DRAFT FOR COMMENT

ML19228A278

Environmental Assessment
for the Renewal of SNM-1107
Columbia Fuel Fabrication Facility
in Richland County, South Carolina

Westinghouse Electric Company, LLC
Docket No. 70-1151

Completed: October 2019
Published: October 2019

Division of Rulemaking, Environmental, and Financial Support
Office of Nuclear Material Safety & Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

This page deliberately left blank.

EXECUTIVE SUMMARY

In December 2014, the U.S. Nuclear Regulatory Commission (NRC) received a license renewal application from Westinghouse Electric Company, LLC (WEC) for its Columbia Fuel Fabrication Facility (CFFF), located in Hopkins, South Carolina. The WEC requested that its NRC license be renewed for 40 years to continue fabricating low-enriched uranium fuel assemblies for commercial nuclear power reactors. The WEC did not propose changes to their current processes or construction of new buildings.

In June 2018, the NRC published a Final Environmental Assessment and a Finding of No Significant Impact concerning the license renewal request. The Environmental Assessment documented the environmental impacts of the continued operation of the CFFF for another 40 years. Shortly after in July 2018, there was a leak from equipment at the CFFF that resulted in uranium entering the subsurface under the facility building. In addition, WEC initiated an investigation, under the purview of the South Carolina Department of Health and Environmental Control (SCDHEC), into a leak in 2011 from a buried pipe that also allowed uranium to enter the subsurface under the main facility building. Because of that new information and the public concerns about the releases, the NRC decided to re-open its environmental review. As a result, the NRC is concurrently withdrawing the June 2018 Environmental Assessment and Finding of No Significant Impact with the *Federal Register* notice for the publication of this Draft EA.

This Draft Environmental Assessment reassesses the potential impacts on land use, geology and soils, water resources, historic and cultural resources, socioeconomics, environmental justice, waste management, air quality, noise and visual resources, public and occupational health, transportation, and aquatic and terrestrial species.

Nonradiological and radiological contamination exists in the groundwater in the shallow aquifer and in the surface water onsite. In December 2018, WEC sampled all groundwater wells and found uranium and technetium-99 in the groundwater, onsite, above drinking water standards. The source of the uranium is believed to be from operations in the main facility, whereas the source of the technetium-99 is still being investigated. In February 2019, WEC entered into a Consent Agreement with SCDHEC related to the investigation and remediation of contamination at the site as well as responses to future releases. As part of the Consent Agreement, WEC prepared a work plan that outlines data gaps and areas of the site that need to be characterized, investigations into the source and extent of known contamination, and other actions WEC must undertake, such as developing a conceptual site model. The WEC began the activities in the work plan in June 2019. As the activities proceed, SCDHEC and WEC will assess next steps. Based on the current knowledge of the site, WEC has proposed substantial changes to its NRC environmental monitoring program. These changes include installing new monitoring wells; adding surface water, groundwater, sediment, and soil sample locations; and use of a conceptual site model. The WEC has also developed procedures to help make decisions about the sampling program and remediation based on analysis of environmental data. As more information and data is gathered as part of the Consent Agreement, these procedures would allow WEC to make further refinements to its monitoring program. The NRC added two license conditions related to WEC's environmental sampling and monitoring program. The first license condition requires WEC to enter elevated groundwater and surface

water results from its environmental monitoring program into its Corrective Action Program (CAP). The second condition requires WEC to submit its environmental monitoring and sampling program to NRC for review and approval upon either SCDHEC's approval of the Remedial Investigation Report, as required by the Consent Agreement, or within five years of the license renewal (whichever comes first). The NRC will continue to inspect WEC's compliance with its NRC license, including the environmental monitoring and corrective action programs. Further, per NRC regulations, WEC must maintain records and funding to ensure the CFFF can be decommissioned to meet NRC's regulatory limits. Due to past releases, the uncertainty of the migration pathways for contamination, and because it is likely that there will be leaks and spills in the future, the NRC determined that there could be noticeable impacts to the soil, surface water, and groundwater, however the impacts will be adequately monitored and mitigated. Therefore, the NRC's evaluation preliminarily concludes that continued operations for an additional 40 years would not have a significant impact on the environment.

The NRC is publishing this Draft Environmental Assessment for public review and comment for 30 days. Comments received from the public will be captured in the final environmental document. The NRC's safety review is still ongoing and will be published at a later date.

CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

AADT	annual average daily traffic
ac	acre(s)
ADR	alternate dispute resolution
ADU	ammonium diuranate
AIT	Augmented Inspection Team
ALARA	as low as is reasonably achievable
AS/SVE	air sparging/soil vapor extraction
BMCU	Black Mingo Confining Unit
µCi	microcurie(s)
CA	Consent Agreement
CAL	Confirmatory Action Letter
CAP	Corrective Action Program
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
CFFF	Columbia Fuel Fabrication Facility
CO	confirmatory order
COC	constituents of concern
CO_2eq	carbon dioxide equivalent
COPC	chemicals of potential concern
CSM	site conceptual model
CWW	contaminated waste water
DFP	decommissioning funding plan
DOT	U.S. Department of Transportation
DP	decommissioning plan
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ERPG	emergency response planning guideline
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FS	feasibility study
ft	foot (feet)
ft^3	cubic foot (feet)

FWS	U.S. Fish and Wildlife Service
GHG	greenhouse gas
gpd	gallon(s) per day
ha	hectare(s)
HF	hydrofluoric acid
HDPE	high-density polyethylene
IROFSs	items relied on for safety
ISA	integrated safety analysis
ISG	interim staff guidance
kg	kilogram(s)
km	kilometer(s)
L	liter
LLRW	low-level radioactive waste
m	meter(s)
m^3	cubic meter(s)
µg	microgram(s)
mbp	million years before present
MBTA	Migratory Bird Treaty Act
mCi	millicurie(s)
mg	milligram(s)
Mgd	million gallons per day
mi	mile(s)
mL	milliliter
mpd	million years before present
mrem	millirem
MCL	Maximum Contaminant Level
MSL	mean sea level
mSv	millisievert(s)
MT	metric ton(s)
NAAQS	National Ambient Air Quality Standards
NCRP	National Council of Radiation Protection and Measurements
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NMFS	National Marine Fisheries Service
NMSS	Office of Nuclear Material Safety and Safeguards
NPDES	National Pollutant Discharge Elimination System

NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
OU	operable units
PCE	perchloroethylene
pCi	picocurie(s)
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
ppm	parts per million
PSD	prevention of significant deterioration
RAI	request for additional information
RI	remedial investigation
S	State Highway
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCDOT	South Carolina Department of Transportation
SER	Safety Evaluation Report
SHPO	State Historic Preservation Office
SNM	Special Nuclear Material(s)
sVOC	semi-volatile organic compounds
T	ton(s)
Tc-99	technicium-99
TCE	trichloroethene
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Office
U	uranium
U-234	uranium-234
U-235	uranium-235
U-238	uranium-238
UF_6	uranium hexafluoride
UN	uranyl nitrate
UO_2	uranium dioxide
UO_2F_2	uranyl fluoride
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey
VCC	voluntary cleanup contract
VOC	volatile organic compound

WEC	Westinghouse Electric Company, LLC
WWTP	wastewater treatment plant
yd	yard(s)
yr	year(s)

1. INTRODUCTION

The Westinghouse Electric Company, LLC's (WEC) Columbia Fuel Fabrication Facility (CFFF) located in Hopkins, South Carolina, has been operating since 1969 and fabricates low-enriched uranium fuel assemblies for commercial nuclear power reactors. In December 2014, WEC submitted an application, including an environmental report (ER), to the U.S. Nuclear Regulatory Commission (NRC) to renew its Special Nuclear Materials (SNM) License SNM–1107 (WEC 2014). If granted as proposed, the renewed license would allow WEC to continue authorized operations and activities at the CFFF site for a period of 40 years from the date the NRC approves the renewal.

The purpose of this environmental assessment (EA) is to assess the potential environmental impacts of the proposed license renewal. The NRC staff has prepared this EA following NRC regulations at Title 10 of the *Code of Federal Regulations* (CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," that implement the National Environmental Policy Act of 1969 (NEPA), and pursuant to guidance in NUREG–1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (NRC 2003).

The NRC previously published a Final EA and Finding of No Significant Impact (FONSI) in the *Federal Register* on June 15, 2018 (NRC 2018a, 83 FR 28014). Shortly after, in July 2018, WEC identified a leak that released uranium and hydrofluoric acid into the subsurface environment. Also, the WEC initiated investigations into past leaks from buried piping. Based on this new information and the public concern about the releases, the NRC decided to re-open its environmental review. As a result, the NRC is concurrently withdrawing the June 2018 EA and FONSI with the *Federal Register* notice for the publication of this Draft EA.

The NRC requested that WEC submit an updated License Renewal Application (LRA) and ER (NRC 2019a). In response, WEC submitted an updated LRA and ER in March 2019 (WEC 2019a,b). The WEC's March 2019 ER thus supersedes the December 2014 ER and March 2018 supplement to the ER, and the March 2019 ER incorporates previous responses to NRC requests for additional information (RAIs). In August 2019, WEC submitted another updated LRA which included changes to its environmental monitoring program (WEC 2019c).

The NRC is publishing this Draft EA for public review and comment. The NRC will issue a Final EA after addressing public comments. The comments received and the NRC's responses to those comments will be included as an appendix in the final environmental review document.

The NRC staff is also performing a detailed safety analysis of the CFFF license renewal to assess compliance with 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." The NRC staff's safety analysis will be documented in a separate Safety Evaluation Report (SER). The NRC decision whether to renew the WEC license as proposed will be based on the results of the NRC staff's review as documented in the SER and the final environmental document.

1.1 Proposed Action

The proposed action, as requested by WEC, is the continued operation of the CFFF for an additional 40 years in Hopkins, South Carolina. Current operations at CFFF include receiving natural and low-enriched uranium hexafluoride (UF_6) in cylinders, converting it to uranium dioxide (UO_2) powder, and processing the UO_2 powder into fuel assemblies (pellet pressing, sintering, fuel rod loading and sealing, assembly fabrication). The WEC has a production capacity of 1,500 MTU/yr with a maximum capacity of 1,600 MTU/yr. The WEC did not propose changes to operations nor construction of new buildings.

1.2 Purpose of and Need for the Proposed Action

The CFFF is one of three facilities in the United States that fabricates fuel assemblies for commercial nuclear power plants. The WEC's proposed license renewal would allow the CFFF to continue to be a source of nuclear fuel for commercial nuclear power plants. The WEC's license (SNM-1107) was renewed in 2007 by the NRC for 20 years and will expire in 2027. The license renewal application, if granted, would extend WEC's license for 40 years from the date the NRC approves the renewal.

1.3 Alternatives to the Proposed Action

This section describes the alternatives to the proposed action, including the no-action alternative.

1.3.1 No-Action Alternative

Under the no-action alternative, the NRC would deny WEC's request to renew CFFF's license. As a result, the CFFF would continue to operate under its current license until it expires on September 30, 2027. The NRC staff previously evaluated the environmental impacts of WEC continuing to operate the CFFF until September 2027 when it approved WEC's license renewal in 2007. The NRC staff concluded in the 2007 EA that the continued operation of the CFFF site would not result in a significant impact on the environment (NRC 2007).

The impacts of the no-action alternative would be similar to those of the proposed action, as discussed in Section 4 of this EA, except the impacts of the no-action alternative would occur only until 2027 and decommissioning, including any site remediation, would occur sooner. Under the no-action alternative, the proposed changes to the environmental monitoring program would not be required, but WEC could choose to incorporate them.

1.3.2 Alternative 1 – License Renewal for Less than 40 Years

Another alternative considered is for the NRC to grant WEC a license renewal, not for the requested 40 years but for some other shorter timeframe (i.e., 10, 20, or 30 years). In SECY-06-186, the Commission approved license terms for up to 40 years for fuel cycle facilities. Terms for less than 40 years would be considered on a case-by-case basis (NRC 2006a). The environmental impacts for continued operations for a timeframe less than 40 years would be similar to those evaluated in this EA for 40 years of continued operation. The timing of decommissioning would also be different if license renewal was granted for less than 40 years

but the types of impacts from decommissioning would be similar. Whether WEC operates for 40 years or less or more, WEC must maintain the necessary funding to assure they can successfully complete decommissioning and meet NRC's regulatory requirements. The environmental impacts of this alternative are discussed in Section 4.17 of this EA.

1.4 Scope of Environmental Analysis

This EA evaluates the environmental impacts of the proposed action—continuing the currently licensed operations through the 40-year license renewal period. It considers the operations and activities occurring at CFFF, the affected environment, and the interaction between the two. This EA incorporates by reference information from EAs prepared for the previous license renewals, where noted. This EA focuses on new and significant information since 2007 and reflects changes in the affected environment and recent operating history.

In preparing this EA, the NRC staff considered various documents and sources of information, including the following:

- WEC's LRA (WEC 2019a,c)
- WEC's ER (WEC 2019b)
- Previous NRC EAs for CFFF operations (NRC 1977, 1985, 1995, 2007)
- Information gathered from NRC site visits (NRC 2017a, 2019b)
- NRC inspection reports (e.g., NRC 2018b)
- Effluent monitoring reports (e.g., WEC 2019d)
- Consent Agreement (CA), Remedial Investigation (RI) Work Plan, and RI addenda (SCDHEC/WEC 2019, WEC 2019e,f,g)
- Geology plates provided by the U.S. National Park Service
- National Pollutant Discharge Elimination System (NPDES) permit and related groundwater reports.

1.5 Previous Environmental Analyses

Because the CFFF was licensed by the Atomic Energy Commission in 1969, prior to the implementation of NEPA, no environmental review was done for the construction and initial operation of CFFF. However, since 1969, multiple license renewals for the continued operation of CFFF have been evaluated by the NRC. In 1977, the NRC prepared an Environmental Impact Assessment[1] to consider the environmental impacts of operations at a capacity of 400 metric tons per year (MT/yr) of uranium and projected impacts of future expansion of up to a capacity of 1,600 MT/yr of uranium (NRC 1977). In 1985, the NRC completed an EA for the license renewal of SNM-1107 (NRC 1985). The NRC completed another EA in 1995 for a 10-year renewal of SNM-1107 (NRC 1995). In 2007, the NRC prepared another EA for renewal of the CFFF license that addressed the potential environmental impacts of 20 more years of continued operation. The 2007 EA concluded that the renewal of the CFFF license would not result in a significant impact on the environment, that no Environmental Impact Statement (EIS)

[1] Environmental Impact Assessments were the NRC's predecessor to EAs.

was warranted, and that a FONSI was appropriate in accordance with 10 CFR 51.31 (NRC 2007). In June 2018, the NRC issued a Final EA and published a FONSI in the *Federal Register* concerning WEC's current application for a 40-year renewal (NRC 2018a). However, the NRC decided to re-open its environmental review, and thus this Draft EA supersedes the June 2018 EA, which the NRC withdrew.

2. GENERAL DESCRIPTION OF CFFF SITE AND OPERATIONS

This section describes the existing CFFF and its operations that would continue during the 40-year license renewal period if the NRC grants the license renewal. The CFFF is a Category III fuel cycle facility[2] that fabricates low-enriched uranium fuel assemblies for use at light water commercial nuclear power reactors.

2.1 Site Location and Layout

The CFFF site occupies 469 hectares (ha) (1,151 acres [ac]) in Hopkins, South Carolina, in Richland County. The site is approximately 13 kilometers (km) (8 miles [mi]) southeast of the City of Columbia. Figure 2-1 provides the general location of the CFFF site.

Approximately 28 ha (68 ac) of the property area are used for facility operations and support activities. Figure 2-2 and Figure 2-3 show the site boundary and the site layout. Figure 2-2 shows that the remaining property is mostly undeveloped. The CFFF is bounded by South Carolina highway (S) 48 (Bluff Road) to the north and private property owners in all other directions. The CFFF site lies within the flood basin of the Congaree River, which flows approximately 6.4 km (4 mi) southwest of the main plant (NRC 2007).

2.2 Facility Operations

WEC fabricates nuclear fuel assemblies containing natural and low-enriched uranium oxide fuel for use in light water commercial nuclear power reactors. The WEC also produces other fuel-related products such as control rods and mechanical components. The primary facilities consist of a main fuel fabrication plant, wastewater treatment plant (WWTP) and lagoons, raw material storage buildings, and office space.

Manufacturing of the fuel assemblies is mostly conducted in the main manufacturing building, which is divided into the Chemical Area and Mechanical Area. The WEC receives cylinders of natural and low-enriched UF_6 via truck shipment. The production of nuclear fuel assemblies at the CFFF (see Figure 2-4) starts with the chemical conversion of UF_6 into UO_2. This is done via the ammonium diuranate (ADU) process, which uses water and ammonium hydroxide. In 2011, WEC replaced the use of anhydrous ammonia with aqueous ammonium hydroxide (WEC 2019b). The UO_2 is processed and pressed into fuel pellets, heated to form a ceramic material, and then further processed through a grinding operation. These fuel pellets are loaded and sealed into metal fuel rods. The rods are assembled into bundles that form the nuclear fuel assemblies.

