impounded in 1972 and is designated by the state as trout "put, grow, and take water" with both rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) fisheries. Duke Energy monitors the water quality of the lake to ensure that the required habitat for trout is available by monitoring water temperatures and DO concentrations in the lake. The lake also provides other sport fishing opportunities for species such as smallmouth and spotted bass. The lake serves as a valuable recreational fishery for anglers and provides other water-related activities.

Lake Hartwell is downstream from the ONS facility. The lake was built during 1953–1963 and is maintained by the USACE. The lake is a 56,000-acre reservoir with approximately 962 miles of shoreline and is one of the most popular lakes in the southeastern United States. Lake Hartwell also offers 23,000 acres of public land. The lake is considered one of the best sportfishing lakes in the state, providing opportunities to catch three species of black bass, striped, and hybrid bass, and several species of sunfish. Additional recreational activities include boating, camping, and hunting. (SCDNR 2019c; SCSP 2019b)

3.7.2 Terrestrial and Wetland Communities

Most of the ONS site consists of generation and maintenance facilities, laydown areas, parking lots, and mowed grass. Onsite terrestrial communities consist of remnants of southern piedmont dry oak-pine forest, pasture/hay, and patches of freshwater emergent and woody wetlands.

This section identifies terrestrial and wetland ecological resources and describes species composition and other structural and functional attributes of terrestrial biotic assemblages that could be affected by the continued operation and maintenance of the facilities.

3.7.2.1 Physiographic Province

The ONS site is located in the Appalachian highlands division of the Piedmont province and it is located to the south of the Appalachian highlands division of the southern Blue Ridge province. Combined, the Piedmont and the southern Blue Ridge provinces are 60 to 200 miles wide. The Piedmont province extends from New York to Alabama, stretching approximately 1,000 miles. It is composed of weathered complex metamorphic and igneous rock, quartz-feldspar gneiss, and schist. Topography consists of rounded ridges with low to moderate relief (NPS 2018).

3.7.2.2 Ecoregion

ONS and Lake Keowee are situated within the Piedmont ecoregion and contain portions of three sub-ecoregions within a 20-mile radius of the site: the southern inner Piedmont, the southern outer Piedmont, and the southern crystalline ridges and mountains, the latter of which falls within the Blue Ridge ecoregion. The Piedmont ecoregion is a transitional area between the mountains and the coastal plain. Rocks are covered with a thick layer of saprolite and soils are likely fairly eroded as land in the Piedmont region was once heavily farmed in corn, tobacco, wheat, and cotton. Land has either returned to forest, or been converted to pasture or urban/suburban land use.

Brief descriptions of each sub-ecoregion are provided below.

3.7.2.2.1 Southern Inner Piedmont

The southern inner Piedmont region falls within the larger Piedmont ecoregion within the Appalachian highlands. It is less mountainous than other portions of the Appalachian highlands. Physiography consists of low to high hills and ridges within dissected irregular plains. The southern inner Piedmont has a higher elevation than the southern outer Piedmont ecoregion. Elevation ranges from 730–1,640 feet and precipitation averages between 55–65 inches annually. The upland areas consist of mostly gneiss and schist bedrock covered with clayey and micaceous saprolite, these generally being finer soils than coastal regions. Streams consist of cobble, gravel, and sandy substrate. The major forest types are mixed oak forest and oak-hickory-pine forest.

3.7.2.2.2 Southern Outer Piedmont

The southern outer Piedmont region falls within the larger Piedmont ecoregion within the Appalachian highlands. Physiography consists of low rounded hills and ridges within dissected irregular plains. The southern outer Piedmont region has less overall relief, elevation, and precipitation than the southern inner Piedmont. Elevation ranges from 180–1,040 feet and precipitation averages between 45–56 inches annually. The region consists of gneiss, schist, and granite rocks covered with clayey soil and deep saprolite. Streams usually consist of cobble, gravel, and sandy substrate. Land use consists of cropland, pasture, and loblolly pine plantations.

3.7.2.2.3 Southern Crystalline Ridges and Mountains

The southern crystalline ridges and mountains region falls within the larger Blue Ridge ecoregion within the Appalachian highlands. The area consists of low to high mountains with both rounded and steep slopes and with narrow valleys. The area consists of pre-Cambrian and high-grade metamorphic rocks, being mostly gneiss and schist and covered with loamy, acidic, well-drained soils. Streams usually have boulder bottoms. Forested areas are mostly oak, while mixed hardwood forests are comprised of hemlock, poplar, and maple.

3.7.2.3 Terrestrial Habitats

Southern Piedmont Mesic Forest

The southern Piedmont mesic forest is a mix of broad-leaved deciduous hardwood species and hardwood-pine forests, with a well-developed understory present. Understory shrub and herbaceous layers are dense and most often species rich. One of the characteristics of this habitat type is a moderate amount of moisture. Most species present are shade tolerant. Abundant and dominant tree species include American beech (*Fagus grandifolia*), northern red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*), and red maple (*Acer rubrum*). White ash (*Fraxinus americana*), white oak (*Quercus alba*), loblolly pine (*Pinus taeda*), and American holly (*Ilex opaca*) are also common. Characteristic shrubs include eastern sweetshrub (*Calycanthus floridus*), mountain sweet pepperbush (*Clethra acuminata*), highland doghobble *(Leucothoe fontanesiana*), painted buckeye (*Aesculus sylvatica*), and oakleaf hydrangea (*Hydrangea quercifolia*). Characteristic herb species include black snakeroot (*Actaea racemosa*), blue cohosh (*Caulophyllum thalictroides*), spotted geranium (*Geranium maculatum*), Canada wood-nettle (*Laportea canadensis*), and bloodroot (*Sanguinaria canadensis*) (Pyne and Gawler 2015).

Southern Piedmont Dry Oak-(Pine) Forest

Most of the southern Piedmont dry oak forest is considered successional forest since most trees were historically cut and cleared. This habitat type occurs most often on upland ridges and slopes and vegetation found in this habitat is likely adapted to periodic fire. A dense understory is common, but the herbaceous layer is sparser and depends on soil type present. This habitat type is dominated by oak species such as white oak, northern red oak, southern red oak (*Quercus falcata),* scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*), and post oak (*Quercus stellata*). Other common tree species found in this vegetation association are pignut hickory (*Carya glabra*), mockernut hickory (*Carya tomentosa*), loblolly pine, shortleaf pine (*Pinus echinata*), Virginia pine (*Pinus virginiana*), red maple, and sweetgum (*Liquidambar styraciflua*).

Southern Piedmont Cliff

This habitat type is found on overhanging rock outcrops and river bluffs, such as those found in river gorges. Bare rock comprises most of the substrate and plant species are adapted to low nutrient levels. Most vegetation consists of lichens, herbaceous species, and occasional shrubs and trees. Species such as Venus' pride (*Houstonia purpurea*), cliff stonecrop (*Sedum glaucophyllum*), and rock polypody (*Polypodium virginianum*) are characteristic species of this ecosystem. Common species include early saxifrage (*Micranthes virginiensis*), poverty oatgrass (*Danthonia spicata*), and little bluestem (*Schizachyrium scoparium*) (Schafale and Pyne 2014).

Southern Piedmont Small Floodplain and Riparian Forest

This vegetation community is driven by flooding through material deposition, addition of nutrients, and scouring. Most of these habitats are found along streams and rivers and floodplains. Most species are adapted to medium amounts of moisture. The soils are fertile in these habitats and support forest species. Common species of trees include: tulip poplar, sweetgum, red maple, sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), boxelder (*Acer negundo*), sugar hackberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*), swamp chestnut oak (*Quercus michauxii*), and cherrybark oak (*Quercus pagoda*). Woody and herbaceous vines are common and include species such as peppervine (*Ampelopsis arborea*), Alabama supplejack (*Berchemia scandens*) muscadine (V*itis rotundifolia*), trumpet creeper (*Campsis radicans*), and saw greenbrier (*Smilax bona-nox*). Common herbaceous species include white edge sedge (*Carex debilis*) and Indian wood-oats (*Chasmanthium latifolium*), bearded beggarticks (*Bidens aristosa*), and swamp smartweed (*Persicaria hydropiperoides*) (Pyne 2015).

3.7.2.4 Wetlands

Wetlands are defined as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. The USACE describes thirteen functions and values typically considered by regulatory and conservation agencies when evaluating wetlands. These include groundwater recharge/discharge; floodflow alteration; fish and shellfish habitat; sediment/toxicant/pathogen retention; nutrient removal/retention/transformation; production export; sediment/shoreline stabilization; wildlife habitat; recreation (consumptive and non-consumptive); educational/scientific value; uniqueness/heritage; visual quality/aesthetics; and threatened and endangered species habitat (USACE 1999).

The USFWS maintains the National Wetlands Inventory (NWI), which integrates digital map data with other resource information to produce current information on the status, extent, characteristics, and functions of wetland, riparian, and deep-water habitats in the United States.

Based on a review of USFWS NWI maps of the site (USFWS 2019a), there are approximately 14,926 acres of wetlands within a 6-mile radius of ONS, composed of the following types (Figure 3.7-1):

- Freshwater emergent wetland habitat covering approximately 102 acres (1 percent of total wetland habitat)

- Freshwater forested/shrub wetland habitat covering approximately 321 acres (2 percent of total wetland habitat)
- Freshwater pond habitat covering approximately 102 acres (1 percent of total wetland habitat)
- Lake habitat covering approximately 13,950 acres (93 percent of total wetland habitat)
- Riverine habitat covering approximately 450 acres (3 percent of total wetland habitat)

The ONS property is bounded by Lake Keowee on the northern and western property boundaries. Based on the NWI data (USFWS 2019a), a total of 67 acres of wetland, lake, and riverine waters are located on the ONS site. Based on the NWI, the following wetland and water types are located on the ONS site (Figure 3.7-2):

- Freshwater emergent wetland habitat covering approximately 12 acres (18 percent of total wetland habitat)
- Freshwater pond habitat covering approximately 4 acres (6 percent of total wetland habitat)
- Lake habitat covering approximately 48 acres (71 percent of total wetland habitat)
- Riverine habitat covering approximately 3 acres (5 percent of total wetland habitat)

3.7.2.5 Terrestrial Animal Communities

The terrestrial community within a 6-mile radius of ONS consists of mixed oak forests interspersed with developed areas. Wildlife species found primarily in the forested and riparian portions of the site are those typically found in the southern Appalachian Mountains. Terrestrial species that are federally and/or state-listed as endangered or threatened known to occur in the vicinity of ONS are discussed in detail in Section 3.7.8. Table 3.7-4 includes all terrestrial species likely to be observed in Oconee and Pickens counties within a 6-mile radius of the ONS site. Duke Energy performs terrestrial and aquatic ecological monitoring as required for permitting and compliance as needed and prior to any new project initiated onsite.

Mammals suited to the habitat and accustomed to human development surrounding the site likely include the northern racoon (*Procyon lotor*), white-tailed deer (*Odocoileus virginianus*), Virginia opossum (*Didelphis virginiana*), eastern gray squirrels (*Sciurus carolinensis*), skunks (*Mephitis mephitis, Spilogale putorius*), woodchucks (*Marmota monax*), and eastern cottontails (*Sylvilagus floridanus*).

Reptiles and amphibians likely to inhabit the ONS site and its surroundings include the American toad (*Anaxyrus americanus*), Cope's gray tree frog (*Hyla chrysoscelis*), Fowler's toad (*Anaxyrus fowleri*), northern cricket frog (*Acris crepitans*), pickerel frog (*Lithobates palustris*), eastern box turtle (*Terrapene carolina*), black rat snake (*Pantherophis obsoletus*), eastern garter snake (*Thamnophis sirtalis sirtalis*), copperhead (*Austrelaps superbus*), southeastern five-lined skink (*Eumeces inexpectatus*), and broad-headed skink (*Eumeces laticeps*) (FERC 2016a, Section 3.3.3.1).

Bird populations on the ONS site include year-round residents, seasonal residents, and migratory transients. While there are resident bird populations, the region serves as a pass-through area for semi-annual migrations of neotropical birds that may range between South America and Canada, as well as seasonal migrations of waterfowl. Common species include: blue jay (*Cyanocitta cristata*), Canada geese (*Branta canadensis*), barn swallow (*Hirundo rustica*), American goldfinch (*Spinus tristis*), Carolina chickadee (*Poecile carolinensis*), turkey vulture (*Cathartes aura*), black vulture (*Coragyps atratus*), mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), osprey (*Pandion haliaetus*), and song sparrow (*Melospiza melodia*). Bird populations on the ONS site are representative of those found in the region (FERC 2016a, Section 3.3.3.1). A heronry, likely great blue herons (*Ardea Herodias*), is used annually for nesting on Island 23B on Lake Keowee, which is approximately ten miles from ONS (FOLKS 2017).

The ONS site is located in the Atlantic flyway, a major migratory route for birds during the fall and spring. The Atlantic flyway extends along the east cost of the United States from the Gulf of Mexico to Canada. Migrants often fly these routes at night, and land to rest early in the morning. Before dawn they seek out suitable habitat called stopovers in which to feed and avoid predators. Large natural barriers such as mountains, deserts, or large bodies of water create especially crowded stopovers. These stopovers are very important because flight over the barrier will be a long stretch without any opportunity to stop for food, rest, or cover. Lake Keowee and the surrounding area offer stopover habitat for migrating birds, particularly waterfowl.

3.7.2.6 Transmission Lines

Physical features (e.g., length, width, route) of each of the in-scope transmission lines are described in Section 2.2.5. The transmission corridors are situated within the Piedmont physiographic province. All in-scope transmission lines are located completely with the ONS EAB, as shown in Figure 2.2-4.

No designated critical habitat (DCH) areas for endangered species exist at ONS or adjacent to associated transmission lines (USFWS 2019b). The in-scope transmission corridors do not cross any state or federal parks. Mechanical mowing and selective herbicide application are the predominate methods for corridor maintenance. In areas where mowing is impractical or undesirable (e.g., wetlands and densely vegetated areas), hand cutting and/or non-restricted-use herbicides are employed.

3.7.3 Potentially Affected Water Bodies

The major water resource in the vicinity of ONS is Lake Keowee, which is located in the Savannah River Basin. The Savannah River basin watershed occupies the western portion of South Carolina and is divided into two sub-basins: the upper Savannah River sub-basin and the lower Savannah River sub-basin. The Savannah River basin spans three geographic provinces: the Blue Ridge, the Piedmont, and the Coastal Plain. The Blue Ridge province, a remnant of a former highland, is composed of rugged terrain with steep slopes and narrow ridges in the north and broad moderate slopes in the south. The Piedmont province extends to the fall line and has scattered hills and small mountains, gradually turning into gently rolling slopes and lower elevation in the eastern portion of the province. The fall zone separates the Coastal Plain province from the Piedmont province. The upper Savannah River sub-basin is located in northwestern South Carolina and extends 140 miles southeast from the North Carolina state line to the Edgefield-Aiken county line. It shares its western border with Georgia along reaches of the Chattooga, Tugaloo, and Savannah rivers and encompasses McCormick and Oconee counties and much of Abbeville, Anderson, Edgefield, Greenwood, Pickens, and Saluda counties. The sub-basin area is approximately 3,200 square miles, 10.3 percent of the state. The upper Savannah River sub-basin is one of the most intensely developed sub-basins in the state and is a region of numerous flood-control projects and hydroelectric power facilities (SCDNR 2009).

Lake Jocassee is located to the north of Lake Keowee. Completed in 1975, Lake Jocassee is South Carolina's sixth largest lake by volume, holding 1,160,298 acre-feet of water with a surface area of 7,565 acres. Immediately downstream from Lake Jocassee is Lake Keowee. ONS falls in the upper Savannah River sub-basin and withdraws water from Lake Keowee. Created in 1971 by damming the Keowee and Little rivers, the lake contains nearly 952,300 acre-feet of water and has a surface area of 18,357 acres. Lake Keowee ranks seventh in area and eighth in volume among South Carolina lakes. It is used as a water supply reservoir for the city of Greenville, and as a popular recreational area. Lake Hartwell is located to the south of Lake Keowee and was constructed by the USACE in 1963. The lake ranks fourth in surface area and first in volume among lakes in South Carolina, with a surface area of 56,000 acres and a volume of 2,549,000 acre-feet (SCDNR 2009). Most large headwater streams entering Lake Jocassee originate in North Carolina and all streams and rivers entering Lake Keowee fall under South Carolina's jurisdiction.

Most of the sub-basin groundwater occurs in saprolite, which stores rainfall and provides recharge to fractures in the underlying rock. The saprolite is as thick as 150 feet in places. About a quarter of the wells in the sub-basin are domestic wells bored into the saprolite (SCDNR 2009).

As discussed in Section 3.6.4, the water of Lake Keowee is of good quality. Lake Keowee is listed as the least eutrophic large lake in South Carolina and is characterized by low nutrient concentrations (SCDNR 2009). As discussed in Section 3.6.3, Lake Keowee is a source of drinking water supply for the City of Greenville and the city of Seneca.

As discussed in Section 3.7.1, sport fishing is a common activity on Lake Keowee and Lake Jocassee. Lake Jocassee is designated by the state as trout "put, grow, and take water". These are freshwater bodies suitable for supporting the growth of stocked trout populations and a balanced indigenous aquatic community of fauna and flora. This lake is also listed as one of the least eutrophic large lakes in South Carolina, and it is characterized by low nutrient concentrations and very clear water (SCDNR 2009).

Duke Energy is responsible for managing activities within the reservoir boundaries of Lake Jocassee and Lake Keowee in a manner that promotes safe public use and maintains environmental safeguards. Duke Energy maintains a shoreline management plan (SMP) for both lakes that classifies the respective shorelines and denotes where environmentally important habitats exist, where existing facilities and uses occur, and where future construction activities may be considered. As part of its SMP, Duke Energy maintains shoreline management guidelines, which, when used in combination with the SMP shoreline classifications, help guide responsible reservoir use activities.

Lake Keowee is licensed by FERC to operate between elevations of 775 and 800 feet. However, based on NRC requirements for ONS and other agreements, Duke Energy typically operates Lake Keowee between elevations 794.6 and 799.5 feet. On a daily average basis, Lake Keowee fluctuates less than 1 foot, rarely exceeding a fluctuation of 1.8 feet during high energy demand periods. Gross storage is 869,338 acre-feet and usable storage is 90,319 acre-feet. (FERC 2016a, Section 3.3.3.2).

ONS is equipped with a once-through heat dissipation system that withdraws cooling water from the Little River arm of Lake Keowee from underneath a skimmer wall. The discharge for the cooling water is located on the Keowee River arm of the lake just above the Lake Keowee dam. As described in Section 2.2.3.5, the Keowee River and the Little River watersheds are connected by a man-made canal. It is nearly 2 miles by lake from the point of discharge to the mouth of the intake canal. A natural cove was deepened and extended to within a few hundred feet of the power plant as part of the project when initially licensed. Across the mouth of the cove, a skimmer wall was constructed extending from above the surface of the lake (normally 800 feet above mean sea level) down to an elevation of 735 feet. This wall ensures that cooler water from near the bottom of the lake enters the intake canal. Further into the intake cove is a submerged dam, or weir, with its crest at 770 feet above mean sea level. The distance from the weir to the intake structures is nearly 0.75 miles. Each generating unit has three separate water loops.

The primary coolant loop is a closed piping system: pressurized water in the system is circulated through the reactor and transfers heat from the reactor to the steam generator. The secondary loop is also a closed system: water from this system is converted into steam (in the steam generators) that is used to drive the turbine. The third loop is an open system: water from the Little River arm of Lake Keowee is used to cool the spent steam in the secondary loop, and then it is returned to the Keowee River arm of Lake Keowee. As stated in the ONS license renewal environmental impact statement (EIS) (NRC 1999b, Section 2.1.3), the principal components of the third cooling loop are the skimmer wall, intake structure, circulating water pumps, condensers, and discharge conduits.

Water from Lake Keowee provides once-through CCW for ONS. Lake Keowee serves as the lower pond for the Jocassee Hydroelectric Station and furnishes energy to drive the Keowee Hydro Station. The Jocassee Hydroelectric Station is a pumped-storage generating facility that discharges into Lake Keowee. During periods of low electrical demand, reversible turbines pump water up from Lake Keowee back into Lake Jocassee, to be used again to generate power during periods of high electrical demand. Water from the Seneca water treatment plant is used for potable water. Treated wastewater from the plant's liquid rad-waste system is diluted and returned to the Keowee Dam tailrace. Treated water from the sewage treatment system, the chemical treatment system, the landfill leachate collection system, chemical treatment ponds, stormwater runoff, and the turbine building sump are returned to the Keowee River at a location below the tailrace. (NRC 1999b)

The SCDHEC monitors the water quality and use of lakes in the state as part of the Clean Lakes Program. Pursuant to the federal Water Pollution Control Act (33 USC 1251), also known as the Clean Water Act (CWA), the water quality of plant effluent discharges is regulated through the NPDES. The SCDHEC is the state agency delegated by the EPA to issue the NPDES permit.

The ONS NPDES permit is issued and enforced by the SCDHEC Bureau of Water, which authorizes wastewater discharges. Additionally, the NPDES permit requires quarterly acute and chronic toxicity testing of Outfall 002. Once-through cooling water and intake screen backwash discharges directly to Lake Keowee. The screens can be cleaned by high pressure washing when they are removed. No biocides or other treatment chemicals are added to the condenser cooling water. Duke Energy determined that the average water velocities in front of the generation intakes were below 1.0 feet per second (fps) with one unit generating and only slightly greater than 1.0 fps with two units generating (FERC 2016a, Section 3.3.2.2).

Conventional wastewater is identified as low volume waste sources (Outfall 002) and discharges below the Keowee Hydro Station into the Keowee River. This is considered the headwater of Lake Hartwell. Outfall 002 is authorized to discharge low volume waste sources, treated chemical metal cleaning wastes, landfill leachate, intake dam underdrain, indigenous springs, and gravity drain system. Backwash from the water treatment room filtered water system and sumps from the turbine building are some of the primary inputs to the conventional wastewater system.

As noted in Section 3.6.1, ONS has three CTPs. CTP-1 and CTP-2 are operated in a batch mode and receive inputs from turbine building sumps and water treatment room. Aeration, mixing, and pH adjustment are provided by these ponds. If needed, chemical additions are made prior to release. CTP-3 flows continuously. Discharges from CTP-1 and CTP-2 go through CTP-3. CTP-3 also collects rainwater from protected areas as well as some miscellaneous sources, such as tendon gallery and other groundwater. The CTP-3 has a skimmer boom and a concrete skimmer wall that is used to contain any oil spills from the station. The final discharge of Outfall 002 is below the Keowee Hydro Station into the Keowee River. Monitoring for pH is conducted weekly. Tests for total suspended soils, oil and grease, and total residual chlorine are conducted monthly. The Keowee Hydro Station is included in the site NPDES permit as Outfall 007. This outfall is visually inspected daily for oil and grease. Industrial stormwater discharges are regulated by a general permit issued by SCDHEC. Quarterly inspections and sampling are conducted for 14 industrial stormwater outfalls as required by the SWPPP.

3.7.4 Places and Entities of Special Ecological Interest

This section contains a description of the occurrence, location, and description of communities and habitats of special ecological interest within a 6-mile radius of ONS, such as natural heritage areas and other areas of public or scientific interest, or areas that may be particularly sensitive or susceptible either directly or indirectly to the effects of continued plant operations and refurbishment.

3.7.4.1 Keowee Wildlife Management Area

Keowee wildlife management area (WMA) is a 4,930-acre property in Pickens and Oconee counties managed by the SCDNR (SCDNR 2018). The Keowee WMA is located to the south of ONS and to the east of the Seneca River and Lake Keowee. It sits at the northern end of Lake Hartwell near Issaqueena Lake. The WMA is comprised of southern Piedmont dry oak/pine forest and southern Piedmont mesic forest interspersed with riverine and freshwater forested/shrub wetlands, which provides habitat for numerous amphibians, reptiles, mammals, waterfowl, and upland game birds.

3.7.5 Invasive Species

Duke Energy has an herbicide/pesticide management plan to combat non-compatible plant and insect species. Mechanical methods, such as mowing, are also used. Plant-specific measures are available to manage invasive bird species that become problematic. Invasive plants, animals, and invertebrates can potentially alter habitat and displace native species. As described below, several invasive species have been documented in Lake Keowee and the surrounding area, while others are listed as posing a significant threat by the State of South Carolina if introduced to the area (SCEPPC 2014).

3.7.5.1 Aquatic Plants

3.7.5.1.1 Hydrilla

Hydrilla (*Hydrilla verticillata*) is a submersed perennial plant that originated in Asia. According to the U.S. Geological Survey (USGS) non-indigenous aquatic species database, hydrilla specimens have been documented in Lake Keowee (USGS 2019d). It is considered a noxious weed in South Carolina and is regulated by state law as well as being included on the federal noxious weed list (SCDNR 2010; South Carolina Legislature 2015). Hydrilla can reproduce rapidly and form dense mats on the water surface with stems up to several feet long. It can reduce DO levels below the surface as well as reduce water quality and displace native species (Jacono et al. 2019; SCDNR 2008). Hydrilla can be controlled through mechanical harvesting or selected herbicide treatments by licensed/certified herbicide applicators. The spread of hydrilla can also be controlled by monitoring and cleaning boats thoroughly before they are placed in another water body. Education can help alert the public about the spread of this species.

3.7.5.1.2 Parrot Feather

Parrot feather watermilfoil (*Myriophyllum aquaticum*) is an aquatic species that has both a submersed leaf and emergent leaf form and is native to South America. It has been documented growing in Cedar Creek near Lake Keowee (FERC 2016a, Section 3.3.2.2). It can be found growing in a variety of wetland habitats from shallow wetlands to lakes up to 16 feet deep. It must be able to root in substrates, but leaves can grow up to a foot above water. Typical of many invasive species, parrot feather watermilfoil can withstand a wide range of environmental conditions. Similar to hydrilla, parrot feather can form dense mats, reducing water quality and DO. This species can grow readily from plant fragments and is very difficult to remove once established. Herbicides and hand removal have been only moderately successful (Wersal et al. 2019). The spread of parrot feather watermilfoil can also be controlled by monitoring and cleaning boats thoroughly before they are placed in another water body. Education can also help alert the public about the spread of this species.

3.7.5.1.3 Common Hornwort

Common hornwort (*Ceratophyllum demersum*), also commonly known as coon's tail, was documented covering approximately 0.25 acre on Frenge Creek where it enters Lake Keowee (FERC 2016a, Section 3.3.3.1). This species is a submersed annual or perennial plant that is free floating and found in areas with still or slow-moving water. Common hornwort can reproduce vegetatively through plant fragments (DiTomaso and Kyser et al. 2013). It often causes problems in waterways due to its ability to form dense mats and remove nitrogen from the water. It also can displace native species (GISD 2019a). Herbicides can be an effective measure to control common hornwort if applied by licensed/certified herbicide applicators. The spread of common hornwort can also be controlled by monitoring and cleaning boats thoroughly before they are placed in another water body. Education can also help alert the public about the spread of this species.

3.7.5.2 Aquatic Animals

3.7.5.2.1 Asian Clam

Asian clam (*Corbicula fluminea*) is a species native to Asia, Africa, and Australia. According to the USGS non-indigenous aquatic species database, Asian clams have been documented in Lake Keowee (USGS 2019e). Asian clams average 25 mm but can be as large as 65mm (USFWS 2015a). This species reproduces very rapidly and is capable of self-fertilization. The main threat to ONS from Asian clams stems from damage to intake pipes from clogging, also known as biofouling, where clams accumulate to an amount that blocks discharge from or intake into pipes. Asian clams can easily outcompete native species for food resources and habitat, as well as alter substrate (SCDNR 2008). Asian clams have been monitored at the intake canal and skimmer wall locations near ONS in pump pits. The most common source for biofouling is from free-floating larval clams. As of 2016, there was a low to moderate potential for biofouling at or near ONS.

3.7.5.2.2 Common Carp

Common carp (*Cyrpinus carpio*) is native to Europe and Asia. According to the USGS non-indigenous aquatic species database, they have been documented in Lake Keowee (USGS 2019f). Carp were also collected during electrofishing surveys in the Keowee Dam tailwater (FERC 2016a, Section 3.3.2.1). Common carp weigh between 8-10 pounds, but can weigh up to 75 pounds (TISI 2014a). This species is known to cause problems from uprooting sediment and aquatic vegetation used by other species for spawning. They will also eat the eggs of other fish species, which can cause the decline of native and imperiled species. Once established, common carp are difficult to eradicate (Nico et al. 2019).

3.7.5.2.3 Green Sunfish

Green sunfish (*Lepomis cyanellus*) are an aggressive fish species that often eats other fish and outcompetes native species for resources, leading to the decline and/or extinction of local populations of native species. According to the USGS non-indigenous aquatic species database, green sunfish have been documented in Lake Keowee (USGS 2019g). This species is able to tolerate a wide range of environmental conditions, can reproduce prolifically, and can hybridize with other sunfish species (TPWD 2019a).

3.7.5.2.4 Spotted Bass

Spotted bass (*Micropterus punctulatus*) are native in some waterbodies of the United States, but are considered invasive in Lake Keowee. Spotted bass were introduced into Lake Keowee in the 1980s and by the mid-1990s it was the most commonly caught sportfish (FERC 2016a). Spotted bass can be found in both rivers and lakes. When found in large reservoirs, spotted bass are widely distributed and often associated with fine substrates. They also have higher growth rates when found in reservoirs. Spotted bass reach sexual maturity at two years, but can do so as early as one year. This species can become top predators, feeding on other fish and crayfish when they reach 50-100mm in length. In Lake Keowee, spotted bass are causing problems by displacing native redeye bass and breeding with them (FERC 2016a).

3.7.5.2.5 Flathead Catfish

Flathead catfish (*Pylodictis olivaris*) are native in some waterbodies of the United States, but are considered invasive in Lake Keowee. Flathead catfish can be found in rivers, streams, and reservoirs. They prefer deep, slow moving areas with debris for cover. Flathead catfish grow rapidly and reach sexual maturity around three years. This species is known for eating live prey, which often consists of native species (Fuller 2019). Flathead catfish can cause declines in a variety of native species.

3.7.5.3 Terrestrial Plants

3.7.5.3.1 Mimosa

Mimosa (*Albizia julibrissin*), also commonly known as silk tree, is originally from China. It is a deciduous tree that grows between 20 and 40 feet tall. It can outcompete native species because of its ability to thrive in a wide range of conditions and its ability to colonize disturbed areas. Mimosas produce large numbers of seeds and can re-sprout easily (MacDonald et al. 2008). They are found in a variety of habitats from riparian and floodplain communities to oak-hickory woodlands. Mimosas can also form dense canopies when more than one tree invades an area (Meyer 2010). The South Carolina Exotic Pest Plant Council (SCEPPC) considers the mimosa to be a significant threat (SCEPPC 2014).

3.7.5.3.2 Princess Tree

Princess tree (*Paulownia tomentosa*) is native to China. It is a deciduous tree that can grow up to 60 feet tall with a canopy of 50 feet. This species has many invasive tendencies, such as tolerating infertile soils and the ability to grow rapidly (Rhoads and Block 2011). Princess trees have a high rate of seed production; as many as 20 million seeds can be produced by a single tree. Once seeds are established, seedling and tree growth can occur rapidly. This species can be detrimental to native plant communities due to its ability to easily invade disturbed areas and crowd out or outcompete native species (Innes 2009). The SCEPPC considers princess trees to be a severe threat (SCEPPC 2014).

3.7.5.3.3 Autumn Olive

Autumn olive (*Elaeagnus umbellata*) is a deciduous shrub native to Eurasia. It prefers sandy and loamy soils and can grow well on nutrient poor soils. Autumn olive can shade out native understory species (AISC 2014). This species often invades forest edges and abandoned agricultural fields and can form dense thickets. More than one method, such as both mechanical and herbicide treatments, is required for successful removal (Smith and Smith 2012). The SCEPPC considers autumn olive to be a severe threat (SCEPPC 2014).

3.7.5.3.4 Chinese Privet

Chinese privet (*Ligustrum sinense*) is a perennial deciduous shrub native to Asia. This shrub species can grow up to 15 feet tall. It can easily invade disturbed areas such as agricultural fields and roadsides. It can tolerate drought, nutrient poor soils, short-term flooding, and a range of environmental conditions (Munger 2003). Chinese privet often forms dense thickets which can displace native species. This species can be controlled effectively through hand pulling (SE-EPPC 2019a). The SCEPPC considers Chinese privet to be a severe threat (SCEPPC 2014).

3.7.5.3.5 Japanese Knotweed

Japanese knotweed (*Fallopia japonica*) is an herbaceous perennial plant that is native to Asia. It can effectively spread vegetatively anywhere rhizomes can establish roots, even in water, and can produce large amounts of seed. This species can tolerate a wide range of conditions, including acidic soil, shade, drought, high temperatures, high salinity, and areas with low levels of nitrogen (GISD 2019b). Because this species emerges earlier and is taller than many species, it can outcompete and shade out many native plants, reducing overall native biodiversity (CABI 2013). The SCEPPC considers Japanese knotweed to be a severe threat (SCEPPC 2014).

3.7.5.3.6 Multiflora Rose

Multiflora rose (*Rosa multiflora*) is a perennial shrub native to Asia. Individual shrubs can grow to a height of 15 feet with a width of thirteen feet. Stem tips can root when in contact with soil and roots can re-sprout, giving this species an advantage is colonizing disturbed areas (NYISI 2019). This species can tolerate a wide range of conditions, from well-drained soils to floodplains (OIPC 2019). Multiflora rose forms dense thickets, allowing it to outcompete and shade out many native plants, reducing overall native plant biodiversity. The SCEPPC considers multiflora rose to be a significant threat (SCEPPC 2014).

3.7.5.3.7 Japanese Honeysuckle

Japanese honeysuckle (*Lonicera japonica*) is a semi-evergreen vine native to eastern Asia. This species can easily grow to more than 18 feet long and form dense mats up to five feet deep as individual plants can produce up to thirty feet of stems per year. Japanese honeysuckle can be found in a variety of habitat types as it often invades disturbed areas. Because of its ability to grow over other species and form dense mats, this species often shades out and outcompetes native species for resources (Munger 2002). The SCEPPC considers Japanese honeysuckle to be a severe threat (SCEPPC 2014).

3.7.5.3.8 Kudzu

Kudzu (*Pueraria montana*) is a perennial, opportunistic climbing herbaceous to semi-woody vine that is native to eastern Asia. It grows up to 25 centimeters a day in ideal conditions. Kudzu can grow on a variety of soils and will grow over anything it comes in contact with. It kills other vegetation by growing over it and smothering the plants below and preventing them from reaching light, thus having a detrimental effect on native species and overall plant community diversity. Kudzu spreads primarily vegetatively (CABI 2007). This species is often found in disturbed habitats, but can overtake habitats near disturbed areas as well. Once established, this species is difficult to eradicate (TISI 2014b). The SCEPPC considers kudzu to be a severe threat (SCEPPC 2014).

3.7.5.3.9 Nepalese Browntop

Nepalese browntop (*Microstegium vimineum*), sometimes known as Japanese stiltgrass, is an annual grass native to Asia. This species is adapted to low light conditions and can be found on a variety of soil types. Nepalese browntop produces large amounts of seed; a single tiller can produce 100 to 1,000 seeds, which helps it maintain dominance in the seed bank. Once the grass is established, it can spread vegetatively during the growing season. This species can alter soil composition and microfauna in areas where it becomes established, which can be detrimental to native species (Fryer 2011). The SCEPPC considers Nepalese browntop to be a severe threat (SCEPPC 2014).

3.7.5.3.10 Sericea Lespedeza

Sericea lespedeza (*Lespedeza cuneata*), also commonly known as Chinese lespedeza, is a perennial herbaceous plant native to central and east Asia. Plants can grow from 1 to 6 feet tall and typically flower in September. Sericea lespedeza produces large amounts of seed; a single stem can produce up to 1,500 seeds, which helps it maintain dominance in the seed bank (Gucker 2010). Seeds can remain viable in the seed bank for up to twenty years and the plant is drought tolerant (SE-EPPC 2019b). This species can tolerate a range of soil conditions including acidic soils. Sercicea lespedeza often uses more water than other species, thus outcompeting native species for resources and allowing it to become dominant in habitats (Gucker 2010). The SCEPPC considers sericea lespedeza to be a severe threat (SCEPPC 2014).

3.7.5.4 Terrestrial Animals

3.7.5.4.1 Emerald Ash Borer

Emerald ash borer (*Agrilus planipennis*) is an insect originally native to northeastern Asia. Adults lay eggs on ash trees (Fraxinus spp.); when the larvae hatch, they tunnel through the trees and feed on phloem. Females can lay between 55 and 150 eggs. When an infestation becomes large enough the trees will die; otherwise the crowns and upper branches become weak and die off first (USFS 2016). Chemically treating infested ash trees is one potential option to combat emerald ash borer infestations (USFS 2017).

3.7.6 Procedures and Protocols

Duke Energy relies on administrative controls and other regulatory programs to ensure that habitats and wildlife are protected as a result of a change in plant operations (i.e., water withdrawal increase, new NDPES discharge point, wastewater discharge increase, air emissions increase) or prior to ground-disturbing activities. The administrative controls, as prescribed in Section 9.5, involve reviewing the change; identifying effects, if any, on the environmental resource area (i.e., habitat and wildlife); establishing BMPs; modifying existing permits; or acquiring new permits as needed to minimize impacts. BMPs include erosion and sediment control as well as stormwater runoff reduction to lower pollutant levels in water discharged to nearby resources used by wildlife. Additional BMPs apply to the storage, application, and disposal of pesticides, such as application of pesticides only by a licensed applicator and storage of pesticides away from water sources. Existing regulatory programs that the site is subject to, as presented in Chapter 9, also ensure that habitats and wildlife are protected. These are related to programs such as the following: stormwater management for controlling the runoff of pollution sources such as sediment, metals, or chemicals; spill prevention to ensure that BMPs and structural controls are in place to minimize the potential for a chemical release to the environment; USACE permitting programs to minimize dredging impacts; and management of herbicide applications.

3.7.7 Studies and Monitoring

Duke Energy performs terrestrial and aquatic ecological monitoring as required for permitting and compliance. Fishery resources have been monitored since 1973 using a variety of sampling techniques such as gillnetting and boat mounted electrofishing. The USACE monitors water quality for fish habitat during spawning season. Duke Energy also conducts yearly monitoring of *Corbicula* populations due to their biofouling potential. Clams are counted, measured, and their biofouling potential calculated. Invasive aquatic plants can become problematic quickly. Duke Energy uses techniques such as winter drawdown, chemical treatments, and manual removal to address problems associated with aquatic invasive species.

3.7.7.1 Impingement, Entrainment, and Thermal Impacts Monitoring

Impingement and entrainment monitoring has been conducted in accordance with Section 316(b) of the CWA. Reports required by 40 CFR 122.21(r)(2)-(13) were submitted in November 2020. Duke Energy complies with the current administratively continued NPDES permit to minimize potential impacts of impingement and entrainment.

The most recent impingement study occurred between 2006 and 2007. Sampling occurred every other week from September 2006 until August 2007. Results from this study estimate that the annual impingement at ONS is 43,923 fish. Impingement rates were highest during the fall, particularly September through November. Impinged individuals were composed of 11 species, which included threadfin shad (*Dorosoma petenense*), blueback herring (*Alosa aestivalis*), bluegill (*Lepomis macrochirus*), and spotted bass (*Micropterus punctulatus*), which were the four most commonly impinged, but also redbreast sunfish (*Lepomis auritus*), redeye bass (*Micropterus coosae*), warmouth (*Lepomis gulosus*), golden shiner (*Notemigonus crysoleucas*), flathead catfish (*Pylodictis olivaris*), white catfish (*Ameiurus catus*), and blackbanded darter (*Percina nigrofasciata*).

Entrainment monitoring was conducted during 2016 and 2017. Species in the Clupeidae family (blueback herring, alewife, gizzard shad, and threadfin shad) composed 98.3 percent of the sample of entrained species. Sunfish composed 0.6 percent of the sample, and the remaining 1.1 percent were unidentified Osteichthyes. The estimated average annual number of entrained icthyoplankton based on maximum cooling water withdrawal volume at ONS is 37.5 million. The period of entrainment in during 2016 and 2017 was relatively low due to the effectiveness of the curtain wall. There were peaks that occurred in June and July. The peaks correspond to the spawning period of blueback herring, which is the species with the highest rates of entrainment. However, blueback herring are prolific spawners with both high fecundity and high natural mortality rates. Therefore, entrainment is unlikely to have adverse impacts on this species or threadfin shad. Threadfin shad also made up a significant portion of the entrained species, but is similar in fecundity and mortality rates to blueback herring. The curtain wall is effective at reducing the number of entrained species. There are no threatened and endangered species that would be expected to be impinged or entrained at the ONS cooling water intake structure.

An analysis was conducted to determine the potential benefits/disadvantages of installing new entrainment reduction technologies which included the installation of mechanical draft cooling towers or the installation and operation of fine-mesh screens with an aquatic organism return system. The model-based estimates were based on conservative assumptions (e.g., all entrained organisms were considered to affect recreational fisheries either directly as equivalent adults or indirectly through trophic transfer of production foregone biomass) and include evaluations of uncertainty at multiple stages of the development process. The social cost to social benefit comparison yielded substantial net-negative benefits for the modeled entrainment reduction technologies, and unavoidable adverse effects were identified for both technologies evaluated. Monetized social costs and social benefits were estimated for both technologies to provide a common basis for comparison.

The study demonstrated that the additional entrainment reduction technologies that were identified as feasible are not justified as best technology available for entrainment at ONS as they would result in adverse effects (e.g., increased air emissions, impacts to system reliability) and the estimated social costs would be wholly disproportionate compared to the potential social benefits. No federal or state threatened or endangered fish or shellfish and no freshwater mussels were collected in the historical impingement and entrainment study and none were collected during the 2016–2017 study. Additionally, the diverse and balanced aquatic community in Lake Keowee has remained consistent since 2006. Therefore, the current impingement and entrainment technologies represent the best technology available to protect the aquatic community of Lake Keowee at ONS.

Studies were also conducted from 2012–2019 to determine the effects of ONS's thermal discharge on the aquatic biological community of Lake Keowee. During this time, overall water temperatures and dissolved oxygen levels were within historical ranges and remained at levels that could support a warmwater fish community, similar to other South Carolina piedmont reservoirs. Results indicate that phytoplankton species diversity remained high, thus supporting a diverse aquatic biological community. The abundance and diversity of zooplankton species also remained similar to previous studies, indicating that there has not been a shift towards more thermally tolerant species. Fish sampling during this time determined that the Lake Keowee fish community was composed of mostly native species. Additionally, the diversity of fish collected from the thermal plume zone were similar to the diversity collected from reference zones away from the thermal plume.

3.7.7.2 Avian Monitoring

The SCDNR conducts surveys for eagle nests and the data are made publicly available through an online mapping tool. No nests were documented in the vicinity of the ONS site, but bald eagles are known to use the area. Within the Keowee-Toxaway vicinity, environmental assessment surveys conducted in January, February, March, May, June, September, and October 2012 documented 150 avian species occurring in the area. Duke Energy monitors any avian mortality that occurs on the ONS site and reports it to the migratory bird hotline. Studies and monitoring at ONS occur as needed to comply with federal, state, and local regulatory requirements as directed by the appropriate agencies and generally prior to new projects, which can include, but are not limited to, land clearing and new construction. (FERC 2016a; SCDNR 2019d)

3.7.7.3 Bat Monitoring

Duke Energy contracted for an acoustic bat survey in 2015 to determine if the federally threatened northern long-eared bat (*Myotis septentrionalis*) was present onsite before commencing timber removal and construction of independent spent fuel storage facility expansions. The tree species occurring onsite are considered suitable summer roosting habitat for this species. Acoustic surveys were used instead of mist-nets to capture bats because of the danger of spreading white-nose syndrome between captured bats. Five species were identified: little brown myotis (*Myotis lucifugus*), eastern red bat (*Lasiurus borealis*), tricolored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), and hoary bat (*Lasiurus cinereus*). The northern long-eared bat was not detected.

Additional bat acoustic surveys were conducted around Lake Keowee and ONS during April, July, and October 2012 as part of an environmental assessment. Nine species were documented, including: eastern small-footed myotis (*Myotis leibii*), little brown myotis (*Myotis lucifugus*), silver-haired bat (*Lasionycteris noctivagans*), tricolored bat, big brown bat, eastern red bat, hoary bat, evening bat (*Nycticeius humeralis*), and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Studies and monitoring at ONS occur as needed to comply with federal, state, and local regulatory requirements as directed by the appropriate agencies and generally prior to new projects, which can include, but are not limited to, land clearing and new construction. (FERC 2016a)

3.7.7.4 Rare and Endangered Plant Monitoring

Plant species identification was conducted around Lake Keowee and ONS during 2012 as part of an environmental assessment. No federal or state threatened or endangered species were present. However, several state critically imperiled species were documented and include Virginia spiderwort (*Tradescantia virginiana*), glade fern (*Diplazium pycnocarpon*), Biltmore sedge (*Carex biltmoreana*), single-sorus spleenwort (*Asplenium monanthes*), and blackstem spleenwort (*Asplenium resiliens*). Studies and monitoring at ONS occur as needed to comply with federal, state, and local regulatory requirements as directed by the appropriate agencies and generally prior to new projects, which can include, but are not limited to, land clearing and new construction. (FERC 2016a)

3.7.7.5 As-Needed Monitoring

Studies and monitoring at ONS occur as needed to comply with federal, state, and local regulatory requirements as directed by the appropriate agencies and generally prior to new projects, which can include, but are not limited to, land clearing and new construction. Any monitoring that occurs is consistent with agency policies and procedures and performed under the guidance of the agency under which coordination is occurring.

3.7.8 Threatened, Endangered, and Protected Species, and Essential Fish Habitat

The USFWS maintains current lists of threatened and endangered species on its website (USFWS 2019c; USFWS 2019b). The SCDNR also maintains lists of state-protected species on its website (SCDNR 2015). The USFWS federal endangered and threatened species listing and the SCDNR state endangered and threatened species listings were reviewed. Consultation letters with state and federal agencies are included in Attachment C.

3.7.8.1 Federally Listed Species

A total of eight federally listed endangered or threatened species and one federally protected species were listed as possibly occurring within the 6-mile radius of ONS based on USFWS information for planning and consultation. No critical habitat for any species is listed within the 6-mile radius of ONS. Federally listed threatened or endangered species possibly occurring within a 6-mile radius of ONS include: northern long eared bat (*Myotis septentrionalis*), bog turtle (*Glyptemys muhlenbergii*), dwarf-flowered heartleaf (*Hexastylis naniflora*), mountain sweet pitcherplant (*Sarracenia jonesii*), persistent trillium (*Trillium persistens*), small whorled pogonia (*Isotria medeoloides*), and smooth coneflower (*Echinacea laevigata*). The bald eagle (*Haliaeetus leucocephalus*), although no longer listed as threatened or endangered, is still protected by federal law and is likely to occur within a 6-mile radius of ONS. Ecological descriptions and requirements for these species are summarized below. Compliance with all regulatory requirements associated with protected species will continue to be an administrative control practiced by Duke Energy for the licensed life of the ONS facility. Adherence to these controls, as well as compliance with applicable laws and regulations should prevent potentially negative impacts to any special status and protected species. (FERC 2016a; USFWS 2019b; USFWS 2019d)

3.7.8.1.1 Bald Eagle

Effective in August 2007, the bald eagle (*Haliaeetus leucocephalus*) was removed from the federal list of threatened and endangered species. However, the bald eagle is still afforded special protection under the Bald and Golden Eagle Protection Act (BGEPA) and the Migratory Bird Treaty Act (MBTA). The bald eagle is currently globally secure, with current estimates at approximately 9,700 nesting pairs in the contiguous United States (USFWS 2019e).

Bald eagles are large, majestic birds distinguished by a white head and white tail feathers. Bald eagles do not get their characteristic white head and tail until about five years of age, remaining mostly brown until then. This can cause identification confusion with golden eagles. However, golden eagles have feathers on the legs all the way down, while bald eagles only have feathers on the tops of the legs. Both males and females are large birds with females weighing up to 14 pounds with an eight-foot wingspan, while males are slightly smaller, averaging 10 pounds with a six-foot wingspan. Eagles mate for life (USFWS 2019e).

The staple food of bald eagles is fish, but they will feed on waterfowl and small mammals such as rabbits. Eagles are found near rivers, lakes, marshes, estuaries, and seacoasts. They can be found in tall trees that they use for perching, roosting, and nesting. Nests are built in the tops of trees and eagles will re-use and add to the same nest year after year. Nests can be up to 10 feet across and weigh up to a half ton. If trees are not available, eagles will nest on cliffs or on the ground. Eagles typically breed once a year and lay one to three eggs that hatch after an incubation period of around 35 days. Young eagles can fly 3 months after hatching and will leave the nest about a month after that. Causes of death of eaglets include human interference, disease, and lack of food. However, research indicates about 70 percent of eaglets survive the first year of life (USFWS 2019e).

Several compounding factors led to the bald eagle's decline. Decline started in the late 1800s with the demise of many waterfowl and shorebird species that were overhunted for their plumage, leading to a loss of prey. Eagles often succumbed to lead poisoning after consuming carrion that had been killed with lead shot. The biggest threat that led to the most significant decline was the pesticide commonly known as DDT (dichlorodiphenyltrichloroethane) that became popular as a means to kill insects after World War II. DDT residues ended up in waterways, where it was ingested by aquatic organisms and fish. Through a process of biomagnification, eagles were ingesting fish that had high levels of the pesticide in their bodies. DDT caused eggshells to be thin, with most either cracking during incubation or never hatching. By 1963, only 487 nesting pairs of eagles remained. DDT was eventually outlawed and the bald eagle was placed on the endangered species list. Recovery efforts included protecting nest sites, captive breeding programs, reintroduction efforts, and law enforcement of prohibited harassment and take of eagles. In July of 2007 the bald eagle was removed from the endangered species list, with the ruling becoming effective in August of 2007 (USFWS 2019e).

Bald eagles nest throughout South Carolina, but most pairs are found along the coast. The closest active eagle nests to ONS, as of July 2019, are located on the northern end of Lake Jocassee (approximately 17 miles from ONS) and a northern tributary of Lake Hartwell (approximately 14 miles from ONS) to the south (SCDNR 2019d; SCDNR 2019e). Activities on the ONS site are evaluated to ensure compliance under the BGEPA and MBTA. When necessary, consultation with responsible agencies is conducted to maintain compliance with existing regulations. ONS maintains a migratory bird special purpose utility permit (SPUT) authorized by the USFWS, which authorizes utilities to collect, transport, and temporarily possess migratory birds found dead on utility property, structures, and rights-of-way for avian mortality monitoring or disposal purposes (USFWS 2018a). Compliance with all regulatory requirements associated with this species will continue to be an administrative control practiced by Duke Energy for the licensed life of the ONS facility. Adherence to these controls, as well as compliance with applicable laws and regulations, should prevent potentially negative impacts to bald eagles.

3.7.8.1.2 Bog Turtle

The bog turtle is federally listed as threatened under the endangered species act due to similarity of appearance to the northern population of bog turtle, which is listed as threatened (USFWS 2019d). It is considered threatened by the state of South Carolina (SCDNR 2015). The bog turtle is the smallest turtle in North America and is between three and four inches long.

They have bright orange or yellow patches on either side of the neck. They hibernate in the winter and emerge to breed by mid-April. The turtles prefer wet muddy habitat found in the grass and moss of bogs, swamps, and marshy herbaceous meadows with a mosaic of micro-habitats for foraging, nesting, sheltering, and breeding. They feed on insects and snails. Threats to this species include habitat loss and degradation from draining wetlands and development for urban areas and agriculture (USFWS 2011a; USFWS 2019f). Although habitat likely exists within the 6-mile radius, as of the completion of the final environmental assessment (EA) of the area in 2016, no individuals had been documented in the area (FERC 2016a).

3.7.8.1.3 Northern Long-eared Bat

The northern long-eared bat is federally listed as threatened. No critical habitat is designated for this species due to the likely increase in vandalism and disturbance to winter habitat if it was declared (81 FR 24707). The northern long-eared bat is 3–3.7 inches long with a wingspan of 9 to 10 inches. It is distinguished by its long ears, which are larger than other species in the genus Myotis. Fur color ranges from medium to dark brown on its back and tawny to pale brown on its front. During the summer, northern long-eared bats use cavities under bark on both dead and live trees as well as mines and caves to roost. Females will roost in small colonies of 30 to 60 bats to give birth to one pup per female on average. During the winter bats hibernate in small crevices and cracks in caves and mines that have constant temperatures, high humidity, and no air currents. Changes to any wintering site microclimates can make that habitat unsuitable for the bats. Sources of threats include white-nose syndrome, impacts to roost sites, loss of habitat, and wind farm operation (USFWS 2015b).

Although this species was not detected during acoustic surveys in 2015, suitable habitat was determined to exist on the site consisting of large shingle-barked oaks, hickories, and snags that can be used for summer roost habitat.

3.7.8.1.4 Dwarf-flowered Heartleaf

Dwarf-flowered heartleaf is a federally threatened species that was listed under the Endangered Species Act (ESA) in 1989. It is a low-growing perennial with an underground stem. The name comes from its dark green and leathery heart-shaped leaves that grow to 4 to 5 inches long. Plants flower from March to June and flowers range in color from beige to dark brown to purple. The flowers are small and jug shaped and found at the base of the plant often beneath the leaf litter. Dwarf-flowered heartleaf is found on acidic soils on bluffs and wetland areas near streams and creeks and along slopes of nearby hillsides (USFWS 2011b).

Main threats to the dwarf-flowered heartleaf include habitat degradation and/or loss. Habitat is lost to conversion to agricultural use, residential, commercial, and industrial uses or conversion to reservoirs which can cause habitat to flood and kill the plants, as well as invasive species (USFWS 2011b).

This species is known to occur in Pickens County and potentially suitable habitat may occur in the forests surrounding the ONS site. This species was not identified by Duke Energy in its 2012 biological surveys and the final EA. Duke Energy's SMP would protect native vegetation and habitat if this species was located within the ONS site in the future (FERC 2016a, Section 3.3.3.1).

3.7.8.1.5 Mountain Sweet Pitcherplant

The mountain sweet pitcherplant is a federally endangered species that was listed under the ESA in 1988. It is a carnivorous perennial herb native to bogs and a few streamsides in the Blue Ridge Mountains of North and South Carolina. The leaves start out "S" shaped until they mature and become tall hollow pitcher-shaped with a heart-shaped hood on the top that is usually 0.4–1.2 inches wide. Plants can be up to 29 inches tall. Mature leaves appear coppery-green with red veins. Flowers are red/maroon (rarely, yellow) and sweet smelling, with plants flowering from April to June. In a trait unique to a few species, this plant gets needed nutrients from insects. Insects fall into the pitcher-like leaves and the liquid and enzymes on the leaves digest the insects. Mountain sweet pitcherplants can reproduce vegetatively through rhizomes. (NCSU 2018; USFWS 2019g)

This species is usually found in level, depressional bogs associated with floodplains. The bogs have deep, saturated, loamy, sandy, and silty soils with a lot of organic matter and a high acidity level. Threats to this species include habitat loss, overcollection of plants, and trampling. (NCSU 2018; USFWS 2019g). This species is known to occur in Pickens County, but was not identified by Duke Energy in its 2012 biological surveys. Duke Energy's SMP would protect native vegetation and habitat if this species was located within the ONS site in the future (FERC 2016a, Section 3.3.3.1).

3.7.8.1.6 Persistent Trillium

The persistent trillium is a federally endangered species that was listed under the ESA in 1978. Persistent trilliums are perennial herbs native to Georgia and South Carolina and are found in mixed hardwood forests. The persistent trillium is in the lily family and is a group of herbs that has unbranched stems, meaning that no true leaves or stems are present above ground. What appears to be leaves is actually part of the flower and function the same way as leaves to help the plant perform photosynthesis. It blooms between March and April, but is slow growing as it takes between seven and ten years to produce a mature plant. It is found on organic soils in mixed deciduous-pine woodlands and along streams near rhododendrons (Pistrang 2019).

The threat to this species is its restricted habitat which makes it vulnerable to habitat loss and degradation, as well as invasive species that can outcompete the persistent trillium for resources. A lot of habitat was lost when dams and reservoirs were created, which flooded and fragmented habitat (NatureServe 2019). One subpopulation is known to exist in Oconee County and potentially suitable habitat may occur within the 6-mile radius of ONS. This species was not identified by Duke Energy in its 2012 biological surveys. Duke Energy's SMP would protect native vegetation and habitat if this species was located within the ONS site in the future (FERC 2016a, Section 3.3.3.1).

3.7.8.1.7 Small Whorled Pogonia

The small whorled pogonia is a federally threatened species that was listed under the ESA in 1982 as endangered, but down-listed to threatened in 1994. It is a member of the orchid family. Each plant has a grayish-green stem that is about 10 inches tall and plants can grow to be 14 inches tall when fruit is produced. The name comes from the whorl of five or six leaves found near the top of the stem below the flower. Plants produce flowers 0.5 to 1 inch long in May or June. Habitat of the whorled pogonia consists of old hardwood forest stands that usually contain beech, birch, oak, and hickory with open understories. It prefers acidic soils with a thick leaf litter layer on slopes near streams (USFWS 2016).

The small whorled pogonia can be found in eighteen states in the eastern United States, but is still rare and populations are small. The main threats to this species are habitat loss, habitat degradation, and trampling. This species is known to occur in Oconee County, but was not identified in the area by Duke Energy in its 2012 biological surveys. Duke Energy's SMP would protect native vegetation and habitat if this species was located within the ONS site in the future (FERC 2016a, Section 3.3.3.1).

3.7.8.1.8 Smooth Coneflower

The smooth coneflower is a federally endangered species that was listed under the ESA in 1992. It is a perennial herb in the aster family. It can grow up to 1 meter tall. Plants produce light pink to purple flowers that bloom from late May through mid-July. Leaves are mostly at the base of the plant and can be up to eight inches across. Smooth coneflowers prefer magnesium and calcium rich soils associated with marble. Optimum habitats have lots of sun and little competition. Habitat for this species can be found in open woods, clear-cut forests, and power line rights-of-way (USFWS 2017).

This species is threatened by loss of disturbance in its habitat, which can allow woody species encroachment and reduce the sunny habitats that it requires. It is also susceptible to habitat loss and degradation from development, right-of-way maintenance, and collection (USFWS 2017). A previous population used to occur near old Keowee Town. No critical habitat has been designated for this species (USFWS 2019d). Potential suitable habitat may exist within the 6-mile radius of ONS, but was not identified by Duke Energy in its 2012 biological surveys. Duke Energy's SMP would protect native vegetation and habitat if this species was located within the ONS site in the future (FERC 2016a, Section 3.3.3.1).

3.7.8.2 State Listed Species

A total of eight state-listed species are listed as potentially occurring in Oconee and Pickens counties. These are: Rafinesque's big-eared bat, eastern small-footed myotis, Indiana myotis (*Myotis sodalis*), American peregrine falcon (*Falco peregrinus anatum*), Bewick's wren (*Thryomanes bewickii*), southern coal skink (*Eumeces anthracinus pluvialis*), and bog turtles (*Glyptemys muhlenbergii*). The bald eagle is also listed as state-threatened in South Carolina. Ecological descriptions and requirements for these species are summarized below. Compliance with all regulatory requirements associated with protected species will continue to be an administrative control practice by Duke Energy for the licensed life of the ONS facility. Adherence to these controls, as well as compliance with applicable laws and regulations should prevent potentially negative impacts to any special status and protected species.

3.7.8.2.1 American Peregrine Falcon

The American peregrine falcon was federally delisted in 1999 and is classified by the USFWS as in recovery, but is considered threatened in South Carolina. Peregrine falcons are approximately 15 to 21 inches long and have a wingspan of about 40 inches. The species is sexually dimorphic with females being larger than males. They have slate blue/gray wings, black bars across the back, and pale white/buff undersides with brown stripes/spots. They also have white faces with black stripes on each check, as well as dark eyes. Birds will mature to breeding age around 2 years. Falcons lay an average of four eggs in nests that are often on cliff edges or on edges of man-made structures. Peregrines are known for their diving speed, which they use to strike prey in mid-air. Prey often consists of other bird species including songbirds, shorebirds, ducks, pigeons, and starlings (USFWS 2006a).

The American peregrine falcon used to be widespread across the United States, but the population was never very abundant. The population crashed by the mid-1960s with the extirpation of the east coast populations. The primary element of the most significant decline was the pesticide commonly known as DDT that became popular as a means to kill insects after World War II. DDT residues were on seeds and insects that small birds ate, and through a process of biomagnification the peregrine falcons were ingesting smaller birds that had high levels of the pesticide in their bodies. DDT caused eggshells to be thin, with most either cracking during incubation or never hatching. DDT was eventually outlawed and the American peregrine falcon was placed on the endangered species list. Recovery efforts included releasing up to 6,000 captive-reared birds through an intensive reintroduction program (USFWS 2006a).

Potential habitat for this species likely exists within the 6-mile radius of ONS. Activities on the ONS site are evaluated to ensure compliance under the MBTA. When necessary, consultation with responsible agencies is conducted to maintain compliance with existing regulations. (USFWS 2006a) Additionally, Duke Energy maintains policies and procedures for addressing every avian incident associated with its facilities. These procedures include an investigation process, required reporting of each incident to the USFWS, and procedures for implementing corrective actions following each incident. This administrative practice is designed to identify and correct potential sources of injury or mortality to avian species. Compliance with all regulatory requirements associated with protected species will continue to be an administrative control practiced by Duke Energy for the licensed life of the ONS facility. Adherence to these controls, as well as compliance with applicable laws and regulations, should prevent potentially negative impacts to any special status and protected species.

3.7.8.2.2 Bewick's Wren

Bewick's wren is considered threatened in South Carolina. This is a small bird, about 5 inches long. Adults are medium brown with a white throat and breast. There are several sub-species of

Bewick's wren, but those that exist east of Mississippi River are the populations in greatest decline. These birds are often found near streams in a variety of habitats such as thickets and woodlands. Breeding adults lay five to eight eggs that incubate for 2 weeks before hatching, with chicks fledging 2 weeks after hatching. The main food source for Bewick's wrens is insects (Thomas et al. 2019).

Threats to this species include competition with other species such as the house wren and house sparrow. Potential habitat for this species likely exists within the 6-mile radius of ONS. This species was not identified by Duke Energy in its 2012 biological surveys (FERC 2016a, Section 3.3.3.1). Activities on the ONS site are evaluated to ensure compliance under the MBTA. When necessary, consultation with responsible agencies is conducted to maintain compliance with existing regulations. Additionally, Duke Energy maintains policies and procedures for addressing every avian incident associated with its facilities. These procedures include an investigation process, required reporting of each incident to the USFWS, and procedures for implementing corrective actions following each incident. This administrative practice is designed to identify and correct potential sources of injury or mortality to avian species. Compliance with all regulatory requirements associated with protected species will continue to be an administrative control practiced by Duke Energy for the licensed life of the ONS facility. Adherence to these controls, as well as compliance with applicable laws and regulations, should prevent potentially negative impacts to any special status and protected species.

3.7.8.2.3 Eastern Small-footed Myotis

The eastern small-footed myotis is considered a threatened species in South Carolina. The eastern small-footed myotis is a small bat, only 3.5 inches long including a 1.5-inch tail, with a wingspan of 8–9.75 inches. The fur is brown with a gold sheen and the bat has a black mask on its face. To hunt, it flies 1 to 3 yards above the ground. Females give birth to one live young in late spring or early summer. Forested areas with caves, mines, or rock outcrops provide summer habitat. Individual bats will roost in hollow trees, under bark, or in cracks and crevices in rock walls during the day. During the winter, bats will hibernate under rocks in caves or in crevices in cave/mine walls and ceilings. Threats to this species include habitat destruction and disturbance to roosting and hibernation sites, as well as white nose-syndrome (Butchkoski 2014). Potential habitat for this species likely exists within the 6-mile radius of ONS. This species was identified during acoustic surveys by Duke Energy in 2012 (FERC 2016a).

3.7.8.2.4 Indiana Myotis

The Indiana myotis is a federally listed endangered species, but was not identified by the USFWS information for planning and consultation as occurring in South Carolina. It is listed as a state endangered species. This is a social bat species that overwinters in large colonies. Bats weigh one quarter of an ounce and have a wingspan of 9 to 11 inches. Females gather in maternity colonies of up to 100 bats where they roost under the bark of trees. Each female gives birth to one pup per year and these pups remain with the maternity colony for the remainder of the summer. Males roost alone or in small groups during the summer under the bark of trees as well. This species eats up to half its body weight in insects a night during the summer months. They can be found in riparian zones and forested wetlands and along forested edges. Hibernation criteria for this species is very specific. Indiana bats require caves or mines with temperatures above freezing, but below 50°F. If conditions change or bats are disrupted during hibernation, they risk burning fats stores and can starve to death (USFWS 2006b).

About half as many bats exist as when the species was listed as federally endangered in 1967. One of the main threats to this species is loss of hibernating habitat as many caves have become tourist attractions. Additional threats to this species include habitat loss and degradation of summer habitat, decreased food availability due to widespread pesticide use and its impacts on insect populations, and white-nose syndrome (USFWS 2006b). Winter habitat has not been documented in South Carolina and critical habitat for this species is not located in Pickens or Oconee counties. There is potentially suitable roosting and foraging habitat within the 6-mile radius of ONS. This species was not identified during acoustic surveys of the site in 2012 and 2015 (FERC 2016a, Section 3.3.3.1).

3.7.8.2.5 Rafinesque's Big-eared Bat

Rafinesque's big-eared bats are considered endangered in South Carolina. They are a medium-sized bat with large ears, weighing between 7 to 13 grams. The fur is brown with white tips, giving the bats a grayish-brown look. It can be identified from other species by the fur that extends past its toes. This species hunts entirely at night rather than during dusk and dawn. Their main diet consists of moths, but they will forage on mosquitoes, beetles, and flies. During the winter, both males and females hibernate together in caves, but during the summer females separate to form maternity colonies and give birth. Females give birth to one pup a year early in the summer. The pup can fly 3 weeks after birth, reaching full size within 3 months. They use cave entrances, hollow trees, and abandoned buildings to roost during the summer months. (TPWD 2019b).

Threats to this species include the loss of hollow dead roosting trees and the collapse of abandoned buildings used as roosting habitat, as well as human disturbance. There is potentially suitable roosting and foraging habitat within the 6-mile radius of ONS. This species was identified during acoustic surveys of the site in 2012 and 2015 (FERC 2016a, Section 3.3.3.1). Duke Energy protects summer roosting habitat for bat species, such as protecting snag trees and mature hardwood tree communities.

3.7.8.2.6 Southern Coal Skink

The southern coal skink is considered a threatened species in South Carolina. There is not a lot known about the natural history and ecology of this species. Coal skinks are small lizards that are 5 to 7 inches long, brown or gray in color, and have two white or yellow strips down each side of its body. Females will lay clutches of eggs in moist soil or moist rotten logs and stay with the eggs until they hatch. Habitat where this species is found is commonly in moist forests and along streams; they can also be found under rocks and logs (UGA 2019a). There is potentially suitable habitat within the 6-mile radius of ONS. This species is known to occur in the region, but was not detected in 2012 biological surveys (FERC 2016a, Section 3.3.3.1).

3.7.8.3 Species Protected Under the Bald and Golden Eagle Protection Act

Bald eagles are protected under the BGEPA. Bald eagles have nested in the region (SCDNR 2019d) and suitable nesting habitat is present with a 6-mile radius of ONS. Current and future bald eagle nests located on the ONS site would be subject to all protections under this act.

The BGEPA was originally enacted in 1940 (16 U.S.C. 668-668c) and it prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, eggs, or feathers. The BGEPA provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle…[or any golden eagle], alive or dead, or any part, nest, or egg thereof." The BGEPA defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

"Disturb" means: "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle; 2) a decrease in its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." In addition to immediate impacts, this definition also covers impacts resulting from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death or nest abandonment (USFWS 2018b). There are currently no BGEPA permitting requirements associated with ONS operations.

3.7.8.4 Species Protected Under the Migratory Bird Treaty Act

In addition to species listed in Table 3.7-4, several avian species that are protected under the MBTA may visit the ONS site. The MBTA makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter or offer for sale, or purchase or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to federal regulations. Other bird species that occur within the 6-mile vicinity are protected under the MBTA. The blue-winged warbler *(Vermivora cyanoptera*) is considered a bird of conservation concern only in particular bird conservation regions in the continental United States (USFWS 2008; USFWS 2019d). The remaining species are considered birds of conservation concern throughout their range in the continental United States and Alaska (USFWS 2019d): Bachman's sparrow (*Peucaea aestivalis*), Eastern whip-poor-will (*Antrostomus vociferous*), Kentucky warbler (*Geothlypis formosa*), king rail (*Rallus elegans*), prairie warbler (*Setophaga discolor*), prothonotary warbler (*Protonotaria citrea*), red-headed woodpecker (*Melanerpes erythrocephalus*), and wood thrush (*Hylocichla mustelina*). The bald eagle is not a bird of concern in this area, but warrants attention because of the BGEPA. ONS maintains a SPUT authorized by the USFWS which authorizes utilities to collect, transport, and temporarily possess migratory birds found dead on utility property, structures, and rights-of-way for avian mortality monitoring or disposal purposes (USFWS 2018a).

3.7.8.5 Essential Fish Habitat

A review of the National Oceanic and Atmospheric Administration's (NOAA) essential fish habitat (EFH) was conducted to determine the location of EFH within 6 miles of ONS. NOAA only provides EFH for federally managed fish and invertebrates. No habitat areas protected from fishing were located within the 6-mile radius; nor were any habitat areas of particular concern (HAPC) (NOAA 2019).