[2] The NRC classifies SNM and the facilities that possess them into three categories based upon the materials' potential for use in nuclear weapons, or their "strategic significance." The three categories are: Category I, high strategic significance; Category II, moderate strategic significance; and Category III, low strategic significance. The NRC's physical security requirements differ by category; for example, Category I facilities are subject to more stringent requirements than Category III facilities.

Figure 2-1 General Site Location

Figure 2-2 CFFF Property Boundary (Source: AECOM 2013)

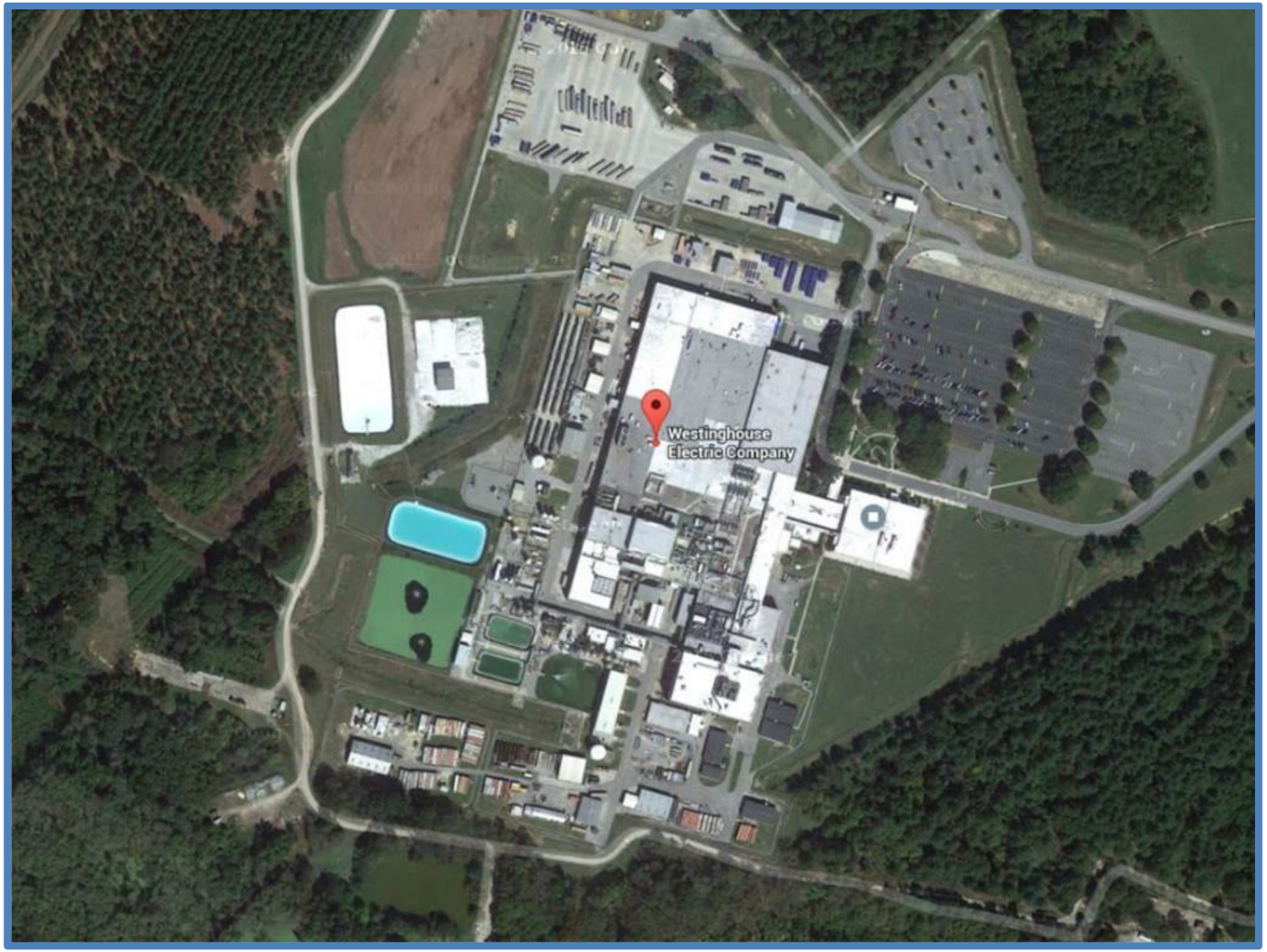


Figure 2-3 Site Layout (Source: WEC 2019b)

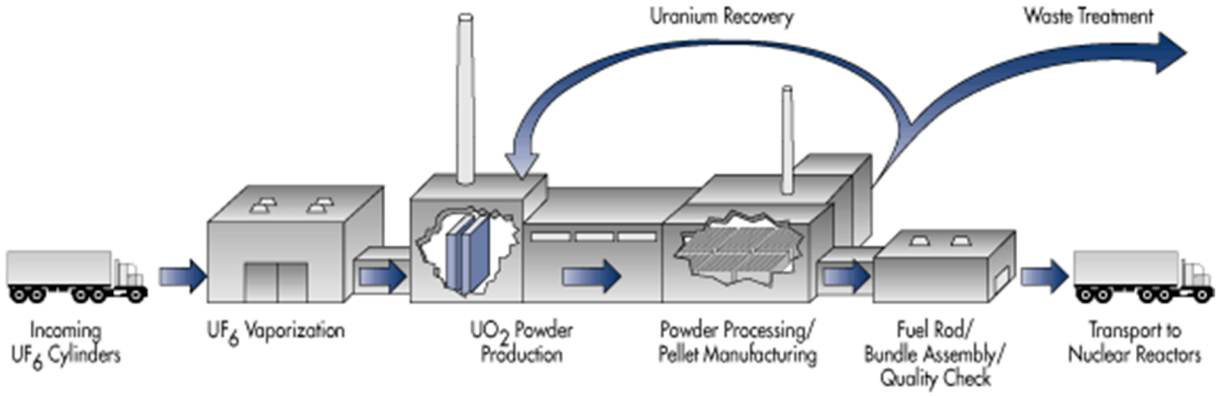


Figure 2-4 Typical Light Water Reactor Fuel Fabrication Facility

Other facilities and processes that support the ADU chemical conversion process and pellet fabrication include oxidation of recycled fuel pellets, cylinder recertification, cylinder washing, respirator cleaning, scrap recovery, laboratory analysis, incineration, solvent extraction, waste treatment, welding, metal fabrication, quality control testing, and shipping container painting. Figure 2-5 shows the chemical process streams at CFFF.

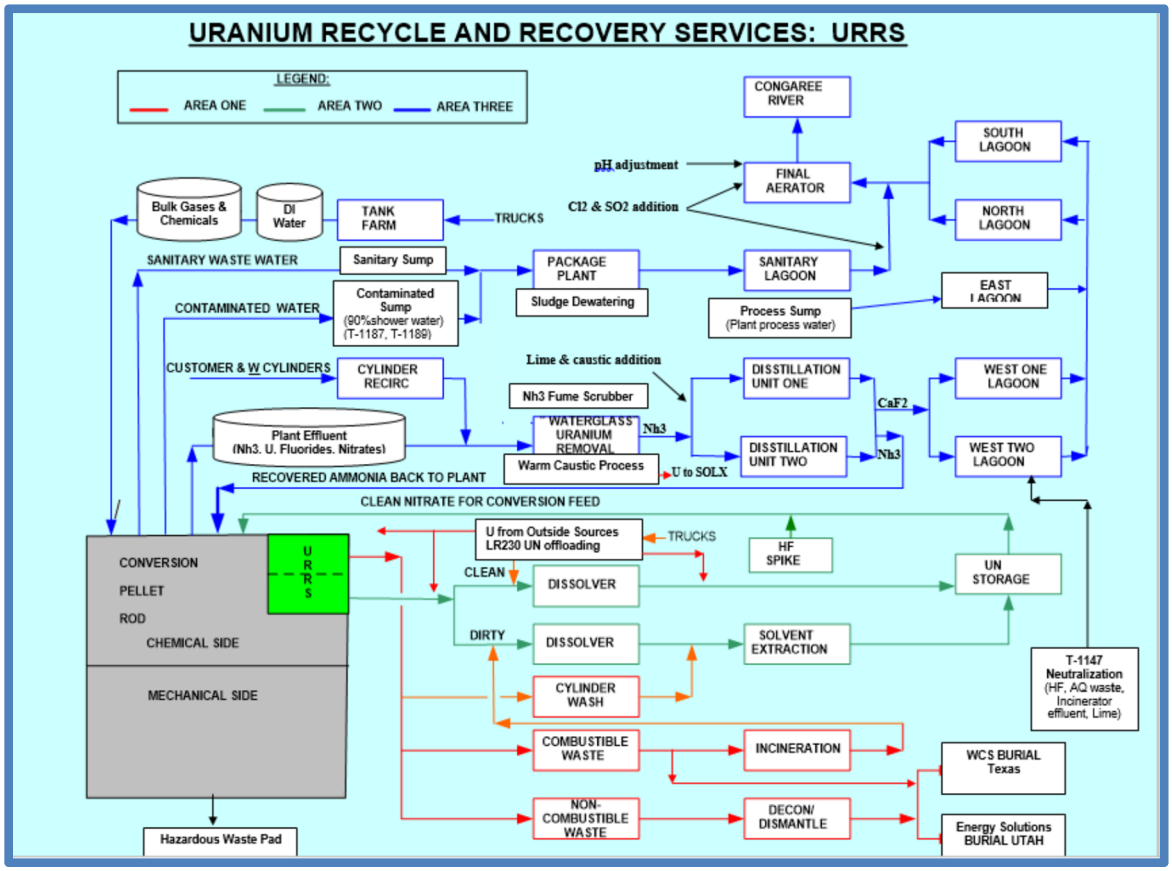


Figure 2-5 CFFF Process Streams (Source: WEC 2019b)

The completed fuel assemblies are shipped in NRC-approved containers to WEC's customers for use at commercial nuclear power plants. The shipments of nuclear materials from CFFF are governed by the NRC, the U.S. Department of Transportation (DOT), and State of South Carolina regulations.

2.2.1 Facility Changes and Events since 2007 License Renewal

The CFFF license has been amended multiple times, mainly to reflect administrative changes (e.g., change in management or notification procedures). The license is currently on Amendment 21 (NRC 2019c).

Some of the substantial changes that have the potential to affect the environment and have occurred since the 2007 license renewal are as follows:

- WEC has increased its storage limits for UF_6 cylinders and built a concrete storage pad on previously disturbed land.
- WEC no longer uses anhydrous ammonia in its ADU process.
- WEC replaced the liners of four WWTP lagoons. The new liners for the West I, West II, South, and North Lagoons are now 80-millimeter high-density polyethylene (HDPE) and were replaced between 2008 and 2012.

Since the 2007 license renewal, there has been a historic flooding event (2015) and there have been multiple leaks or spills that have resulted in the contamination of the subsurface at CFFF. The leak events are summarized below and discussed in more detail in Section 3. The flooding event is discussed further in Section 3.3.

- Leaks from a buried pipe (contaminated wastewater (CWW) line) were discovered in 2008 and 2011 and released an unknown amount of uranium into the subsurface. In response to the 2008 leak, WEC replaced the underground piping system using a pipe burst system. In response to the 2011 leak, the affected buried piping under the building floor was abandoned in place and replaced with above ground polyvinyl chloride (PVC) piping. Due to its location underneath the building, no remediation of the soil was performed at the time the leak was discovered, nor is any remediation planned that NRC is aware.
- In January 2014, there was a leak from a tank transfer line. The WEC estimated that 20–25 gal of liquid containing uranium were spilled. Soil sampling results showed concentrations up to 26.3 ppm uranium. The WEC removed and disposed of approximately 1,000 cubic feet (ft^3) of contaminated soil (WEC 2019b).
- In October 2015, there was a rain event/flood in the Columbia area. Columbia received 8.19 in. of rain in a 24-hr period and a total of 12.4 in. over 4 days. The Congaree River crested at 123.3 ft above mean sea level (MSL) and flooded the floodplains, but did not reach the manufacturing buildings. However, two lagoons overflowed due to the rain.
- In June 2018, a leak from the hydrofluoric acid (HF) spiking station released uranyl nitrate (UN) and hydrofluoric acid into the subsurface. The WEC took out the HF spiking station, removed the contaminated soil, and is currently installing a redesigned HF spiking station

system. Once the new system is in place, WEC will replace the second HF spiking station and investigate the subsurface.

- In July 2019, during a routine inspection of storage containers holding drums of combustible waste containing uranium, WEC discovered the structural integrity of its storage containers and the drums within had been compromised. Rain water had penetrated the storage container and drums. The WEC sampled the water found within the storage containers and the soil underneath those containers. The WEC is currently investigating this area as part of an agreement with South Carolina Department of Health and Environmental Control (SCDHEC).

Scrubber Event

In 2016, while conducting an annual inspection and cleaning a scrubber, WEC found a large mass of material inside the scrubber inlet transition. The WEC believed that the material was low in uranium content, but upon further analysis WEC found that the uranium mass limit was exceeded. The WEC reported the event to the NRC on July 14, 2016 (EN #52090). On July 31, 2016, WEC updated the event notification to report that material found in the scrubber packing and floor also exceeded the uranium mass limit for the scrubber criticality safety evaluation. The NRC established an Augmented Inspection Team (AIT) to inspect and assess the facts and circumstances surrounding the event. The AIT completed the inspection on September 1, 2016, and provided its report to WEC on October 26, 2016 (NRC 2016b). The AIT found that IROFSs for the scrubber did not ensure that a criticality accident was highly unlikely and that the controls and measures to protect against a criticality were not sufficient to assure subcriticality conditions. The AIT also found that WEC did not establish adequate management measures to ensure the availability and reliability of the IROFS and that WEC failed to provide adequate levels of oversight, enforcement, and accountability to the organizations directly involved with configuration management, operations, and maintenance of the wet ventilation systems (NRC 2016b).

On August 9, 2016, WEC provided its commitments to NRC addressing the actions to be taken to identify the causes of the event and corrective actions (WEC 2016). The NRC issued a Confirmatory Action Letter (CAL) on August 11, 2016, (NRC 2016c) to confirm WEC's commitments and ensure that the root causes of the event were adequately evaluated and appropriate corrective actions were implemented before resumption of operations. Accordingly, in September 2016, the NRC staff conducted an inspection of the actions in the CAL to verify that the commitments necessary to restart the conversion process equipment and scrubber system were completed and that the actions taken provided reasonable assurance of WEC's ability to safely operate the facility (NRC 2016d). By letter dated October 20, 2017, the NRC staff informed WEC that there were no issues with the licensee's plan to restart the conversion process equipment and scrubber (NRC 2017f). On February 27, 2017, the NRC completed a follow-up inspection, and issued an Inspection Report (NRC 2017g), which documented four apparent violations that were considered for escalated enforcement in accordance with the NRC's Enforcement Policy. The NRC's Inspection Report offered Westinghouse a choice to (1) attend a Predecisional Enforcement Conference, (2) provide a written response, or (3) request an alternate dispute resolution (ADR) session with the NRC in an attempt to resolve any

disagreement regarding whether violations occurred, the appropriate enforcement action, and the appropriate corrective actions.

In response, WEC requested an ADR to resolve the enforcement aspects and to discuss corrective actions. The ADR process culminated in the issuance of a confirmatory order (CO) (WEC 2017h) requiring corrective actions and enhancements which the NRC determined were sufficient to address the underlying cause of the scrubber event.

2.2.2 Ongoing and Anticipated Future Changes

In December 2018 during a pre-application meeting with the NRC, WEC indicated plans to remodel its administration building, which they anticipated would require a license amendment (WEC 2018a). However, WEC has since stated it does not plan to request those changes at this time (NRC 2019b). For any future license amendment request, NRC would review the request and conduct a safety analysis and the appropriate environmental review.

The WEC has entered into an agreement with SCDHEC to address contamination at the site. Therefore, WEC will continue to implement that agreement until the conditions are satisfied. More information on that agreement can be found in Section 2.4.3.

2.3 Effluent Management

Operations at CFFF generate gaseous and liquid effluents. This section briefly describes the two effluent waste streams and how WEC manages them. Solid waste generation, management, and disposal is discussed in Section 3.15 of this EA.

2.3.1 Gaseous Effluents

Under the proposed license renewal application, operations at the CFFF would continue to generate gaseous effluents. These effluents would come mainly from the process stacks, equipment, and from fugitive dust. There are 47 exhaust stacks at the CFFF, which are typically short stacks or roof vents that release gaseous effluents into the air.

Table 2-1 provides the annual average discharge rates for uranium, ammonia, and fluorides as provided by WEC. The emissions are normally treated and sampled prior to release to the environment. High-efficiency particulate air filters and scrubbers are commonly used pollution control equipment employed at CFFF.

The stacks are continuously sampled to ensure concentrations are below WEC's action levels, set lower than regulatory limits, which would trigger further investigation by WEC (WEC 2019b). The WEC also operates gas-fired boilers, calciners, and oil-fired diesel generators, and generate air emissions.