Table 3.7-1 Phytoplankton Taxa of Lake Keowee (Sheet 1of 4)

Family	Scientific Name	Family	Scientific Name
Chlorophyceae	*Ankistrodesmus brauni*	Bacillariophyceae	*Achnanthes linearis*
	Ankistrodesmus falcatus		*Achnanthes microcephala*
	Arthrodesmus convergens		*Anomoeoneis vitrea*
	Arthrodesmus convolutus		*Asterionella formosa*
	Arthrodesmus incus		*Atthya zachariasi*
	Arthrodesmus incus v. extensus		*Cyclotella comta*
	Arthrodesmus octocornis		*Cyclotella glomerata*
	Arthrodesmus ralfsii		*Cyclotella meneghiniana*
	Arthrodesmus subulatus		*Cyclotella stelligera*
	Asterococcus limneticus		*Cymbella minuta*
	Botryococcus sudeticus		*Denticula elegans*
	Clamydomonas spp.		*Eunotia zasuminensis*
	Chlorogonium euchlorum		*Fragilaria crotonenis*
	Closteriopsis longissima		*Frustulia rhomboids*
	Closteriopsis incurvum		*Gomphonema acuminatum*
	Coelastrum cambricum		*Gomphonema parvulum*
	Coelastrum reticulatum		*Melosira ambigua*
	Coelastrum sphaericum		*Melosira distans*
	Cosmarium angulosum v. concinnum		*Melosira granulata v. angustissima*
	Coelastrum asphearosporum v. strigosum		*Navicula cryptocephala*
	Coelastrum contractum		*Navicula exigua*
	Coelastrum ornatum		*Navicula radiosa v. tenella*
	C. polygonum		*Navicula palea*
	Coelastrum regnellii		*Navicula sublinearis*
	Coelastrum tenue		*Pleurosigma delicatulum*
	Coelastrum tinctum		*Pleurosigma* spp.
	Coelastrum tinctum v. tumidum		*Rhizosolenia* spp.
	Coelastrum tinctum		*Surirella* spp.
	Coelastrum spp.		*Synedra acus*
	Crucigenia crucifera		*Synedra filiformis v. exilis*
	Crucigenia irregularis		*Synedra planktonica*
	Crucigenia tetrapedia		*Synedra rumpens*

Table 3.7-1 Phytoplankton Taxa of Lake Keowee (Sheet 2 of 4)

Family	Scientific Name	Family	Scientific Name
	Dictyosphaerium ehrenbergianum		*Synedra ulna*
	Dictyosphaerium pulchellum		*Tabellaria fenestrata*
	Elakatithrix gelatinosa		*Tabellaria flocculosa*
	Eudorina elegans	Chrysophyceae	*Aulomonas pudyii*
	Franceia droescheri		*Bicoeca petiolotum*
	Franceia ovalis		*Bitrichia chodatii*
	Geminella interupta		*Chromulina* spp.
	Geminella spp.		*Chrysolykos planktonicus*
	Gloeocystis botryoides		*Chrysosphaerella solitaria*
	Gloeocystis gigas		*Chrysococcus planktonicus*
	Gloeocystis planktonica		*Codomonas annulata*
	Gloeocystis vesciculosa		*Dinobyon bavaricum*
	Golenkinia paucispina		*Dinobyon cylindricum*
	Gloeocystis radiata		*Dinobyon divergens*
	Gonium sociale		*Dinobyon sertularia*
	Kichneriella contorta		*Dinobyon sociale*
	Kichneriella lunaris		*Dinobyon* spp.
	Kichneriella lunaris v. dianii		*Erkenia subaequicilliata*
	Kichneriella obese v. aperta		*Kephyrion littorale*
	Kichneriella spp.		*Kephyrion rubri-klaustri*
	Lagerhiemia citriformis		*Kephyrion* spp.
	Lagerhiemia subsala Lemmerman		*Mallomonas globosa*
	Mesostigma viride		*Mallomonas producta*
	Micractinium pusillum		*Mallomonas pseudocoronata*
	Mougeotia elegantula		*Mallomonas tonsurata*
	Mougeotia spp.		*Ochromonas granularis*
	Nephrocytium agardhianum		*Ochromonas* spp.
	Nephrocytium limneticum		*Pseudokephyrion concinnum*
	Oocystis borgii		*Pseudokephyrio schilleri*
	Oocystis lacustris		*Pseudokephyrio* spp.
	Oocystis parva		*Rhyzochrysis polymorpha*
	Oocystis pusilla		*Stelexomonas dichotoma*
	Pediastrum biradiatum		*Stokesiella epipyxis*

Table 3.7-1 Phytoplankton Taxa of Lake Keowee (Sheet 3 of 4)

Family	Scientific Name	Family	Scientific Name
	Pediastrum duplex		*Synura spinosa*
	Pediastrum tetras v. tetroadon		*Synura uvella*
	Planktospearia gelatinosa	Haptophyceae	*Chrysochromulina parva*
	Quadrigula closterioides	Xanthophyceae	*Centritractus belanophorus*
	Quadrigula lacustris		*Characiopsis acuta*
	Scenedesmus abundans		*Characiopsis dubia*
	Scenedesmus abundans v. asymmetrica	Cryptophyceae	*Cryptomonas erosa*
	Scenedesmus armatus v. bicaudatus		*Cryptomonas erosa v. reflexa*
	Scenedesmus bijuga		*Cryptomonas ovata*
	Scenedesmus brasiliensis		*Cryptomonas reflexa*
	Scenedesmus denticulatus		*Rhodomonas minuta*
	Scenedesmus quadricauda	Myxophyceae	*Agmenellum quadriduplicatum*
	Schizochlamys compacta		*Chroococcus disperses*
	Schizochlamys gelatinosa		*Chroococcus limneticus*
	Selenastrum bibrianum		*Chroococcus* spp.
	Selenastrum minutum		*Coelosphearium kutzingianum*
	Selenastrum westii		*Coelosphearium neagelianum*
	Sphaerocystis schroeteri		*Lyngbya* spp.
	Staurastrum americanum		*Microcystis aeruginosa*
	Staurastrum apiculatum Brebisson		*Merismopedia convolute*
	Staurastrum brachiatum Ralfs		*Oscillatoria amphibia*
	Staurastrum brevispinum Brebisson		*Oscillatoria geminata*
	Staurastrum curvatum W. West		*Oscillatoria limnetica*
	Staurastrum curvatum v. elongatum		*Oscillatoria substilissima*
	Staurastrum cuspidatum		*Oscillatoria* spp.
	Staurastrum dejectum	Ugenophyceae	*Euglena minima*
	Staurastrum dickei v. circulare		*Euglena proxima*
	Staurastrum manfeldtii v. fluminense	Dinophyceae	*Ceratium hirundinella v. brachiatum*

Table 3.7-1 Phytoplankton Taxa of Lake Keowee (Sheet 4 of 4)

Family	Scientific Name	Family	Scientific Name
	Staurastrum megacanthum		*Glenodinium gymnodinium*
	Staurastrum paradoxum v. cingulum		*Glenodinium quadridens*
	Staurastrum paradoxum v. parvum		*Gymnodinium spp.*
	Staurastrum pentacerum		*Peridinium bipes*
	Staurastrum subcruciatum		*Peridinium inconspicuum*
	Staurastrum tetracerum		*Peridinium intermedium*
	Staurastrum vestitum		*Peridinium pusillum*
	Truebaria caudatum		*Peridinium quadridens*
	Truebaria minimum		*Peridinium wisconsinense*
	Truebaria setigerum		

Table 3.7-2 Zooplankton Taxa of Lake Keowee

Family	Scientific Name	Family	Scientific Name
Copepoda	*Cyclops thomasi*	Rotifera	*Asplanchna* spp.
	Diaptomus bergii		*Collotheca balatonica*
	Diaptomus mississippiensis		*Collotheca mutabilis*
	Epischura fluviatilis		*Collotheca* spp.
	Mesocyclops edax		*Conochiloides dossuarius*
	Tropocyclops prasinus		*Conochilus unicornis*
	Calanoid copepodid		*Conochilus* spp.
	Cyclopoid copepodid		*Gastropus stylifer*
	Nauplii		*Hexarthra mira*
Cladocera	*Bosmina longirostris*		*Kellicottia bostoniensis*
	Bosminopsis deitersi		*Kellicottia longispina*
	Ceriodaphnis lacustris		*Keratella cochlearis*
	Chydorus spp.		*Keratella taurocephala*
	Daphnia parvula		*Keratella* spp.
	Daphnia spp.		*Monostyla*
	Diaphanosoma brachyurum		*Ploesoma hudsonii*
	Holopedium amazonicum		*Ploesoma truncatum*
	Leptodora kindtii		*Ploesoma* spp.
	Leydigia acanceroides		*Polyarthra major*
	Macrothicidae		*Polyarthra vulgaris*
Chaoboridae	*Chaoborus* spp.		*Polyarthra* spp.
			Ptygura libra
			Synchaeta spp.
			Trichocerca cylindrica
			Trichocerca multicrinis
			Trichocerca porcellus

Table 3.7-3 Fish Reported in Lake Keowee

Family	Scientific Name	Common Name
Centrarchidae	*Lepomis macrochirus*	Bluegill
	Lepomis auritus	Redbreast Sunfish
	Lepomis cyanellus	Green Sunfish
	Lepomis gulosus	Warmouth
	Lepomis microlophus	Redear Sunfish
	Micropterus coosae	Redeye Bass
	Micropterus dolomieu	Smallmouth Bass
	Micropterus punctulatus	Spotted Bass
	Micropterus salmoides	Largemouth Bass
	Pomoxis nigromaculatus	Black Crappie
Cyprinidae	*Cyprinella nivea*	Whitefin Shiner
	Cyprinus carpio	Common Carp
	Notemigonus crysoleucas	Golden Shiner
	Notropis hudsonius	Spottail Shiner
	Luxilus albeolus	White Shiner
Clupeidae	*Alosa aestivalis*	Blueback Herring
	Dorosoma petenense	Threadfin Shad
Ictaluridae	*Ameiurus brunneus*	Snail Bullhead
	Pylodictis olivaris	Flathead Catfish
	Ameiurus platycephalus	Flat Bullhead
	Ictalurus punctatus	Channel Catfish
	Ameiurus catus	White catfish
Percidae	*Percina nigrofasciata*	Blackbanded Darter
Poeciliidae	*Gambusia holbrooki*	Eastern Mosquitofish
Catostomidae	*Hypentelium nigricans*	Northern Hog Sucker
	Minytrema melanops	Spotted sucker
	Moxostoma collapsum	Notchlip redhorse
	Moxostoma sp.	Brassy jumprock
Salmonidae	*Oncorhynchus mykiss*	Rainbow Trout
	Salmo trutta	Brown trout

(FERC 2016a)

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 1 of 13)

Common Name	Scientific Name
Amphibians	
American Toad	*Bufo americanus*
Blackbelly Salamander	*Desmognathus quadramaculatus*
Bullfrog	*Rana catesbeiana*
Chamberlain's Dwarf Salamander	*Eurycea chamberlaini*
Cope's Gray Treefrog	*Hyla chrysoscelis*
Eastern Narrowmouth Toad	*Gastrophryne carolinensis*
Eastern Newt	*Notophthalmus viridescens*
Eastern Spadefoot Toad	*Scaphiopus holbrookii*
Four-toed Salamander	*Hemidactylium scutatum*
Fowler's Toad	*Bufo quericus*
Green Frog	*Rana clamitans*
Green Salamander	*Aneides aeneus*
Hellbender	*Cryptobranchus alleganiensis*
Marbled Salamander	*Ambystom opacum*
Mud Salamander	*Pseudotriton montanus*
Northern Cricket Frog	*Acris crepitans*
Northern Dusky Salamander	*Desmognathus fuscus*
Ocoee Dusky Salamander	*Desmognathus ocoee*
Pickerel Frog	*Lithobates palustris*
Red Salamander	*Pseudotriton ruber*
Red-spotted Newt	*Notophthalmus viridescens*
Seal Salamander	*Desmognathus monticola*
Seepage Salamander	*Desmognathus aeneus*
Shovelnose Salamander	*Desmognathus marmoratus*
Slimy Salamander	*Plethodon glutinosus complex*
Southern Appalachian Salamander	*Plethodon teyahalee*
Southern Gray-cheeked Salamander	*Plethodon metcalfi*
Southern Leopard Frog	*Rana sphenocephala*
Southern Two-lined Salamander	*Eurycea cirrigera*
Spotted Salamander	*Ambystoma maculatum*
Spotted Dusky Salamander	*Desmongnathus conanti*
Spring Peeper	*Pseudacris crucifer*
Spring Salamander	*Gyrinophilus porphyriticus*
Three-lined Salamander	*Eurycea guttonlineata*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 2 of 13)

Common Name	Scientific Name
Upland Chorus Frog	*Pseudacris feriarum*
Wood Frog	*Lithobates sylvaticus*
Birds	
Acadian Flycatcher	*Empidonax virescens*
Alder Flycatcher	*Empidonax alnorum*
American Bittern	*Botaurus lentiginosus*
American Coot	*Fulica americana*
American Crow	*Corvus brachyrhynchos*
American Back Duck	*Anas rubripes*
American Goldfinch	*Spinus tristis*
American Kestrel	*Falco sparverius*
American Peregrine Falcon	*Falco peregrinus anatum*
American Redstart	*Setophaga ruticilla*
American Robin	*Turdus migratorius*
American White Pelican	*Pelecanus erythrorhynchos*
American Wigeon	*Anas americana*
American Woodcock	*Scolopax minor*
Appalachian Bewick's Wren	*Thryomanes bewickii altus*
Bachman's Sparrow	*Peucaea aestivalis*
Bald Eagle	*Haliaeetus leucocephalus*
Baltimore Oriole	*Icterus galbula*
Bank Swallow	*Riparia riparia*
Barn Owl	*Tyto alba*
Barn Swallow	*Hirundo rustica*
Barred Owl	*Strix varia*
Bay-breasted Warbler	*Setophaga castanea*
Belted Kingfisher	*Megaceryle alcyon*
Bewick's Wren	*Thryomanes bewickii*
Black-and-white Warbler	*Mniotilta varia*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Blackburnian Warbler	*Setophaga fusca*
Black-crowned Night Heron	*Nycticorax nycticorax*
Black Scoter	*Melanitta nigra*
Black-throated Blue Warbler	*Setophaga caerulescens*
Black-throated Green Warbler	*Setophaga virens*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 3 of 13)

Common Name	Scientific Name
Black Vulture	*Coragyps atratus*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Blue Grosbeak	*Passerina caerulea*
Blue-headed Vireo	*Vireo solitarius*
Blue Jay	*Cyanocitta cristata*
Blue-winged Teal	*Anas discors*
Blue-winged Warbler	*Vermivora cyanoptera*
Bonaparte's Gull	*Chroicocephalus philadelphia*
Broad-winged Hawk	*Buteo platypterus*
Brown Creeper	*Certhia americana*
Brown-headed Cowbird	*Molothrus ater*
Brown-headed Nuthatch	*Sitta pusilla*
Brown Thrasher	*Toxostoma rufum*
Bufflehead	*Bucephala albeola*
Canada Warbler	*Cardellina canadensis*
Canada Goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Cape May Warbler	*Setophaga tigrina*
Carolina Chickadee	*Poecile carolinensis*
Carolina Wren	*Thryothorus ludovicianus*
Cattle Egret	*Bubulcus ibis*
Cedar Waxwing	*Bombycilla cedrorum*
Cerulean Warbler	*Setophaga cerulea*
Chestnut-sided Warbler	*Setophaga pensylvanica*
Chimney Swift	*Chaetura pelagica*
Chipping Sparrow	*Spizella passerina*
Chuck-will's-widow	*Antrostomus carolinensis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Common Goldeneye	*Bucephala clangula*
Common Grackle	*Quiscalus quiscula*
Common Loon	*Gavia immer*
Common Nighthawk	*Chordeiles minor*
Common Raven	*Corvus corax*
Common Tern	*Sterna hirundo*
Common Yellowthroat	*Geothlypis trichas*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 4 of 13)

Common Name	Scientific Name
Connecticut Warbler	*Oporornis agilis*
Cooper's Hawk	*Accipiter cooperii*
Dark-eyed Junco	*Junco hyemalis*
Double-crested Cormorant	*Phalacrocorax auritus*
Downy Woodpecker	*Picoides pubescens*
Eastern Bluebird	*Sialia sialis*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Meadowlark	*Sturnella magna*
Eastern Phoebe	*Sayornis phoebe*
Eastern Screech Owl	*Megascops asio*
Eastern Towhee	*Pipilo erythrophthalmus*
Eastern Whip-poor-will	*Antrostomus vociferus*
Eastern Wood-Pewee	*Contopus virens*
Eurasian collared-dove	*Streptopelia decaocto*
European Starling	*Sturnus vulgaris*
Field Sparrow	*Spizella pusilla*
Fish crow	*Corvus ossifragus*
Fox Sparrow	*Passerella iliaca*
Gadwall	*Anas strepera*
Golden-crowned Kinglet	*Regulus satrapa*
Golden-winged Warbler	*Vermivora chrysoptera*
Grasshopper Sparrow	*Ammodramus savannarum*
Gray Catbird	*Dumetella carolinensis*
Great Blue Heron	*Ardea herodias*
Great Crested Flycatcher	*Myiarchus crinitus*
Great Egret	*Ardea alba*
Great Horned Owl	*Bubo virginianus*
Greater Yellowlegs	*Tringa melanoleuca*
Green Heron	*Butorides virescens*
Green-winged Teal	*Anas crecca*
Hairy Woodpecker	*Picoides villosus*
Henslow's Sparrow	*Ammodramus henslowii*
Hermit Thrush	*Catharus guttatus*
Herring Gull	*Larus argentatus*
Hooded Merganser	*Lophodytes cucullatus*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 5 of 13)

Common Name	Scientific Name
Hooded Warbler	*Setophaga citrina*
Horned Grebe	*Podiceps auritus*
Horned Lark	*Eremophila alpestris*
House Finch	*Haemorhous mexicanus*
House Sparrow	*Passer domesticus*
House Wren	*Troglodytes aedon*
Indigo Bunting	*Passerina cyanea*
Kentucky Warbler	*Geothlypis formosa*
Killdeer	*Charadrius vociferus*
King rail	*Rallus elegans*
Least Flycatcher	*Empidonax minimus*
Least Sandpiper	*Calidris minutilla*
Lesser Scaup	*Aythya affinis*
Lesser Yellowlegs	*Tringa flavipes*
Loggerhead Shrike	*Lanius ludovicianus*
Louisiana Waterthrush	*Parkesia motacilla*
Magnolia Warbler	*Setophaga magnolia*
Mallard	*Anas platyrhynchos*
Marsh Wren	*Cistothorus palustris*
Merlin	*Falco columbarius*
Mourning Dove	*Zenaida macroura*
Nashville Warbler	*Leiothlypis ruficapilla*
Northern Bobwhite	*Colinus virginianus*
Northern Cardinal	*Cardinalis cardinalis*
Northern Flicker	*Colaptes auratus*
Northern Harrier	*Circus cyaneus*
Northern Mockingbird	*Mimus polyglottos*
Northern Parula	*Setophaga americana*
Northern Pintail	*Anas acuta*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Northern Saw-whet Owl	*Aegolius acadicus*
Orchard Oriole	*Icterus spurius*
Orange-crowned Warbler	*Leiothlypis celata*
Osprey	*Pandion haliaetus*
Ovenbird	*Seiurus aurocapilla*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 6 of 13)

Common Name	Scientific Name
Palm Warbler	*Setophaga palmarum*
Pied-billed Grebe	*Podilymbus podiceps*
Pileated Woodpecker	*Dryocopus pileatus*
Pine Siskin	*Spinus pinus*
Pine Warbler	*Setophaga pinus*
Prairie Warbler	*Setophaga discolor*
Prothonotary Warbler	*Protonotaria citrea*
Purple Finch	*Haemorhous purpureus*
Purple Martin	*Progne subis*
Red-bellied Woodpecker	*Melanerpes carolinus*
Red-breasted Merganser	*Mergus serrator*
Red-breasted Nuthatch	*Sitta canadensis*
Red Crossbill	*Loxia curvirostra*
Red-eyed Vireo	*Vireo olivaceus*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Red-necked Grebe	*Podiceps grisegena*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Ring-billed Gull	*Larus delawarensis*
Ring-necked Duck	*Aythya collaris*
Rock Dove	*Columba livia*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Ruby-crowned Kinglet	*Regulus calendula*
Ruby-throated hummingbird	*Archilochus colubris*
Ruddy Duck	*Oxyura jamaicensis*
Ruffed Grouse	*Bonasa umbellus*
Rusty Blackbird	*Euphagus carolinus*
Savannah Sparrow	*Passerculus sandwichensis*
Scarlet Tanager	*Piranga olivacea*
Semipalmated Plover	*Charadrius semipalmatus*
Semipalmated Sandpiper	*Calidris pusilla*
Sharp-shinned Hawk	*Accipiter striatus*
Snow Goose	*Chen caerulescens*
Solitary Sandpiper	*Tringa solitaria*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 7 of 13)

Common Name	Scientific Name
Song Sparrow	*Melospiza melodia*
Spotted Sandpiper	*Actitis macularius*
Summer Tanager	*Piranga rubra*
Swainson's Thrush	*Catharus ustulatus*
Swainson's Warbler	*Limnothylpis swainsonii*
Swallow-tailed Kite	*Elanoides forficatus*
Swamp Sparrow	*Melospiza georgiana*
Tennessee Warbler	*Leiothlypis peregrina*
Tree Swallow	*Tachycineta bicolor*
Tufted Titmouse	*Baeolophus bicolor*
Turkey Vulture	*Cathartes aura*
White-eyed Vireo	*Vireo griseus*
White-crowned Sparrow	*Zonotrichia leucophrys*
White-breasted Nuthatch	*Sitta carolinensis*
White-throated Sparrow	*Zonotrichia albicollis*
Wild Turkey	*Meleagris gallopavo*
Willow Flycatcher	*Empidonax traillii*
Wilson's Snipe	*Gallinago delicata*
Winter Wren	*Troglodytes troglodytes*
Wood Duck	*Aix sponsa*
Wood Stork	*Mycteria americana*
Wood Thrush	*Hylocichla mustelina*
Worm-eating Warbler	*Helmitheros vermivorum*
Veery	*Catharus fuscescens*
Vesper Sparrow	*Pooecetes gramineus*
Virginia Rail	*Rallus limicola*
Yellow-billed Cuckoo	*Coccyzus americanus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Yellow-bellied Flycatcher	*Empidonax flaviventris*
Yellow-breasted Chat	*Icteria virens*
Yellow-crowned Night Heron	*Nyctanassa violacea*
Yellow-rumped Warbler	*Setophaga coronata*
Yellow-throated Warbler	*Setophaga dominica*
Yellow-throated vireo	*Vireo flavifrons*
Yellow Warbler	*Setophaga petechia*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 8 of 13)

Common Name	Scientific Name
Invertebrates	
American Copper	*Lycaena phlaeas*
American Lady	*Vanessa virginiensis*
Aphrodite Fritillary	*Speyeria aphrodite*
Appalachian Azure	*Celastrina neglectamajo*
Appalachian Brown	*Satyrodes appalachia*
Appalachian Tiger Swallowtail	*Papilio appalachiensis*
Baltimore Checkerspot	*Euphydryas phaeton*
Black Swallowtail	*Papilio polyxenes*
Brazilian Skipper	*Calpodes ethlius*
Carlson's Polycentropus Caddisfly	*Polycentropus carlsoni*
Carolina Saddlebags	*Tramea carolina*
Common Darner	*Anax junius*
Creole Pearly-eye	*Enodia creola*
Diana Fritillary	*Speyeria diana*
Eastern Comma	*Polygonia comma*
Eastern Pondhawk	*Erythemis simplicicollis*
Eastern Tailed-Blue	*Everes comyntas*
Eastern Tiger Swallowtail	*Papilio glaucus*
Ebony Jewelwing	*Calopteryx maculata*
Edmund's Snaketail	*Ophiogomphus edmundo*
Edward's hairstreak	*Satyrium edwardsii*
Fiery Skipper	*Hylephila phyleus*
Goatweed Leafwing	*Anaea andria*
Golden-banded Skipper	*Autochoton cellus*
Gorgone Checkerspot	*Chlosyne gorgone*
Green Comma	*Polygonia faunus*
Gulf Fritillary	*Agraulis vanillae*
Hackberry Emperor	*Asterocampa celtis*
Harvester	*Feniseca tarquinius*
Holly Azure	*Celastrina idella*
Margaret's River Cruiser	*Macromia margarita*
Monarch Butterfly	*Danaus plexippus*
Mourning Cloak	*Nymphalis antiopa*
Northern Pearly-eye	*Enodia anthedon*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 9 of 13)

Common Name	Scientific Name
Oak Hairstreak	*Satyrium favonius*
Pipevine Swallowtail	*Battus philenor*
Red Admiral	*Vanessa atalanta*
Red-spotted Purple	*Limenitis arthemis astyanax*
Reversed Roadside Skipper	*Amblyscirtes reversa*
Silver Spotted Skipper	*Epargyreus clarus*
Spicebush Swallowtail	*Papilio troilus*
Small Tortoiseshell	*Nymphalis urticae*
Smokies Needlefly	*Megaleuctra williamsae*
Swamp Darner	*Epiaeschna heros*
Tawny Emperor	*Asterocampa clyton*
Variegated Fritillary	*Euptoieta claudia*
Viceroy	*Limenitis archippus*
White M Hairstreak	*Parrhasius m-album*
Zebra Swallowtail	*Eurytides marcellus*
Mammals	
American Beaver	*Castor canadensis*
American Black Bear	*Ursus americanus*
American Mink	*Mustela vison*
Appalachian Cottontail	*Sylvilagus obscurus*
American Red squirrel	*Tamiasciurus hudsonicus*
American Water Shrew	*Sorex palustris*
Big Brown Bat	*Eptesicus fuscus*
Bobcat	*Lynx rufus*
Brazilian Free-tailed Bat	*Tadarida brasiliensis*
Brown Rat	*Rattus norvegicus*
Carolina Red-backed Vole	*Myodes gapperi carolinesis*
Common Muskrat	*Ondatra zibethicus*
Coyote	*Canis latrans*
Common Deer Mouse	*Peromyscus maniculatus*
Cotton Deermouse	*Peromyscus gossypinus*
Eastern Chipmunk	*Tamias striatus*
Eastern Cottontail	*Sylvilagus floridanus*
Eastern Fox Squirrel	*Sciurus niger*
Eastern Gray Squirrel	*Sciurus carolinensis*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 10 of 13)

Common Name	Scientific Name
Eastern Harvest Mouse	*Reithrodontomys humulis*
Eastern Mole	*Scalopus aquaticus*
Eastern Red bat	*Lasiurus borealis*
Eastern Small-footed Myotis	*Myotis leibii*
Eastern Spotted Skunk	*Spilogale putorius*
Eastern Woodrat	*Neotoma floridana haematoreia*
Evening Bat	*Nycticeius humeralis*
Feral Hog	*Sus scrofa*
Golden Mouse	*Ochrotomys nuttalli*
Gray Bat	*Myotis grisescens*
Gray Fox	*Urocyon cineroargenteus*
Hairy-tailed Mole	*Parascalops breweri*
Hispid Cotton Rat	*Sigmodon hispidus*
Hoary Bat	*Lasiurus cinereus*
House Mouse	*Mus musculus*
Indian Myotis	*Myotis sodalis*
Least Weasel	*Mustela nivalis*
Least Shrew	*Cryptotis parva*
Little Brown Myotis	*Myotis lucifugus*
Long-tailed shrew	*Sorex dispar*
Long-tailed Weasel	*Mustela frenata*
Marsh Rice Rat	*Oryzomys palustris*
Masked Shrew	*Sorex cinereus*
Meadow Jumping Mouse	*Zapus hudsonius*
Meadow Vole	*Microtus pennsylvanicus*
Muskrat	*Ondatra zibethica*
Nine-banded Armadillo	*Dasypus novemcinctus*
North American Deermouse	*Peromyscus maniculatus*
North American River Otter	*Lontra canadensis*
Northern Flying Squirrel	*Glaucomys sabrinus coloratus*
Northern Long-eared Myotis	*Myotis spetentrionalis*
Northern Raccoon	*Procyon lotor*
Northern Short-tailed Shrew	*Blarina brevicauda*
Oldfield Deermouse	*Peromyscus polionotus*
Pygmy Shrew	*Sorex hoyi*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 11 of 13)

Common Name	Scientific Name
Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*
Red Fox	*Vulpes vulpes*
Red Squirrel	*Tamiasciurus hudsonicus*
River Otter	*Lutra canadensis*
Rock Shrew	*Sorex dispar*
Rock Vole	*Microtus chrotorrhinus*
Roof Rat	*Rattus rattus*
Seminole Bat	*Lasiurus seminolus*
Silver-haired bat	*Lasionycteris noctivagans*
Smoky Shrew	*Sorex fumeus*
Southeastern Myotis	*Myotis austroriparius*
Southeastern Shrew	*Sorex longirostris*
Southern Bog Lemming	*Synaptomys cooperi*
Southern Flying Squirrel	*Glaucomys volans*
Southern Red-Backed Vole	*Myodes gapperi*
Southern Short-tailed Shrew	*Blarina carolinensis*
Star-nosed Mole	*Sorex hoyi*
Striped Skunk	*Mephitis mephitis*
Swamp Rabbit	*Sylvilagus auaticus*
Tricolored Bat	*Perimyotis subflavus*
Virginia Opossum	*Didelphis virginiana*
Water Shrew	*Sorex palustris*
White-footed Deermouse	*Peromyscus leucopus*
White-tailed Deer	*Odocoileus virginianus*
Woodchuck	*Marmota monax*
Woodland Jumping Mouse	*Napaeozapus insignis*
Woodland Vole	*Microtus pinetorum*
Reptiles	
Black Racer	*Coluber constrictor*
Black Rat Snake	*Elaphe obsoleta*
Bog Turtle	*Glyptemys muhlenbergii*
Broad-headed Skink	*Eumeces laticeps*
Brown Snake	*Storeria dekayi*
Coal Skink	*Eumeces anthracinus*
Common Musk Turtle	*Sternotherus odoratus*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 12 of 13)

Common Name	Scientific Name
Common Snapping Turtle	*Chelydra serpentina*
Copperhead	*Agkistrodon contortrix*
Corn Snake	*Elaphe guttata*
Eastern Box Turtle	*Terrapene carolina*
Eastern Chicken Turtle	*Deirochelys reticularia*
Eastern Fence Lizard	*Sceloporus undulatus*
Eastern Garter Snake	*Thamnophis sirtalis*
Eastern Hognose Snake	*Heterodon platirhinos*
Eastern Kingsnake	*Lampropeltis getula*
Eastern Milksnake	*Lampropeltis triangulum*
Eastern Mud Snake	*Farancia abacura*
Eastern Mud Turtle	*Kinosternon subrubrum*
Eastern Painted Turtle	*Chrysemys picta*
Eastern Ribbon Snake	*Thamnophis sauritus*
Eastern River Cooter	*Pseudemys concinna*
Eastern Six-lined Racerunner	*Cnemidophorus sexlineatus*
Five-lined Skink	*Eumeces fasciatus*
Florida Cooter	*Pseudemys concinna floridana*
Green Anole	*Anolis carolinensis*
Ground Skink	*Scincella lateralis*
Mediterranean Gecko	*Hemidactylus turcicus*
Mole Kingsnake	*Lampropeltis calligaster*
Northern Fence Lizard	*Sceloporus undulatus hyacinthinus*
Northern Rough Green Snake	*Opheodrys aestivus*
Northern Watersnake	*Nerodia sipedon*
Painted Turtle	*Chrysemys picta*
Pigmy Rattlesnake	*Sistrurus miliarius*
Pine Snake	*Pituophis melanoleucus*
Queen Snake	*Regina septemvittata*
Red-bellied Snake	*Stoerira occipitomaculata*
Ringneck Snake	*Diadophis punctatus*
River Cooter	*Pseydemys concinna*
Rough Green Snake	*Opheodrys aestivus*
Scarlet Snake	*Cemophora coccinea*
Six-lined Racerunner	*Cnemidophorus sexlineatus*

Table 3.7-4 Terrestrial Species Likely to be Observed in Oconee and Pickens Counties within a 6-Mile Radius of the ONS Site (Sheet 13 of 13)

Common Name	Scientific Name
Slender Glass Lizard	*Ophisaurus attenuatus*
Smooth Earth Snake	*Virginia valeriae*
Snapping Turtle	*Chelydra serpentina*
Southeastern Crowned Snake	*Tantilla coronata*
Southeastern Five-lined Skink	*Eumeces inexpectatus*
Southern Coal Skink	*Eumeces anthracinus pluvialis*
Spiny Softshell Turtle	*Apalone spinifera*
Timber Rattlesnake	*Crotalus horridus*
Worm Snake	*Carphophis amoenus*
Yellow-bellied Slider	*Trachemys scripta*

(Clemson 2019a; Cornell 2019; Odonata Central 2019; SCDNR 2015; UGA 2019b; UGA 2019c; UGA 2019d; UGA 2019e; USGS 2018)

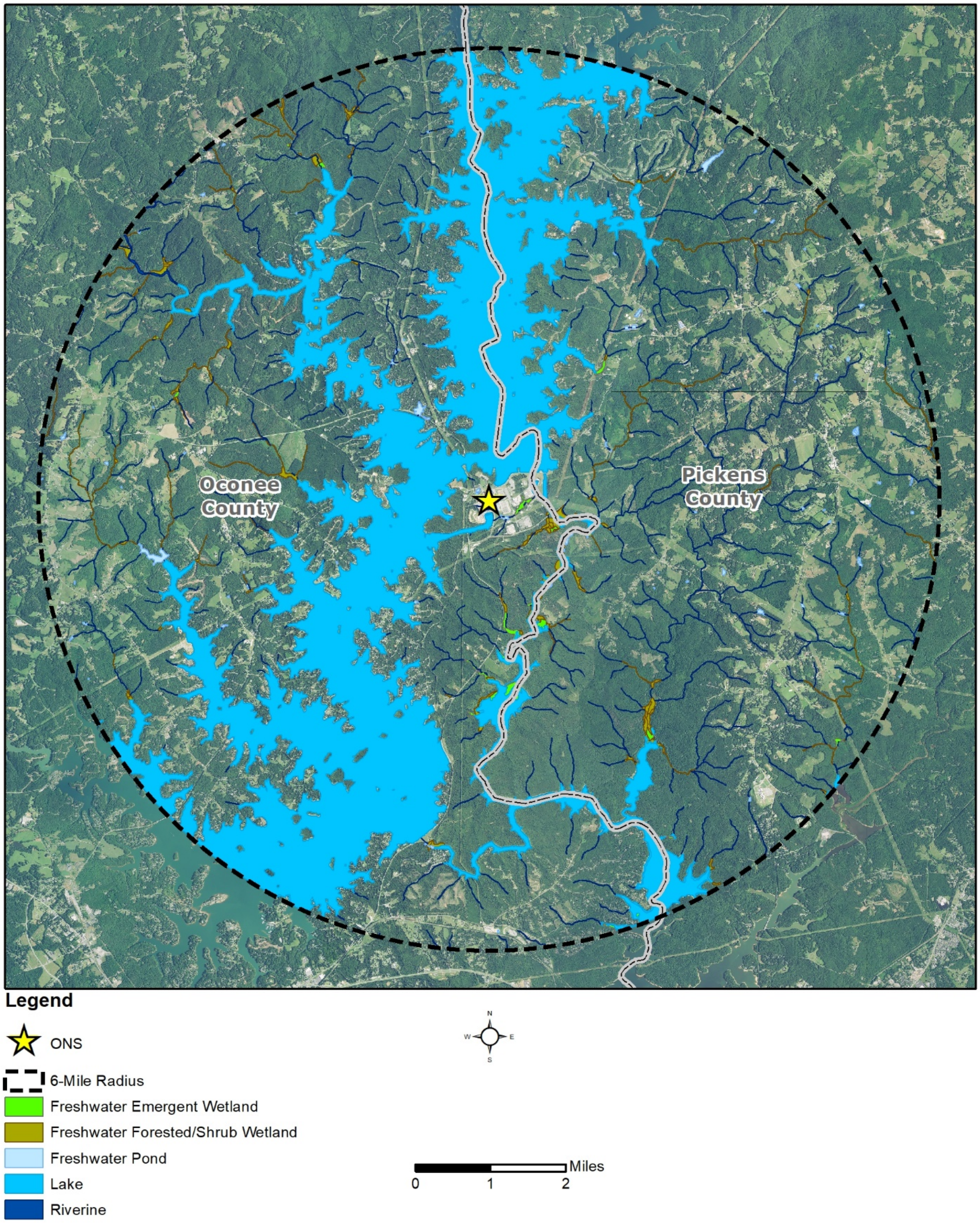


Figure 3.7-1 NWI Wetlands, 6-Mile Radius of ONS

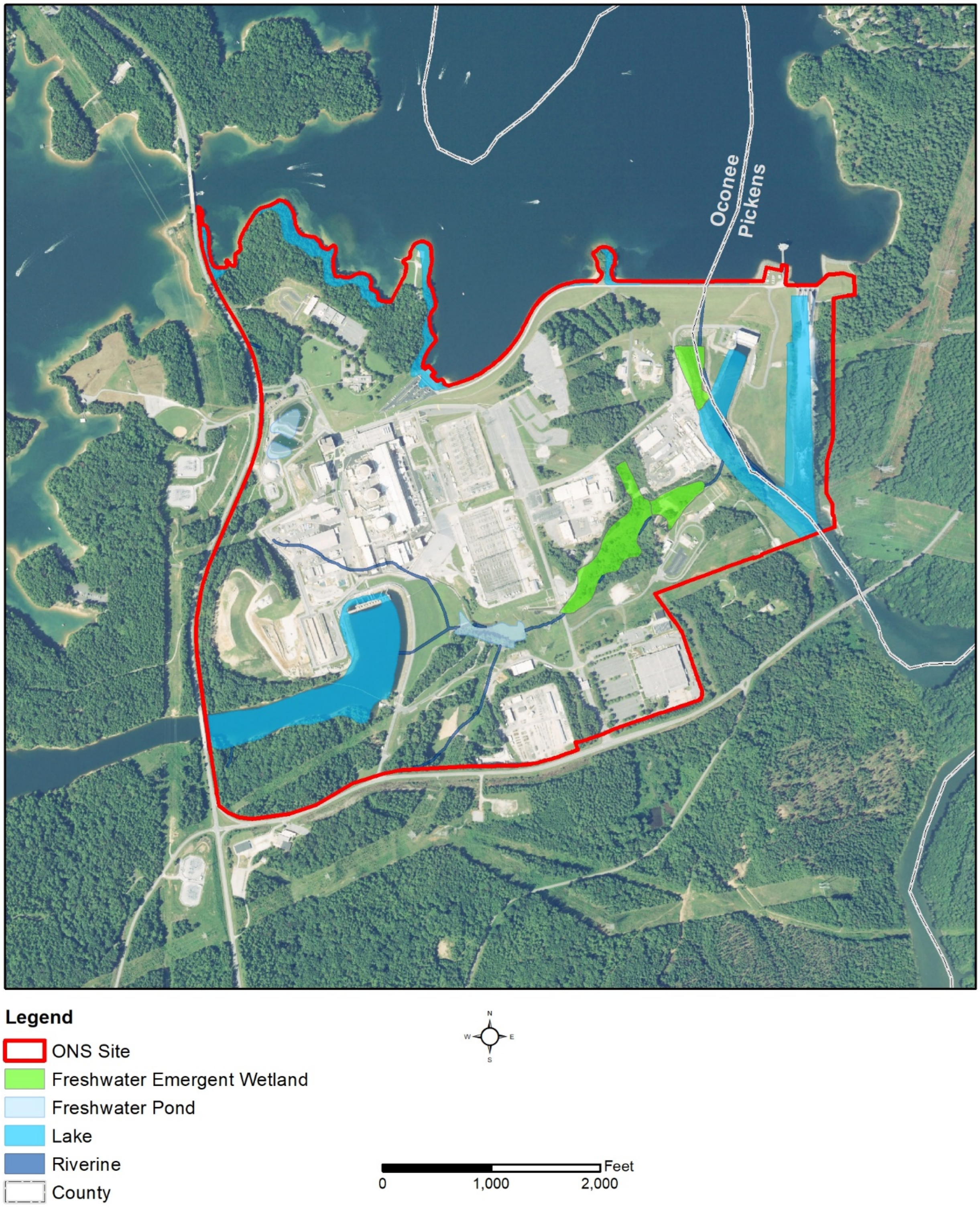


Figure 3.7-2 NWI Wetlands, ONS Site

3.8 Historic and Cultural Resources

Cultural resources include prehistoric era and historic era archaeological sites and objects, architectural properties and districts, and traditional cultural properties, which are defined as significant objects or places important to Native American tribes for maintaining their culture (USDOI 1998). Of particular concern are those cultural resources that may be considered eligible for listing on the NRHP. Any cultural resources listed on or eligible for the NRHP are considered historic properties under the National Historic Preservation Act (NHPA) [16 USC 470].