Table 2-1 Annual Average Discharge Rate

Constituent	Average Discharge Rates
Uranium	444 uCi/yr[(a)]
Ammonia	72 lb/d[(b)]
Fluorides	*de minimis*[(c)]

Source: WEC 2019b
(a) Average of activity released from 2003 to 2018
(b) At 1600 MTU/yr
(c) At normal capacity

The WEC has an air operating permit (No. SOP-1900-0050) from SCDHEC. The permit does not require direct monitoring for nonradiological pollutants but does allow WEC to provide modeled emission rates that SCDHEC uses to determine compliance with South Carolina air quality control regulations (Regulations 61-62) (WEC 2019b). The WEC's air operating permit renewal application is currently with SCDHEC for review. On September 12, 2019, SCDHEC publicly noticed the draft air operating permit for a 30-day comment period (SCDHEC 2019a).

2.3.2 Liquid Effluents

Operations at CFFF generate two liquid effluent streams: process liquid wastes and sanitary waste sewage. See Figure 2-5. The liquid process wastes are generated primarily from the ADU process, and, to a lesser extent, from the mechanical side of the fuel fabrication process where fuel rods are bundled to form assemblies, as well as from laboratory and controlled area sinks. The ADU process liquid waste is treated to remove uranium and nonradiological components, such as ammonium fluoride. The waste is sampled for levels of uranium and other contaminants prior to consolidation with other waste streams. The other process stream is sanitary waste sewage, which is initially treated at the WWTP. The sanitary waste sewage is chlorinated and mixed with the process liquid waste. The combined liquid waste is treated onsite at the WWTP prior to its discharge into the Congaree River. Treatment includes filtration, flocculation (i.e., clumping), lime addition, distillation, and precipitation. (WEC 2019b). The liquid effluent must meet NRC regulatory limits in 10 CFR Part 20, Appendix B, Table 2, and must also meet the limits established in the NPDES permit.

The WWTP includes a system of six lagoons—North, South, West I, West II, East, and sanitary. The North, South, West I, and West II Lagoons were relined with 80-mil HDPE in 2012 after groundwater monitoring indicated increasing nitrate and fluoride concentrations. The sanitary lagoon is unlined. Treated wastewater from the West I and West II lagoons is then sent to the North and South Lagoons for further treatment. The treated sanitary wastewater is mixed with the stream from the North and South Lagoons, receives further treatment (aeration, dichlorination, pH adjustment), and is then pumped to the Congaree River, in accordance with their NPDES permit.

The main constituents of the process liquid waste streams are uranium and ammonium fluoride. The ammonium fluoride is mixed with lime and caustic to create an insoluble calcium fluoride, which is then physically removed (via centrifugation or settling). The WEC sends the calcium fluoride offsite for reuse in concrete, if uranium concentrations are less than 30 pCi/g. The ammonia is recovered and returned to the ADU process (WEC 2019b).

The WEC samples the liquid waste stream before it is discharged into the Congaree River.

Table 2-2 summarizes the uranium and technetium-99 (Tc-99) discharged into the Congaree River since the last license renewal in 2007. The WEC started sampling for Tc-99 in 2010 after elevated gross beta results were found in groundwater wells and determined to be from Tc-99. The 2019 effluent monitoring report indicated that the measured concentration for liquid effluent for July through December 2018 was 210 pCi/L for uranium, compared to the NRC limit of 300 pCi/L, and was 8 pCi/L for Tc-99 compared to the NRC limit of 60,000 pCi/L (WEC 2019d).

Table 2-2 Measured Uranium and Tc-99 Discharged to Congaree River (WEC 2019b)

Year	U (mCi)	Tc-99 (mCi)
2007	10.5	Not Sampled
2008	10.2	Not Sampled
2009	10.3	Not Sampled
2010	8.12	19.2
2011	6.92	14.1
2012	3.1	18.5
2013	5.2	9.2
2014	3.8	10.1
2015	4.3	10.1
2016	3.9	4.0
2017	4.1	7.2
2018	3.4	1.1

The liquid waste stream is discharged into the Congaree River through a submerged pipe, about 6 meters (m) (20 ft) from the shore. The flow rate into the river is 378,541 liters per day (L/d) (100,000 gallons/d [gpd]) based on rates averaged during the 10-year period from 2007–2017 (WEC 2019b).

The East Lagoon receives liquid inputs from the Deionized Water building and rainwater from tank containments. The East Lagoon provides overflow from other lagoons or for containment for spills or emergency events. When the lagoon is full, its contents are pumped into the North or South Lagoon. The East Lagoon has a 36-mil HDPE liner that was installed in the early 1980s.

2.4 Monitoring Programs

WEC conducts effluent and environmental monitoring and sampling to comply with SCDHEC's NPDES permit and Consent Agreement and to comply with its NRC license. The different monitoring programs are described below.

2.4.1 Monitoring for NRC License

2.4.1.1 Effluent Monitoring Program

Section 2.3 describes the liquid and gaseous effluents released at the CFFF. As required by 10 CFR 70.59, "Effluent Monitoring Reports," WEC submits semi-annual reports on its effluents (e.g., WEC 2019d). Using the sampling results, WEC calculates the estimated dose to the public and worker. The WEC conducts representative stack sampling from 47 stacks to monitor gaseous effluents. Sampling and monitoring methods and frequencies are determined by WEC. The WEC also samples its liquid effluents before it is discharged to the Congaree River. The NRC's limits for liquid and gaseous effluents are provided in Table 2 of Appendix B to 10 CFR Part 20.

2.4.1.2 Environmental Monitoring Program

The WEC samples air, surface water, groundwater, the Congaree River, sediment, soil, and vegetation as part of its environmental monitoring program (WEC 2019c). Monitoring and sampling criteria have evolved during each subsequent license renewal (NRC 1985, 1995, 2007). Any change made to the environmental monitoring program by WEC must be reflected in updates to the license application and are subject to review by NRC during inspections (WEC 2019c). The NRC reviews WEC compliance with its environmental monitoring program during inspections. Those inspection reports are publicly available.

Since June 2018, WEC proposed substantial changes to its sampling program, adding monitoring wells and adding sediment, soil, surface water, and groundwater sample locations. Table 2-3 summarizes the proposed environmental sampling program. A significant change is the direct analysis for uranium and Tc-99 for all media, except air particulates, instead of the analysis of gross alpha and gross beta as surrogates. Past laboratory analysis had indicated that gross beta was a reasonable indicator for Tc-99; however, a direct correlation between gross alpha and uranium concentrations attributed to CFFF operations was not as clear. Because there is known uranium in the subsurface, WEC will be able to identify impacts to the various media from operations at CFFF by performing isotopic analyses for uranium and accurately delineating areas of subsurface residual radioactivity that will need to be decommissioned to meet the unrestricted release criteria. Gross alpha is retained for the air particulate due to limitations in the sampling methodologies.

As a requirement of the CA with SCDHEC, WEC developed a site conceptual model (CSM) as a tool to incorporate sampling data and the current understanding of the site hydrogeology, known sources, and potential migration pathways. The WEC will be required, by license condition, to submit its environmental monitoring program to NRC for review and approval upon either SCDHEC's approval of the RI Report, as required by the CA, or within five years of the license renewal, whichever comes first. The WEC states in its LRA that it will use a CSM to inform decisions about their environmental monitoring program and remediation strategy. The WEC will also be required by license condition to enter exceedances of Federal and State standards into its Corrective Action Program (CAP) (WEC 2019c) such as the maximum contaminant level (MCL) under the U.S. Environmental Protection Agency's (EPA) National Primary Drinking Water Regulations. The MCL for uranium is 30 µg/L, based in part on chemical toxicity of

uranium. The WEC uses the MCL to calculate an activity-based limit of 84 pCi/L to account for the fact that an impact to the environment from the facility will likely be enriched rather than naturally-occurring uranium.

Table 2-3 Environmental Sampling Program

Type of Sample	Number of Locations	Analyses	Minimum Sampling Frequency
Air Particulates	4	Alpha	Continuous (Collection Weekly)
Surface Water	7	Uranium, Tc-99	Quarterly
Soil	5	Uranium, Tc-99	Annually
Vegetation	4	Uranium, Tc-99, Fluoride	Annually
Fish	1	Uranium, Tc-99	Annually
Well Water	59	Uranium, Tc-99	Semi-Annually
River Water	4	Uranium, Tc-99	Quarterly
Sediment	3	Uranium, Tc-99	Annually

Source: Table 10-1 from WEC 2019c

2.4.1.3 Air

In addition to effluent monitoring of the stacks, WEC will continuously monitor ambient air at four onsite locations (see Figure 2-6) for alpha activity (WEC 2019c). This is the same ambient air monitoring performed for the 2007 license.

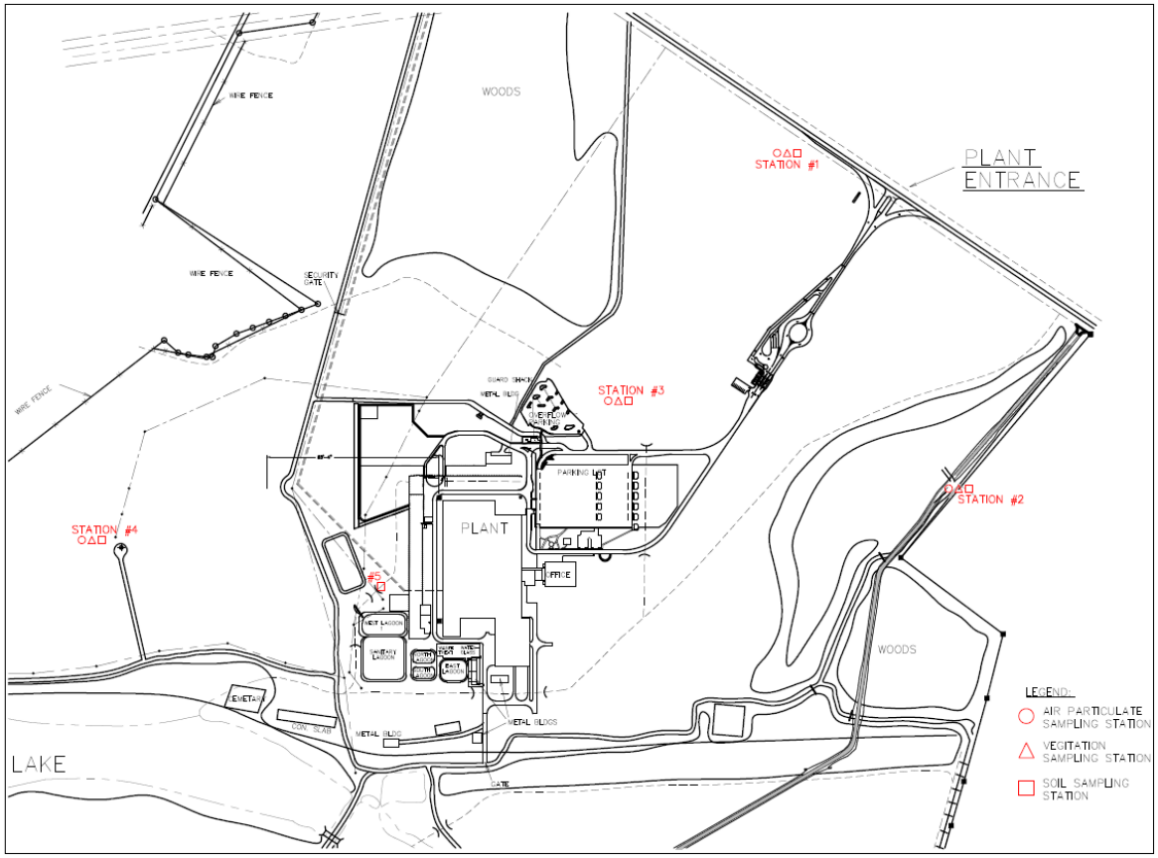


Figure 2-6 Sampling Locations for Air, Vegetation, and Soil (Source: WEC 2019c, Figure 10.1)

2.4.1.4 Soil and Vegetation

During the license renewal period, WEC will collect four co-located soil and vegetation samples annually and evaluate for uranium and Tc-99. A fifth soil sample will be analyzed to monitor for potential migration of uranium from the groundwater to surface water (Sample #5). The vegetation samples are also analyzed for fluoride. The soil and vegetation samples are collected at the same locations as the ambient air samples (see Figure 2-6).

2.4.1.5 Surface Water and Sediment

The WEC will take seven surface water samples quarterly from the locations shown in Figure 2-7. The WEC will analyze the samples for uranium and Tc-99. The samples are collected at the entrance of Upper Sunset Lake, the causeway between the Upper and Lower Sunset Lakes, the spillway from Lower Sunset Lake into Mill Creek, the location where Mill Creek exits the WEC property, and the confluence of two onsite ditches (“C” valve/“roadway”). A new sample location was added at Gator Pond and another location to monitor a ditch that was newly identified that runs from the Lower Sunset Lake and rejoins Mill Creek near the point where the creek crosses the CFFF property line. The ditch was identified on maps but has not been ground-truthed at this time. If uranium and Tc-99 levels in surface water samples exceed Federal or State regulatory limits, WEC is required to enter the exceedance into its CAP (WEC

2019c). Through its CAP, WEC will determine what, if any, actions need to be taken. Examples could include additional sampling, re-analysis of the sample, or adding sampling locations.

The WEC will collect three sediment samples from Gator Pond, Lower Sunset Lake, and at or near the point of discharge into the Congaree River. Two new onsite sediment sample locations were added to the monitoring program to monitor the potential accumulation of contamination in the sediment of onsite surface water bodies. Samples will be collected annually and will be analyzed for uranium and Tc-99 (WEC 2019c).

2.4.1.6 Congaree River

During the license renewal period, WEC will collect quarterly Congaree River water samples from four locations: (1) at the Blossom Street Bridge 16 km (10 mi) upstream of the CFFF discharge point; (2) 457 m (500 yards [yd]) upstream; (3) 457 m (500 yd) downstream of the discharge point; and (4) where Mill Creek enters the Congaree River. Samples will be evaluated for uranium and Tc-99. This is the same monitoring WEC has conducted since the 2007 license renewal.

From 2010 through 2015, WEC collected river samples at two additional locations—at the discharge point into the Congaree River, and at the Hwy 601 bridge, which is approximately 30 km (18 mi) from CFFF. The samples were collected for additional data points but the uranium levels were below EPA drinking water standards so WEC discontinued the sampling. The gross alpha concentrations ranged from zero to less than 5 pCi/L (WEC 2019c).

2.4.1.7 Fish

During the license renewal period, WEC will annually collect one fish from near the discharge point into the Congaree River. The fish will be analyzed for uranium and Tc-99.

Figure 2-7 Surface Water and Sediment Sampling Locations (Figure 10.2 from WEC 2019c)

2.4.1.8 Groundwater

For the renewed license, WEC's monitoring program is substantially different from its current program due to groundwater contamination. The WEC sampled 10 groundwater wells and analyzed samples annually for gross alpha, gross beta, and ammonia (WEC 2007). Going forward, WEC will sample 59 groundwater wells and analyze for uranium and Tc-99 to determine (1) whether the source of the current shallow groundwater contamination is leaks from plant operation and/or (2) if existing, known or unknown, uranium and Tc-99 is moving offsite. The monitoring wells are binned into four categories—perimeter wells, NPDES wells, sentinel wells, and plume wells. The monitoring wells might fall into one or more bins.

Figure 2-8 shows the locations of the groundwater monitoring wells.

- *Perimeter wells* will help WEC detect if groundwater contamination is leaving the site. The perimeter wells are the outermost monitoring wells at the site.
- *NPDES wells* are those identified in the NPDES permit to detect leaks from the WWTP.
- *Sentinel wells* are those wells to monitor for releases from each operable units.
- *Plume wells* are those that monitor for known groundwater contamination plumes. The WEC will monitor, at a minimum, three wells per known plume of radioactive contamination, with one well monitoring the maximum concentration and two wells monitoring downgradient. These wells are expected to change as the plume moves. There are currently two known radiological plumes – uranium and Tc-99. The WEC will monitor wells W-55, W-74, and W-75 for the uranium plume and wells W-6, W-11, W-15, and W-27 for the Tc-99 plume.

2.4.2 SCDHEC NPDES Permit

As part of the NPDES permit (SC0001848) issued by SCDHEC, WEC monitors and collects both Congaree River and groundwater samples. The WEC's NPDES permit sets the requirements for its discharge into the Congaree River. In September 2015, SCDHEC informed WEC that regulatory oversight for groundwater monitoring related to previous releases determined to be from the WWTP lagoons would be managed by the SCDHEC's Bureau of Water (AECOM 2017). Therefore, groundwater monitoring requirements were added to the NPDES permit. To comply with its current NPDES permit requirements, WEC monitors groundwater conditions for water-table elevation, pH, specific conductance, fluoride, nitrate, volatile organic compound (VOC), gross alpha, gross beta, fission, activation products, and tritium (SCDHEC 2017a). The current NPDES permit requires semi-annual sampling, but WEC takes groundwater samples quarterly, typically in October, January, April, and July. The WEC provides annual reports to SCDHEC with the sampling results. The WEC will submit the annual NPDES groundwater sampling reports to the NRC during the license renewal period (WEC 2019c).