Prior to taking any action to implement an undertaking, Section 106 of the NHPA requires the NRC as a federal agency to do the following:

- Take into account the effects of an undertaking (including issuance of a license) on historic properties, including any district, site, building, structure, or object included in or eligible for inclusion in the NRHP.
- Afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertaking.

To provide early consultation for the Section 106 process, Duke Energy contacted the South Carolina Department of Archives and History for informal consultation concerning the ONS SLR and potential effects on cultural resources within the approximately 510-acre site and on historic properties within a 6-mile radius of ONS. Native American groups recognized as potential stakeholders were also consulted by Duke Energy with the opportunity for comment. (Attachment D)

This ER identifies all known archaeological sites within a 6-mile radius of ONS, as well as properties listed on the NRHP within that same radius. The approximately 510-acre Duke Energy ONS property consists primarily of developed lands and forested areas. For the purpose of SLR, the aboveground area of potential effect (APE) is defined as the entire ONS property and everything within a 6-mile radius of ONS. The aboveground APE considers the visual integrity of historical properties in relation to continued ONS operation. The archaeological APE is considered bounded by the approximately 510 acres, where ground disturbance, though unanticipated during the subsequent period of extended operation, might compromise the physical integrity of archaeological data.

No ground disturbance associated with ONS is considered within the scope of the 10 CFR 51 evaluation. As such, the SLR consists of an administrative action relative to historic and cultural resources. Although construction of the existing ONS facility itself would have impacted any archaeological resources that may have been located within its footprint, much of the surrounding area remains largely undisturbed.

The literature review for the SLR of previously recorded archaeological sites included the area within a 6-mile radius of ONS. The purpose of the literature review was to help develop an understanding of the local context by conducting an inventory of all previously and newly recorded archaeological sites on the 510-acre ONS property and within a 6-mile radius of ONS, regardless of NRHP status.

The results of the literature review showed that there are 99 archaeological resources and five architectural resources previously recorded within 6 miles of ONS (SCIAA + SCDAH 2019). There are six resources that are either NRHP listed, determined eligible, or recommended eligible for the NRHP, or have the equivalent eligibility or potential eligibility under national heritage or legacy commission designations (Tables 3.8-1 and 3.8-2). There are an additional seven resources within the 6-mile radius of ONS whose NRHP status has not been evaluated and is therefore undetermined (Table 3.8-1).

3.8.1 Land Use History

The land use history for ONS and the surrounding region was developed as part of a Phase 2A literature review and archaeological sensitivity assessment of the ONS property and is summarized here. Section 3.8.2 provides a more detailed discussion of historical land use as part of the cultural history. Early maps provide information on how the area was used in the past. An 1880 map shows the railroad expanding into the area, which indicates growth and a change from agriculture to industry soon to come (Figure 3.8-1). A 1961 USGS map shows a largely forested area with few scattered buildings. There are more unpaved jeep trails than paved roads and Old Pickens Cemetery is indicated just outside of the ONS property to the southeast (Figure 3.8-2). A 1961 USGS, photo-revised 1981 edition has an overlay of Lake Keowee, the Keowee Dam, the ONS powerplant, substations, and power lines (Figure 3.1-2). The 2014 USGS map shows Lake Keowee filled in along all previous low-lying areas. The jeep trails are gone, as are most of the scattered structures previously seen. Old Pickens Cemetery is still present, along with a new cemetery, Craig Memorial Cemetery, alongside it (Figure 3.8-3). Associated with the Old Pickens Cemetery is the Old Pickens Presbyterian Church, an NRHP-listed structure from the 1850s (Figure 3.8-4).

Photographs taken prior to, during, and after the construction of the ONS facility are useful in showing the environmental context during that time period. At the time of construction, the ONS facility consisted of undeveloped forests, small towns, and agricultural fields (Figure 3.8-5). The trees and brush were removed, and the area was mechanically leveled (Figure 3.8-6). Construction included excavation for the ONS facility components (Figure 3.8-7). Final construction of the ONS facility included multiple buildings, structures, and parking lots surrounded by forest (Figure 3.8-8).

The ONS property and the surrounding region hold evidence of both prehistoric and historic occupation by Native Americans and Euro-Americans. Archaeological records suggest that the ONS property and the surrounding area were potentially occupied by Native American populations during the Archaic Period (ca.8000 BC to 3000 BC), the Woodland Period (ca. 3000 BC to 1000 AD), and the Mississippian Period (ca. 1000 to 1520 AD).

Duke Energy's consultations with Native American groups are included in Attachment D.

3.8.2 Cultural History

3.8.2.1 Paleoindian Period (Prior to 8000 BC)

The Paleoindian period is the earliest substantiated cultural adaptation in South Carolina (SCE&G 2019). Due to lower global temperatures, more water was trapped in glaciers resulting in a larger area of the continental shelf being exposed. Paleoindian peoples tended to live in small bands which traveled seasonally within set territories for food sources that included hunting megafauna, caribou, elk, and deer (SCE&G 2019). Many of these bands likely lived along large rivers for access to higher resource areas. These same resource areas commonly have lithic resources suitable for tool manufacture. The material culture is characterized by large, fluted points such as the Clovis and the Middle Paleo Point. Later point types, such as Hardaway Side Notched, Hardaway Blade, and Hardaway-Dalton no longer exhibited fluting, but retained a high level of technical sophistication indicative of Paleoindian tools. Subsistence of Paleoindian peoples focused on large game as well as small game, fishing, and foraging. A more diversified view of the Paleoindian economy is becoming accepted as a result of recent research, in contrast to the previous view emphasizing a heavy reliance on the exploitation of megafauna. Paleoindian sites are primarily located in locations where large streams entered major rivers. (Judge 2017)

3.8.2.2 Archaic (8000 BC to 3000 BC)

The Archaic Period is marked by changes in subsistence and settlement patterns likely associated with rising sea levels related to glacial melt. This period is divided into the Early, Middle, and Late Archaic and is characterized by the exploitation of a larger variety of plant and animal resources with an overall greater diversity in material culture. The transition to the Early Archaic Period is inferred to include a less mobile and more localized lifestyle than the preceding Paleoindian Period. Projectile points no longer exemplified the intricate work characteristic of Paleoindian tools. Early Archaic tools such as spear points, knives, drills, scrappers, and gravers were still used, but varied in size and shape and were often fashioned with side or corner notches to allow for hafting (Judge 2017).

By the Middle Archaic, the "tool kit" is inferred to have expanded to include atlatls for hunting with notched and stemmed points as well as mortars and pestles for food processing. Stone axes became common for obtaining wood for structures and fire suggesting a greater level of sedentism with mostly egalitarian social organization. The occurrence of steatite and soapstone bowls and early pottery also suggests longer term occupations and more intense resource exploitation. During this period, the first inland shell middens were constructed, and long-distance trade was established. (SCDAH 2019a)

The Late Archaic had important innovations such as tribal societies, clay pottery vessels, shell rings, and three-quarter grooved axes. (Judge 2017) The earliest known house in South Carolina is from this period on Hilton Head Island. Shell middens were used as architectural materials to construct fifteen large shell ring complexes along the outer coastal plain. (Judge 2017) Overall, the exploitation strategy during the Archaic Period appears to have been a mostly mobile population conducting hunting and foraging activities around a seasonal movement strategy based on the state's major river systems, exploiting resources from the coast, to the coastal plain, to the Piedmont. (Judge 2017)

3.8.2.3 Woodland (3000 BC to 1000 AD)

The Woodland Period is characterized by increasing horticultural expertise, widespread adoption of ceramic technology, and increasing sedentism and social complexity, when compared to the previous Archaic Period (SCDAH 2019a). Early Woodland settlements in the upper coastal plain indicate a shift away from riverine settings, with small, semiautonomous groups living in the uplands at sites containing relatively few artifacts and little artifact diversity (SCE&G 2019).

The Middle Woodland is not currently well documented in South Carolina, particularly in non-coastal areas. A large site found in the Savannah River Valley suggests a year-round settlement occupied by a small resident population. This site contains several hundred pits, posts, and human and dog burials. (SCE&G 2019) Smaller sites, located in the coastal plains, contained few features and little artifact density, suggesting the presence of hunting/butchering camps. The diet continued to include aquatic and game resources, but began to include more plants. The carbohydrate-rich diet, evident in human bone analysis, suggests an increase in agriculture and less reliance on hunting and foraging. Smaller projectile points, resulting from the conversion from atlatls and darts to the bow and arrow and celts appear. There appeared to be a pattern where small villages were occupied on a year-round basis, with smaller outlying sites representing seasonally occupied special purpose camps. (SCE&G 2019)

By the Late Woodland, political stratification was evident within permanent and semi-permanent large villages, some located within palisades, suggesting an increase in intercommunity violence across the larger region. Agriculture appears to have increased in importance, particularly corn and squash. However, foraging and hunting comprised the bulk of the diet. Sites from this time period are rarely discovered in South Carolina, in particular, the South Carolina Piedmont, and it is possible this was a buffer zone for warring groups. (SCE&G 2019)

3.8.2.4 Mississippian (1000 to 1520 AD)

The Mississippian Period is characterized by the practice of maize agriculture, complex chiefdoms, populous villages and zones of dispersed housing, and constructed earthen mounds in some of the villages, usually along the floodplains of major rivers (SCDAH 2019a). The mounds were built in stages with temples and the houses of the chief often erected on the summits of these truncated pyramids. The buildings were burned down, and a new layer of earth added over the top when the chief died before the new chief's home was built on top of the fresh layer. (Judge 2017) The mound centers were supported by outlying villages, also typically built along major rivers, smaller hamlets and farmsteads to provide food, tribute, services, and labor to the chief in return for protection and inclusion in the sociopolitical system.

(SCE&G 2019) Trade networks were extensive, and exchanged resources included marine shell, copper, and exotic lithic materials. These items, in turn, could be fashioned into jewelry or other items of status for the elites of the society. Non-mound sites are also common across South Carolina, and are recognized through the presence of carved, paddle-stamped designs on exterior surfaces of their pottery. The arrival of the Spanish explorers in the early to mid-sixteenth century brought an end to the Mississippian Period and changed the trajectory of Native American culture. (Judge 2017)

3.8.2.5 Exploratory Period (1520 to 1670 AD)

The Exploratory Period begins with the arrival of Europeans. At that time, the area was the home of numerous Native American groups. The Spanish made contact in South Carolina in 1526 and they had a mission concept meant to bring the native population under their control. They established La Florida, with Santa Elena as the capital. The Spanish were followed by the French in 1562, who established Charlesfort on present day Parris Island, but it was abandoned shortly thereafter. These early settlement attempts resulted in a severe reduction of the Native American populations due to the introduction of European and African diseases to which the Native population had no immunity. (SCDAH 2019a)

3.8.2.6 Historic Period (1670 AD to present)

The Historic Period begins with colonization by the British in late 1600s. The English colonial economy excelled on deerskin trade and slave-labor plantations. Trading posts, such as Ninety-Six, were established to help facilitate the deerskin trade. Various tribes from the southeast, including the Cherokee and the Pee Dee, tried to remove the colonists, resulting in the Yamasee War from 1715 to 1717; however, they were ultimately unsuccessful. The key archaeological features of this period are a severe reduction in Native American materials replaced with industrial mass-produced European-American materials, English trade items, firearms, and glass beads. While most of the local tribes were forced out of the state, many on the Trail of Tears to the Oklahoma Territory, the Catawba were granted a reservation in 1763 and remain there to this day. (SCDAH 2019a)

The northwestern corner of South Carolina is an area of lakes and mountains and was home to the Cherokee Indians until the Revolutionary War, when they were driven from all except the northernmost region. (Badders 2017; Roper 2017) The Oconee Station was built in 1792 as one in a series of militia blockhouses along the South Carolina frontier and the site, alongside the neighboring William Richards house (ca. 1802), remains to this day as part of the NRHP-listed Oconee Station State Park. The Old Pickens Presbyterian Church, also an NRHP-listed site, was constructed in 1827. (Badders 2017) During the period between the Revolutionary War and the Civil War, the region was populated by small farms focused primarily on livestock and grain production and to a lesser extent, cotton. Perhaps due to the rural, isolated nature of the area, the area largely escaped the destruction resulting from the Civil War. Very few of the farmers from the upcountry owned slaves prior to the war. (Roper 2017) As part of the economic recovery process from the war, male citizens were ordered to work on the roads. The area focused on transportation, first on the roads, then later on the railroads to transport crops quickly and inexpensively to market. The railroads reached the area in the 1850s but stalled with the war, picking back up again in the 1870s through 1890s (Figure 3.8-1). Small towns popped up along the new railways and industrial development soon followed. The Courtenay Manufacturing Company established in 1893, the Norris Cotton Mill at Cateechee in 1895, and Longdale Manufacturing Company in Seneca in 1901, were just a few of the early large companies in the area. Industry attracted rural farmers into the mills to work, and agriculture slowly declined in importance as a result. (Badders 2017; Roper 2017)

Foreign competition weakened the textile industry during the last decades of the twentieth century, which led the county to look to its natural and scenic resources to supplement its economy (Badders 2017). The Duke Power Company began a large-scale power-generating project. To this end, both Lake Keowee and Lake Jocassee were constructed. Collectively called the Keowee-Toxaway complex, these projects included the Keowee, Jocassee, and Bad Creek hydroelectric stations and ONS. The lakes, as well as Sumter National Forest, and four state parks with scenic forests, rolling hills, and waterfalls, make the area a tourist destination. Retirement communities developed along the lakes as well. (Badders 2017)

3.8.3 Onsite Cultural Resources

Onsite cultural resources are those located within the 510-acre ONS property. That property includes the entirety of the archaeological APE, which is also the onsite portion of the aboveground APE.

No NRHP-eligible cultural resources have been confirmed within the 510-acre ONS property (Figure 3.8-4). No structures within the ONS property have been documented through the Historic American Buildings Survey or the Historic American Engineering Record programs. Following up on the South Carolina Department of Archives and History comments (Attachment D), Duke Energy continues to work towards addressing their consultation response for onsite cultural resources.

3.8.4 Offsite Cultural Resources

Offsite cultural resources are those outside the 510-acre ONS property boundary. There are 104 offsite resources within 6 miles of the ONS. Lists of known archaeological sites and historic properties within a 6-mile radius of ONS are presented in Tables 3.8-1 and 3.8-2, but due to the large number of resources, the table is restricted to NRHP-listed resources, as well as those that are potentially eligible, determined eligible, or very close proximity. There are three NRHP-listed resources within 6 miles of ONS (Table 3.8-2 and Figure 3.8-4).

3.8.5 Cultural Resource Surveys

There is no documentation of a cultural resources survey of the 510-acre property conducted prior to the construction of ONS; however, surveys were conducted prior to the construction of Lake Keowee. There have been nine cultural resources surveys documented within the 6-mile radius of the ONS property. (SCIAA + SCDAH 2019) Archaeological resources surveys, such as these, are the means by which archaeological sites are located and documented.

3.8.6 Procedures and Integrated Cultural Resources Management Plan

Cultural resources on the ONS site are protected by Duke Energy's Cultural Resources Program, which is specifically applicable to ONS. The guidance document ensures that cultural resource remains are not damaged and protected from unauthorized removal, and that in the event disturbance is required in these areas, remains will be appropriately protected for their cultural resource information value. The guidance protects known cultural resources, as well as unknown cultural resources, by establishing a process for all activities that require a federal permit, use federal funding, or have the potential to impact historic resources.

Table 3.8-1 Eligible or Potentially Eligible Sites within a 6-Mile Radius of ONS[a]

Site ID#	County	Quadrangle	NRHP Status
38OC0001	Oconee	Old Pickens	Not evaluated
38OC0002	Oconee	Old Pickens	Not evaluated
38OC0036	Oconee	Old Pickens	NRHP listed
38OC0105	Oconee	Old Pickens	Probably not eligible
38OC0225	Oconee	Old Pickens	Probably not eligible
38OC0460	Oconee	Old Pickens	Potentially eligible
38OC0466	Oconee	Old Pickens	Potentially eligible
38PN0001	Pickens	Old Pickens	Not evaluated
38PN0002	Pickens	Old Pickens	Not evaluated
38PN0004	Pickens	Old Pickens	Not evaluated
38PN0005	Pickens	Old Pickens	Not evaluated
38PN0012	Pickens	Old Pickens	Not evaluated
38PN0051	Pickens	Old Pickens	Probably not eligible
38PN0149	Pickens	Old Pickens	Recommend additional work
38PN0178	Pickens	Old Pickens	Not eligible
38PN0179	Pickens	Old Pickens	Not eligible
0004	Oconee	Seneca	NRHP listed
0029	Oconee	Old Pickens	NRHP listed

(SCIAA + SCDAH 2019)

a. Due to the large number of sites (104) within 6 miles of ONS, only sites that are potentially eligible, determined eligible, or in very close proximity are included.

Table 3.8-2 NRHP-Listed Sites within a 6-Mile Radius of ONS

Resource Name	County	Quadrangle	NRHP Listed	Distance from ONS[(a)]
Alexander-Hill House	Oconee	Old Pickens	1972	2.18 miles
Newry Historic District	Oconee	Seneca	1982	4.87 miles
Old Pickens Presbyterian Church	Oconee	Old Pickens	1996	0.35 miles

(SCIAA + SCDAH 2019)

a. Distances are approximate and based on the ONS center point and NRHP location data.

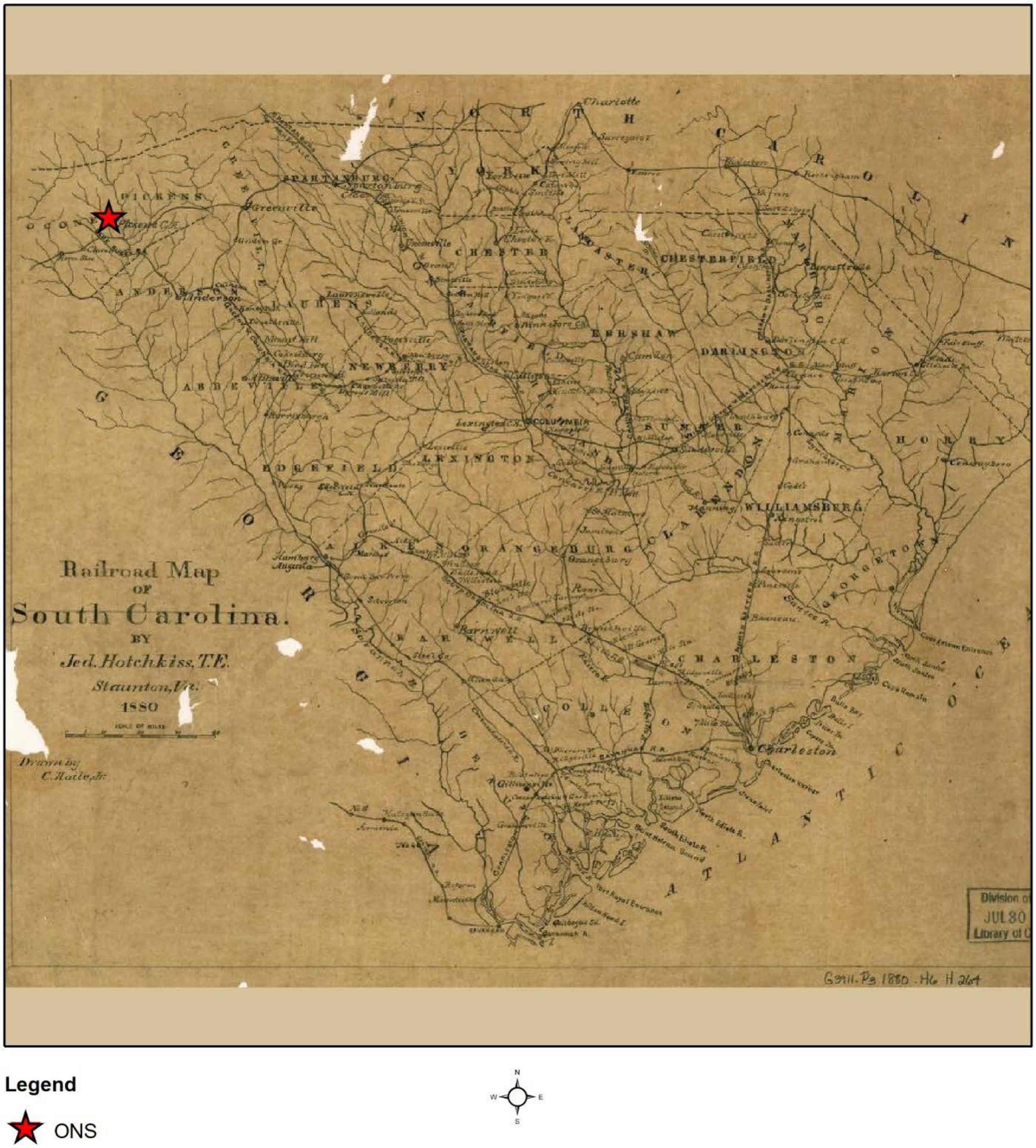


Figure 3.8-1 1880 Railroad Map of South Carolina

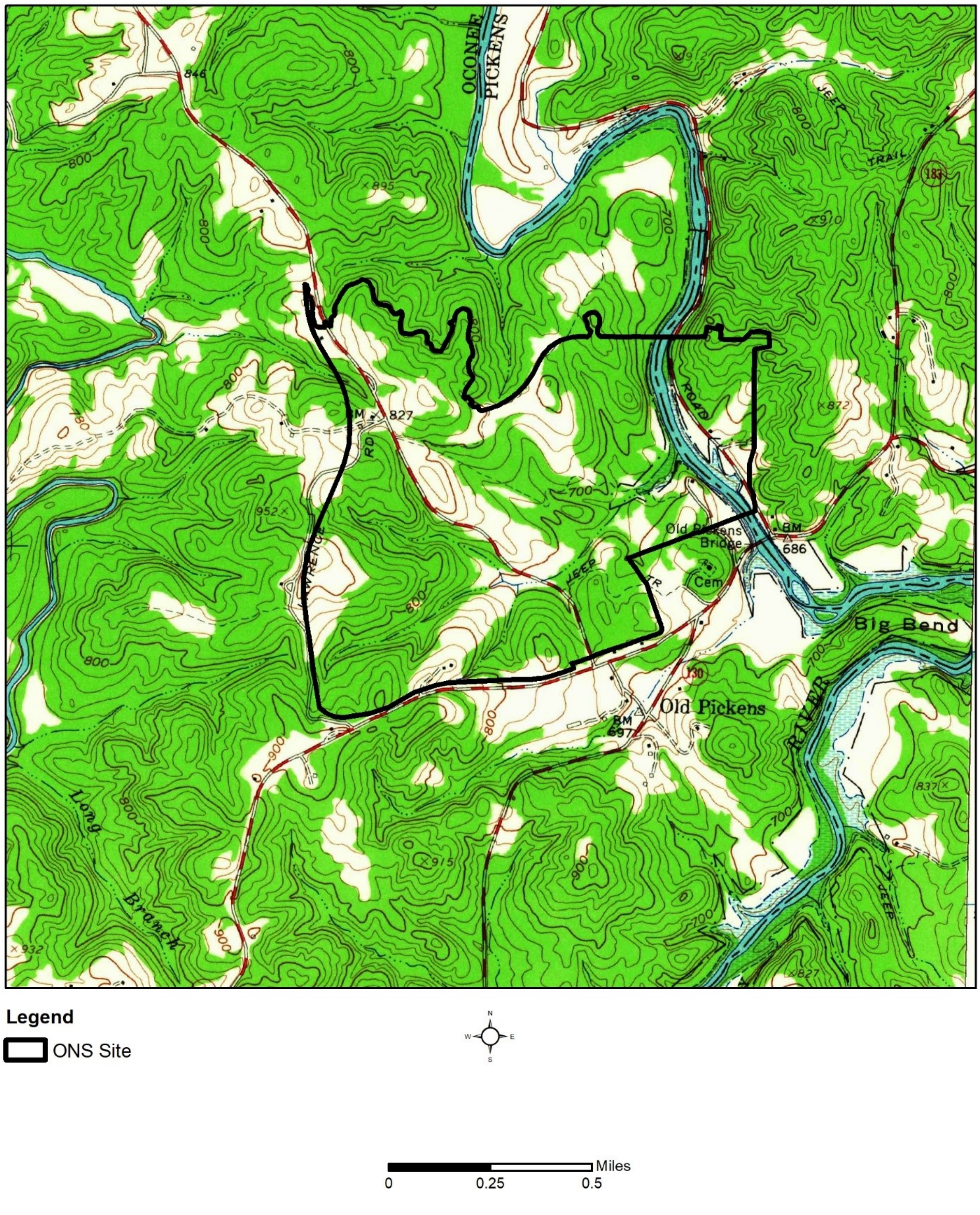


Figure 3.8-2 Duke Energy Property, 1961

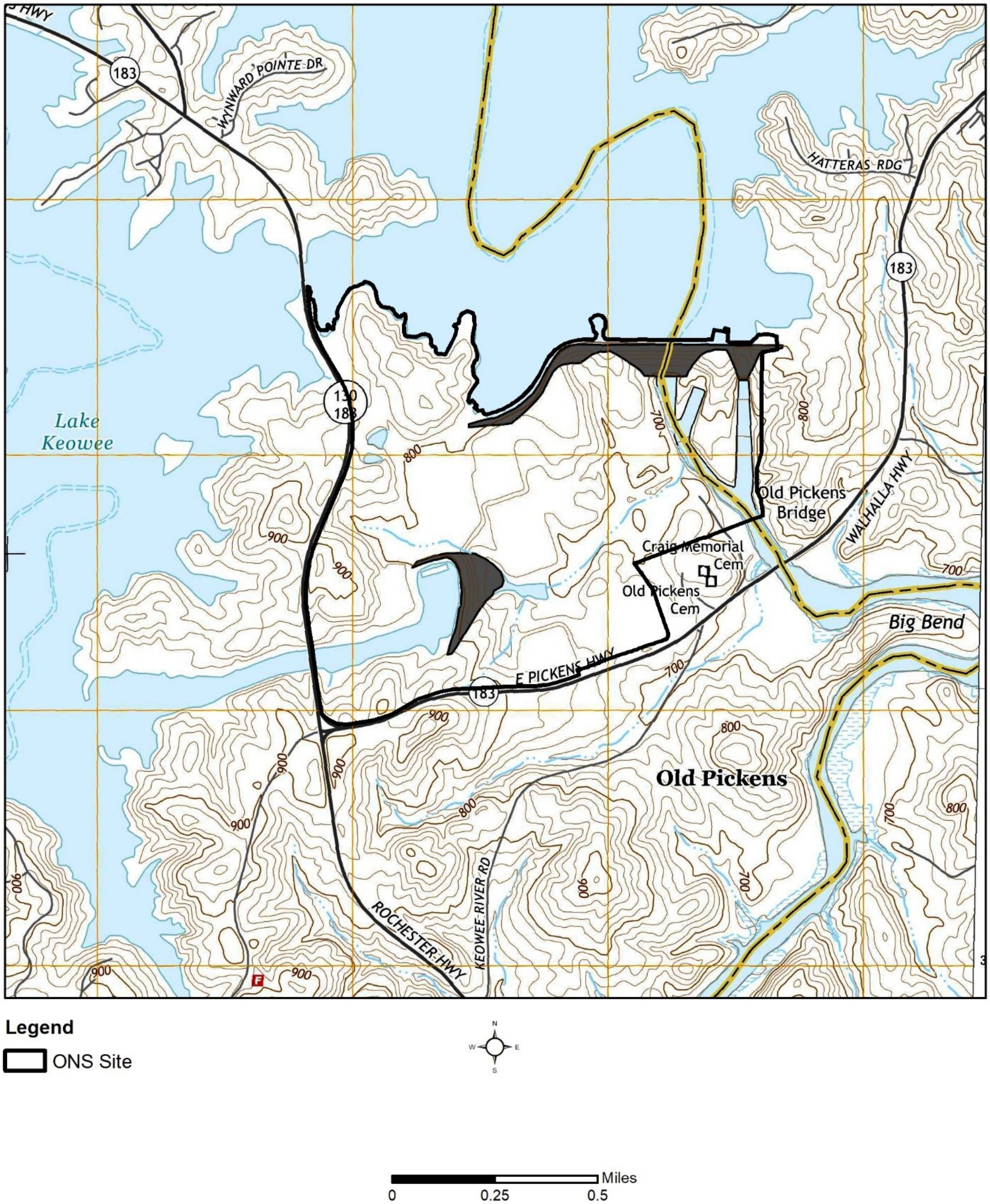


Figure 3.8-3 Duke Energy Property, 2014

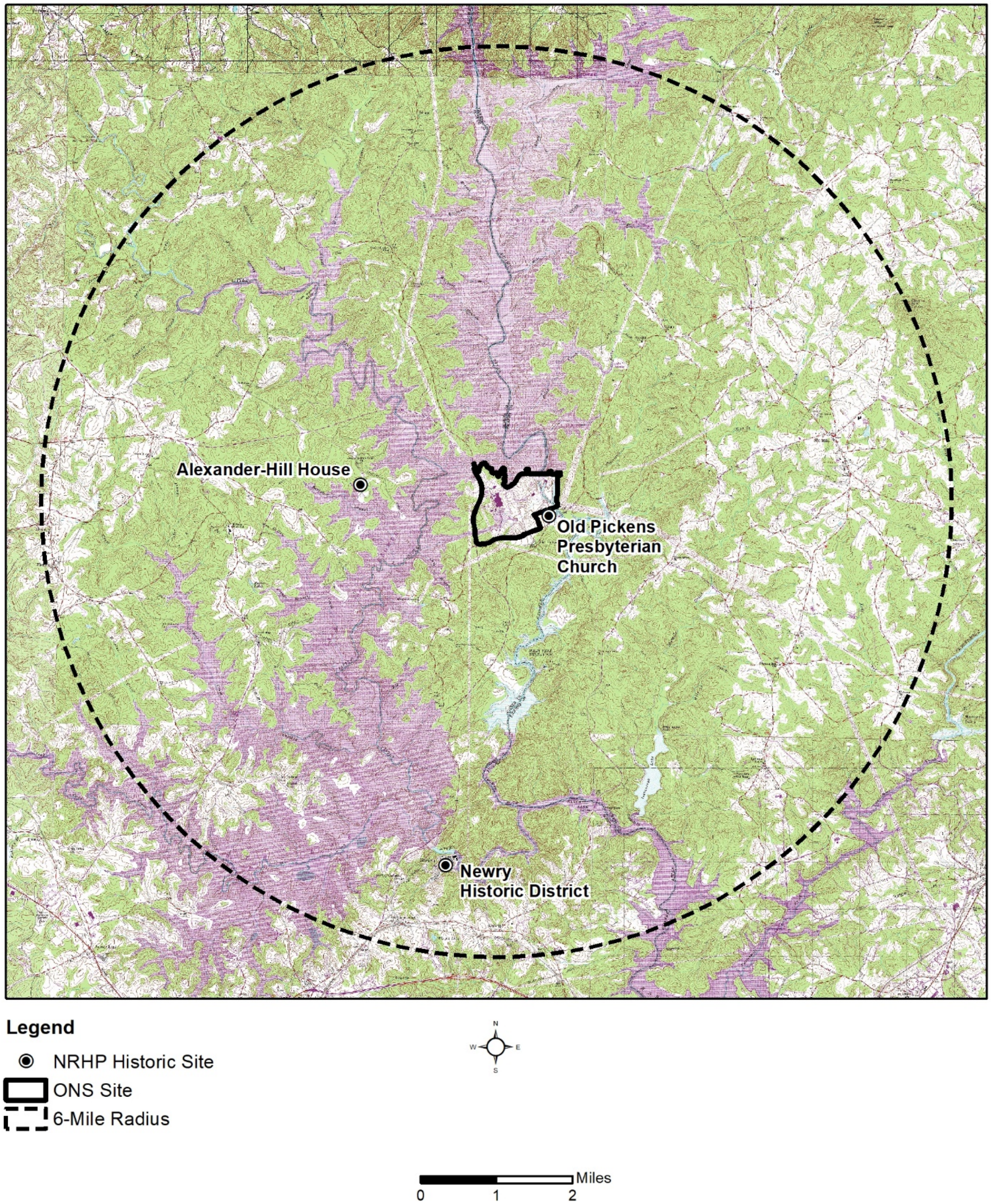


Figure 3.8-4 NRHP-Listed Resources, 6-Mile Radius of ONS

Figure 3.8-5 Pre-Construction Photograph (circa 1963) of the ONS Site Showing Primarily Undeveloped Forest