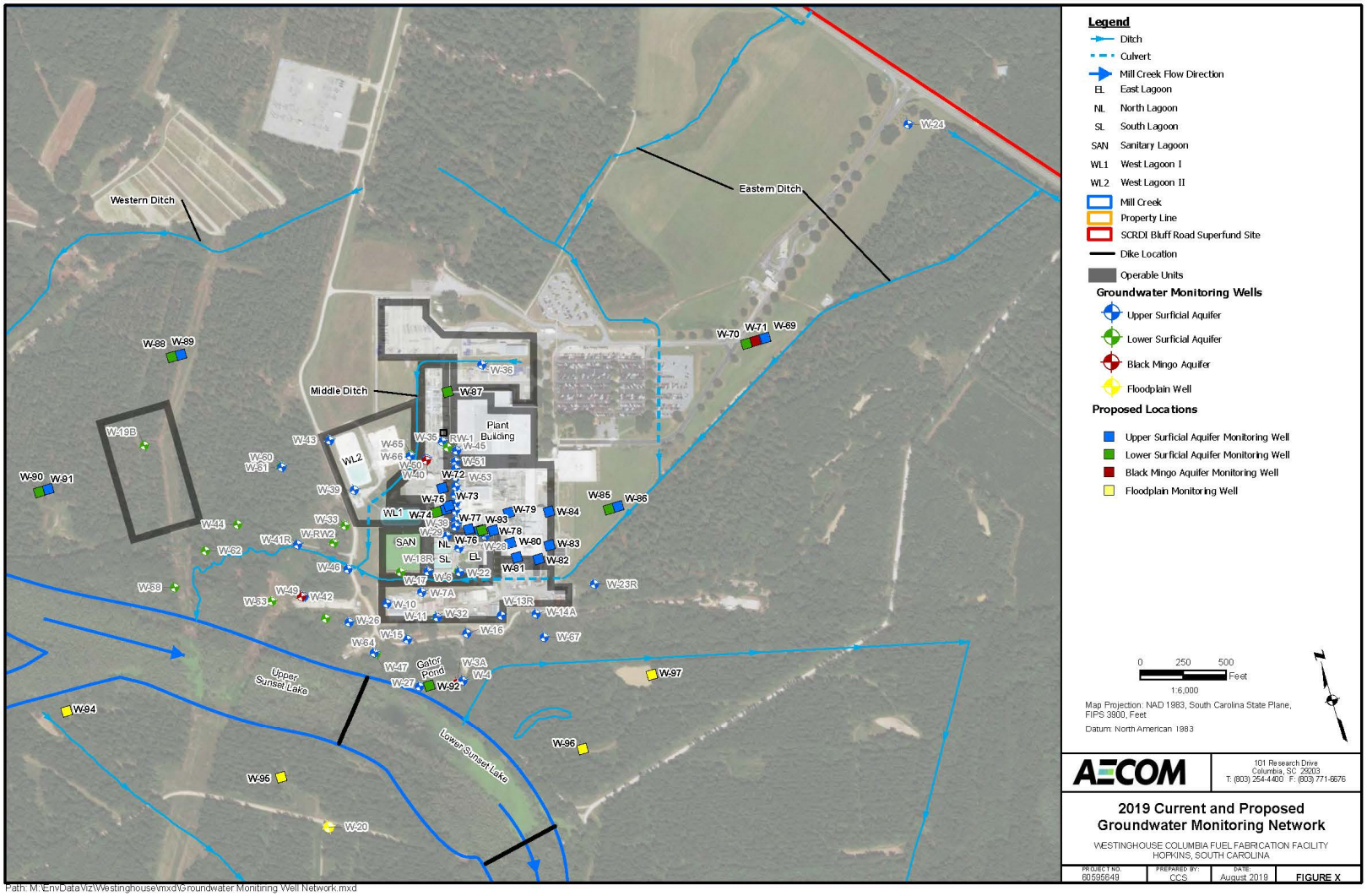


Figure 2-8a Groundwater Sampling Locations

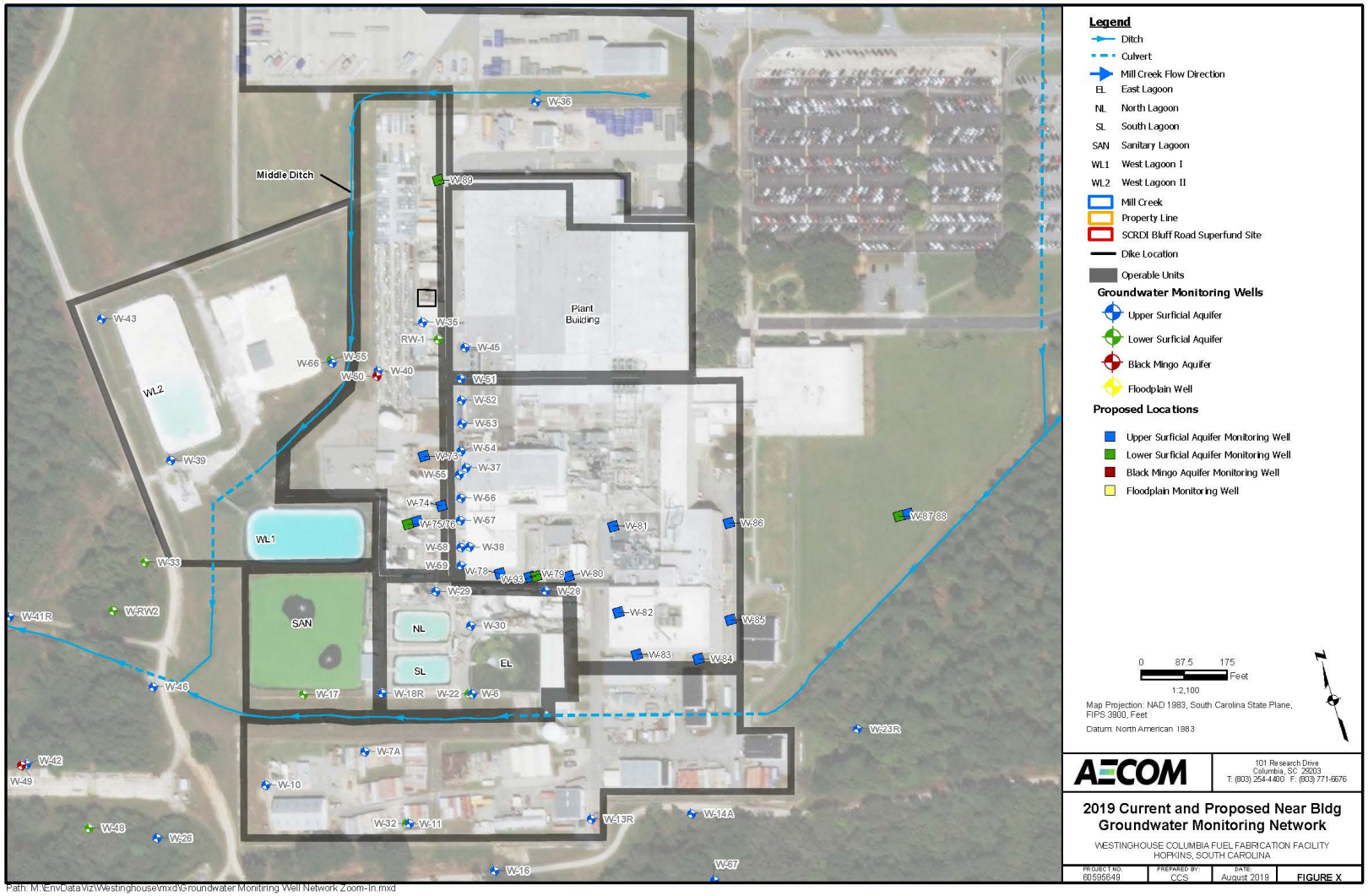


Figure 2-8b Groundwater Sampling Locations

The NPDES permit must be renewed every 5 years. The NPDES permit was last modified in May 2017 and expired in March 2018; however, WEC submitted a renewal application in September 2017 (WEC 2017) which leaves WEC's NPDES valid while the State completes its review. The SCDHEC noticed the draft NPDES permit for a 30-day public comment period on September 12, 2019 (SCDHEC 2019a). The monitoring requirements within the NPDES permit are subject to change, including the number of wells monitored, the frequency of monitoring, and the constituents that are monitored. The draft NPDES permit for public comment currently requires WEC to monitor 40 wells related to the lagoons. The WEC will notify the NRC any time when the NPDES permit is renewed, revoked, or revised, and if WEC receives an NPDES Notice of Violation (WEC 2019c).

The WEC also has a general NPDES permit for stormwater runoff/discharges associated with industrial activity, but not construction activities. The permit requires WEC to have a Stormwater Pollution Prevention Plan.

2.4.3 Consent Agreement with SCDHEC

In February 2019, SCDHEC and WEC entered into a CA related to the investigation and remediation of radiological and nonradiological contamination at the CFFF and response to future releases. The CA includes procedures for investigation and evaluations established by the EPA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and by SCDHEC under the Hazardous Waste Management Act (SCDHEC/WEC 2019). The CA replaces a Voluntary Cleanup Contract (VCC) that WEC and SCDHEC had entered in August 2016 in response to the VOC contamination in groundwater at the site.

As required by the CA, WEC had to prepare an RI Work Plan which lays out WEC's approach for evaluating water, sediment, and soil onsite (WEC 2019c). The RI Work Plan delineates the site into smaller areas referred to as operable units (OU), which focus the investigation and remediation efforts. The WEC has currently divided the CFFF site into eight OUs (see Figure 2-9). The WEC began work on activities laid out in the RI Work Plan starting in June 2019. The WEC has also submitted Addendum 1 to SCDHEC, related to the southern storage area (intermodal/sea-land container leak), Addendum 2 regarding the East Lagoon, and an additional Floodplain Assessments (SCDHEC 2019a). As the RI Work Plan investigations proceed, activities may be modified based on results.

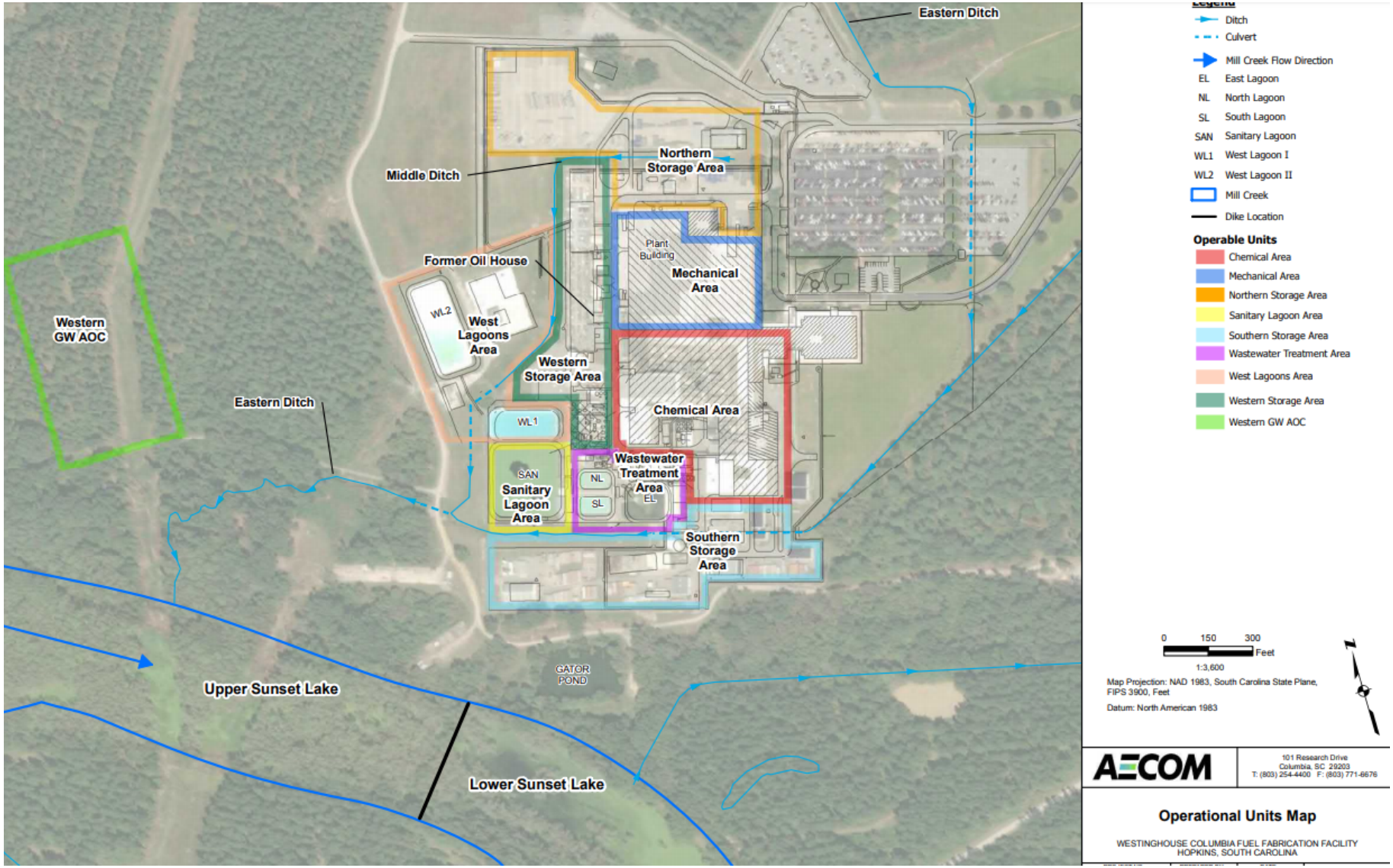


Figure 2-9 Operable Units as currently defined in the RI Work Plan (WEC 2019e)

2.5 Decommissioning

Decommissioning is the safe removal of a facility from service and reduction of residual radioactivity to a level that permits either unrestricted or restricted release. Depending on what it decides to do with the site after decommissioning, WEC would have to ensure the site meets applicable NRC regulations for either unrestricted or restricted release. Unrestricted release, defined in 10 CFR 20.1402, means the residual radioactivity distinguishable from background radiation results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 millirem per year (mrem/yr), including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to as low as is reasonably achievable (ALARA) levels.

The NRC requires that licensees comply with the License Termination Rule in 10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination." This rule provides radiological criteria for unrestricted and restricted use, financial assurance and recordkeeping conditions, and timeliness conditions. The NRC guidance for implementation of the License Termination Rule is found in NUREG-1757, "Consolidated Decommissioning Guidance" (NRC 2006b).

Per 10 CFR 70.38(g), SNM licensees must submit a decommissioning plan (DP) to the NRC for review and approval, if required by license condition or if the procedures necessary to decommission have not been previously approved by the Commission and could increase potential health and safety impacts to workers or the public. The DP, to be implemented at the end of the license period, describes in detail how the facilities and grounds will be decontaminated so that they can be released for unrestricted or restricted use. The environmental impacts of decommissioning activities are addressed in the cumulative impacts analysis in Section 6 of this EA.

Adequate planning and funding need to be in place for the eventual decommissioning of the CFFF. The WEC is required to submit its Decommissioning Funding Plan (DFP) to the NRC at intervals not to exceed 3 years in accordance with 10 CFR 70.25(e)(2). As required by 10 CFR 70.25(e)(1), the DFP must contain a detailed cost estimate for decommissioning, including consideration of the volume of onsite subsurface material containing residual radioactivity that will require remediation. The NRC considers the current state of site contamination and expected remediation provided by WEC when reviewing the DFP for approval. The NRC approved WEC's 2016 DFP (NRC 2016a). The WEC submitted its 2019 DFP and updated it to reflect recent environmental investigations (WEC 2019h). The NRC is currently reviewing the 2019 DFP. The WEC also developed a new remediation procedure, referenced in the LRA, to "… prevent migration of licensed material offsite and/or to minimize decommissioning impacts…." (WEC 2019c).

3. AFFECTED ENVIRONMENT

This section provides a framework for the environmental impacts discussion in Chapter 4.

3.1 Land Use

3.1.1 CFFF Site

The CFFF is in Hopkins, South Carolina, on an approximately 469-ha (1,151-ac) site in Richland County, approximately 13 km (8 mi) southeast of the City of Columbia. CFFF operations and support activities occur on about 28 ha (68 ac) or 5 percent of the entire site; the remaining portions of the site are mainly undeveloped and consist of swamps and wetlands, woodland areas, and hardwood forests (see Figure 2-2).

In the undeveloped portions of the site, forested areas are used for timber production and hay fields are harvested. Recreational facilities for employees include a fitness trail and a picnic pavilion (WEC 2019b).

There is an electrical substation, owned by South Carolina Electric and Gas, on approximately 2.8 ha (7 ac) of the CFFF site near Bluff Road. The land was purchased from WEC in 2005 (WEC 2019b).

In 2012, WEC notified the NRC that it had completed a UF_6 storage pad project, located within the controlled access area (WEC 2012). The concrete storage pad holds additional cylinders of UF_6 and was built on previously disturbed land.

3.1.2 Site Vicinity

This section describes land use within an 8-km (5-mi) radius around the plant. Ninety percent of this area falls in Richland County, while the remaining 10 percent falls within Calhoun County (WEC 2019b).

The CFFF is bounded by private property owners to the east, south, and west. Manufacturing facilities are located about 0.5 km (0.3 mi) from the site boundary, at its nearest point. Farms, single-family dwellings, and light commercial activities are located chiefly along nearby highways. Within a 1.6-km (1-mi) radius of the CFFF site, agricultural use makes up 44 percent of the area (see ER Figure 3.1-2). The remaining 56 percent is classified as “other” (WEC 2019b).

The WEC’s ER shows manufacturing and distribution business locations within the 8-km (5-mi) radius (WEC 2019a, Figure 3.1-3). These businesses and their products are: (1) DAK Americas [formerly Carolina Eastman] (man-made production fibers); (2) Nephron Pharmaceuticals (eye drop medications, respiratory medicine, vaccines, and injectable drugs); (3) Knight’s Redi-Mix (concrete batching plant for commercial use); (4) Wallace Concrete Products (manhole production); (5) Schneider Electric (industrial motor control production); (6) Devro Inc. (collagen casings for food); and (7) an Amazon Distribution Center.

Five farms are located within 8 km (5 mi) of the CFFF. These provide quail, strawberries, fish for pond stocking, and full-service equestrian services (WEC 2019b).

Two schools (Hopkins Elementary and Hopkins Middle School) are located northeast of the CFFF, 6.4 km (4 mi) and 7.4 km (4.6 mi) away. Three other schools (Lower Richland High School, Mill Creek Elementary, and Sandhills School) are located to the northeast and north-northeast of the CFFF, slightly more than 8 km (5 mi) away (WEC 2019b). Nine churches are located within the 8-km (5-mi) radius around the CFFF.

No hospitals are located within 8 km (5 mi) of the CFFF. The Alvin C. Glenn (Richland County) Detention Center is located 8 km (5 mi) north of the CFFF (WEC 2019b).

Two military bases, Ft. Jackson U.S. Army Base and McEntire Joint National Guard Base, are located, respectively, 11 km (7 mi) north and 10 km (6 mi) northeast of the CFFF (WEC 2019b).

The Congaree National Park, located 8-km (5-mi) southeast of the CFFF site, is designated as an International Biosphere, a designated Globally Important Bird Area, and a National Natural Landmark. The park contains important high-quality habitats including unique bottomland hardwood forests and well-preserved, species-rich, and dynamic floodplains. These protected floodplains provide a unique ecosystem when the Congaree and Wateree Rivers flood the area, bringing nutrients and sediments to help contribute to the productivity of the area. The diversity of habitats within the Congaree National Park supports a wide variety of biota, including fish, birds, amphibians, reptiles, mammals, insects, and other aquatic life (NPS 2015).

3.2 Geology, Seismology, and Soils

3.2.1 Regional Geology

The main feature describing the regional South Carolina geological provinces is the Fall Line (Campbell and Coes 2010; Cooke 1936). The Fall Line represents a demarcation where bedrock at the surface on the inland side consists of the older, more-resistant crystalline or metamorphic lithologies (largely the Piedmont province) whereas, on the ocean side, the surficial geology consists of the younger, less-resistant, generally unconsolidated, sedimentary lithologies (i.e., the Coastal Plain Provinces) (Figure 3-1). The Fall Line is located approximately 190 to 240 km (120 to 150 mi) inland from the current South Carolina shoreline (Cooke 1936).

The Fall Line is not unique to South Carolina but, in fact, the Atlantic Seaboard Fall Line extends 900 miles along the coast from Alabama to New Jersey (see Figure 3-1). Geographically, the Fall Line is characterized as a nick point in a river draining the upland areas. The nick point results in a waterfall in the river because of the contrast in erosion of the surficial geology on either side of the line, which is the source for its name. The waterfalls had an impact on the earliest settlements in America because they impeded the inland migration of boat traffic along the river. Consequently, many cities including Columbia, South Carolina, were developed at or near the Fall Line because of that impediment.

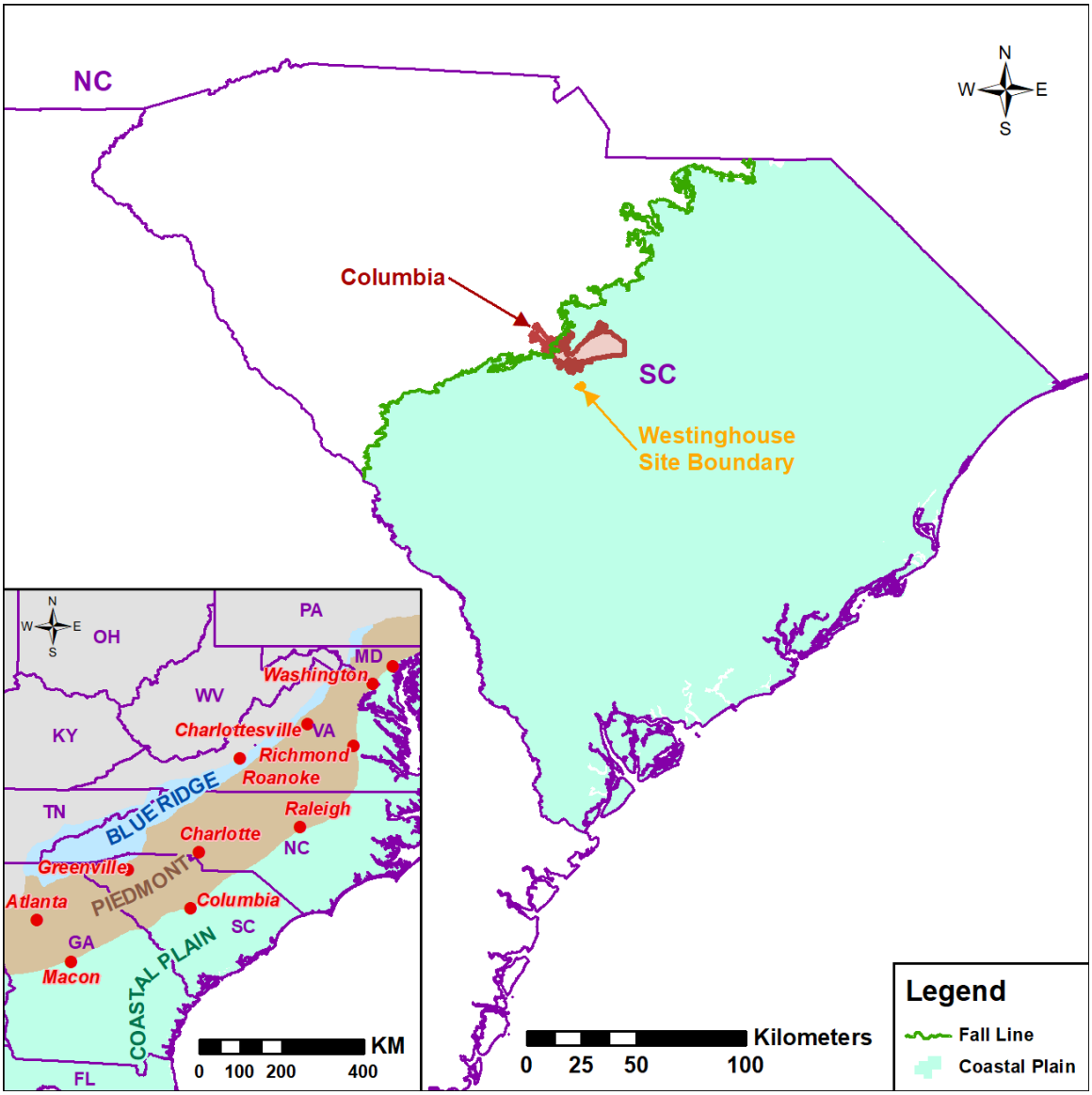


Figure 3-1 South Carolina Coastal Plain Province (Sources: ESRI 2019; SCDNR 2019a; SCDOT 2019; Richland County 2019b)

The WEC site is located approximately 18 km (11 mi) southeast of the Fall Line within the Coastal Plain Province. The sedimentary lithologies located within the Coastal Plain Province are most relevant to the discussions relative to the CFFF and will be the focus of the following discussions.

In South Carolina, the thickness of the Coastal Plain sediments/lithologies varies from 0 ft at the Fall Line to approximately 4,000 ft in the vicinity of the present-day coast line (Hockensmith 2003). The age of the sediments within the Coastal Plain varies between the Late Cretaceous (100 million years before present [mbp]) to Recent (Hockensmith 2003). In general, except for the recent (Holocene) deposits associated with the present-day rivers, surface expressions of the older sediments are located near the Fall Line whereas the surface expressions of progressively younger sediments are found as one moves toward the coast (Figure 3-2).

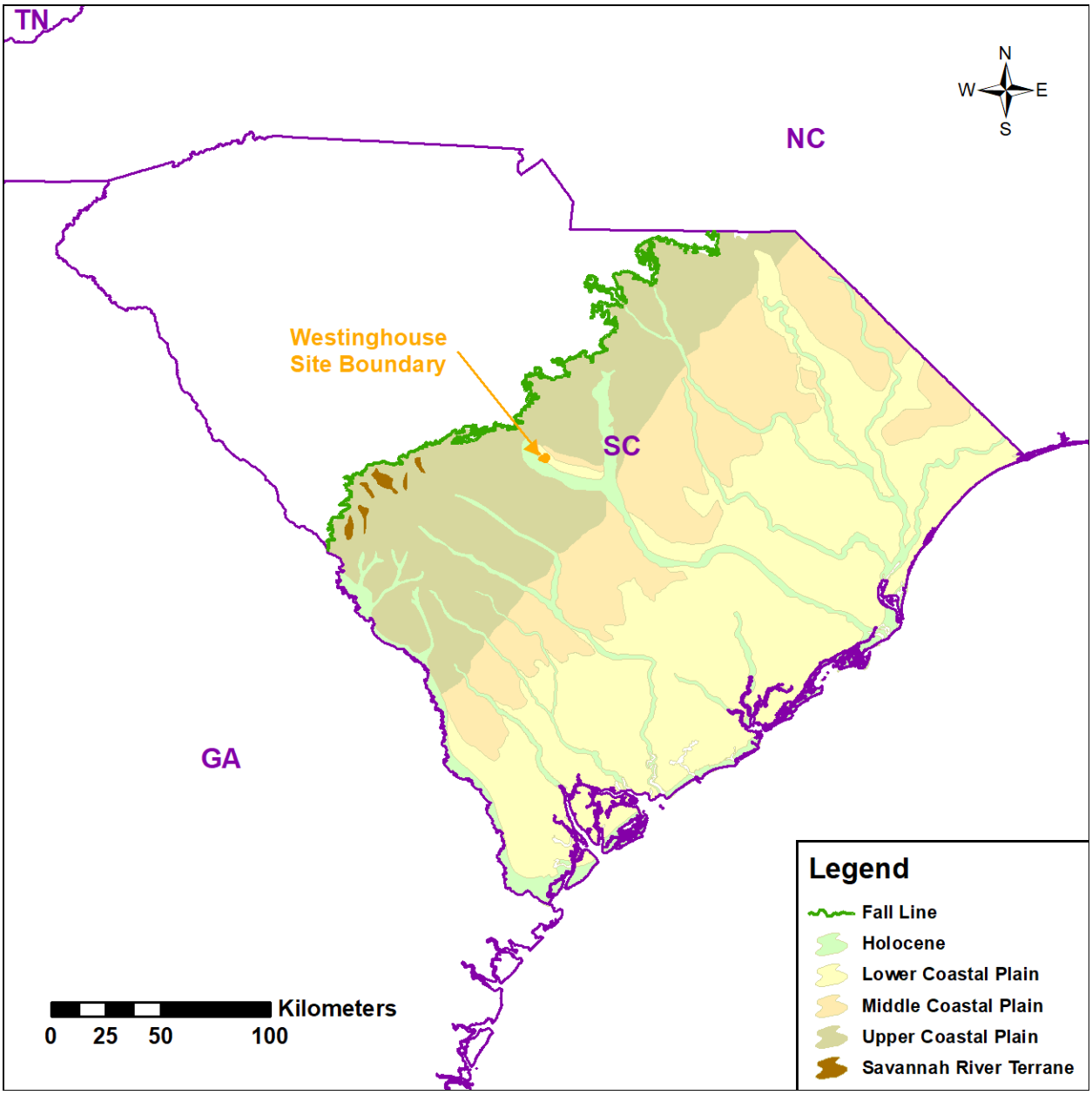


Figure 3-2 Surficial Geology of the South Carolina Coastal Plain (Sources: ESRI 2019; SCDNR 2019a, b; Richland County 2019b; USGS 2019c)

Based on topography and surficial geology, the South Carolina Coastal Plain is divided into three major physiographic provinces. The provinces have been described as the Upper, Middle and Lower Coastal Plain (Willoughby 1999). Historically, the physiographic provinces have been referred to as the Sand Hill, Upper Coastal Plain, and Lower Coastal Plain (e.g., Cooke 1936). The topography is characterized by numerous terraces each at specific elevation separated from each other by an erosional escarpment (or scarp). Each terrace reflects a deposition of material at differing sea level elevations as the ocean rose or fell during the geologic history. The escarpment to the abutting higher terrace reflects the extent of erosion of the higher (older) terrace during the deposition of that terrace.

The material in a terrace is defined as a geologic formation. The older formations may or may not be found in the subsurface throughout the Coastal Plain Provinces due to the nature of the depositional environment. If found in the subsurface, each formation unconformably underlies or overlies the abutting formations. In general, the Coastal Plain sediments consist of coarse-grained to clay detrital material or possibly marine carbonates. The sediments are generally devoid of animal debris but contains terrestrial fossil plant or small marine fossil shells.

The regional geologic setting is commonly discussed in terms of a geohydrologic framework (Aucott et al. 1987). In the area of the CFFF site, the hydrogeologic formations in the subsurface have been mapped from oldest (deepest) to youngest (shallowest) as the Upper Cretaceous Middendorf (100 to 70 mbp), Upper Cretaceous Black Creek (70 mbp), and Tertiary Sand aquifers (5 mbp) (Aucott et al. 1987). Each of the aquifers is separated from each other by confining units.

3.2.2 Site-Specific Geology

Similar to the regional descriptions, WEC describes the geology at the site based on the topography (WEC 2019b). The site is comprised of two terraces, an upper and a lower terrace, separated by a bluff (a.k.a., escarpment). The upper terrace consists of sediments deposited during the Pleistocene, which WEC states is the Okefenokee Formation and the aquifer contained therein as the surficial aquifer. The upper terrace, which is found in the northeastern portion of the site at elevations between 41 and 44 m MSL (136 and 144 ft MSL), contains the production facility improvements in addition to undeveloped areas. The thickness of the Okefenokee Formation is between 6 and 12 m (20 to 40 ft) and, based on borings completed by WEC, consists of an upper firm clayey, silty sand unit (3 to 6 m [10 to 20 ft]) and a lower loose sand and silty sand unit. The WEC also reports that on a regional scale, the South Carolina Department of Natural Resources (SCDNR) describes the Okefenokee Formation as containing mixtures of alluvial clay and poorly sorted silty, fine to coarse sand with sub-rounded granules and gravel. This formation may contain remnants of preserved channel morphologies and other landform scars (WEC 2019b).

The lower terrace, which is found in the southern portion of the site at elevations between 34 and 35 m MSL (112 and 115 ft MSL) contains the floodplain of the Congaree River as well as its tributary Mill Creek. The surficial sediments deposited within the lower terrace are Holocene age and associated with deposition of alluvium in the floodplain of the modern-day surface waters. The WEC refers to the aquifer in the lower terrace as the floodplain sediment aquifer and reports that deposition of the floodplain sediments effectively cut into and completely removed the Okefenokee Formation within the lower terrace (WEC 2019b). The WEC did not report a thickness for, or a description of the floodplain sediments. However, based on the thickness and depth of the underlying confining unit, the Black Mingo confining clay (as discussed below), WEC contends that the Congaree River did not erode through the Black Mingo confining unit (WEC 2019b). While WEC has demonstrated that the Black Mingo confining clay exists within its site, potentiometric data suggest that groundwater flow in the aquifer underlying the Black Mingo (Middendorf Aquifer) is affected by the Congaree River from Columbia to the CFFF site in the area west of the site (Hockensmith 2003), and that the confining units above the Middendorf Aquifer are missing in the same area (Aucott et al. 1987).

The WEC reports that the Paleocene-to-Eocene-age Black Mingo Formation underlies both the Okefenokee Formation (within the upper terrace) and the floodplain sediments (within the lower terrace) (WEC 2019b). The thickness of the Black Mingo Formation at the WEC site is 22.9 m (75 ft) and consists of an upper clay rich unit (upper Black Mingo Confining Unit, BMCU) and a lower sand unit (Black Mingo Aquifer). The range in thickness of the upper clay unit is 12 to 25 m (39 to 83 ft) (WEC 2019b) or may be up to 30.5 m (100 ft) (AECOM 2013). The NRC staff has reviewed this information and finds it is consistent with published information on the South Carolina geology.