Figure 3.8-6 Construction Photograph of the ONS Site (January 1970) Showing Tree Removal, Lake Keowee, and Mechanical Leveling

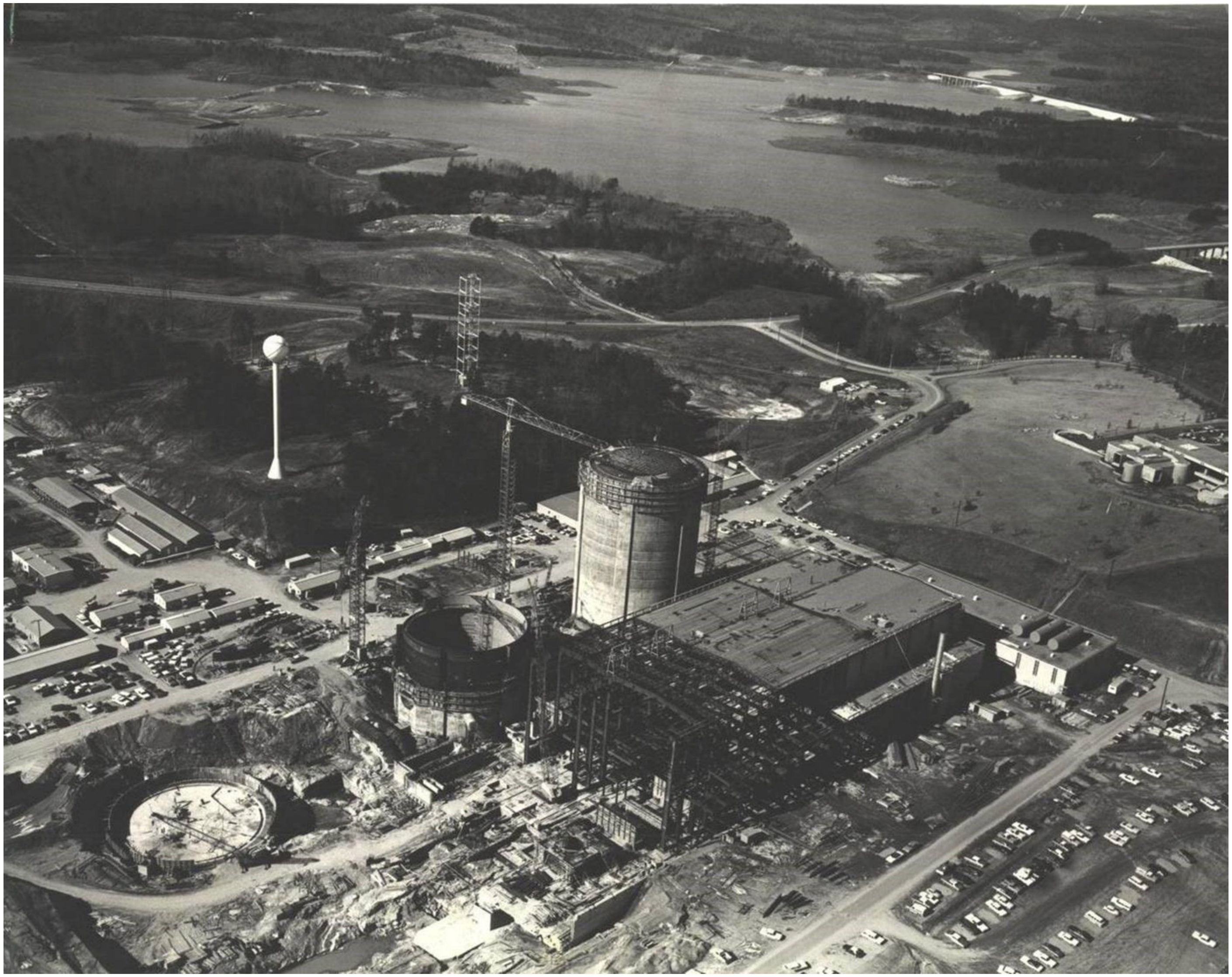


Figure 3.8-7 Construction Photograph of ONS (circa 1969), Showing Areas Excavated for Structures

Figure 3.8-8 Post-Construction Photograph of ONS Showing Structures, Buildings, Parking Lots, and Forest

3.9 Socioeconomics

Socioeconomic descriptions are focused on Oconee County and Pickens County, SC, because approximately 80 percent of the ONS workforce are located in those two counties, while the remaining workforce is dispersed throughout the region (see Table 2.5-1).

Refueling and maintenance outages for the three ONS units are on a staggered schedule, with one fall refueling outage scheduled during odd years and a spring and fall outage scheduled for even years. As presented in Section 2.5, during an outage there are approximately 800 to 900 contingent workers providing onsite support. As seen in Figure 3.1-4, within the 50-mile radius of ONS there are several nearby South Carolina municipal areas, including Seneca, Clemson, Anderson, and Greenville. There are also numerous motel, campground, and food service conveniences available for contract workers who provide temporary support during site outages. Transportation corridors such as I-85 and local state highways provide commuter access to ONS.

3.9.1 Employment and Income

The two geographic areas most influenced by ONS operations are Oconee and Pickens counties in South Carolina. Additionally, ONS is one of Duke Energy's assets on which property taxes are paid to Oconee County. As presented in Section 3.11.1, the population for Oconee County is expected to increase until 2025, and Pickens County's population is projected to increase through 2054 (the SLR operating term). Low-income populations and poverty thresholds for the counties are described Section 3.11.2.

The estimated employed population in Oconee County in 2018 was 34,470 persons. The leading reported occupational sector was manufacturing, with approximately 18.2 percent, or 6,263 persons employed. This was followed by the government and government enterprises sector with 13.0 percent, or 4,476 persons employed; and the retail trade sector with 11.6 percent, or 3,999 persons employed. (BEA 2020) Oconee County's largest employer is the School District of Oconee County, followed by Duke Energy and the Oconee Memorial Hospital (UA 2019). The annual payroll in Oconee County was approximately $3.4 billion in 2018, and the average wage per job was $48,486 (BEA 2020). In 2018, per capita personal income was $43,312 (BEA 2020), and the annual unemployment rate has been in a continuous decline from a reported 11.4 in 2010 to 2.8 in 2019 (BLS 2020).

The estimated employed population in Pickens County in 2018 was 52,788 persons. The leading reported occupational sector was government and government enterprises, with approximately 20.7 percent, or 10,910 persons employed. This was followed by the retail trade sector with 12.1 percent, or 6,408 persons employed; and the manufacturing sector with 11.6 percent, or 6,125 persons employed. (BEA 2020) Pickens County's largest employer is Clemson University, followed by the School District of Pickens County, and Pickens County (government) (UA 2019). The annual payroll in Pickens County was approximately $4.8 billion in 2018, and the average wage per job was $41,058 (BEA 2020). In 2018, per capita personal income was $38,344 (BEA 2020), and the annual unemployment rate has been in a continuous decline from a reported 10.9 in 2010 to 2.8 in 2019 (BLS 2020).

3.9.2 Housing

Between 2010 and 2017, the South Carolina counties where the majority of the ONS workforce resides had an increase in population: Oconee County (2.2 percent); and Pickens County (1.9 percent) (see Table 3.11-2).

As presented in Table 3.9-1, the 2018 estimated housing vacancy rates indicate that with the growth in population in the two counties, there was sufficient housing available in 2018 to keep up with the population increase, with vacancy rates as follows: Oconee County, 22.5 percent; and Pickens County, 12.5 percent (USCB 2019e; USCB 2020).

Table 3.9-1 also details an increase in median housing values that took place in both counties between 2000 and 2010, with values increasing by nearly a third. Between 2010 and 2018, the median housing values continued to increase as follows: Oconee County by 27.8 percent; and Pickens County by 19.9 percent. (USCB 2019e; USCB 2020)

Between 2000 and 2010, median monthly rents increased along with median housing values in both counties. Between 2010 and 2018, the cost of median monthly rents continued to climb, though at slower rates when compared to the 2000 to 2010 time period. Oconee County saw a median rent increase of 3.1 percent between 2010 and 2018, and Pickens County experienced an increase of 14.4 percent during the same period. (USCB 2019e; USCB 2020)

3.9.3 Water Supply and Wastewater

Lake Keowee and Lake Hartwell provide raw water for some users in the region. The city of Greenville and the town of Seneca take their raw water supplies from Lake Keowee. The town of Anderson, the town of Clemson, the town of Pendleton, Clemson University, and several industrial plants take their raw water supplies from Lake Hartwell.

Currently, there are five major water suppliers in Oconee County that rely on a combination of area lakes, streams, reservoirs, springs, and wells. The Seneca Light & Water system's primary source is Lake Keowee and is at approximately 33 percent of capacity; the City of Walhalla's primary source is Coneross Creek and is at 63 percent capacity; the Westminster Commission of Public Works primary water source is the Chauga River and is at 75 percent capacity. The Pioneer Water System purchases water from Seneca and Westminster water systems and reported an average daily demand of 1.3 MGD. The Salem Water Department's primary source is wells (no available capacity breakdown). In addition to the major providers listed above, a number of private suppliers offer service to residents living in developments across the county. Oconee County residents also rely on private wells. The expansion of public water availability is seen as a priority for Oconee County to encourage future economic growth. (Oconee County 2019c; OEA 2019a)

Originally a division of county government, the Oconee Joint Regional Sewer Authority includes three member cities: Seneca, Walhalla, and Westminster. The 5.0 MGD Coneross Creek Wastewater Treatment Facility began operations on February 4, 1980. The original treatment plant was upgraded to 7.8 MGD in 1996 to accommodate the industrial and commercial growth Oconee County experienced during the early 1990s. (OJRSA 2019). The current facility treated approximately 869 million gallons of wastewater and processed 3,179 tons of dewatered sludge in 2016. As of August 2017, the facility has allocated 4.378 MGD to residential, commercial, and industrial users in Oconee County, which is 56 percent of the facility's total design flow. As well as the public sewer system, several private providers offer service to some of the larger residential developments in the county. Public sewer service is not available county-wide, with residential septic systems utilized across the county. There is concern that improperly operated septic tanks are a contributing source of local pollution. The availability of public wastewater facilities county-wide is a main priority of Oconee County's near-term economic development efforts. (Oconee County 2019c)

The Pickens County Water Authority serves as the coordinator of planning and development of county water delivery systems. There are 14 separate water districts named for each of the community supply and distribution agencies: Central (town), Clemson (city), Easley Combined Utilities, Liberty (city), Norris (town), Pickens (city), Six Mile (town), Bethlehem-Roanoke, Dacusville-Cedar Rock, Easley-Central 1&2, Highway 88, Powdersville, Six Mile & Twelve Mile, and Southside. The county water suppliers draw water from Lake Keowee, Lake Hartwell, Twelve Mile Creek, Eighteen Mile Creek, the City Reservoir, and Lake Saluda. Water line service reaches 57 percent of the county, with the remaining area, mostly in the northern area of the county, servicing themselves through pumps on their property. Details of overall county water infrastructure capacity were not available. (Pickens County 2016)

In Pickens County, sewer service is currently available to about 40 percent of county residents. The remainder of the county utilizes private community or individual septic systems (most common in rural areas). The communities of Easley, Pickens, and Clemson provide sewer services to residents. (Pickens County 2016) The Pickens County Public Service Commission serves unincorporated Pickens County, Liberty, and Central, and operates six wastewater facilities and maintains 2.9 MGD of treatment capacity. (Pickens County 2019b).

ONS uses water from the Seneca water treatment plant for potable water. As discussed in Section 3.6.1.2.3, once collected, the ONS sanitary wastes are discharged to the city of Seneca treatment facilities.

3.9.4 Community Services and Education

Oconee County has one public school district, and based on the 2017–2018 school year, there were 17 total schools in the county and 10,405 students. The student/teacher ratio was 13.65. There are six private schools in the county (2015–2016 school year), with 298 students. (NCES 2019)

Pickens County also has one public school district. During the 2017–2018 school year, there were 24 total schools in the county with 16,378 students. The student/teacher ratio was 16.76. There are four private schools in the county (2015–2016 school year), with 331 students. (NCES 2019)

Regarding two-year and four-year educational institutions located in Oconee and Pickens counties, there are no colleges or universities reported for Oconee County. As discussed in Section 3.9.5, Oconee County does allocate funding for the Tri-County Technical College, located in the city of Pendleton, Anderson County, SC (approximately 12 miles from ONS). Within 10 miles of ONS, both Clemson University and Southern Wesleyan University are located in Pickens County. (NCES 2019)

For Oconee County emergency services, primary law enforcement is provided through the sheriff's office, and the communities of Salem, Seneca, Walhalla, West Union, and Westminster all have police departments. (USACOPS 2019) Oconee County residents are served by a combination of community and rural fire departments with both active career firefighters and volunteers. There are 13 fire departments and 30 stations in Oconee County, manned by 69 active career firefighters and 752 volunteer firefighters, with two firefighters paid per call. (USFA 2019) Oconee County also has a staffed hazardous materials response team (Oconee County 2019e). A wide range of health care services are available in Oconee County. The Oconee Medical Center, located near Seneca, has a 169-bed hospital featuring a range of inpatient and outpatient services, and a host of community-based services. These include doctor's offices, a long-term nursing care facility, and a residential hospice house. (Prisma 2019)

Pickens County emergency services primary law enforcement is provided through the sheriff's office, and the communities of Central, Clemson, Easley, Liberty, and Pickens all have police departments. (USACOPS 2019) There are 17 fire departments in Pickens County (Pickens County 2016). The U.S. Fire Administration lists 13 stations located in Pickens County, with 87 active career firefighters, 178 volunteer firefighters, and 73 paid per call firefighters (USFA 2019) There are two hospitals in Pickens County. The Baptist Easley Medical Center, in the community of Easley, has a 109-bed facility. AnMed Health Cannon hospital is located in the community of Pickens, SC (AnMed 2019). Additional nursing care facilities are located in various communities in Pickens County. (Pickens County 2016)

3.9.5 Local Government Revenues

Oconee County bills and collects its own property taxes and collects taxes for the Keowee Key Fire District and the Oconee County School District. The county also collects taxes for surrounding municipalities. Duke Energy pays annual property taxes to Oconee County on behalf of ONS. The county's total general revenues were $68.1 million for the fiscal year (FY) ending June 30, 2019. This is an approximate 5.5 percent increase from FY 2018 ($64.6 million). General property taxes, the largest source of revenue in Oconee County, were $44.2 million in 2019, or 72 percent of total revenues for governmental activities. Along with property tax income, sources for Oconee County's remaining 28 percent of governmental activity revenues include charges for services, operating grants and contributions, capital grants and contributions, unrestricted grants and contributions, unrestricted investment earnings, insurance recoveries, and other taxes. (Oconee County 2020)

The county's total government and business-type activities expenses was $61.4 million for FY 2019. This was an overall decrease from $68.8 million in FY 2018, or 10.8 percent. Generally, the decrease was due to program expense reallocation. Oconee County expenses cover a wide range of services, and some of the larger government programs receiving county funding in FY 2019 were public safety ($24.8 million) or 43 percent; general government ($10.0 million) or 17 percent; transportation ($7.1 million) or 12 percent; and public works ($4.5 million) or 8 percent. Oconee County is also financially accountable for Keowee Fire Tax District; and is in partnership with the School District of Oconee County and Tri-County Technical College in the construction of a workforce development center with the goal to create a more diverse employment foundation to draw businesses and industry to the county. In FY 2019, Oconee County program funding for education was $1.6 million, or 3 percent of the total government expenses. (Oconee County 2020)

In FY 2019, the assessed valuation of Duke Energy property in Oconee County was approximately $159.1 million. As seen in Table 3.9-2, Duke Energy's initial 2019 property tax payment to Oconee County was approximately 72.6 percent of the FY 2019 total property tax revenues. The reported property tax payment represents approximately 29.0 percent of the 2018 levy. For FY 2019, approximately $25.3 million of the amount collected from the Duke Energy property tax payment was distributed to the School District of Oconee County and Tri-County Technical College. In 2020, Duke Energy appealed a State of South Carolina 2019 tax year fair market assessment of Duke Energy Carolinas and Duke Energy Progress taxable assets. As a result of the appeal, the Duke Energy 2019 tax payment amount to Oconee County was reduced to $29,659,545.87. Oconee County has not released a 2020 analysis update that reflects Duke's annual 2019 property tax payment adjustment. (Oconee County 2020)

Between 2016 and 2018, Duke Energy's property tax payments rose slightly, mostly as a result of some increased costs (capital expenditure) and increasing tax rates. After 2017, a new partial property tax exemption went into effect (SC Revenue Ruling #18-13), although the State of South Carolina concluded that a power company does not qualify as a manufacturer under the new statute. Duke Energy is currently contesting the decision, and should they prevail, a reduction in the reported 2018 property tax payment amount is likely. The South Carolina partial exemption is phased in over six equal and cumulative percentage installments, and this would be a continued reduction in the assessment for Duke Energy going forward. (SCDR 2019)

Duke Energy also actively encourages employees to participate in charitable fundraising, and along with Duke Energy Foundation community grants, contributed over $109,000 to Oconee County. Recipients include the United Way of Oconee County, Baby Read, Youth Link, and the Education Foundation of Oconee County.

3.9.6 Transportation

Transportation in the ONS region includes a rural and urbanized road network, plus rail and airports. A public bus service is located in several communities in Oconee and Pickens counties, but there is no public transit service with access to ONS (see Section 3.1.1).

As discussed in Section 3.1, the primary road network in the area is shown in Figure 3.1-3 and Figure 3.1-4. Interstate-85 (I-85) is a major southwest-northeast interstate that traverses the 50-mile region, running through the Greenville-Anderson-Mauldin, SC, metropolitan area. There is also rail service in the region, including Amtrak passenger service, with Clemson the location of the nearest station to ONS. South Carolina state highways with access to ONS include north-south SC-130 and east-west SC-183.

As seen in Figure 3.1-1, within the vicinity, road access to the ONS plant entrance is from SC-183, east of the intersection with SC-130. The SC-130 intersection has traffic lights and a dedicated east-bound turning lane accessing SC-183. There is also a dedicated north-bound turning lane accessing SC-130 from SC-183. In 2008, turning lanes were added to SC-183 at the ONS plant entrance, west of Keowee River Road.

The South Carolina Department of Transportation (SCDOT) average annual daily traffic (AADT) volumes for state roads in the 6-mile vicinity that link to ONS are listed in Table 3.9-3. SC-183 access to the plant is via a two-lane, predominantly east-west, paved road. Over the years, the traffic volume counts reveal little fluctuation on roads leading to SC-183 plant access. At SCDOT station number (SN) 245, on SC-183 between SC-130 and the Oconee/Pickens county line, the most recent 2018 AADT count was 7,200, which is an increase from a 5,900 AADT count in 2010. At SCDOT SN 368, on SC-183 between Oconee/Pickens County line east to Gap Hill Road, the traffic flow has been fairly consistent over the years (2010 AADT count 5,900 and 2018 AADT count 5,500). The Keowee River Road is a local road and SCDOT SN 329 (location between SC-183 and SC-130) AADT count was 1,100 for both 2018 and 2010, which indicates no fluctuation in the traffic load. (SCDOT 2019a)

The U.S. Transportation Research Board developed a commonly used indicator called level of service (LOS) to measure how well a highway accommodates traffic flow. LOS is a qualitative assessment of traffic flow and how much delay the average vehicle might encounter during peak hours. LOS categories are listed and defined Table 3.9-4.

No SCDOT traffic study specific to SC-183 improvements in the area of ONS was available. Due to the rural nature of the area and limited access to the ONS site, no additional transportation studies have taken place and no recent LOS assignments were available for an assessment of local road segments. To provide a current evaluation of LOS for SC-183, the known AADT traffic volumes were compared to the estimated capacity of a two-lane highway, as presented in the highway capacity manual. The manual notes that the capacity of a two-lane highway under base conditions is 1,700 passenger cars per hour (pc/h) in one direction, with a limit of 3,200 pc/h for the total of the two directions. Because of the interactions between directional flows, when a capacity of 1,700 pc/h is reached in one direction, the maximum opposing flow would be limited to 1,500 pc/h. Based on 2018 AADT recorded volumes, at SCDOT SN 245, SC-183 has a reported flow rate of 300 pc/h on average; and at SCDOT SN 368, SC-183 has a reported flow rate of 229 pc/h on average. Because traffic flow has stayed consistent over the years, and the base condition capacities for a two-lane road are not exceeded by the current average traffic conditions, there should be ample traffic capacity on SC-183 in the road areas associated with plant access. Applying the LOS traffic conditions defined in Table 3.9-4, SC-183 should fall within the LOS "A" to "C" range of conditions. Based on the lower AADT counts taken at SCDOT SN 329, Keowee River Road access to SC-183 is minimal and appears that it does not act as a main feeder road to the plant.

SCDOT has included Oconee County SC-183 in the 10-year improvement plan list, targeting rural road safety as an initiative, although no process has been described or date set for implementation (SCDOT 2019b). The Oconee County comprehensive plan notes that many of the roads in the county are state owned, but prioritizing construction and maintenance of all roads (state or local) is an influence for local economic prosperity. (Oconee County 2019c)

3.9.7 Recreational Facilities

See Figure 3.1-5 for locations of area attractions that can be found within the vicinity of ONS. While there are a number of local Oconee County and Pickens County parks with playgrounds, day use picnic shelters, overnight camping, marina services, and recreational access to the waters of Lake Keowee (boat docks and boat ramps), no data on present and projected percentage of visitor use were available.

In Oconee County, High Falls County Park is located within the ONS vicinity and has water sports access to Lake Keowee. Along with a sandy beach and recreational facilities, the park has a campground with 100 campsites. Camping facilities close during the winter months. High Falls County Park is also the location of the historic Alexander-Hill House (discussed in Section 3.8), which is listed with the NRHP and used as the park store. (OCC 2019) The Newry Historic District is also listed with the NRHP and located in the community of Newry, SC, with a number of historic structures available for viewing by area visitors (SCDAH 2019b). Next door to ONS, the Old Pickens Church property is accessible to the public with the gate to the church and cemeteries open every day. While the church is open to visitors on Sunday afternoons in the spring and summer months, no regular religious services are held. (OPC 2019) Also located in Oconee County, the Keowee WMA is on the border with Lake Hartwell and Pickens County. It is available for the enjoyment of all wildlife enthusiasts and open to the public for permitted seasonal hunting. Camping is not permitted on WMA lands except in designated camp sites. No visitation numbers were available. (SCDNR 2019f). Just outside the ONS vicinity, South Cove County Park supports day use recreational activities and overnight access to Lake Keowee with an 88-site campground. (OCC 2019).

In Pickens County, Mile Creek Park is located within the ONS vicinity and has recreational access to Lake Keowee, with day use facilities, 69 overnight campsites, and 10 lakefront cabins (MCP 2019). Ponderosa Park is in the town of Six Mile, SC, and has community day use picnic facilities, and ball fields for athletic team competitions. (SMSC 2019) Clemson University Forest is associated with Clemson University, and includes 17,500 acres dedicated to education, research, and regulated public recreation. Day use activities are permitted, but not overnight camping. (Clemson 2019b) No visitor use information was available for the Lake Keowee conservation easement.

As seen in Figure 3.1-1, the Duke Energy ONS World of Energy visitor center is outside the ONS owner-controlled area but within the EAB. According to visitor records, over 3.2 million visitors have been to the World of Energy since it opened in 1969, although visitation has steadily dropped over the years. In the last ten years, the highest annual visitation was 28,018 persons in 2008. In 2018, the visitation had dropped to 22,220 persons.

Table 3.9-1 Housing Statistics, 2000 – 2018

Name	2000	2010	2000 to 2010 Change (%)	2018 Estimate[b]	2010 to 2018 Change (%)
Oconee County					
Total housing units	32,383	38,763	19.7	40,812	5.3
Occupied units	27,283	30,676	12.4	31,612	3.1
Vacancy units	5,100	8,087	58.6	9,200	13.8
Vacancy rates (percent)	15.7	20.9	5.1	22.5	1.7
Median house value ($)	97,500	129,700[a]	33.0	165,800	27.8
Median rent ($/month)	424	677[a]	59.7	698	3.1
Pickens County					
Total housing units	46,000	51,244	11.4	55,067	7.5
Occupied units	41,306	45,228	9.5	48,185	6.5
Vacancy units	4,694	6,016	28.2	6,882	14.4
Vacancy rates (percent)	10.2	11.7	1.5	12.5	0.8
Median house value ($)	96,100	126,900[a]	32.0	152,200	19.9
Median rent ($/month)	479	707[a]	47.6	809	14.4

(USCB 2019e; USCB 2020)

a. 2010 American Community Survey one-year estimates.

b. 2018 American Community Survey one-year estimates.

Table 3.9-2 Property Tax Payments to Oconee County, 2015–2019

Year	Annual Property Tax Paid by Duke Energy[(a)]	FY Total County Property Tax Revenues	Duke Energy % of Total County Property Tax	FY Duke Energy Payment Appropriated to School District [(b)]
2015	$30,020,644.08	$40,208,079	74.7	$17.7 million
2016	$30,744,461.03	$41,172,258	74.7	$20.3 million
2017	$33,310,325.18	$42,188,898	79.0	$21.3 million
2018	$33,472,064.49	$43,219,013	77.4	$23.7 million
2019	$32,073,177.72	$44,172,858	72.6	$25.3 million

(Oconee County 2019f; Oconee County 2019g; Oconee County 2019h; Oconee County 2019i; Oconee County 2020)

a) In 2020, after appeal to the State of South Carolina, the annual 2019 Duke Energy property tax payment to Oconee County was adjusted to $29,659,545.87 (see Section 3.9.5 discussion). Oconee County has not released the 2020 analysis that reflects the Duke Energy 2019 property tax payment adjustment.

b) FY appropriation for school district of Oconee County and Tri-County Technical College.

Table 3.9-3 Total Average Annual Daily Traffic Counts on Routes Near ONS

Count Location (Station Number)	Route	AADT Count Location (near ONS entrance)	2018	2010
209	SC-130	S-38 (Katelynn Lane) to SC 183 (Rochester Hwy), S-15	7,800	7,500
211	SC-130	SC-183 (Rochester Hwy), S-15 to SC 183 (Pickens Hwy)	9,800	7,300
245	SC-183	SC-130 (Rochester Hwy) to County Line – Pickens	7,200	5,900
329	S-6 (Keowee River Road)	SC-183 (E Pickens Hwy) to SC 130 (Rochester Hwy)	1,100	1,100
368	SC-183	County Line – Oconee (and Pickens) to S 157 Gap Hill RD), L-157	5,500	5,900

(SCDOT 2019a)

Table 3.9-4 Level of Service Definitions

Level of Service	Conditions
A	Free flow of the traffic stream; users are mostly unaffected by the presence of other vehicles.
B	Free flow of the traffic stream, although the presence of other vehicles becomes noticeable. Drivers have slightly less freedom to maneuver.
C	The influence of the traffic density on operations becomes marked and queues may be expected to form. The ability to maneuver with the traffic stream is clearly affected by other vehicles.
D	The ability to maneuver is severely restricted due to traffic congestion. Travel speed is reduced by the increasing volume. Only minor disruptions can be absorbed without extensive queues forming and the service deteriorating.
E	Operations at or near capacity, an unstable level. The densities vary, depending on the free-flow speed. Vehicles are operating with the minimum spacing (or gaps) for maintaining uniform flow. Disruptions cannot be dissipated readily, often causing queues to form and service to deteriorate to LOS F.
F	Forced or breakdown of flow. It occurs either when vehicles arrive at a rate greater than the rate at which they are discharged or when the forecast demand exceeds the computed capacity. Queues form behind these breakdowns. Operations within queues are highly unstable, with vehicles experiencing brief periods of movement followed by stoppages.

3.10 Human Health

3.10.1 Microbiological Hazards

In the GEIS, the NRC considered health impacts from thermophilic organisms posed to both the public and plant workers because ideal conditions for thermophilic bacteria can result from nuclear facility operations and discharges. The NRC designated public health impacts resulting from thermophilic organisms as a Category 2 issue requiring plant-specific analysis. Information to be considered in evaluating impacts includes thermal discharge temperature; thermal characteristics of the receiving water bodies; thermal conditions for the enhancement of *Naegleria fowleri* and other pathogens; and potential impacts to public health. (NRC 2013a)

The GEIS discussion of microbiological hazards focuses on the thermophilic microorganisms *Legionella* spp. (which can be a hazard in cooling towers) and the pathogenic amoeba, *N. fowleri* (which can be a hazard resulting from cooling water discharges). The cooling system for ONS does not use cooling towers, but does have a thermal discharge to publicly accessible water.

Naegleria spp. is ubiquitous in nature and thrives in heated water bodies at temperatures ranging from 95–106°F or higher and is rarely found in water cooler than 95°F. Infection rarely occurs in water temperatures of 95°F or less. (NRC 2013a, Section 3.9.3) SCDHEC, South Carolina's state public health agency, characterized the risk of infection from *N. fowleri* as very rare, but warns that "recreational water users should assume that *N. fowleri* is present in warm freshwater across the United States and be aware that there is always a low-level risk of infection." There have been only eight cases of primary amebic meningoencephalitis, the infection caused by *N. fowleri*, in South Carolina from 1962 to 2018 (CDC 2019).

ONS utilizes an open-cycle cooling system in which cooling water is withdrawn from Lake Keowee from its intake channel on the south side of the ONS plant, heated in the condensers, and returned to Lake Keowee through the discharge point on the northeast side of the ONS plant. The lake waters near the discharge area are open to the public. Activities in the area include recreational boating, fishing, and scuba diving. Lake Keowee also has residential housing and public swimming areas.

The current NPDES permit for ONS establishes both a maximum allowable discharge temperature and a limit for increases of water temperature between the intake and discharge. The maximum discharge temperature is 100°F as a daily average, unless critical hydrological, meteorological, and electrical demand conditions apply. In such situations, the discharge temperature shall not be allowed to exceed 103°F. The maximum temperature rise above the intake temperature is limited to 22°F when the intake temperature is greater than 68°F. (Attachment B) In the 2013 permit renewal application, Duke requested the daily maximum value of 100°F to be changed to a 7-day average not to exceed 100°F.

As part of a CWA Section 316(a) demonstration monitoring, Duke monitors water temperatures at several Lake Keowee stations. The most recent report submitted to the SCDHEC is from

2013 and covers the years 2006 to 2011. The closest station to the plant's discharge is location 508, which is approximately 200 meters from the discharge. The annual maximum measured surface temperatures at location 508 in the years 2006 to 2011 ranged from 92.5 °F in 2009 to 94.8°F in 2008. Annual maximum temperatures were similar to values reported in 1995 and 2007. The report also noted that no exceedances of permit thermal limits occurred over the 2006–2011 period.

As noted above, *N. fowleri* is rarely found in water cooler than 95°F, and infection rarely occurs in water temperatures of 95°F or less. While the immediate discharge area could have temperatures above 95°F in the summer, the maximum temperatures recorded 200 meters from the discharge were below 95°F, indicating lower risk. In addition, the discharge point and this monitoring point are located in an area of deep water, approximately 23 meters. *N. fowleri* infection risk is higher in shallow, warm water (SCDHEC 2018).

The Friends of Lake Keowee published an article in its newsletter in 2016 from Dr. J. Hains of Clemson University that addressed the risk for promoting *N. fowleri* posed by the heated discharge from ONS. Dr. Hains wrote, "The temperature at which this organism grows best is reported to be far greater (approximately 112°F) than the ONS discharge. Moreover, that water originates in the coldest, deepest depths of Lake Keowee, not an optimal habitat. To my knowledge there have been no studies of the distribution of this organism in Lake Keowee (or in other nearby lakes in recent times)." (Hains 2016)

For the initial license renewal of ONS, Duke consulted with the SCDHEC to determine if the continued operation of ONS would have public health impacts due to the enhancement of thermophilic organisms. By letter dated October 25, 1996, Dr. John F. Brown, state toxicologist at the SCDHEC, summarized the agency's position and opinion regarding the public health implications of continued operation of ONS. Regarding the potential public health hazard from pathogenic microorganisms whose abundance might be promoted by ONS's artificial warming of recreational waters, Dr. Brown indicated that there seems to be no significant threat to offsite persons near such heated recreational waters. (Duke 1998, Section 4.8.4) Duke again initiated consultation with the SCDHEC for the SLRA, and the SCDHEC again agreed that ONS's thermal discharge does not pose a significant public health risk. The results of the consultation are included in Attachment F.

Microbiological hazards to plant workers are designated as a Category 1 issue. Exposure to *Legionella* spp. from power plant operations is a potential problem for a subset of the workforce. Plant personnel most likely to come into contact with *Legionella* aerosols would be those who dislodge biofilms, where *Legionella* are often concentrated, such as during the cleaning of condenser tubes and cooling towers (NRC 2013a, Section 3.9.3.3). Duke has a comprehensive health and safety program with procedures that implement industrial hygiene practices to minimize the potential for plant worker exposure.

3.10.2 Electric Shock Hazards

The in-scope transmission lines at ONS are depicted on Figure 2.2-4. The electrical field created by these high-voltage line can extend from the energized conductors on the lines to other conducting objects, such as the ground, vegetation, buildings, vehicles, and persons if appropriate clearances are not maintained, posing a shock hazard for the public and workers. Potential field effects can include induced currents, steady-state current shocks, spark-discharge shocks, and other effects. Objects located near transmission lines can become electrically charged because of their immersion in the lines' electrical field. The electrical charge results in a current that flows through the object to the ground. The current is "induced" because there is no direct connection between the power line and the object. The induced current can also flow to the ground through the body of a person (or animal) that touches the object. An object that is insulated from the ground can actually store an electrical charge, thereby becoming capacitively charged. A person (or animal) standing on the ground and touching a vehicle or fence receives an electrical shock as a result of the sudden discharge of the capacitive charge through the body to the ground. The severity of these shocks depends on the operating voltage of the power line, the distance from the conductor, the size or length of the object, its orientation to the line, and how well the object is grounded. (NRC 2013a, Section 3.9.5.2)

To minimize the shock that could be experienced by someone touching an object that is capacitively charged, the clearance between the power lines and the object must limit the induced current to a low enough electrical charge. The National Electrical Safety Code (NESC) contains the basic provisions considered necessary for the safety of workers and the public. NESC standards require that utility companies design transmission lines so the short-circuit current to ground, produced from the largest anticipated vehicle or object beneath the power lines, is limited to less than 5 milliamperes (mA). (NRC 2013a, Section 3.9.5.2; Idaho Power 2017; Rocky Mountain Power 2017).