The WEC reports that the Upper Cretaceous Middendorf Formation underlies the Black Mingo Formation and overlies "bedrock," which is interpreted by the NRC staff to infer that the Middendorf Formation is the basal sediment at the WEC site. However, WEC also refers to the lowermost formation as the Tuscaloosa Formation. The WEC reports that thickness of the Tuscaloosa Formation is between 38.1 and 44.2 m (125 and 145 ft) and that the total thickness of the Coastal Plains sediments at the CFFF site is 240 ft (73.2 m). However, WEC reports that "… pervious *[sic]* subsurface investigations have not extended into the Middendorf Aquifer." NRC staff has reviewed this information and finds it is consistent with published information on the South Carolina geology. The WEC will continue to refine the characterization of geologic heterogeneities of the subsurface at the site as it continues to complete activities in the RI Work Plan.

3.2.3 Seismology

Based on the U.S. Geological Survey (USGS) database (USGS 2019a), 287 historical earthquakes occurred in the South Carolina Region, which includes South Carolina and parts of North Carolina and Georgia between 1900 and 2019 (Figure 3-3). Of those, 239 earthquakes had a magnitude less than 3 on the Richter scale, 39 earthquakes had magnitudes between 3 and 4, and 9 earthquakes had magnitudes between 4 and 5 (USGS 2019a). The earthquake epicenter closest to the WEC site was located approximately 2 km (1.25 mi) south of the property. The earthquake occurred on May 24, 2007, at a depth of approximately 10 km (6 mi) and had a magnitude of 2.4 (USGS 2019a).

Earthquakes with magnitudes less than 3 are generally not felt by most people. Earthquakes with magnitudes between 3 and 5 are felt with negligible to slight damage (e.g., damaged chimneys). Generally, earthquakes with magnitudes greater than 6 result in considerable damage.

Perhaps the earthquake with the largest magnitude in the region occurred in in the Charleston area prior to 1900, on August 31, 1886 (WEC 2019b; Greene and Gori 1982; Bolinger 1972). Based on the reported damage, the intensity near the epicenter is estimated as an intensity "X" on the Modified Mercalli Intensity Scale and an estimated magnitude between 7.1 and 7.3 by comparison to similarly intense earthquakes with measured magnitudes (Bolinger 1972). It is thought that this earthquake was the largest along the eastern coast of North America during the recorded history timeframe.

The intensity or peak ground acceleration reflect the greatest hazard associated with earthquakes. The peak horizontal acceleration is commonly used in estimating seismic hazards and developing building codes. Based on published USGS mapping, the estimated peak

ground acceleration at the WEC site with a 2 percent probability of exceedance in 50 years is 20 to 30 percent of gravity (USGS 2014). Such a peak ground acceleration would correspond to an intensity of VII on the Modified Mercalli Intensity Scale for which very strong shaking would be felt and the potential for damage would be negligible for buildings constructed of good design and construction, slight to moderate in well-built ordinary structures and considerable damage to poorly built structures (USGS 2019b).

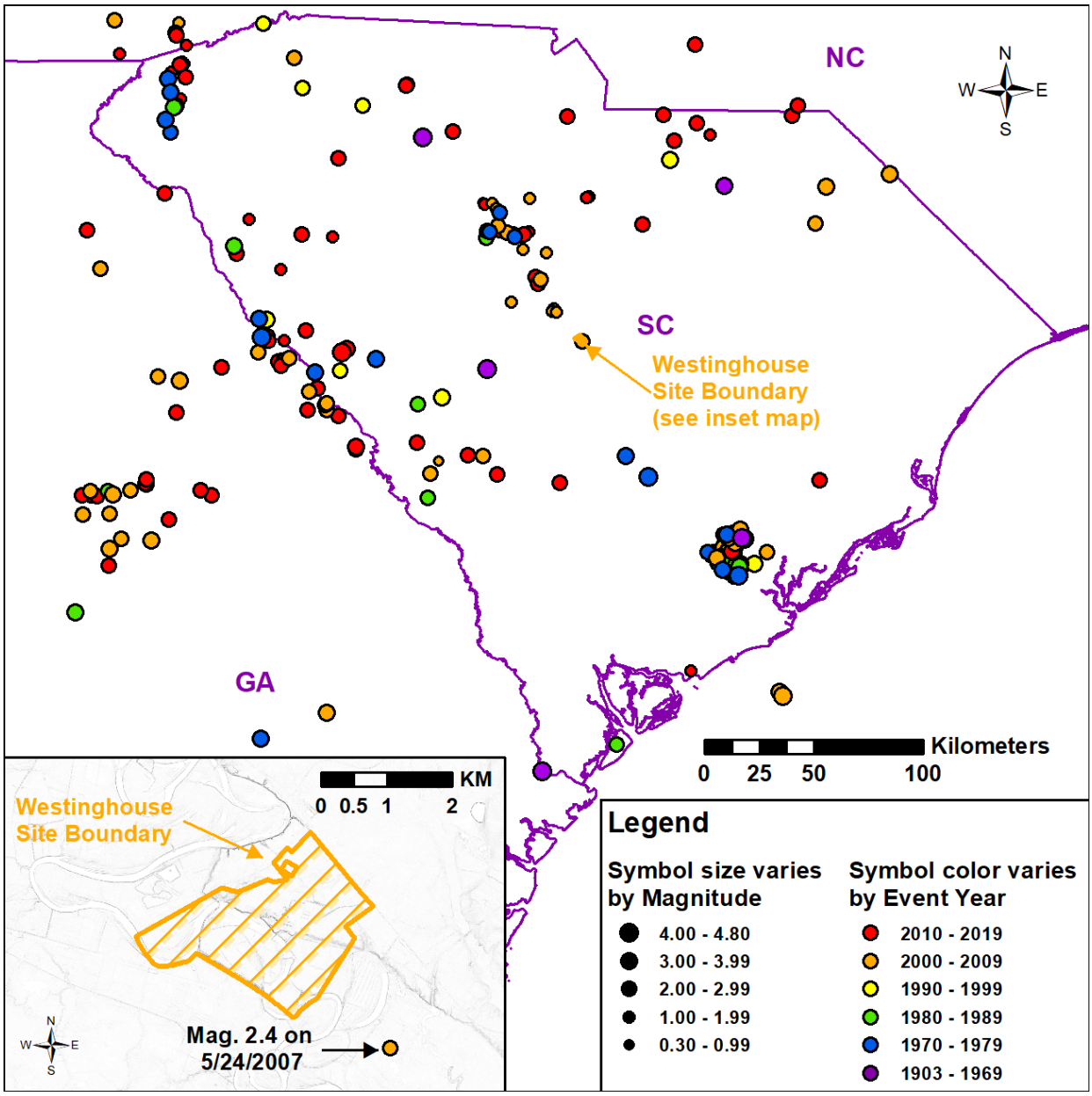


Figure 3-3 Location Map of Earthquake Epicenters for Earthquakes between 1900 and 2019 for the South Carolina Region (Sources: ESRI 2019; Richland County 2019b; USGS 2019a)

3.2.4 Soils

Based on published data (NRCS 2019), the mapped soil series in and around the WEC site are shown on Figure 3-4. The soil series that may be directly impacted by operations (e.g., spills, releases) include the Orangeburg-Urban land complex and the Goldsboro loamy sand series. The Orangeburg-Urban land complex series reflect the artificial fill that was brought to the area to construct the facility. It is estimated the maximum thickness of these soils are on the order of 1.2 m (4 ft). The Goldboro loamy sand series is less likely to be impacted because of the minimum development in the area west of the main facility. The Goldsboro loamy sand series as well as the Orangeburg loamy sand and the Faceville loamy sand series, which are located in the northern undeveloped portions of the site, are designated as prime farmland (Richland County 2019a).

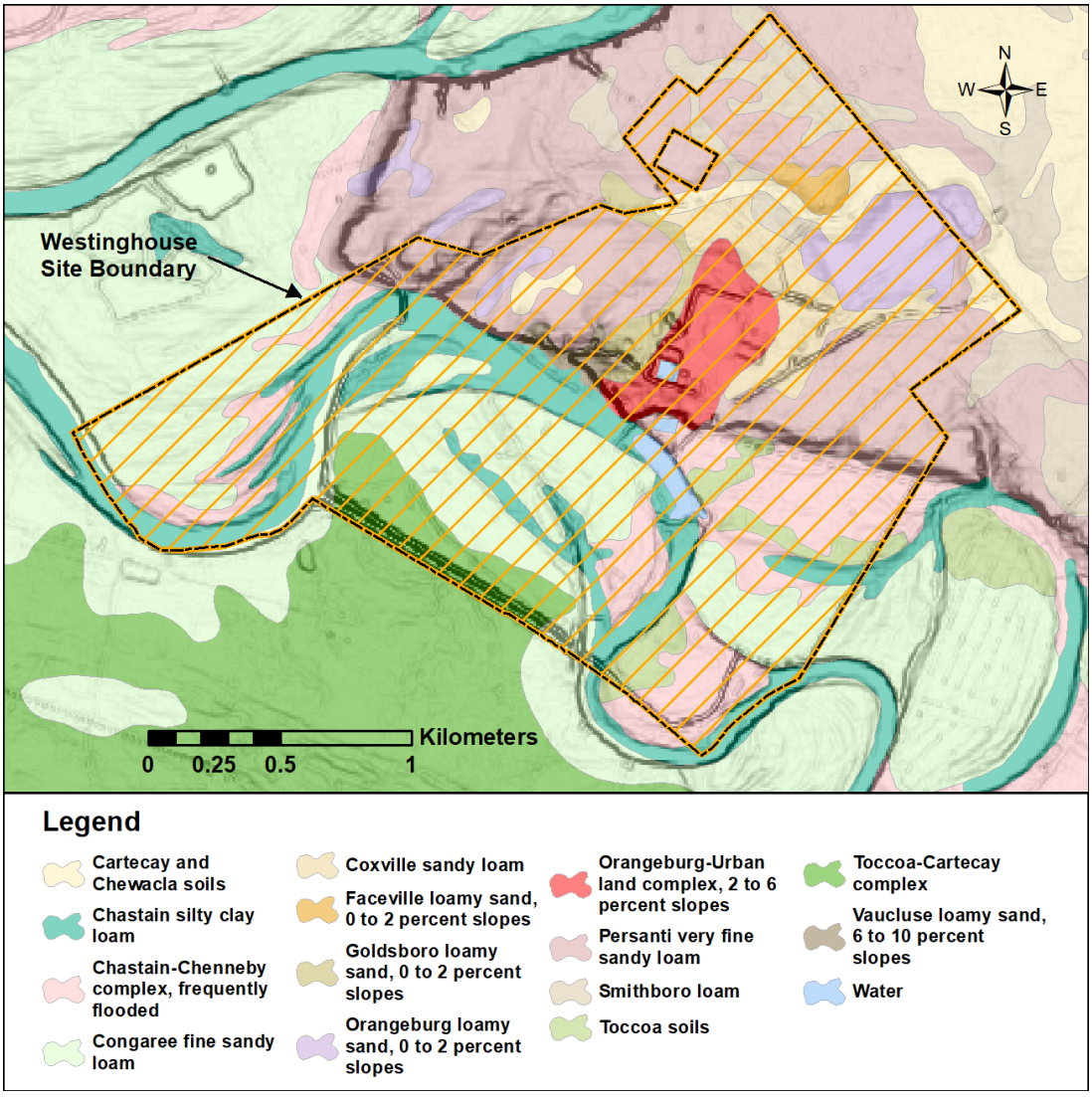
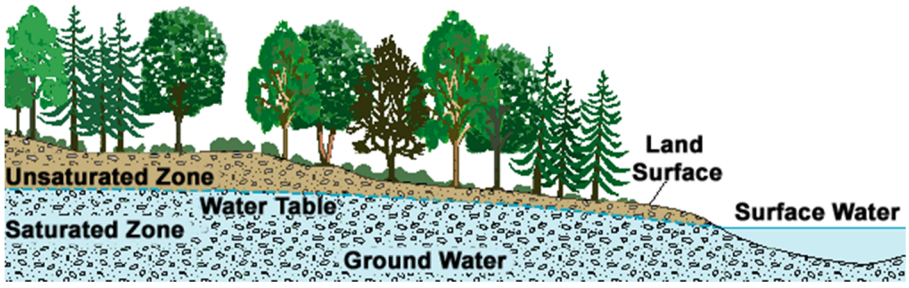


Figure 3-4 Mapped Soil Series in the vicinity of the WEC Facility (Sources: ESRI 2019; Richland County 2019b; NRCS 2019)

Based on historical air quality sampling performed as part of the environmental monitoring program, the impacts to the surficial soil quality due to precipitation of material in the facility's gaseous effluents are estimated to be negligible. Historical operations at the facility have affected the subsurface quality, primarily within the Orangeburg-Urban land complex and underlying strata. The impacts to the subsurface from operations extend back to 1972 and include both radiological and nonradiological constituents (NRC 1985). However, past NRC environmental reviews conducted for the previous WEC license renewals have determined that the impact to the subsurface was not significant (NRC 1977, 1987, 1995; 2007). The historical constituents of concern (COCs) identified in the groundwater and by inference that are likely impacting the subsurface and surface soils are nitrate; fluoride; gross alpha (as a surrogate for uranium); gross beta (as a surrogate for Tc-99); VOCs (primarily perchloroethylene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene and vinyl chloride (WEC 2019b)), and ammonia, which at least historically is related to the 1980 fish kill in Gator Pond (NRC 1985). The findings for the previous NRC assessments were based on low levels of COCs in groundwater and soils outside of the building footprint especially at the downgradient wells, changes in facility operations that prevented or minimized releases (e.g., changes to storage of material, lining of the impoundments), ongoing remediation of the VOC plume, ongoing groundwater monitoring program, and the lack of detected impacts to the deeper Black Mingo Aquifer and surface water of the Congaree River.

Historic data on the subsurface soil quality are limited. Subsurface soil data for the area west of the main facility building indicated low levels of radioactive contamination (gross alpha and gross beta) but the reported levels detected in the subsurface soil under the building were two to three magnitudes higher, which would likely require remediation during decommissioning. In addition, if a release were to occur at the surface outside of the building, the subsurface soils in and throughout the vadose zone may be impacted. The VOC contamination in the soil is most likely the source of the VOC contamination in the groundwater due to infiltration of rain or runoff (AECOM 2013).

Vadose Zone—also known as the 'unsaturated zone'—is the zone between the top of the ground surface to the water table. Figure from USGS.



Since the last EA was prepared in 2007, there have been several incidents that may have impacted the existing subsurface soil quality. The incidents identified include the following:

- 2008 Breach in the CWW line identified
- 2011 Another breach in the CWW line identified
- 2014 Cylinder recertification transfer line leak
- 2015 October 2015 flood event and lagoon overflow
- 2018 HF spiking station #2 leak
- 2019 Leaks from sea-land containers storing 55-gal drums of uranium-containing material.

For these incidents, WEC stated that soils that required immediate remediation based on its criteria were removed (WEC 2019b). The criteria for immediate remediation were based on impacts to workers or industrial standards and not necessarily NRC's unrestricted use regulations at 10 CFR 20.1402. In addition, if access to the soils was limited (i.e., under the building or adjacent to underground piping), WEC deferred remediation until decommissioning, which is acceptable to the NRC provided adequate funding for that remediation is included in the DFP. The WEC contends that deferring the cleanup of residual subsurface soil impacts does not pose a problem based on levels observed in groundwater at the nearby wells.

3.3 Surface Water Resources

The Congaree River is the principal surface water body draining the watershed in which the facility is located. At its closest point, the Congaree River is approximately 5 km (3 mi) southwest of the main manufacturing facility. The Congaree River is formed by the confluence of the Broad and Saluda Rivers upstream in Columbia, South Carolina. Flow in the Congaree River depends on inflows from the Broad and Saluda River basins. Flow in the Broad River is regulated by the Parr Shoals Dam and Saluda River flow is regulated by the Lake Murray Dam (NRC 2007). The average flow of the Congaree River in the vicinity of the CFFF is 8,652 cubic feet per second (cfs) based on water data for 1940 through 2016 (NRC 2018c).

The CFFF site is located within the flood basin of the Congaree River. The flood stage for the Congaree River at the Carolina Eastman gauging station is 35 m (115 ft) MSL. The CFFF site elevation ranges from 34–44 m (110–140 ft) MSL. Flooding occurs when the river level rises above the flood stage and backs up water in the floodplains (WEC 2014). Flooding is possible at any time of the year, but on the Congaree River is most likely to occur from June through October due to tropical hurricanes (Richland County 2017).

There are other surface waters near CFFF: Adams Pond, approximately 5 km (3 mi) to the northwest; Roundabout Lake, approximately 3 km (2 mi) south; Goose Pond, approximately 5 km (3 mi) to the southeast, and Myers Creek, approximately 3 km (2 mi) to the east (NRC 2007).