The in-scope transmission lines (Figure 2.2-4) are located completely within the ONS property boundary within the owner-controlled area. Thus, the public risk is minimized due to restricted site access. The lines were constructed in compliance with the NESC in effect at the time, the 1961 edition. For the initial license renewal of ONS, it was confirmed that the lines met the vertical clearance requirements of the NESC in effect in 1998, which was the 1997 edition. (Duke 1998, Section 4.9.4) The NESC is updated every five years and the current code is the 2017 edition (Idaho Power 2017; NESC 2016). The lines are maintained in compliance with NESC standards for "steady-state" current as further discussed in Section 4.9.2. Because the in-scope transmission lines are not part of the regional electrical grid, Duke Energy—rather than the transmission system operator—is responsible for these lines. Duke Energy controls the ground elevations under these transmission lines, what vehicles can be parked there, and what equipment can be permanently or temporarily installed there.

3.10.3 Radiological Hazards

The ONS radiological environmental monitoring program (REMP) has been conducted since before power operations began at the plant. This program carefully monitors and documents radiological impacts to the members of the public and site employees by measuring radiation and radioactive materials with potential exposure pathways and confirms measurable concentrations of radioactive effluent releases do not exceed expected concentrations within the environment. Duke Energy monitors radioactivity levels by collecting samples of air, drinking water, surface water, shoreline sediment, fish, milk, and broadleaf vegetation, and collects direct radiation exposure using thermoluminescent dosimetry (TLD) at various sampling locations. Control samples are collected from areas not subject to the influence of ONS or any other nuclear facility, while indicator samples are obtained from areas where environmental radiation levels could increase as a result of station operations. (Duke 2020d; ONS 2020, Section 2.0)

Duke Energy prepares an annual radiological environmental operating report for ONS for submittal to NRC. Each annual report presents the results of the monitoring program performed for the previous year and compares the results to regulatory standards, previous years' results, and projected results based on plant effluents. The results for 2019 were within the ranges of radioactivity concentrations observed in the past. Radioactivity concentrations in drinking water, surface water, fish, and shoreline sediment were higher than the activities reported for samples collected at control locations. All positively identified measurements attributable to station operation were within selected license commitment levels which are selected for evaluation and trending. Trending was performed by comparing annual mean concentrations of any detected radionuclides attributable to plant effluents to historical results. Factors evaluated include the frequency of detection and the concentration in terms of the percentage of the radionuclide's selected license commitment levels. The highest value during 2019 reached for a radionuclide due to ONS operation was 0.96 percent. (Duke 2020d; ONS 2020)

Additionally, environmental radiological monitoring data is consistent with effluents introduced into the environment by plant operations. Total dose from liquid and gaseous effluents from ONS and direct and air-scatter dose from the onsite ISFSI is conservatively estimated to be less than 12 mrem/year to the nearest real individual. This meets the 40 CFR Part 190 requirements of an annual dose commitment to any member of the general public. Background radiation dose in the United States is approximately 620 mrem/year. From the review of these results, Duke Energy concluded that station operations have no significant radiological impact on the health and safety of the public or the environment. (ONS 2020)

Occupational exposure at nuclear power plants is monitored by the NRC. The 3-year (2015 to 2017) average annual occupational dose (total effective dose equivalent [TEDE]) was 0.046 rem for ONS. The annual TEDE limit is 5 rems [10 CFR 28 20.1201(a)(1)]. The NRC also trended ONS's collective dose for workers. From 2014 to 2017, the collective dose per reactor at ONS was below the average collective dose for pressurized water reactors (NRC 2019a, Table 4.6, D-36).

3.10.3.1 Liquid and Gaseous Effluent Releases

A description of the ONS Units 1, 2, and 3 radwaste system is presented in Section 2.2.6. Normal liquid and gaseous release pathways are continuously monitored to ensure that potential doses to the public would remain within the allowable limits of 10 CFR Part 20 and 10 CFR Part 50, Appendix I.

Per 10 CFR 50.36(a), nuclear power plants are required to submit an annual report to the NRC that lists the types and quantities of radioactive effluents released into the environment. Calculations for dose estimates to members of the public are based on radioactive gaseous and liquid effluent release data, and atmospheric and aquatic transport models. Based on review of ONS annual radioactive effluent release reports from the years 2014 to 2019, doses to members of the public were in accordance with NRC and EPA radiation protection standards (Duke 2015a; Duke 2016; Duke 2017; Duke 2018; Duke 2019b; Duke 2020d).

No license renewal-related refurbishments are planned for ONS and any future operational changes would be reviewed for their adherence to the ONS operating license. Duke Energy will continue to operate ONS within applicable NRC effluent standards and NRC and EPA worker and public dose limits.

3.11 Environmental Justice

3.11.1 Regional Population

The GEIS presents a population characterization method based on two factors: "sparseness" and "proximity" (NRC 1996b, Section C.1.4). Sparseness measures population density and city size within 20 miles of a site and categorizes the demographic information as follows.

Demographic Categories Based on Sparseness

		Category
Most sparse	1.	Less than 40 persons per square mile and no community with 25,000 or more persons within 20 miles.
	2.	40 to 60 persons per square mile and no community with 25,000 or more persons within 20 miles.
	3.	60 to 120 persons per square mile or less than 60 persons per square mile with at least one community with 25,000 or more persons within 20 miles.
Least sparse	4.	Greater than or equal to 120 persons per square mile within 20 miles.

(NRC 1996b, Section C.1.4)

"Proximity" measures population density and city size within 50 miles and categorizes the demographic information as follows.

Demographic Categories Based on Proximity

		Category
Not close proximity	1.	No city with 100,000 or more persons and less than 50 persons per square mile within 50 miles.
	2.	No city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles.
	3.	One or more cities with 100,000 or more persons and less than 190 persons per square mile within 50 miles.
Close proximity	4.	Greater than or equal to 190 persons per square mile within 50 miles.

(NRC 1996b, Section C.1.4)

The GEIS then uses the following matrix to rank the population in the region of the plant as low, medium, or high.

GEIS Sparseness and Proximity Matrix

		Proximity			
		1	**2**	**3**	**4**
Sparseness	**1**	1.1	1.2	1.3	1.4
	2	2.1	2.2	2.3	2.4
	3	3.1	3.2	3.3	3.4
	4	4.1	4.2	4.3	4.4

Low Population Area

Medium Population Area

High Population Area

(NRC 1996b, Figure C.1)

The 2010 census population and TIGER/Line data from the U.S. Census Bureau (USCB) were used to determine demographic characteristics in the vicinity of the ONS site (USCB 2019c). The data were processed at the state, county, and census block levels using ESRI ArcGIS 10.4 software (USCB 2019b; USCB 2019f; USCB 2019i). Census data include people living in group quarters such as institutionalized and non-institutionalized populations. Examples of institutional populations living in group quarters are correctional institutions (i.e., prisons, jails, and detention centers); nursing homes; mental (psychiatric) hospitals; hospitals or wards for the chronically ill; and juvenile institutions. Examples of non-institutional populations living in group quarters are group homes; college dormitories; military quarters; soup kitchens; shelters for abused women (shelters against domestic violence or family crisis centers); and shelters for children who are runaways, neglected, or without conventional housing. (USCB 2019h)

The 2010 census data indicate that approximately 207,344 people live within a 20-mile radius of the ONS site, which equates to a population density of 165 persons per square mile (USCB 2019i). Based on the GEIS sparseness index, the site is classified as Category 4 with greater than or equal to 120 persons per square mile within 20 miles.

The 2010 census data indicate that approximately 1,394,743 people live within a 50-mile radius of the ONS site, which equates to a population density of 178 persons per square mile (USCB 2019i). No city within a 50-mile radius has a population greater than 100,000 residents (Table 3.11-1). Based on the GEIS proximity index, the site is classified as Category 2, no city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles.

As illustrated in the GEIS sparseness and proximity matrix, the combination of "sparseness" Category 4 and "proximity" Category 2 results in the conclusion that ONS is located in a "medium" population area.

The area within a 50-mile radius of the ONS site totally or partially includes 29 counties within the states of Georgia, North Carolina, and South Carolina (Table 3.11-2). According to the 2010 census, the combined permanent population (not including transient populations) of all 29 counties was approximately 2,311,479 (Table 3.11-2). By 2054, the end of the proposed ONS operating term, the combined permanent population (not including transient populations) of all 29 counties is projected to be approximately 3,454,092. Based on 2010–2054 population projections, an annual growth rate of approximately 0.92 percent is anticipated for the combined permanent population in the 29 counties wholly or partially within a 50-mile radius of ONS (GAOPB 2019; NCOSBM 2019; SCPRT 2019).

As shown in Table 3.11-2, the total population (including transient populations) of the 29 counties totally or partially included within a 50-mile radius of ONS, is projected to be approximately 3,664,165 in 2054. The total population (including transient populations) within the 50-mile radius is projected to be 2,213,662 in 2054. (AHLA 2019; GAOPB 2019; GTP 2019; NCOSBM 2019; SCPRT 2019; SCRFAO 2019; USCB 2019f; USCB 2019g; VNC 2019)

The latest permanent population projections for Georgia were obtained from the Georgia Office of Planning and Budget (GAOPB 2019). The latest permanent population projections for North Carolina were obtained from the North Carolina Office of State Budget and Management (NCOSBM 2019). The latest permanent population projections for South Carolina were obtained from the South Carolina Revenue and Fiscal Affairs Office (SCRFAO 2019). County-level permanent population values for the counties within a 50-mile radius are shown in Table 3.11-2.

Transient data for the State of Georgia were obtained from the Georgia Tourism Portal (GTP 2019). Transient data for the State of North Carolina were obtained from the "Visit North Carolina" website (VNC 2019). Transient data for the State of South Carolina were obtained from the South Carolina Department of Parks, Recreation, and Tourism (SCPRT 2019). For Georgia and North Carolina, the average length of stay for international visitors was not available. For that information, data from the American Hotel and Lodging Association were used (AHLA 2019).

ONS is located in Oconee County. As shown in Table 3.11-2, the population of Oconee County, SC, as reported in the 2010 census was 74,273. Based on South Carolina's population projection data, Oconee County's projected permanent population for 2054 is expected to be 77,500. A portion of the ONS site also falls in Pickens County, which had a reported population of 119,224 in 2010. Pickens County's projected permanent population for 2054 is expected to be 133,546. (SCRFAO 2019). Estimated projected populations and average annual growth rates for Oconee and Pickens counties are shown in Table 3.11-3.

Cities, towns, villages, and some census designated places (CDPs) with centers falling within a 50-mile radius of ONS are listed in Table 3.11-1. As seen in Figure 3.1-3, within the 6-mile vicinity of the plant, the town nearest to ONS is Six Mile, SC, in Pickens County (approximately 5 miles east). Its 2017 estimated population was reported at 800 persons. Located approximately 5 miles south of ONS is the community of Newry, SC, in Oconee County (estimated 2017 population 137). (USCB 2019a).

As shown in Table 3.11-1, the largest community in Oconee County is the city of Seneca (2017 population 8,199), located approximately 8 miles south-southwest of ONS. The largest city in Pickens County is Clemson (2017 population 15,375), located approximately 8 miles south-southeast of ONS. There are no communities within a 50-mile radius of ONS that have a population greater than 100,000. A total of four communities (Asheville, NC; and Anderson, Greenville, and Greer, SC) within a 50-mile radius have a population greater than 25,000 as of 2017 (Table 3.11-1).

3.11.2 Minority and Low-Income Populations

3.11.2.1 Background

The NRC performs environmental justice analyses utilizing a 50-mile radius around the plant as the environmental impact area. LIC-203 Revision 4 (NRC 2020a) defines a geographic area for comparison as a 50-mile radius (also referred to as "the region" in this discussion) centered on the nuclear plant. An alternative approach is also addressed that uses an individual state that encompasses the 50-mile radius individually for comparative analysis as the "geographic area." Both approaches were used to assess the minority and low-income population criteria for ONS.

LIC-203 guidance suggests using the most recent USCB decennial census data. However, low-income data are collected separately from the decennial census and are available in 5-year averages. The 2017 low-income and minority census population data and TIGER/Line data for Georgia, North Carolina, and South Carolina were obtained from the USCB website and processed using ArcGIS software (USCB 2019g). Census population data were used to identify the minority and low-income populations within a 50-mile radius of ONS. Environmental justice evaluations for minority and low-income populations are based on the use of USCB block groups for minority and low-income populations.

3.11.2.2 Minority Populations

NRC procedural guidance categorizes "minority" populations as Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian/other Pacific Islander, some other race, two or more races, the aggregate of all minority races, Hispanic or Latino ethnicity, and the aggregate of all minority races and Hispanic ethnicity (NRC 2020a). The guidance indicates that a minority population is considered present if either of the following two conditions exists:

1. The minority population in the census block group exceeds 50 percent; or

2. The minority population percentage is more than 20 percent greater in the census block group than the minority percentage of the geographic area chosen for the comparative analysis.

To establish minimum thresholds for each minority category, the non-white minority population total for each state was divided by the total population in the state. This process was repeated with a 50-mile radius total minority population and 50-mile radius total population. As described in the second criterion, 20 percent was added to the minority percentage values for each geographic area. The lower of the two NRC conditions for a minority population was selected as defining a minority area (i.e., census block group minority population exceeds 50 percent, or minority population is more than 20 percent greater than the minority population of the geographic area). Any census block group with a percentage exceeding this value was considered a minority population. Minority percentages for Georgia, North Carolina, South Carolina, and a 50-mile radius, and the corresponding criteria, are shown in Table 3.11-4.

A minority category of "aggregate of all races" is created when the populations of all the 2017 USCB minority categories are summed. As shown in Table 3.11-4, the 2017 "aggregate of all races" category, when compared to the total population, indicates 18.0 percent of the population in a 50-mile radius (region) are minorities. The "aggregate of all races" population percentages for Georgia, North Carolina, and South Carolina are 40.6 percent, 31.0 percent and 32.7 percent, respectively. Because 60.6 percent, 51.0 percent, and 52.7 percent exceed the 50 percent noted for Condition 1, defined above, the lower criterion (50 percent) would be used for the threshold. Using the alternate approach defined above, where a 50-mile radius is used as the geographic area, any census block group with a combined "aggregate of all races" population equal to or greater than 38.0 percent would be considered a minority population. Similarly, each state was evaluated and a series of criteria for each race and low-income category were defined. When the three states are used as the geographic area, any census block group with an "aggregate of all races" population exceeding 50 percent in Georgia, North Carolina, or South Carolina would be considered a minority population.

Because Hispanic is not considered a race by the USCB, Hispanics are already represented in the census-defined race categories. However, because Hispanics can be represented in any race category, some white Hispanics not otherwise considered minorities become classified as a minority when categorized in the "aggregate and Hispanic" category.

The number of census block groups contributing to the minority population count were evaluated using the criteria shown in Table 3.11-4 and summarized in Table 3.11-5. The results of the evaluation are census block groups flagged as having a minority population(s). The resulting maps (Figures 3.11-1, 3.11-2, 3.11-3, 3.11-4, 3.11-5, 3.11-6, 3.11-7, 3.11-8, 3.11-9, 3.11-10, 3.11-11, 3.11-12, 3.11-13, and 3.11-14) depict the location of minority population census block groups flagged accordingly for each race or aggregate category. Because no block group met the criteria for the "Asian" and "Native Hawaiian/Other Pacific Islander" race categories, no figures illustrating those race categories were produced.

The percentage of census block groups exceeding the "aggregate of all races" minority population criterion was 12.4 percent when a 50-mile radius (region) was used and 6.8 percent when the individual state was used as the geographic area (Table 3.11-5). For the "aggregate and Hispanic" category, 15.0 percent of the census block groups contained a minority population when the region was used, and 10.9 percent of the block groups contained minority populations when the individual state was used (Table 3.11-5). The minority population values of the block groups were significantly reduced when races were analyzed individually.

The identified minority population closest to the ONS center point is located approximately 8 miles south-southwest of the site: Block Group 450730307013. This census block group contained a total of 725 people, with 325 "Black or African American," and 59 "two or more races." Using the regional criteria, the block group contains a "Black or African American" population. Using either the individual state criteria or the regional criteria, the block group contains an "aggregate of all minority races" population. (USCB 2019f; USCB 2019g)

There are no block groups within a 6-mile radius that meet the criteria for a minority population. There are 215 identified minority population block groups located in, partially within, or adjacent to cities, municipalities, or USCB-defined urban areas. This leaves 11 block groups that do not fall within or are not immediately adjacent to cities, municipalities, or USCB-defined urban areas. (USCB 2019c; USCB 2019g)

As presented in Section 3.1.3, the Eastern Band of the Cherokee Nation have lands in the ONS region. The state of South Carolina also recognizes the Piedmont American Indian Association Lower Eastern Cherokee Nation of SC, in the town of Gray Court, in Laurens County, SC.

3.11.2.3 Low-Income Populations

NRC guidance defines "low-income" using USCB statistical poverty thresholds for individuals or families (NRC 2020a). As addressed above with minority populations, two alternative geographic areas (Georgia, North Carolina, and South Carolina individually and the region) were used as the geographic areas for comparison in this analysis. The guidance indicates that a low-income population is considered present if either of the two following conditions exists:

1. The low-income population in the census block group exceeds 50 percent; or
2. The percentage of households below the poverty level in a block group is significantly greater (typically at least 20 percent) than the low-income population percentage of the geographic area chosen for the comparative analysis (i.e., individual state and region's combined average).

To establish minimum thresholds for the individual low-income category, the population with an income below the poverty level for the state was divided by the total population for whom poverty status is determined in the state. To establish minimum thresholds for the family low-income category, the family population count with an income below the poverty level for the state was divided by the total family population count in the state. This process was repeated for the regional population with an income below the poverty level and regional total population for whom poverty status is determined. As described in Condition 2, above, 20 percent was added to the low-income values for individuals and families and each geographic area. None of the geographic areas described in the first condition exceeded 50 percent.

As shown in Table 3.11-6, when the 2013–2017 census data category "income in the past 12 months below poverty level" (individual) is compared to "total population for whom poverty status is determined," 15.4 percent of the population in the region has an individual income below poverty level. In the states of Georgia, North Carolina, and South Carolina, the percentages of individuals with an income below poverty level are 16.9 percent, 16.1 percent and 16.6 percent, respectively.

As shown in Table 3.11-6, Georgia has an estimated 575,538 families, North Carolina has an estimated 583,436 families, and South Carolina has an estimated 297,699 families living below poverty level. When the 2013–2017 census data family category "income in the past 12 months below poverty level" is compared to "total family count," 15.1 percent of the families within the region has an income below poverty level. In the states of Georgia, North Carolina, and South Carolina, the percentages of the family population with an income below poverty level are 15.7 percent, 15.1 percent and 15.9 percent, respectively.

As an example, when the region is used as the geographic area, any census block group within a 50-mile radius with populations of low-income individuals equal to or greater than 35.1 percent of the total block group population would be considered a "low-income population." Using this criterion, 96 of the 954 census block groups (10.1 percent) were identified as low-income populations within a 50-mile radius of the ONS site, as shown in Figure 3.11-15. (USCB 2019g)

When South Carolina is used as the geographic area, any census block group within the region with a low-income population equal to or greater than 36.6 percent of the total block group, the population would be considered a "low-income population" (individual) (Table 3.11-6). Using the appropriate criteria for the individual state (Georgia, North Carolina, and South Carolina), 87 of the total 954 census block groups (9.1 percent) have low-income individual population percentages that meet or exceed the threshold criteria noted in Table 3.11-5. These census block groups are illustrated in Figure 3.11-16.

Similarly, these criteria are found using both geographies and family census counts (Table 3.11-5). Using the family individual state and regional criteria, 66 census block groups were identified as having low-income families in each criterion (Table 3.11-5). These census block groups are illustrated in Figures 3.11-17 and 3.11-18. (USCB 2019f; USCB 2019g) The closest low-income block group that meets the guidance criteria for individuals or families is located adjacent to the ONS center point (Block Group 450770112041). (USCB 2019g)

3.11.3 Subsistence Populations and Migrant Workers

3.11.3.1 Subsistence Populations

Subsistence refers to the use of natural resources as food for consumption and for ceremonial and traditional cultural purposes, usually by low-income or minority populations. Specific examples of subsistence use include gathering plants for direct consumption (rather than produced for sale from farming operations), for use as medicine, or in ritual practices. Fishing or hunting activities associated with direct consumption or use in ceremonies, rather than for sport, are other examples. Determining the presence of subsistence use can be difficult, as data at the county or block group level are aggregated and not usually structured to identify such uses on or near the site.

The area surrounding ONS is largely rural and agricultural, with no known subsistence activity. As reported in the 1999 NUREG-1437 Supplement 2, the NRC found no unusual resource dependencies or practices, such as subsistence agriculture, through which the minority and low-income populations could experience disproportionately high and adverse impacts (NRC 1999b). No additional subsistence studies have been conducted, but plant staff living and working in the area are not aware of any cases of subsistence activity in the vicinity of ONS.

3.11.3.2 Migrant Workers

Migrant labor, or migrant worker, is defined by the USDA as "a farm worker whose employment required travel that prevented the migrant worker from returning to his/her permanent place of residence the same day." In 2017, Oconee County reported that 152 out of 815 total farms employed farm labor. Pickens County reported 124 out of 740 total farms employed farm labor. The 2017 Census of Agriculture reported that none of the Oconee County farms employed migrant farm workers. One farm in Pickens County reported employing migrant workers. For Oconee County, an estimated total of 373 farm laborers were hired, of which 200 were estimated to work fewer than 150 days per year. For Pickens County, an estimated total of 413 farm laborers were hired, of which 281 were estimated to work fewer than 150 days per year. (USDA 2019b)

Table 3.11-1 Cities or Towns Located Totally or Partially within a 50-Mile Radius of ONS (Sheet 1 of 5)

City/Town/Village/CDP	County	2000 Census Population[(a)]	2010 Census Population[(a)]	2017 Census Population[(a)(b)]	Distance to ONS (miles)[(c)(d)]	Direction[(c)(d)]
Georgia						
Alto	Habersham	876	1,172	1,073	45	WSW
Avalon	Stephens	278	213	227	26	SW
Baldwin	Habersham	2,425	3,279	3,397	42	WSW
Bowersville	Hart	334	465	471	31	SSW
Bowman	Elbert	898	862	870	41	SSW
Canon	Franklin	755	804	848	33	SSW
Carnesville	Franklin	541	577	893	35	SW
Clarkesville	Habersham	1,248	1,733	1,735	38	WSW
Clayton	Rabun	2,019	2,047	1,989	29	WNW
Cleveland	White	1,907	3,410	3,779	51	WSW
Commerce	Jackson	5,292	6,544	6,677	52	SW
Cornelia	Habersham	3,674	4,160	4,212	41	WSW
Danielsville	Madison	457	560	849	50	SSW
Demorest	Habersham	1,465	1,823	2,130	40	WSW
Dillard	Rabun	198	339	391	30	WNW
Elberton	Elbert	4,743	4,653	4,392	47	S
Franklin Springs	Franklin	762	952	868	38	SSW
Hartwell	Hart	4,188	4,469	4,456	30	S
Helen	White	430	510	372	48	W
Hiawassee	Towns	808	880	908	50	WNW
Homer	Banks	950	1,141	1,257	47	SW

Table 3.11-1 Cities or Towns Located Totally or Partially within a 50-Mile Radius of ONS (Sheet 2 of 5)

City/Town/Village/CDP	County	2000 Census Population[(a)]	2010 Census Population[(a)]	2017 Census Population[(a)(b)]	Distance to ONS (miles)[(c)(d)]	Direction[(c)(d)]
Ila	Madison	328	337	323	48	SSW
Lavonia	Franklin	1,827	2,156	1,963	27	SSW
Lula	Hall	1,438	2,758	2,857	52	WSW
Martin	Stephens	311	381	470	27	SW
Mount Airy	Habersham	604	1,284	1,214	39	WSW
Mountain City	Rabun	829	1,088	1,010	29	WNW
Royston	Franklin	2,493	2,582	2,851	37	SSW
Sky Valley	Rabun	221	272	332	28	WNW
Tallulah Falls	Habersham	164	168	75	29	W
Tiger	Rabun	316	408	478	31	W
Toccoa	Stephens	9,323	8,491	8,307	29	WSW
North Carolina						
Asheville	Buncombe	68,889	83,393	89,318	57	NNE
Brevard	Transylvania	6,789	7,609	7,759	32	NNE
Canton	Haywood	4,029	4,227	4,191	51	N
Columbus	Polk	992	999	1,339	51	NE
Dillsboro	Jackson	205	232	258	44	NNW
Flat Rock	Henderson	2,565	3,114	3,267	42	NE
Fletcher	Henderson	4,185	7,187	7,737	49	NNE
Forest Hills	Jackson	330	365	341	39	NNW
Franklin	Macon	3,490	3,845	3,934	38	NW
Hendersonville	Henderson	10,420	13,137	13,620	44	NE

Table 3.11-1 Cities or Towns Located Totally or Partially within a 50-Mile Radius of ONS (Sheet 3 of 5)

City/Town/Village/CDP	County	2000 Census Population[(a)]	2010 Census Population[(a)]	2017 Census Population[(a)(b)]	Distance to ONS (miles)[(c)(d)]	Direction[(c)(d)]
Highlands	Macon	909	924	1,079	25	NW
Laurel Park	Henderson	1,835	2,180	2,738	43	NNE
Maggie Valley	Haywood	607	1,150	1,541	51	NNW
Mills River	Henderson	NA	6,802	7,079	45	NNE
Rosman	Transylvania	490	576	598	24	NNE
Saluda	Polk	575	713	830	44	NE
Sylva	Jackson	2,435	2,588	2,612	44	NNW
Tryon	Polk	1,760	1,646	1,669	47	NE
Waynesville	Haywood	9,232	9,869	9,804	48	N
Webster	Jackson	486	363	442	42	NNW
South Carolina						
Anderson	Anderson	25,514	26,686	27,011	25	SE
Belton	Anderson	4,461	4,134	4,268	30	SE
Campobello	Spartanburg	449	502	512	48	ENE
Central	Pickens	3,522	5,159	5,161	8	SE
Clemson	Pickens	11,939	13,905	15,375	8	SSE
Donalds	Abbeville	354	348	326	43	SE
Due West	Abbeville	1,209	1,247	1,412	43	SE
Duncan	Spartanburg	2,870	3,181	3,327	44	ENE
Easley	Pickens	17,754	19,993	20,521	17	E
Fountain Inn	Greenville	6,017	7,799	8,455	41	E
Gray Court	Laurens	1,021	795	784	46	ESE
Greenville	Greenville	56,002	58,409	64,061	29	E

Table 3.11-1 Cities or Towns Located Totally or Partially within a 50-Mile Radius of ONS (Sheet 4 of 5)

City/Town/Village/CDP	County	2000 Census Population[a]	2010 Census Population[a]	2017 Census Population[a][b]	Distance to ONS (miles)[c][d]	Direction[c][d]
Greer	Greenville	16,843	25,515	28,587	39	ENE
Honea Path	Anderson	3,504	3,597	3,645	38	SE
Inman	Spartanburg	1,884	2,321	2,435	49	ENE
Iva	Anderson	1,156	1,218	1,206	36	SSE
Landrum	Spartanburg	2,472	2,376	2,475	48	ENE
Liberty	Pickens	3,009	3,269	3,200	12	E
Lowndesville	Abbeville	166	128	78	43	SSE
Lyman	Spartanburg	2,659	3,243	3,411	45	ENE
Mauldin	Greenville	15,224	22,889	24,813	33	E
Newry	Oconee	NA	172	137	5	S
Norris	Pickens	847	813	788	9	ESE
Pelzer	Anderson	97	89	1,304	27	ESE
Pendleton	Anderson	2,966	2,964	3,135	12	SSE
Pickens	Pickens	3,012	3,126	3,151	12	ENE
Reidville	Spartanburg	478	601	811	45	E
Salem	Oconee	126	135	122	8	NNW
Seneca	Oconee	7,652	8,102	8,199	8	SSW
Simpsonville	Greenville	14,352	18,238	20,741	37	E
Six Mile	Pickens	553	675	800	5	E
Starr	Anderson	173	173	157	31	SSE
Travelers Rest	Greenville	4,099	4,576	4,965	28	ENE
Walhalla	Oconee	3,801	4,263	4,259	10	W
Ware Shoals	Greenwood	2,363	2,170	2,759	46	SE

Table 3.11-1 Cities or Towns Located Totally or Partially within a 50-Mile Radius of ONS (Sheet 5 of 5)

City/Town/Village/CDP	County	2000 Census Population[(a)]	2010 Census Population[(a)]	2017 Census Population[(a)(b)]	Distance to ONS (miles)[(c)(d)]	Direction[(c)(d)]
Wellford	Spartanburg	2,030	2,378	2,519	46	ENE
West Pelzer	Anderson	879	880	848	26	ESE
West Union	Oconee	279	291	267	9	WSW
Westminster	Oconee	2,743	2,418	2,477	14	SW
Williamston	Anderson	3,791	3,934	4,088	27	ESE
Woodruff	Spartanburg	4,229	4,090	4,140	49	E

a. (USCB 2019a)

b. Five-year 2013–2017 estimates.

c. (USDOT 2019a)

d. Reported distances and directions were calculated from the ONS center point to the city center.

NA = data not available.

Table 3.11-2 County Populations Totally or Partially Included within a 50-Mile Radius of ONS (Sheet 1 of 2)

State and County	2000 Population[(a)]	2010 Population[(a)]	2017 Population Estimate[(a)]	2054 Projected Permanent Population[(a,b)]	2054 Projected Total Population[(a,b,c)]
Georgia (12 counties)	390,461	477,254	496,369	743,075	791,134
Banks	14,422	18,395	18,363	19,946	21,236
Elbert	20,511	20,166	19,288	20,166	21,470
Franklin	20,285	22,084	22,328	31,386	33,416
Habersham	35,902	43,041	43,878	55,924	59,541
Hall	139,277	179,684	192,865	291,545	310,401
Hart	22,997	25,213	25,535	27,788	29,585
Jackson	41,589	60,485	63,851	138,081	147,012
Madison	25,730	28,120	28,600	42,688	45,449
Rabun	15,050	16,276	16,354	20,024	21,319
Stephens	25,435	26,175	25,625	31,854	33,914
Towns	9,319	10,471	11,173	19,184	20,425
White	19,944	27,144	28,509	44,489	47,366
North Carolina (9 counties)	481,869	556,455	578,849	852,624	888,729
Buncombe	206,330	238,318	252,268	374,264	390,112
Clay	8,775	10,587	10,753	17,381	18,117
Haywood	54,033	59,036	59,854	80,778	84,199
Henderson	89,173	106,740	112,156	165,045	172,034
Jackson	33,121	40,271	41,725	67,141	69,984
Macon	29,811	33,922	34,160	54,911	57,236
Polk	18,324	20,510	20,434	26,044	27,147
Swain	12,968	13,981	14,208	19,641	20,473

Table 3.11-2 County Populations Totally or Partially Included within a 50-Mile Radius of ONS (Sheet 2 of 2)

State and County	2000 Population[(a)]	2010 Population[(a)]	2017 Population Estimate[(a)]	2054 Projected Permanent Population[(a,b)]	2054 Projected Total Population[(a,b,c)]
Transylvania	29,334	33,090	33,291	47,419	49,427
South Carolina (8 counties)	1,138,124	1,277,770	1,340,890	1,858,393	1,984,302
Abbeville	26,167	25,417	24,788	25,417	27,139
Anderson	165,740	187,126	194,174	247,239	263,990
Greenville	379,616	451,225	490,332	845,198	902,461
Greenwood	66,271	69,661	69,981	69,981	74,722
Laurens	69,567	66,537	66,508	66,545	71,054
Oconee	66,215	74,273	75,926	77,500	82,751
Pickens	110,757	119,224	121,449	133,546	142,594
Spartanburg	253,791	284,307	297,732	392,967	419,591
Total	**2,010,454**	**2,311,479**	**2,416,108**	**3,454,092**	**3,664,165**

a. (USCB 2019b)

b. (GAOPB 2019; NCOSBM 2019; SCRFAO 2019)

c. (AHLA 2019; GTP 2019; SCPRT 2019; USCB 2019f; VNC 2019)

Note: When a county exhibits declining population trends, the projected population for 2054 is held constant at the highest reported population value.

Table 3.11-3 County Population Growth, 2010–2054

			2010	2017	2020	2025	2030	2035	2040	2045	2050	2054
South Carolina	Oconee County	Population	74,273	75,926	76,870	77,500	77,500	77,500	77,500	77,500	77,500	77,500
		Average Annual Growth %		0.31	0.41	0.16	0.00	0.00	0.00	0.00	0.00	0.00
	Pickens County	Population	119,224	121,449	123,590	124,920	125,330	127,603	129,167	130,731	132,295	133,546
		Average Annual Growth %		0.26	0.58	0.21	0.07	0.36	0.24	0.24	0.24	0.24

Note: Projected population values are based on the population projection growth trend for the years reported by the South Carolina Revenue and Fiscal Affairs Office (SCRFAO 2019; USCB 2019b).

According to SCRFAO projection information, Oconee County's population is expected to decline after 2025. To provide conservative estimates, the population value for 2025 was extended through 2054.

Table 3.11-4 Minority Populations Evaluated Against Criterion

Geographic Area	Georgia[a]			North Carolina[a]			South Carolina[a]			50-Mile Radius (Region)[b]		
Total Population	10,201,635			10,052,564			4,893,444			1,565,474		
Census Categories	**State Population by Census Category[a]**	**%[c]**	**Criteria**	**State Population by Census Category[a]**	**%[c]**	**Criteria**	**State Population by Census Category[a]**	**%[c]**	**Criteria**	**Regional Population by Census Category[b]**	**%[c]**	**Criteria**
Black or African American	3,195,268	31.3	50.0	2,159,427	21.5	41.5	1,332,110	27.2	47.2	191,109	12.2	32.2
American Indian or Alaska Native	30,552	0.3	20.3	117,998	1.2	21.2	14,992	0.3	20.3	7,080	0.5	20.5
Asian	388,946	3.8	23.8	269,164	2.7	22.7	71,994	1.5	21.5	23,872	1.5	21.5
Native Hawaiian/Other Pacific Islander	5,237	0.1	20.1	6,393	0.1	20.1	3,015	0.1	20.1	876	0.1	20.1
Some Other Race	282,570	2.8	22.8	310,920	3.1	23.1	74,328	1.5	21.5	28,245	1.8	21.8
Two or More Races	237,241	2.3	22.3	251,196	2.5	22.5	104,407	2.1	22.1	30,762	2.0	22.0
Aggregate of All Races	4,139,814	40.6	50.0	3,115,098	31.0	50.0	1,600,846	32.7	50.0	281,944	18.0	38.0
Hispanic or Latino	950,380	9.3	29.3	914,792	9.1	29.1	267,398	5.5	25.5	101,769	6.5	26.5
Aggregate and Hispanic[d]	4,732,189	46.4	50.0	3,655,104	36.4	50.0	1,773,768	36.2	50.0	349,720	22.3	42.3

a. (USCB 2019f)

b. (USCB 2019g)

c. Percent values were calculated by dividing each census categories' population by the state or region total population values.

d. Includes everyone except persons who identified themselves as White, Not Hispanic, or Latino (NRC 2013d; NRC 2020a).

Table 3.11-5 Minority Census Block Group Counts, 50-Mile Radius of ONS

Total number of block groups with population within 50-mile radius	Individual State Method		50-Mile Radius (Region)	
	Census Block Groups		Census Block Groups	
	954		954	
Census Categories	**Number of Block Groups with Identified Minority and Low-Income Category**	**% of Block Groups within 50 miles**	**Number of Block Groups with Identified Minority and Low-Income Category**	**% of Block Groups within 50 miles**
Black or African American	56	5.9	114	11.9
American Indian or Alaska Native	2	0.2	2	0.2
Asian	0	0	0	0
Native Hawaiian/Other Pacific Islander	0	0	0	0
Some Other Race	4	0.4	5	0.5
Two or More Races	1	0.1	1	0.1
Aggregate of All Races	65	6.8	118	12.4
Hispanic or Latino	40	4.2	40	4.2
Aggregate and Hispanic	104	10.9	143	15
Low Income Individuals	87	9.1	96	10.1
Low Income Families (Households)	66	6.9	66	6.9

(USCB 2019c; USCB 2019g)

Table 3.11-6 Low-Income Population Criteria Using Two Geographic Areas

State	Georgia[(a)]			North Carolina[(a)]			South Carolina[(a)]			50-Mile Radius (Region)[(b)]		
(Income) Total Population	9,931,935			9,783,738			4,751,345			1,527,318		
(Income) Total Families	3,663,104			3,874,346			1,871,307			611,692		
Census Category	**State Population by Census Category**	**%[(c)]**	**Criteria**	**State Population by Census Category**	**%[(c)]**	**Criteria**	**State Population by Census Category**	**%[(c)]**	**Criteria**	**State Population by Census Category**	**%[(c)]**	**Criteria**
Low Income – Number of Persons Below Poverty Level (Individuals)	1,679,030	16.9	36.9	1,579,871	16.1	36.1	790,657	16.6	36.6	235,569	15.4	35.4
Low Income – Number of Families Below Poverty Level (Households)	575,538	15.7	35.7	583,436	15.1	35.1	297,699	15.9	35.9	92,595	15.1	35.1

a. (USCB 2019f)

b. (USCB 2019g)

c. Percent values were calculated by dividing each census categories' population by the state and regional total population values.

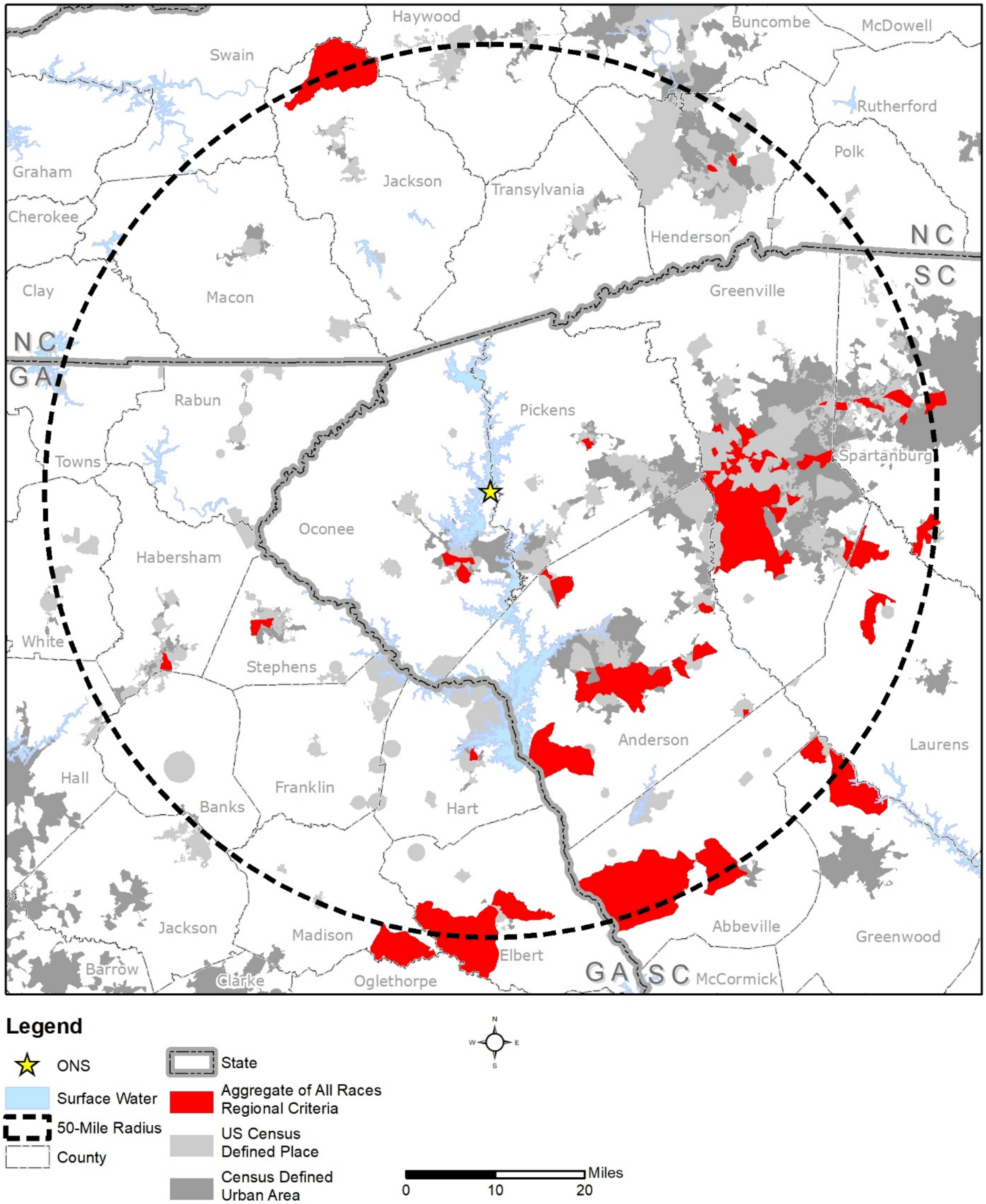


Figure 3.11-1 Aggregate of All Races Populations (Regional)

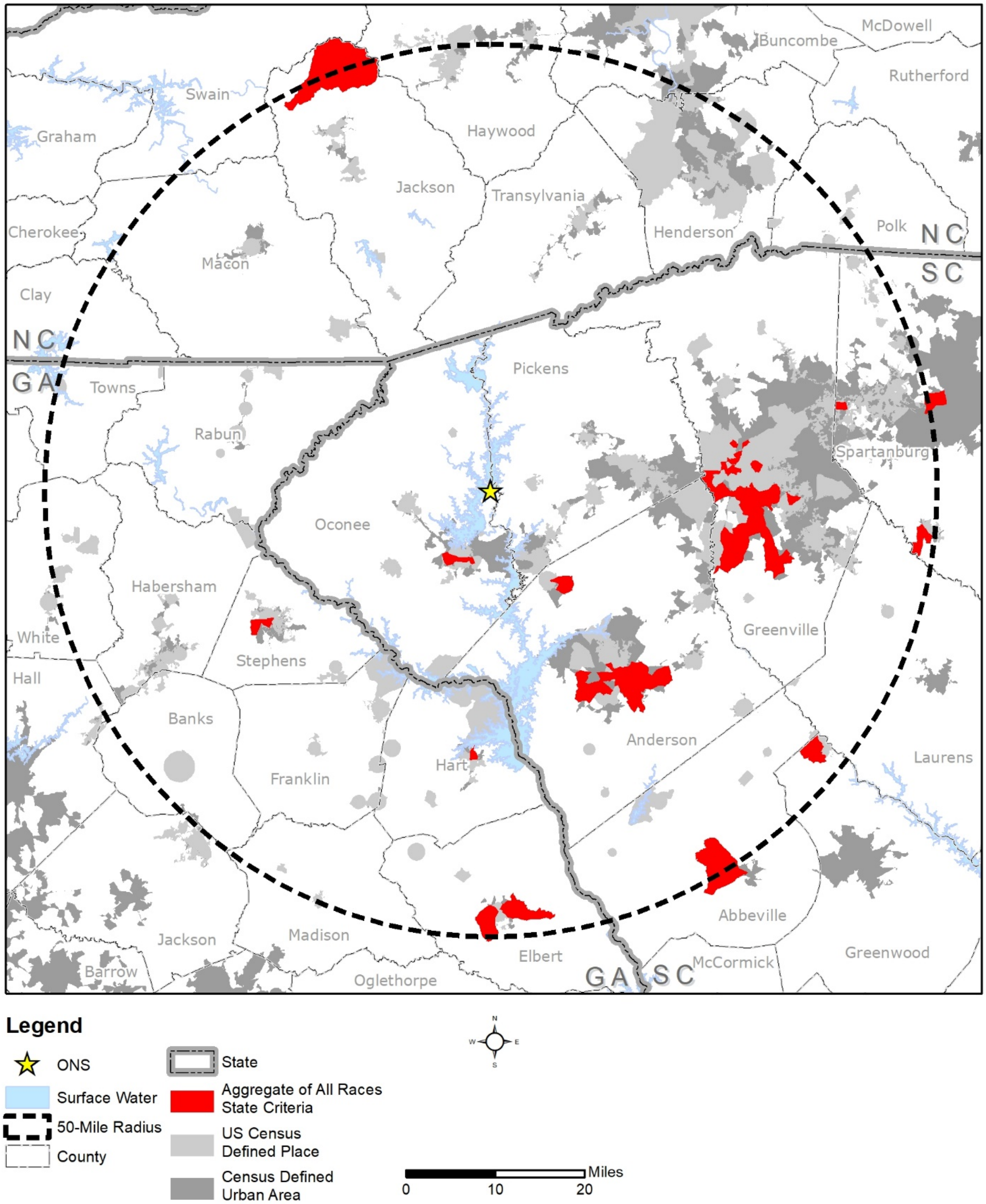


Figure 3.11-2 Aggregate of All Races Populations (Individual State)

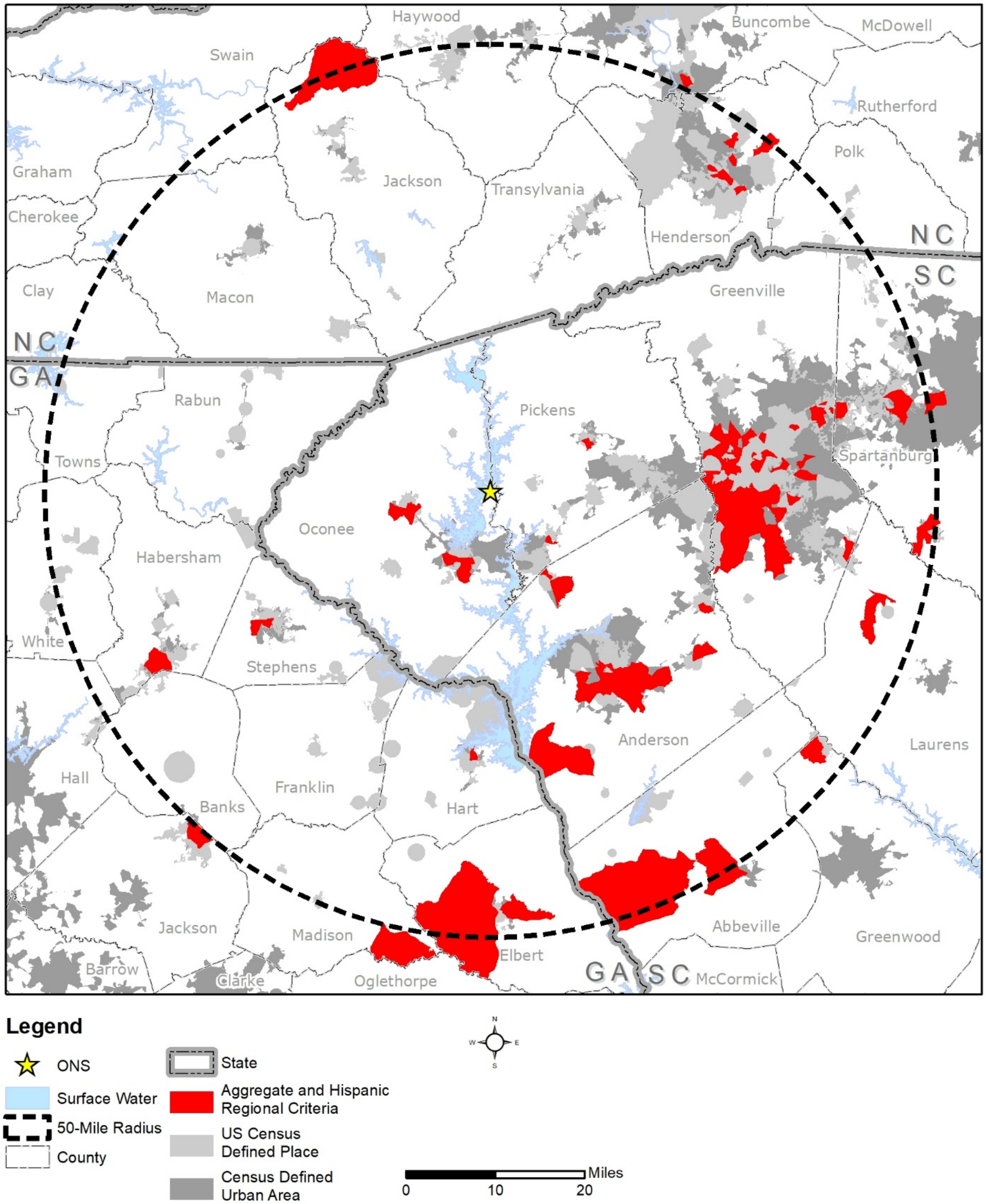


Figure 3.11-3 Aggregate and Hispanic Populations (Regional)

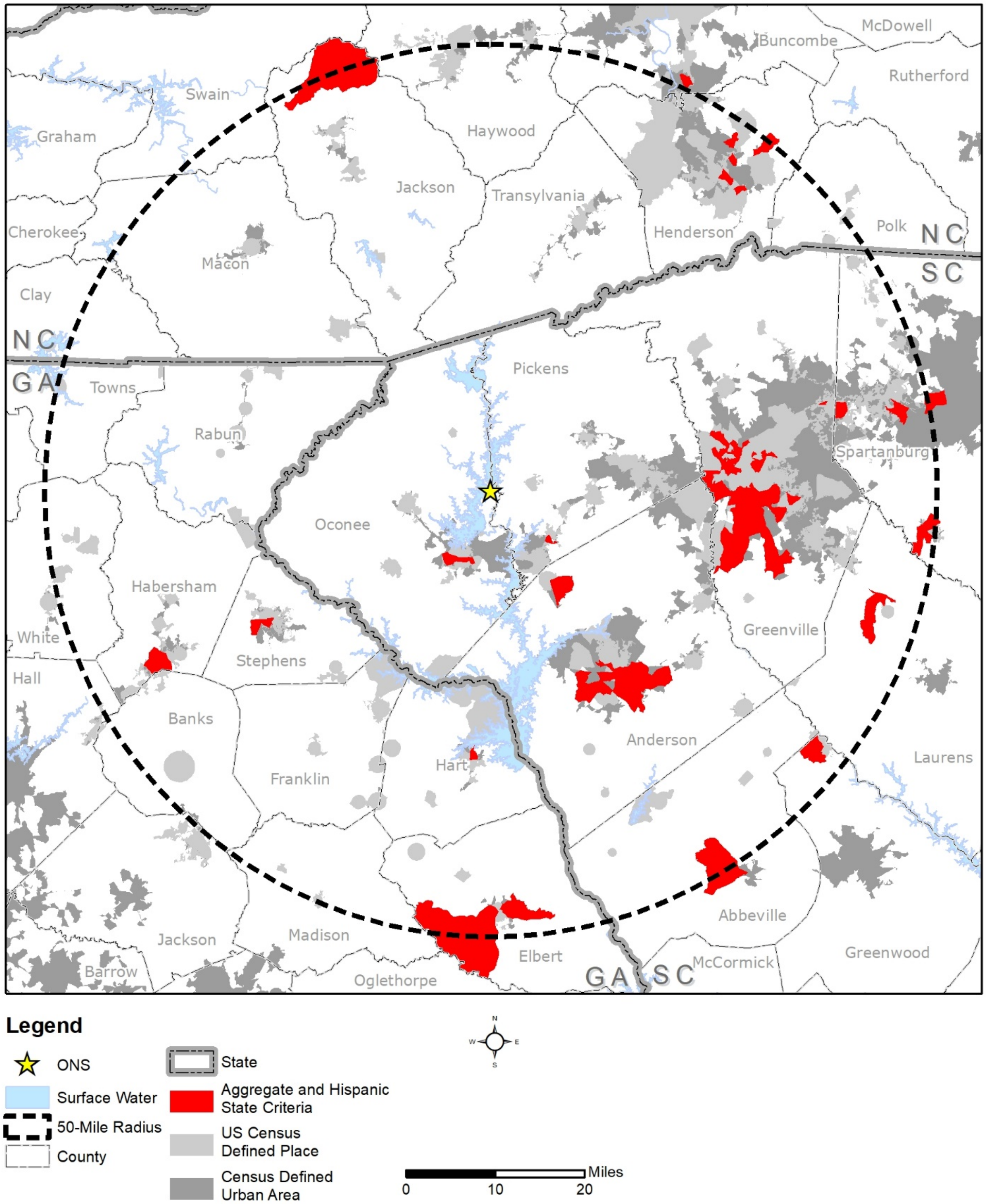


Figure 3.11-4 Aggregate and Hispanic Populations (Individual State)

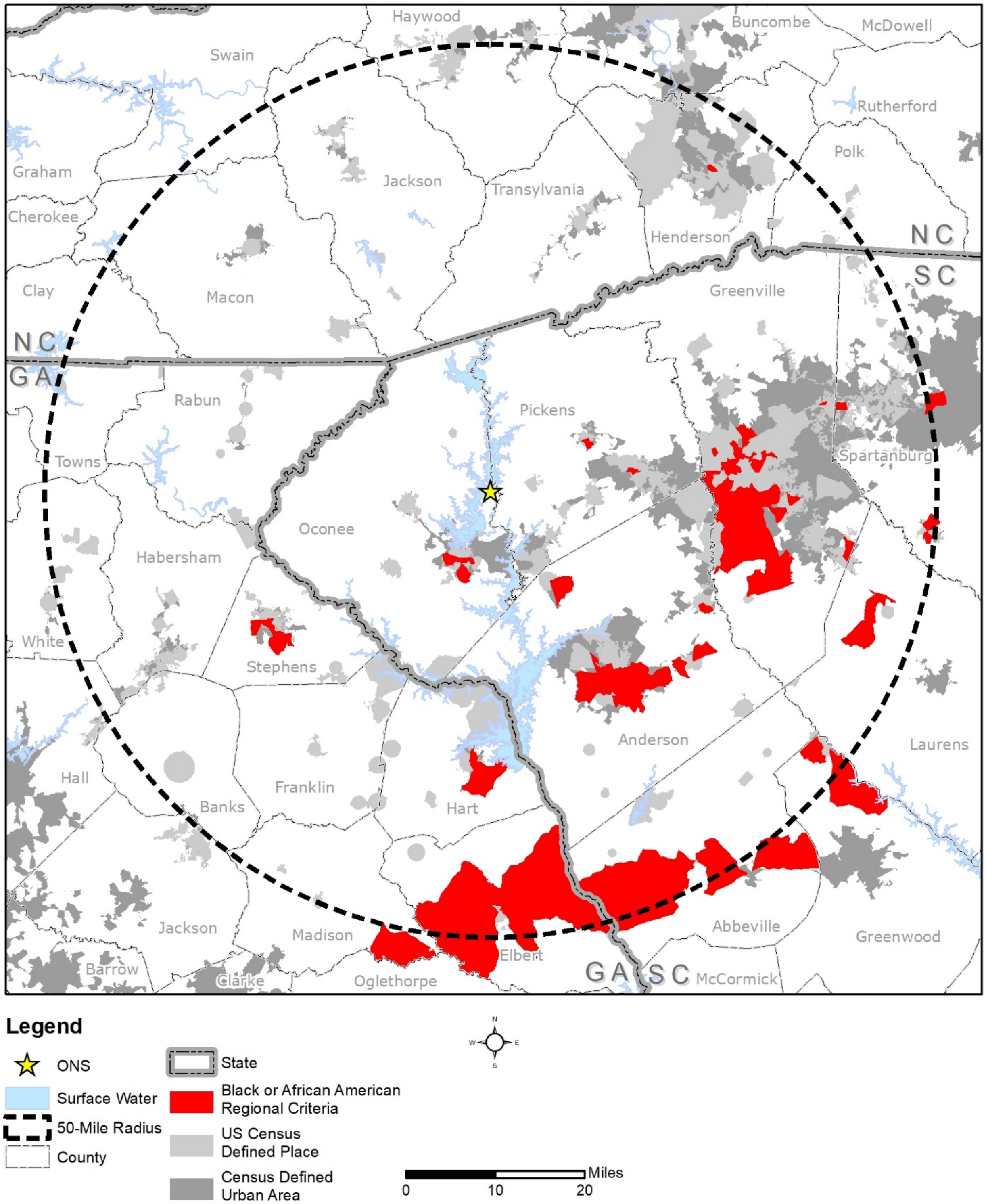


Figure 3.11-5 Black or African American Populations (Regional)

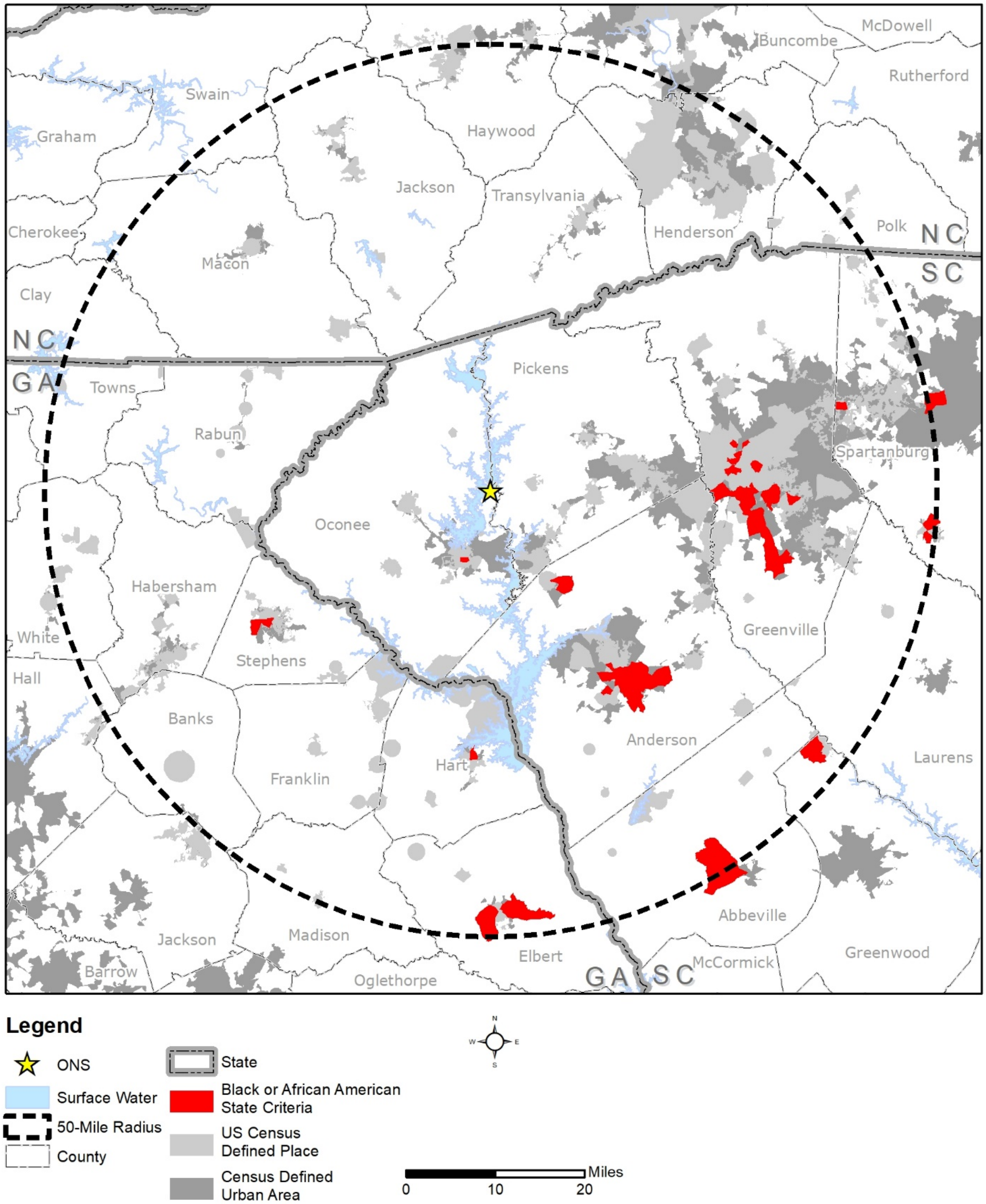


Figure 3.11-6 Black or African American Populations (Individual State)

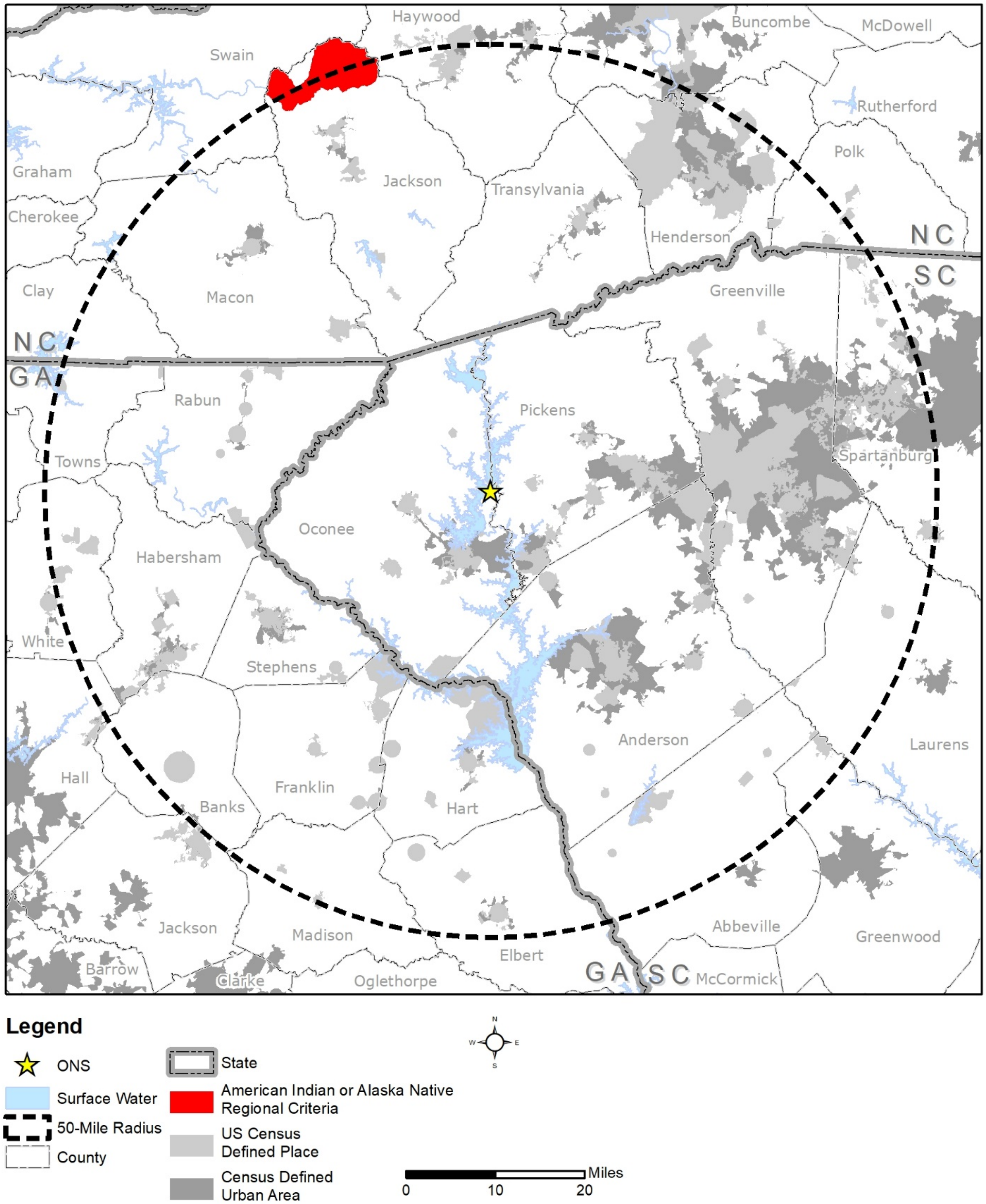


Figure 3.11-7 American Indian or Alaska Native Populations (Regional)

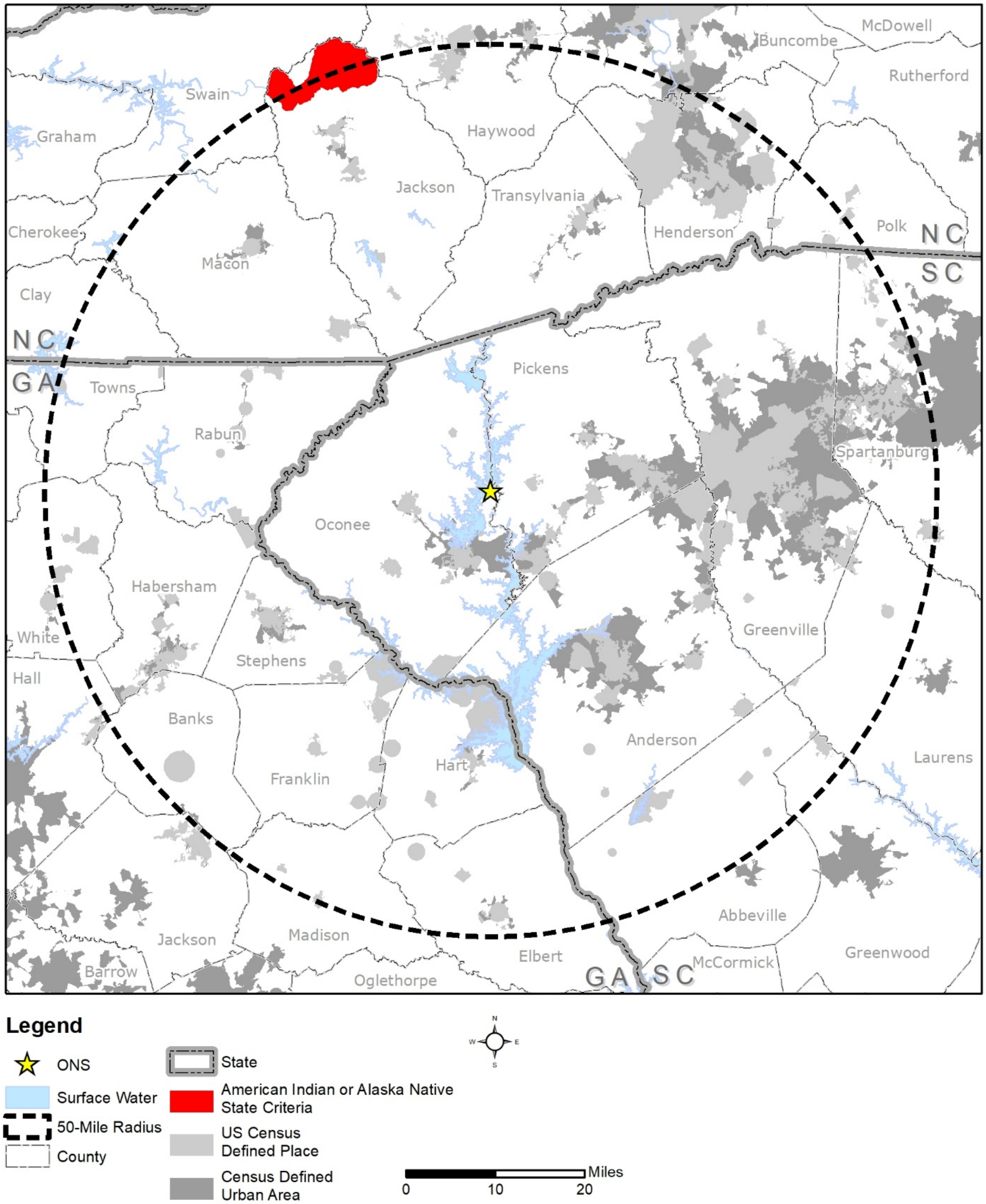


Figure 3.11-8 American Indian or Alaska Native Populations (Individual State)

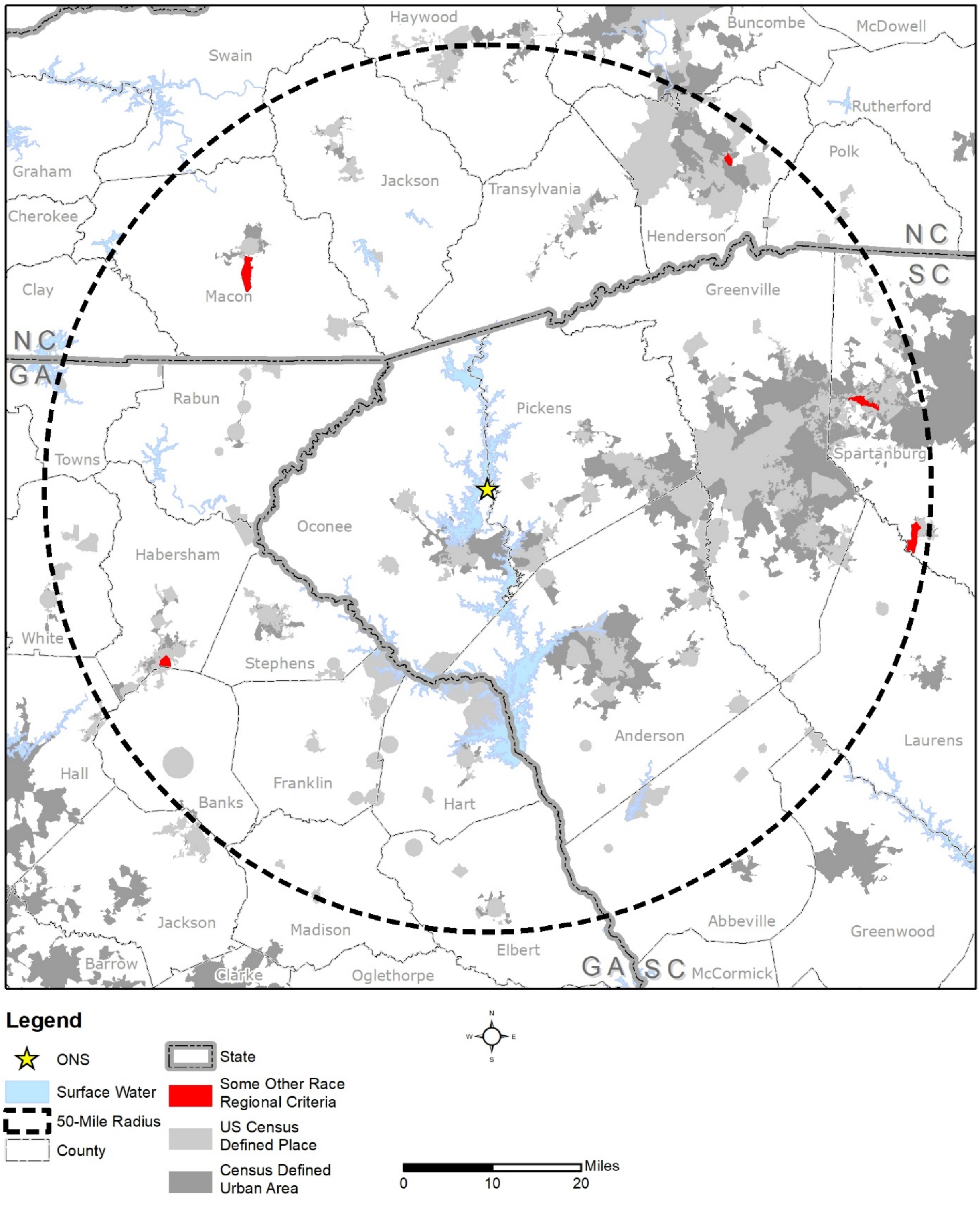


Figure 3.11-9 Some Other Race Populations (Regional)