There are several surface water bodies within the CFFF site boundary (Figure 3-5). Located southwest of the plant building, Sunset Lake is fed by Mill Creek, which is a tributary of the Congaree River. Mill Creek continues as an outflow from Sunset Lake through a swamp area that discharges into the Congaree River about 4.8 km (3 mi) south of the site (AECOM 2013; NRC 2007). Water from the Lower Sunset Lake may have been diverted at one point to irrigate

the area to the southeast of the plant site, where remnants of an irrigation ditch still exist today (WEC 2019b, Figure 6.1-2). The irrigation ditch rejoins Mill Creek near the point where the creek crosses the CFFF property line. Man-made Gator Pond, which is fed by a natural spring, sits 152 m (500 ft) southwest of the WWTP. The source of the spring water is very likely the shallow groundwater aquifer directly beneath the plant site according to the conceptual understanding of WEC (e.g., AECOM 2013, Figure 3-2,). Gator Pond existed prior to construction of the CFFF (AECOM 2013).

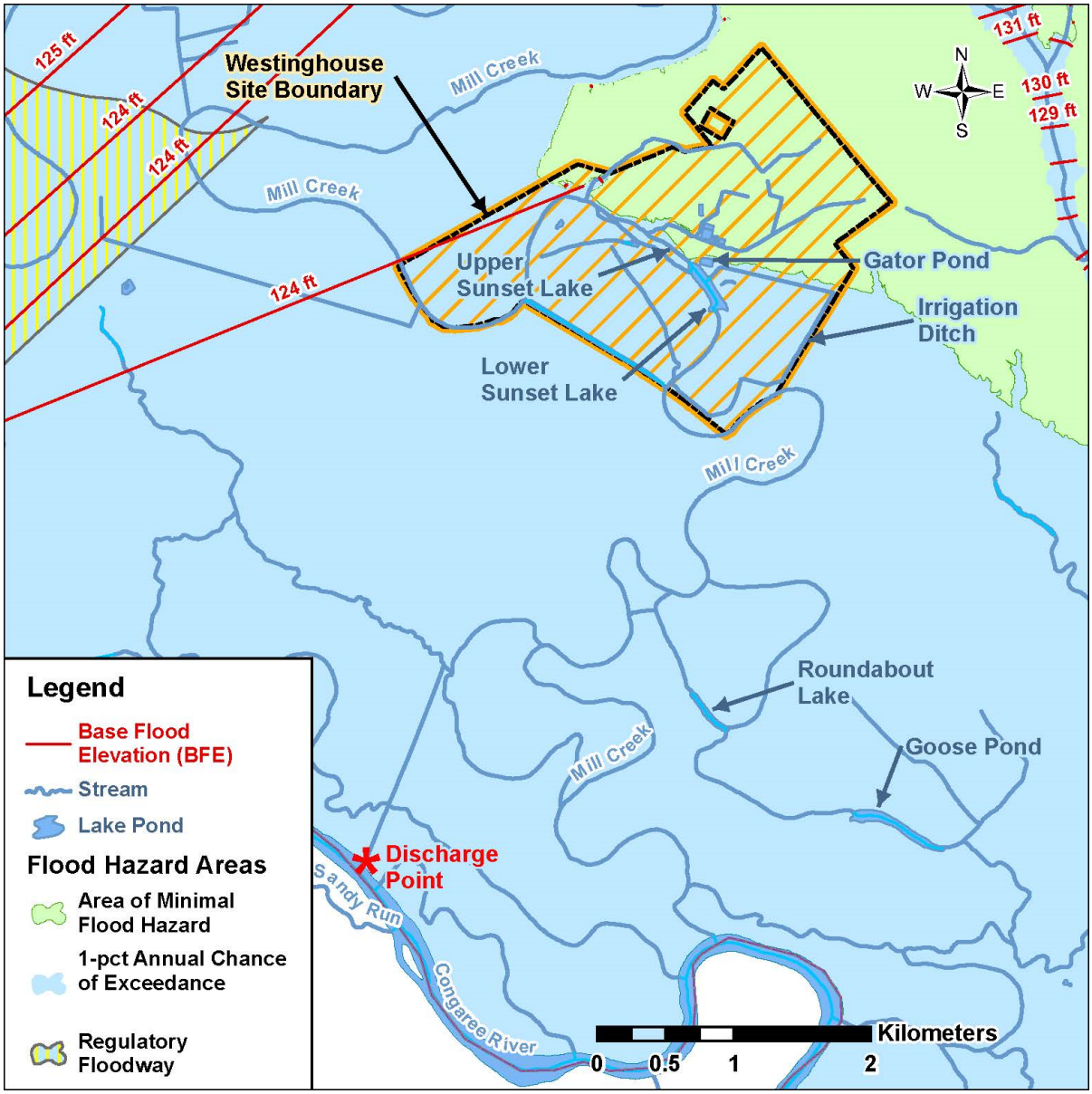


Figure 3-5 Onsite Surface Water Bodies

Sunset Lake is a shallow impoundment within the Mill Creek channel created by the pre-1950s construction of a man-made earthen berm across the channel. The upper portion of Sunset Lake is primarily a wooded swamp with some open water; the lower portion of Sunset Lake is largely open water (NRC 1985). The upper portion of the Sunset Lake receives discharge from

the surface ditch system within the CFFF (WEC 2019b, Figure 6.1-2). The southern portion of the site, including Gator Pond, Mill Creek, and Sunset Lake, is located within the floodplain of Mill Creek and the Congaree River. A bluff, about 6 m (20 ft) high, separates the plant and WWTP from the floodplain (AECOM 2014). Significant surface water and groundwater interaction (e.g., through shallow groundwater table recharge north of the bluff, seepage off the bluff surface and ditch embankment, and through potential seasonal variation of groundwater table in the floodplain surrounding Sunset Lake and Mill Creek) may exist within the plant site.

3.3.1 Surface Water Use

WEC receives its water from the City of Columbia, which takes water from the Congaree River. The WEC consumes 4.4×10^7 gallons of water per year, based on the average rates from 2014 to 2018 (WEC 2019b). The other major industrial water user within the Congaree watershed is DAK Americas. Municipal users also include the City of Cayce and East Richland County Public Service District Gills Creek Plant. The WEC does not use any water from Mill Creek, Sunset Lake, or Gator Pond.

The WEC discharges its liquid effluent directly into the Congaree River. The WEC discharges 378,541 L/d (0.15 cfs) based on rates from 2007 to 2017 (WEC 2019b). Based on the average flow of the Congaree River (8,652 cfs), the volume of CFFF discharged effluents represents less than 0.001 percent of the overall river flow.

3.3.2 Surface Water Quality

Section 2.3.2 describes the liquid effluents discharged to the Congaree River and Section 2.4 describes the monitoring and sampling program WEC has in place for surface water onsite and within the Congaree River. This section discusses the quality of the Congaree River and the surface water onsite based on recent sampling results.

3.3.2.1 Congaree River

Within the Mill Creek portion of the Congaree River basin (into which CFFF discharges its liquid effluent), there are naturally low pH conditions, decreasing trends in total phosphorus concentrations, and upward trends for dissolved oxygen (SCDHEC 2017b). The SCDHEC lists certain segments of the Congaree River as being impaired for recreational use due to reported *Escherichia coli* (*E. coli*) concentrations (SCDHEC 2016).

As described in Section 2.4.2, WEC has a NPDES permit from SCDHEC to discharge into the Congaree River (Permit No. SC0001848), and the permit imposes effluent limitations and monitoring requirements upon WEC. The WEC must ensure the CFFF's liquid discharge meets the NRC's 10 CFR Part 20 effluent limits for radiological components. In 2018, the measured uranium released to the Congaree River was 3.4 mCi. Since 2007, the amount of uranium released to the River has decreased (See Table 2-2). The WEC began monitoring for Tc-99 in its liquid effluent starting in 2010, and detected levels have ranged from 19.2 mCi in 2010 to 1.1 mCi in 2018 (WEC 2019b).

Samples collected from the Congaree River between 2010 and 2015, as part of WEC's environmental monitoring program required by its NRC license, show gross alpha

concentrations are less than 10 pCi/L, which is lower than the 15 pCi/L MCL. Figure 3-6 shows the gross alpha results for river water samples from 2010 through 2018.

Annual sediment samples taken from the Congaree River during the same timeframe show uranium levels are below 4 pCi/g. Gross beta results from 2008 to 2018 range from 3 to 17 pCi/g (WEC 2019c). There are no regulatory limits for sediments.

Fish samples collected from 2008 to 2018 have shown uranium concentrations at less than 1 pCi/g. Fish were not consistently analyzed for Tc-99, but when they were, gross beta counts ranging from 8 to 65 pCi/g (WEC 2019c).

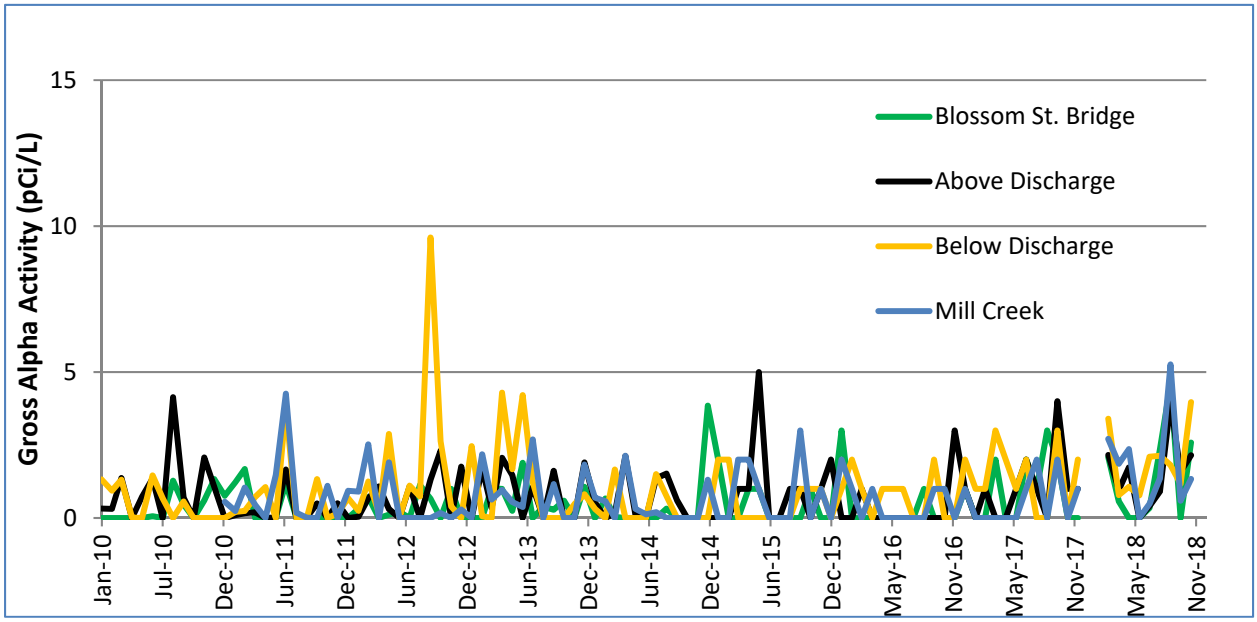


Figure 3-6 Gross Alpha Results for Congaree River Samples

3.3.2.2 Onsite Surface Water and Floodplains

The WEC has a general NPDES permit for stormwater discharges (Permit No. SC0001848), which requires implementation of a Storm Water Pollution Prevention Plan (WEC 2019b). Drainage at the site moves either through overland flow or through a stormwater drainage system. The drainage converges west of the Sanitary Lagoon through ditches and then flows to the west until they discharge through the single stormwater outfall (“C” valve) into an upstream area of Upper Sunset Lake (Mill Creek). Flow from Mill Creek and Sunset Lake enters the Congaree River about 5 km (3 mi) downstream.

Onsite surface water has been contaminated with radiological and nonradiological constituents: VOCs, gross alpha, gross beta, fluoride, nitrate, and ammonia. The near-surface groundwater table usually follows the terrain in a subdued manner in undeveloped or undisturbed areas. The elevation of the site is higher in the central and northeast area, and the bottom of the ditch in this area is usually above the groundwater table of the shallow aquifer. When there is flowing water in the ditch in this area (e.g., during an intense rainstorm), the ditch becomes a source of recharge to the shallow groundwater table. Toward the west and southwest near the bluff, the

groundwater table intersects with the ditch, either providing base flow during the dry season or discharging subsurface storm water to the ditch during the wet season. In this area, contaminants previously released into or retained in the shallow aquifer may discharge into the ditch and migrate through the ditch system, subsequently entering the Upper Sunset Lake. Gator Pond, at the bottom of the bluff, is spring fed. The source of the spring or seepage through the bluff surface is very likely derived from the shallow groundwater aquifer. Therefore, contaminants found in Gator Pond could also be those previously released into or retained in the shallow aquifer (AECOM 2013).

In 2008 and 2009 as part of a site investigation, WEC collected two samples (December 2008 and March 2009) from 10 surface water locations within Upper and Lower Sunset Lakes, Gator Pond, and onsite drainage ditches. Results from the Gator Pond sample location (SW-10), reported in the 2013 AECOM Report, indicated levels of gross beta, fluoride, and nitrate above or at their respective MCLs. Gross alpha was noted above its 15 pCi/L MCL in the drainage ("middle") ditch. Fluoride was above its 4 mg/L MCL in the Upper and Lower Sunset Lakes and drainage ditch sample while nitrate exceeded the 10 mg/L MCL in Gator Pond (Table 4-6, AECOM 2013).

Surface water samples taken as part of WEC's environmental monitoring program between 2010 and 2018 were only analyzed for gross alpha. Results show that gross alpha was below the MCL (15 pCi/L) for all sampling locations except for the "roadway" sample collected at the drainage ditch connection ("C" valve). Between 2011 and 2018, WEC's monthly surface water sampling results also indicated elevated levels of gross beta at Gator Pond, ranging from 2 pCi/L up to 56 pCi/L. (WEC 2019c).

The detection of contaminants in Gator Pond indicates the effect of CFFF onsite groundwater contamination to surface water in the wetlands and floodplain within and surrounding the western and southern portions of the CFFF property. Wetlands and floodplains may receive groundwater discharges and become source of groundwater recharge where ponded water exists. For example, the piezometric surface of the shallow groundwater aquifer suggested that Sunset Lake may be receiving shallow groundwater discharges (NRC 1985). Contaminants discharged from groundwater may be retained in the sediments of wetlands and floodplains, which can in turn become secondary sources of contamination to groundwater during recharge events. Samples collected at Gator Pond suggested that contaminants have been retained in the bottom sediment of the man-made pond (AECOM 2013), most likely coming from groundwater discharged into the pond. On the other hand, groundwater samples taken from a well south of Sunset Lake did not indicate elevated level of contaminants. The WEC is currently collecting sediment samples from Upper and Lower Sunset Lake as part of the RI Work Plan (WEC 2019e).

In October 2015, the CFFF site received 35.5 cm (12.4 in.) of rainfall over a 4-day period. As a result, two process lagoons overflowed beyond containment—the sanitary lagoon spilled over into adjacent lagoons and the West II Lagoon overflowed but stayed within the bermed area. The WEC initiated an emergency discharge to the river, per procedures. The WEC staff conducted in-process sampling for fluoride, ammonia, pH, and total suspended solids and also took activity samples. There was one elevated total suspended solids reading and the highest activity readings were 100 and 10 pCi/L, which are below NRC effluent limits for uranium

(WEC 2019b). Additionally, unknown levels of biological oxygen demand, fecal coliform, ammonia, calcium, fluoride, and nitrates could have been released from the lagoon overflow to the surrounding water bodies. The WEC notified SCDHEC of the event, and SCDHEC did not require any further action by WEC (WEC 2015a). No supplemental sampling of environmental media was conducted during or immediately following the flooding event (NRC 2017a). During the rain event, the Congaree River rose to an elevation of 37.6 m (123.3 ft) above MSL in the area of the site (WEC 2019b); however, although depressions may have been locally flooded by the direct precipitation, the Congaree River did not overflow the bluff.

3.3.2.3 Sediment

There is limited data on onsite sediments because there was no requirement in WEC's NRC-issued license for WEC to conduct onsite sediment samples. In July 2013, as part of a site investigation and based on communication with SCDHEC, WEC collected sediment samples from 10 onsite locations (taken in same locations as surface water samples). Two samples were collected from the dike between Upper and Sunset Lake, seven samples collected from the ditch draining the site, and one sample was collected from Gator Pond. Samples were analyzed for PCE, fluoride, nitrate, gross alpha, and gross beta (among others). While there are no standards for contaminants in sediments, Table 3-1 summarizes the highest concentrations of some contaminants and their locations.

Table 3-1 Results of July 2013 Sediment Sampling Event (AECOM 2013)

Contaminant	Concentration	Location[(a)]
Fluoride	220 mg/kg	Gator Pond
PCE	30 µg/kg	Ditch to the west of the WWTP
Gross alpha	377 pCi/g	Between the plant building and the West II Lagoon
Gross beta	295 pCi/g	Gator Pond

(a) Locations of sediment samples are noted on Figure 1-3 in the RI report (AECOM 2013).