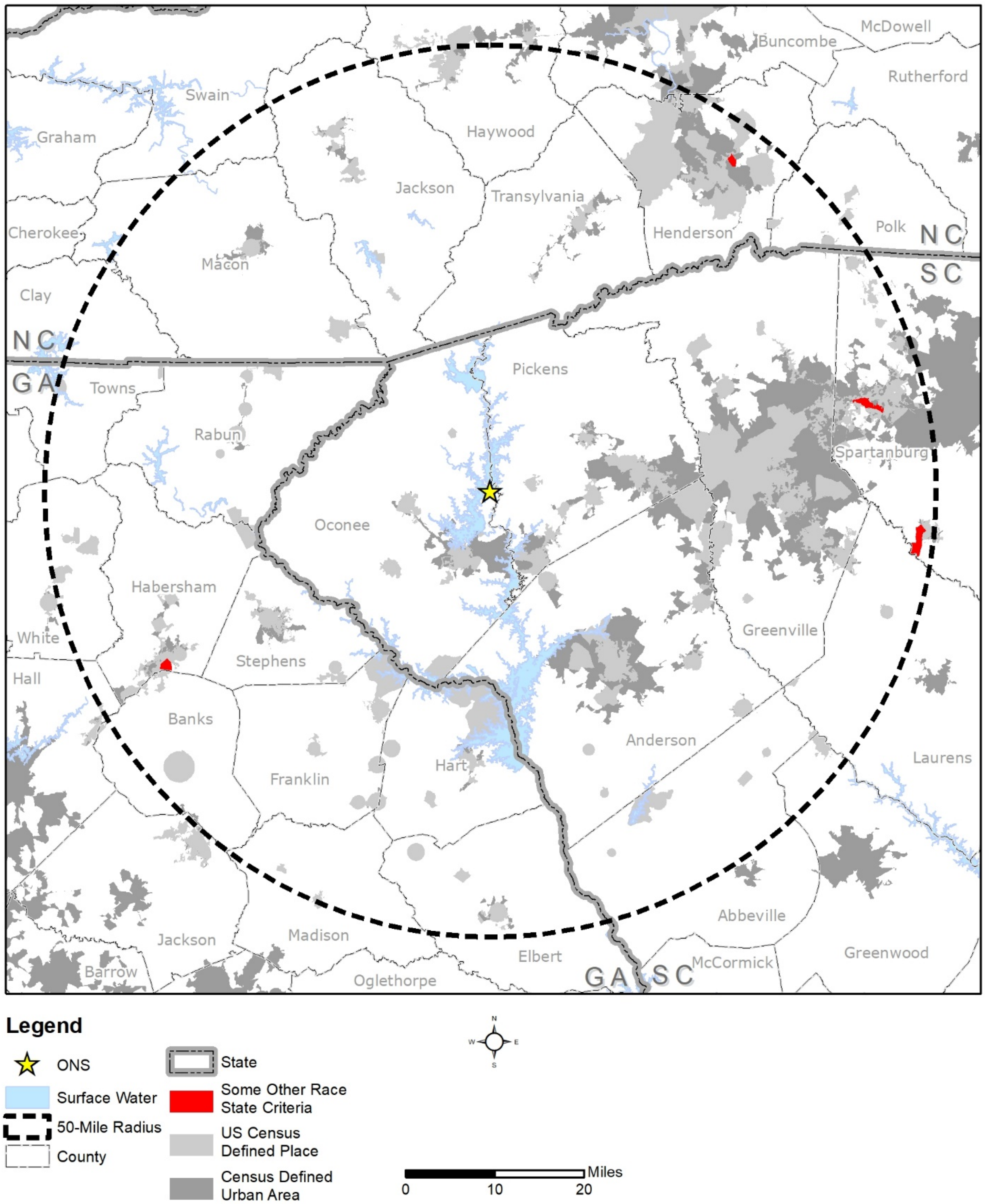


Figure 3.11-10 Some Other Race Populations (Individual State)

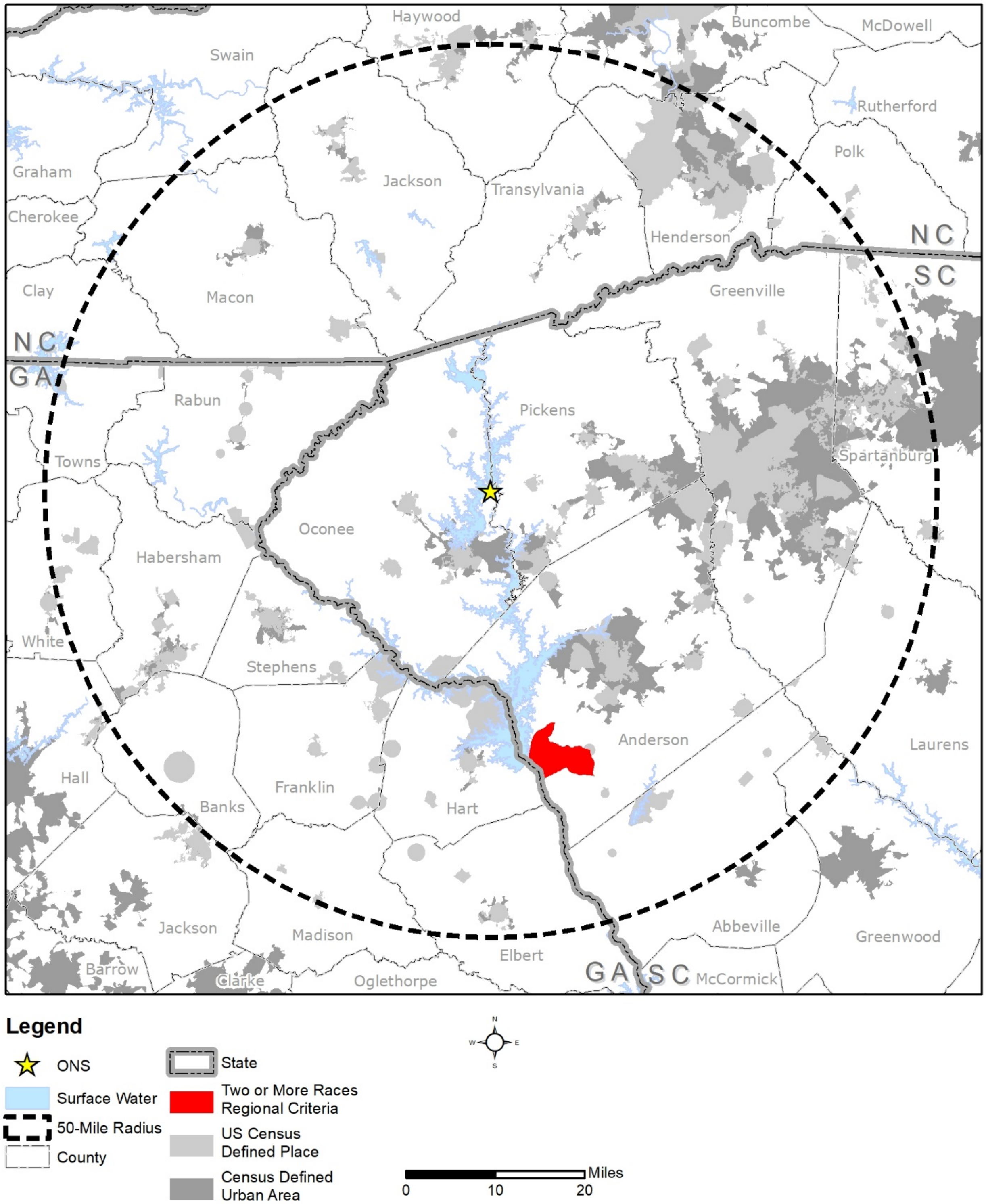


Figure 3.11-11 Two or More Races Populations (Regional)

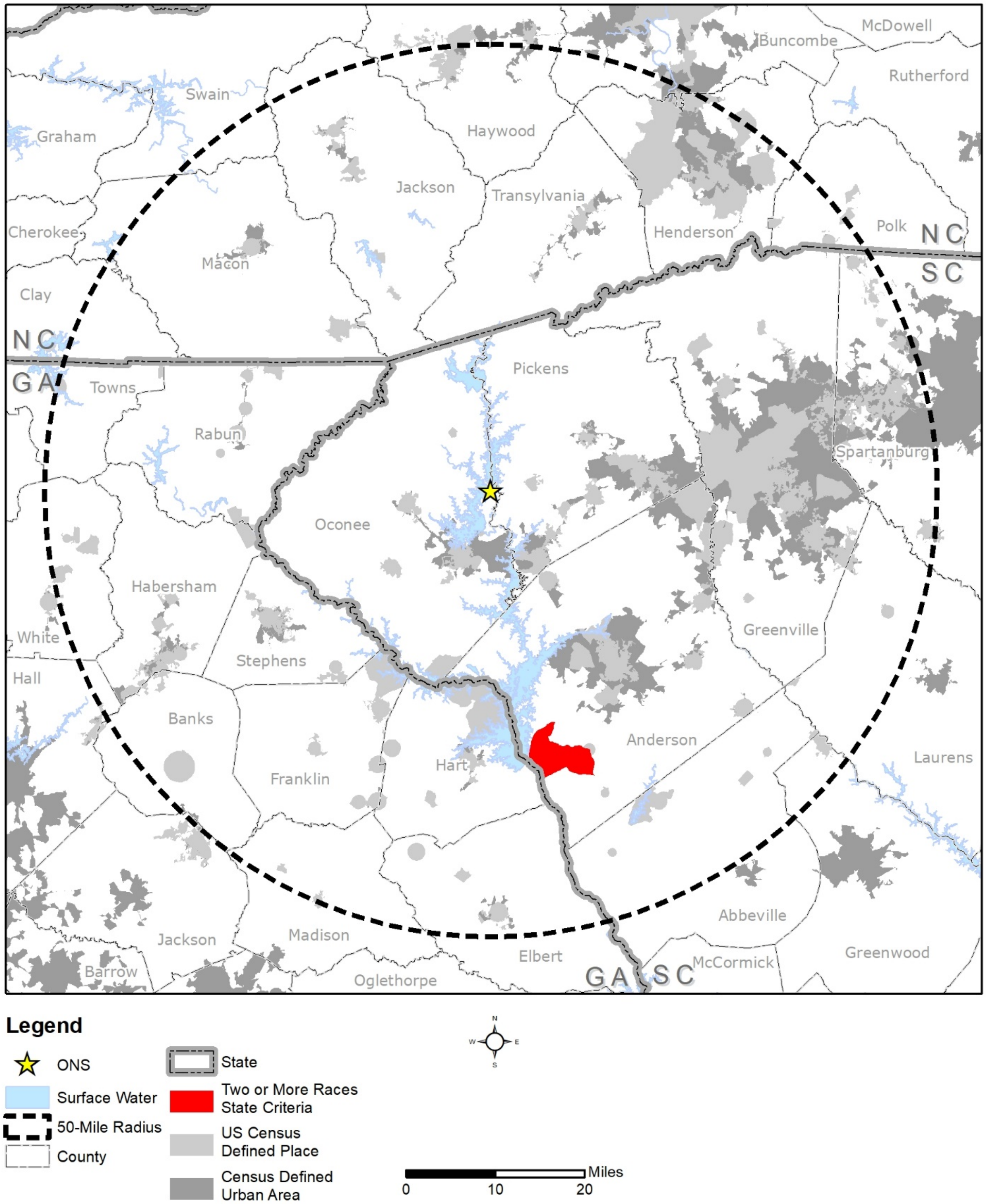


Figure 3.11-12 Two or More Races Populations (Individual State)

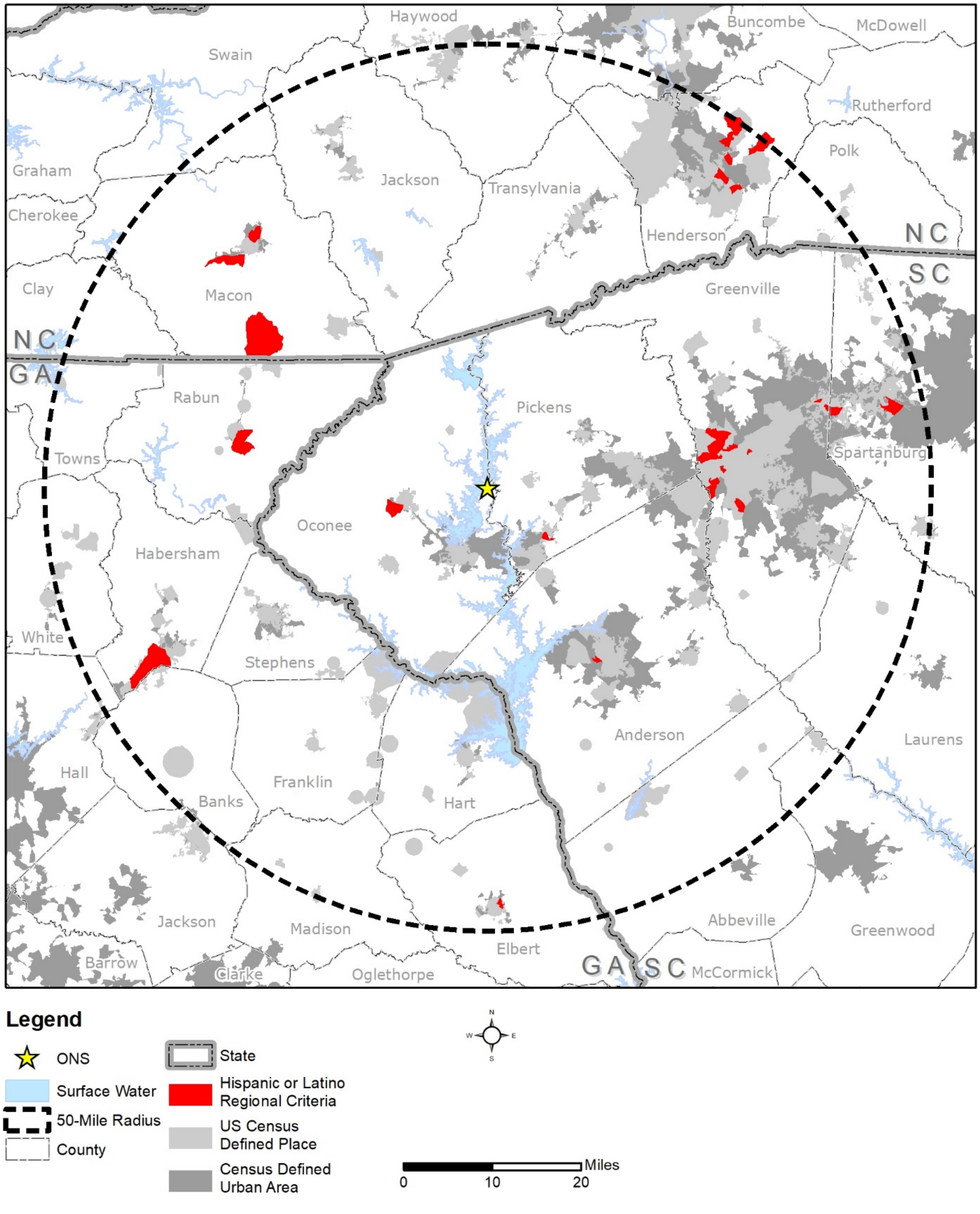


Figure 3.11-13 Hispanic or Latino Populations (Regional)

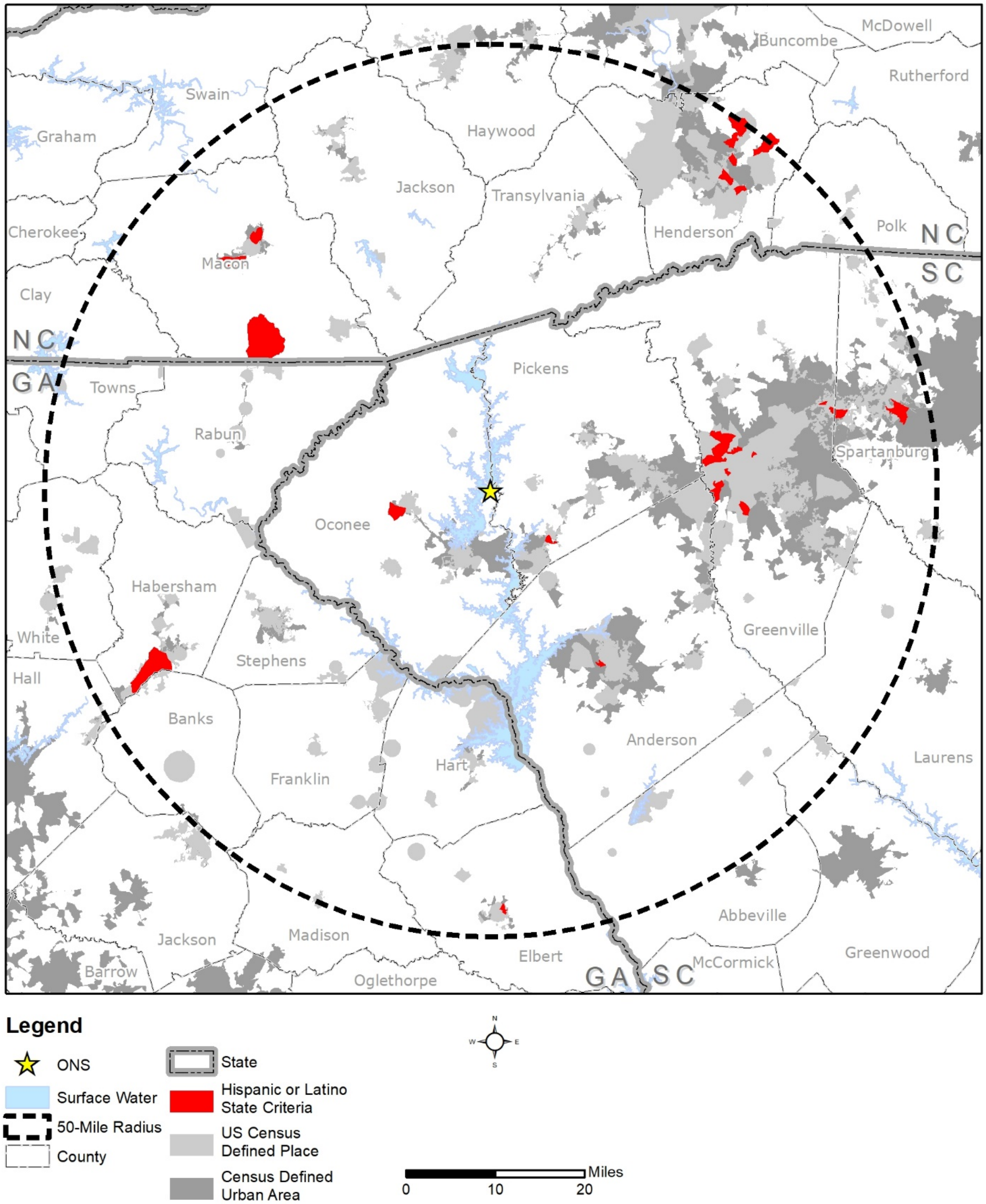


Figure 3.11-14 Hispanic or Latino Populations (Individual State)

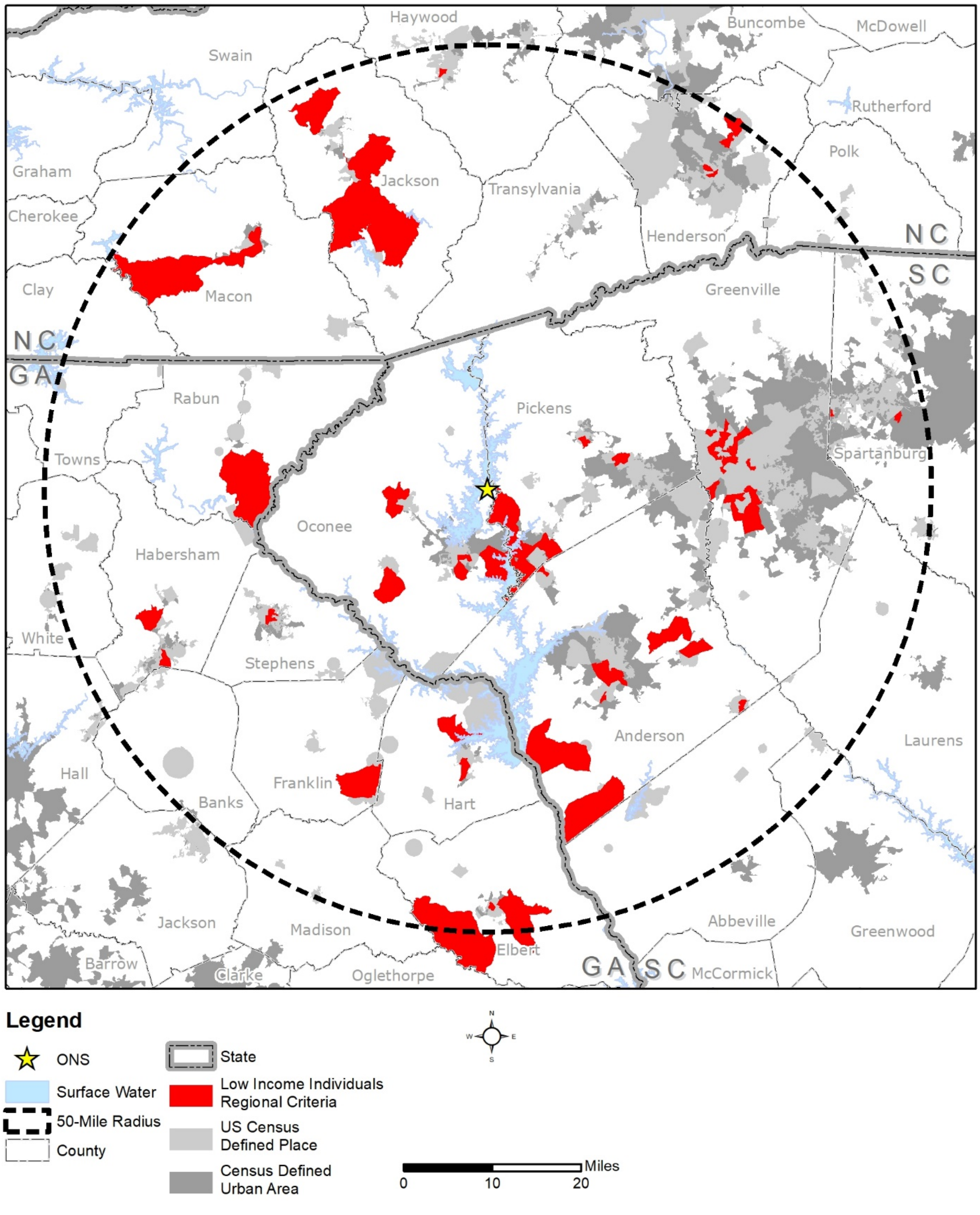


Figure 3.11-15 Low Income Individuals (Regional)

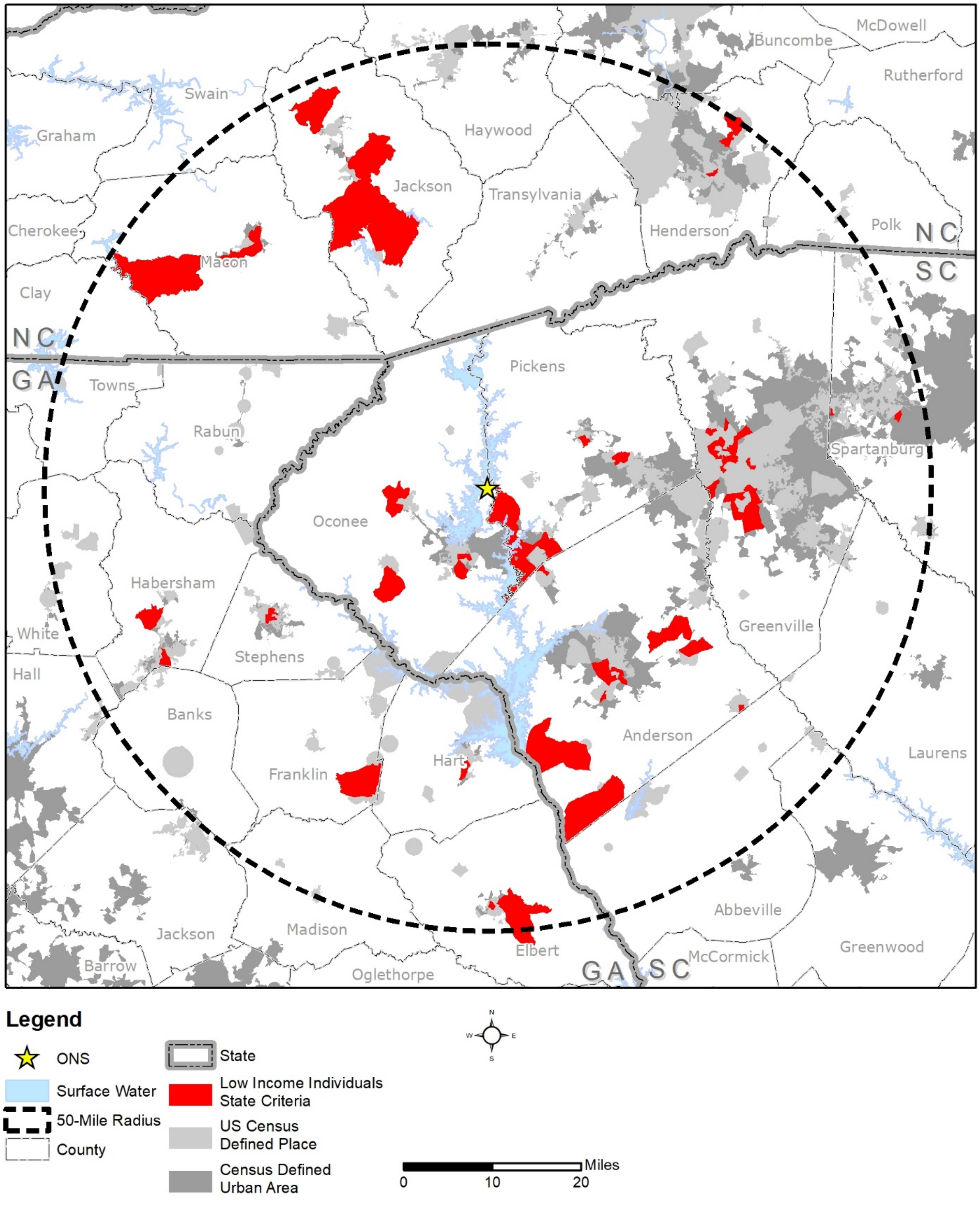


Figure 3.11-16 Low Income Individuals (Individual State)

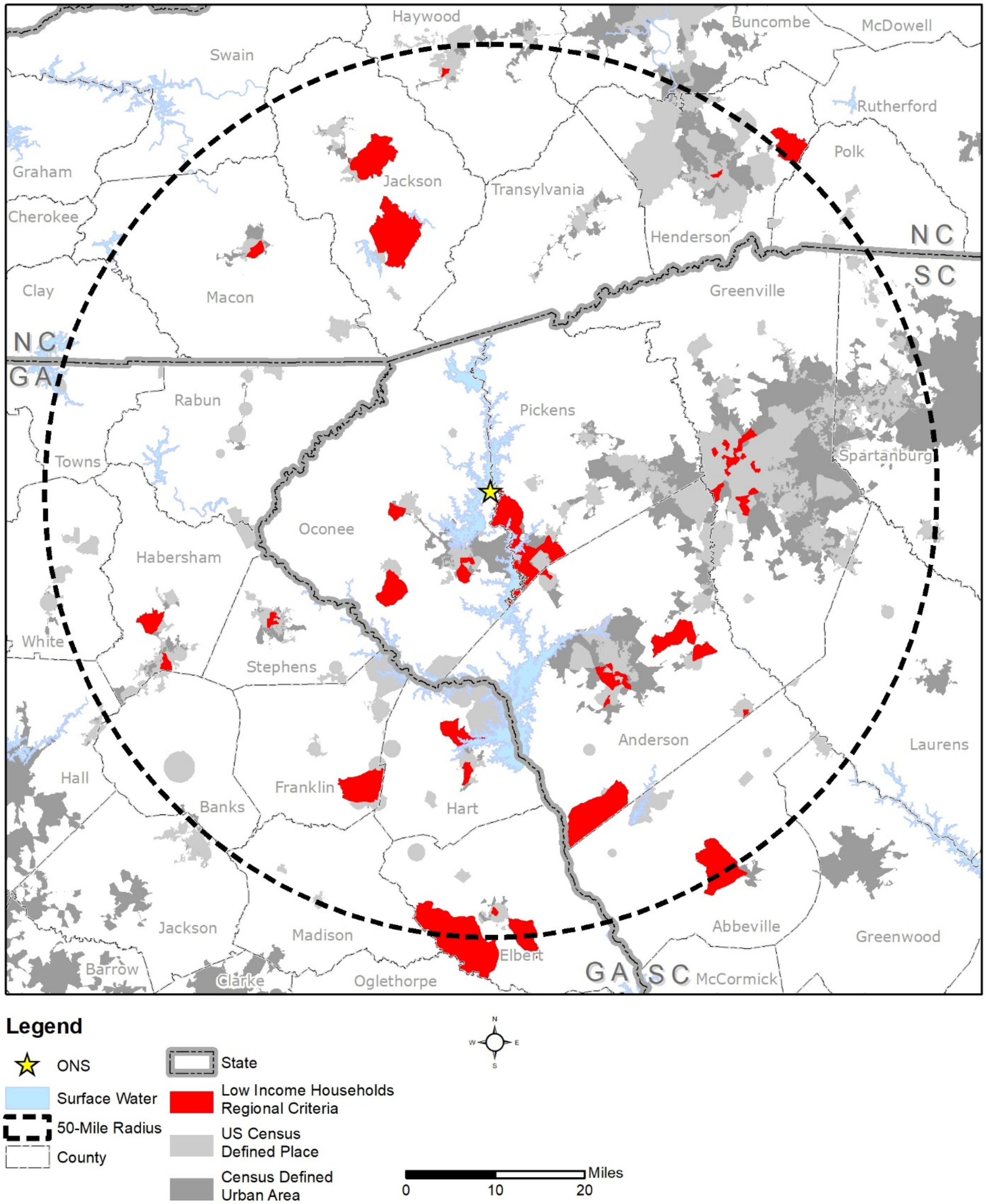


Figure 3.11-17 Low Income Households (Regional)

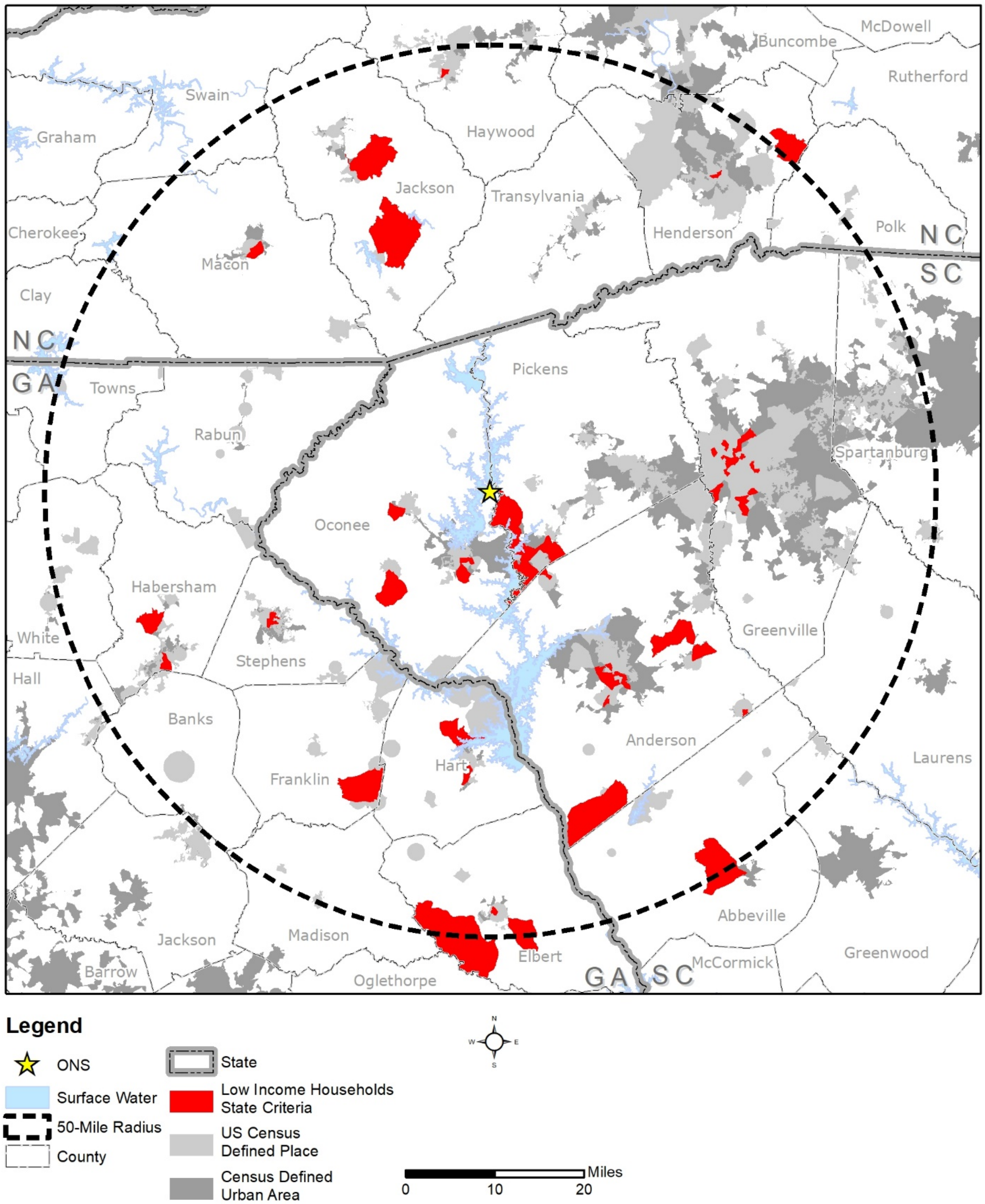


Figure 3.11-18 Low Income Households (Individual State)

3.12 Waste Management

In addressing the plant's radioactive and nonradioactive waste management systems and programs, NRC Regulatory Guide 4.2, Supplement 1, Revision 1, specifies that the information requested in this section can be incorporated by reference to Section 2.2 of the ER (NRC 2013b, Section 3.11). Therefore, consistent with NRC Regulatory Guide 4.2, Duke Energy is providing the information below to address ONS's radioactive and nonradioactive waste management systems and program.

3.12.1 Radioactive Waste Management

Section 2.2.6 includes a discussion of ONS's liquid, gaseous, and solid radwaste systems. The section provides a description of the systems, management of low-level mixed waste (LLMW), radwaste storage, spent fuel storage, and permitted facilities currently utilized for offsite processing and disposal of radioactive wastes.

3.12.2 Nonradioactive Waste Management

Section 2.2.7 includes a discussion of ONS's RCRA nonradioactive waste management program, types of wastes generated, waste minimization program, and permitted facilities currently utilized for disposition of wastes.