3.4 Groundwater Resources

The subsurface immediately beneath the CFFF site is composed of two primary aquifer systems, the shallow and deeper systems (NRC 1985; NRC 2007; AECOM 2013). The shallow system is the groundwater table aquifer, which is unconfined, recharged locally by infiltration in the vicinity of the site, and has a relatively small productivity due to limited saturated thickness. The deeper system consists of confined aquifers that are recharged in a regional scale, and are capable of providing large quantities of water for industrial and municipal uses. Between the two aquifer systems is a confining layer of silt/clay and brittle shale with variable thicknesses based on borehole data from two wells (W-3a and W-50) (AECOM 2013). Communication of groundwater between the shallow and the deeper aquifer systems can go through either the confining layer or, potentially, through open-hole groundwater wells penetrating the confining layer (NRC 1985). Presently, groundwater in the shallow aquifer is contaminated by organic and inorganic chemicals as well as radioactive materials from CFFF operations. Well samples obtained from the three on-site wells penetrating the confining layer suggest that groundwater in the deeper aquifer is not contaminated as a result of the WEC plant operations (WEC 2019c).

Hydrogeologically, the shallow aquifer is composed of a stratified, but poorly sorted, mixture of alluvial clay, silt, sand, and gravel. The depths of the aquifer vary between 6 and 12 m (20 and 40 ft) below the CFFF site (AECOM 2013). The aquifer is derived from the sediments of the Okefenokee and Wicomico formations. Groundwater in the shallow aquifer principally flows from areas of higher topography (e.g., in and around the main facility) to lower topography (e.g., Mill Creek floodplain). Groundwater flow velocities for the aquifer were estimated to be around 46.6 m/yr (153 ft/yr) in the south-southwest direction toward the Mill Creek floodplain (AECOM 2013). The shape of the shallow groundwater table generally is a subdued replica of the topography, except for locations below the plant buildings and facilities. As discussed in Section 3.3.2.2, the depth to the shallow aquifer groundwater table decreases toward the southern portion of the site, resulting in surface ditches intercepting the groundwater table and seepage or spring on the Mill Creek floodplain. Thus, the shallow groundwater could potentially exit the aquifer in the southern portion of the site, discharging into Gator Pond and Sunset Lake (NRC 1985).

Beneath the shallow aquifer, the confining layer is the upper unit of the Black Mingo Formation (Black Mingo Confining Unit, BMCU), which can be differentiated from the lower, sandy unit of the formation (Black Mingo Aquifer, see discussion in Section 3.2.2). The Black Mingo Aquifer is very likely as permeable as the underlying Middendorf Aquifer. The WEC estimated the thickness of the two units of the Black Mingo Formation beneath the CFFF to vary between 23 and 35.5 m (75 and 100 ft) (AECOM 2013). The WEC's analysis suggested that the top of the confining BMCU forms a structural ridge plunging from West Lagoon I, West Lagoon II, and the Sanitary Lagoon toward the south-southeast of the site (AECOM 2013), which may have implications in terms of groundwater movement and contaminant transport pathways on the eastern side of this subsurface ridge.

Below the Black Mingo Formation is the Tuscaloosa Formation, which hosts the regional, Middendorf Aquifers, but there is usually not an apparent boundary between the Middendorf Aquifers and the lower Black Mingo Aquifer (AECOM 2013). The Tuscaloosa Formation consists of sandy, artesian aquifers that have regionally higher artesian pressure than the Black Mingo Aquifer. The upward gradient from the Middendorf Aquifers through the Black Mingo Aquifer may prevent downward movement of contaminants from the shallow water table aquifer through the BMCU and into the lower Black Mingo Aquifer. For example, on the southern portion of the site below the bluff where the Okefenokee Formation was completely removed and replaced by floodplain sediments (see Section 3.2.2), WEC's well potentiometric measurements indicated that local hydraulic gradient is upwards near Gator Pond (Figure 3-4, AECOM 2013). Locally, apparent downward hydraulic gradient between the shallow groundwater table and the Black Mingo Aquifer, for example above the bluff in the upper terrace, is in effect a result of the much less permeable BMCU and the existing Okefenokee Formation that make a potentiometric surface in the shallow aquifer higher than that in the Black Mingo Aquifer sustainable. Because of the Black Mingo confining layer and the upward gradient from its underlying aquifers, WEC ruled out significant transfer of water between the shallow aquifer and the Black Mingo Aquifer (AECOM 2013).

The SCDHEC classifies the groundwater at the CFFF site as "Class GB," meaning the groundwater at the CFFF site meets the definition of underground sources of drinking water as defined by State regulations in R.61-68, "Water Classifications and Standards." The WEC had

previously requested that SCDHEC reclassify the site as a groundwater mixing zone, as defined in R.61-68, but SCDHEC denied the request (AECOM 2013). Therefore, groundwater at the CFFF site must meet drinking water standards (i.e., MCLs).

3.4.1 Groundwater Use

The WEC does not use groundwater for operations at CFFF. As noted in Section 3.3.1, service and potable water are provided by the City of Columbia, which gets its water from the Congaree River.

Well records from SCDNR indicate there are groundwater wells for domestic use within 5 km (3 mi) of CFFF, but they are located upgradient from CFFF (SCDNR 2017, see Figure 3-7). According to the RI Work Plan, there are hunt club property owners to the east, south, and west of the CFFF property, within a one-mile radius, however, there is no information about domestic or irrigation wells on these properties (WEC 2019e). The SCDHEC attempted to contact lodge ownership to sample that well but have not been able to do so yet (NRC 2019b). Furthermore, three wells formerly existed on the CFFF site prior to the current owner WEC (NRC 1985; SCDNR 2019). These wells are no longer used and the abandonment of these wells has not been documented.

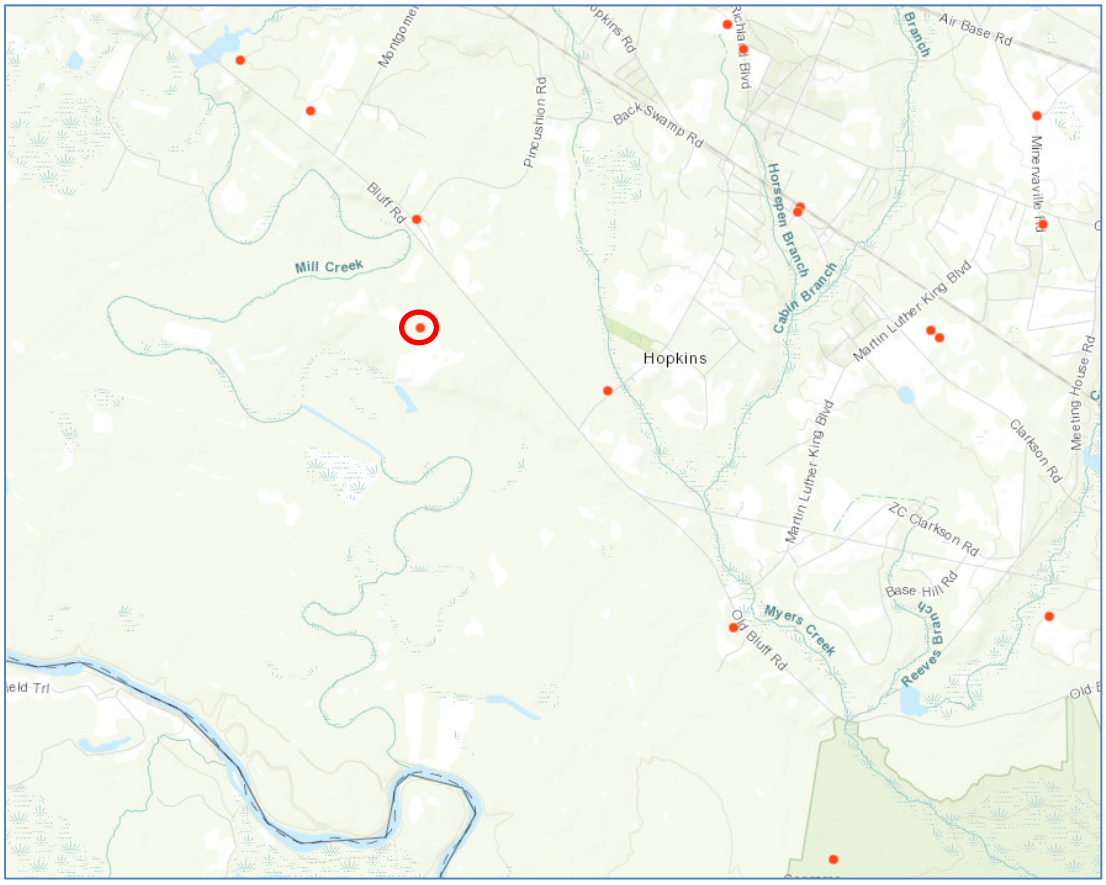


Figure 3-7 Location of Known Water Wells near CFFF (circled in red) (Source: SCDNR 2017)

Well water tests conducted in 2018 indicated that total uranium, gross alpha, and gross beta levels of these offsite groundwater wells are below the MCLs or the detection limits (SCDHEC 2019). Other contaminants of potential concern, including nitrate and fluoride, are also below the MCLs or detection limits (SCDHEC 2019). Richland County sampled 62 wells and all results were below the EPA's drinking water standard for uranium (Richland County Council 2019).

3.4.2 Groundwater Quality

Groundwater contamination was discovered in the 1980s and has been the subject of ongoing investigations. The quality of the shallow groundwater has been affected by nonradioactive and radioactive contaminants from CFFF operations. Contaminants that have been identified include VOCs, fluoride, nitrate, ammonia, gross alpha, uranium, and Tc-99. Investigations conducted by WEC have identified the WWTP, CFFF operations, buried piping systems, and the former oil house as potential sources of contamination. The RI Work Plan identified data needs regarding the sources and extent of groundwater contamination (WEC 2019e).

The following summaries of the various constituents found in the shallow groundwater is based on data and analysis in WEC's 2013 RI report and 2014 Baseline Risk Assessment report; the 2019 RI Work Plan and addenda; annual groundwater reports submitted to SCDHEC; WEC's ER; and supplemental information submitted by WEC to the NRC. As discussed earlier, groundwater in the deeper Middendorf and Black Mingo Aquifers is not contaminated as a result of the WEC plant operations, discussion of groundwater quality impact in the following sections exclusively refers to the shallow groundwater table aquifer.

3.4.2.1 Nonradiological Contaminants

The groundwater at CFFF has been contaminated with VOCs and inorganics from facility operations. Storage of petroleum products and solvents in the former oil house prior to 1980 contributed to the VOC contamination. The oil house has been removed. Studies conducted by WEC since the assessment in 1994 indicated that the source area is near the West II Lagoon, although not the West II Lagoon itself (WEC 2019b). The WWTP is suspected of being the source of the nonradiological contaminants—nitrate, fluoride, and ammonia. Four of the WWTP lagoons were relined between 2008 and 2012. The East Lagoon, which receives various waste streams (including radioactive elements) has been in service for almost 40 years. Sludge in the East lagoon contains a variety of radiological and nonradiological contaminants. The WEC intends to characterize the lagoon sediments as noted in the RI Work Plan (WEC 2019g).

3.4.2.2 Volatile Organic Compounds

The VOCs contaminating the groundwater are primarily PCE and trichloroethene (TCE) with some breakdown products. The WEC installed an air sparging/soil vapor extraction (AS/SVE) system in 1997 and operated it until 2011. In December 2012, WEC discontinued operation of the AS/SVE system because the contaminants were no longer being detected (WEC 2015a). However, since the AS/SVE system has been turned off, VOC concentrations have been increasing (SCDHEC/WEC 2016).

There appears to be two primary plumes and other localized areas that have been impacted. One plume with elevated PCE and TCE appears to come from a source near the West II Lagoon features elevated PCE concentrations in the shallow and intermediate water tables. The second plume is south of the WWTP upgradient of Gator Pond, and its PCE concentrations appear to be confined to the shallow aquifer. The RI Work Plan states that the source of this PCE plume is unknown. (WEC 2019b). The WEC has installed four shallow and five intermediate-depth wells to further monitor the evolution of the VOC plumes (WEC 2019b). These additional wells could help WEC understand the behavior of the plumes and possibly determine the origin. Beginning in late 2018, WEC also started monitoring VOCs and semi-VOCs at the site's existing wells (WEC 2019b). Results from early 2019 indicate that the MCLs of PCE (5 µg/L) and TCE (5 µg/L) were exceeded in 15 and 7 of the 60 wells, respectively (WEC 2019c). The RI Work Plan indicates that VOCs could be a potential COC for multiple OUs (WEC 2019e).

3.4.2.3 Fluoride and Nitrate

Activities at the WWTP and plant operations are believed to be the source of fluoride and nitrate in groundwater. The fluoride and nitrate plumes are located in the vicinity of the WWTP, Gator Pond, and Sunset Lake. Concentrations of fluoride and nitrate in sampled wells continue to exceed EPA MCLs (4 mg/L for fluoride and 10 mg/L for nitrate). Between 2004 and 2019, the highest concentrations of fluoride were around and above 15 mg/L and were found in the wells surrounding the WWTP, including W-7, W-18, W-22, W-28, and W-30. Concentrations of fluoride peaked around 2010 and have been gradually trending down since then. Surrounding the WWTP, the highest nitrate concentrations were often higher than 150 mg/L at wells W-18, W-30, W-32, W-29, and W-7. Well water samples with high nitrate concentrations were obtained from wells W-30 (1,900 mg/L) and W-29 (980 mg/L) in late 2011 and early 2013, respectively. The large concentrations may be related to leaks and subsequent liner replacement of the lagoons that took place between 2008 and 2012. Nitrate concentrations in well water from these two wells have been below 100 mg/L (W-30) or trending downward (W-29) since then. Nitrate concentrations in wells W-18 and W-7, on the other hand, have been trending up and reached relatively steady concentrations around 1,000 mg/L and 300 mg/L, respectively, since 2012. The two wells are located southwest of the WWTP and along the principal shallow groundwater flow direction.

Characterization efforts for the 2011 CWW pipe leak indicated fluoride in the soil and sludge samples, at 47 mg/kg and 85 mg/kg, respectively. Liquid collected from the well boring indicated nitrate levels at approximately 2 mg/L. The contaminated soil and sludge will remain beneath the CFFF Uranium Recycling and Recovery Services area until decommissioning, which will begin after the 40-year license renewal period ends. Therefore, the fluoride could leach through the contaminated soil into the groundwater. Fluoride and nitrate move with the groundwater flow, although nitrate concentrations can be lowered through natural processes such as denitrification (AECOM 2013). The WEC will continue to monitor for fluoride and nitrate and submit results to SCDHEC in its annual groundwater report as part of its NPDES permit. Recent well water from the nine new wells along the CWW line suggest that fluoride concentrations were mostly below the MCL and nitrate concentrations were mostly below the MCL except at wells W-58 and W-59. The two wells are on the southwestern end of the CWW

line and close to well W-29 and the WWTP lagoons. The nitrate concentrations were measured between the MCL and 20 mg/L.

During the response to the 2018 HF spiking station leak, WEC obtained fluoride concentrations up to 1,180 mg/kg from soil samples around and beneath the facility. Two of these samples also showed nitrate concentrations above 700 mg/kg. The WEC, as part of the CA with the State of South Carolina, is installing sentinel wells along an east-west line to monitor for releases from the main plant building. The RI Work Plan indicates that fluoride and nitrate could be potential COCs for multiple OUs (WEC 2019e).

3.4.2.4 Ammonia

Historic leaks near the WWTP and nearby product storage are believed to have caused the ammonia groundwater contamination. The 1985 EA indicated the highest concentration was 900 mg/L (at W-7) in 1981 (NRC 1985). Removal of ammonia from the environment often involves two bacteria-mediated transformation processes, nitrification of ammonia to nitrite and/or nitrate and denitrification of nitrate to gaseous nitrogen. Both processes are sensitive to temperature, pH, amount of biomass, and amount of oxygen (nitrification) and the lack of oxygen (denitrification). Recent concentrations are down to less than 200 mg/L. The highest concentrations were recently found in W-18 (WEC 2019c), where ammonia concentrations are stable to around 100 mg/L. Ammonia concentrations in wells W-32 and W-7 south of the WWTP also stabilized around 50 mg/L. The amount of ammonia and nitrate in groundwater may be correlated if a sustainable nitrification-denitrification process is maintained. For most of the groundwater measurements obtained by WEC, this appears to be the case—however, wells W-18 and previously W-22 have notably showed relatively high ammonia concentrations and ammonia to nitrate ratios. In wells W-30 and previously W-29, relatively high nitrate-to-ammonia concentration ratios suggest the source of nitrate in these wells may not necessarily be the WWTP through the nitrification process. The two wells are located upstream of the WWTP lagoons in the principal groundwater flow direction. The RI Work Plan indicates that ammonia could be a potential COC for multiple OUs (WEC 2019e).

3.4.2.5 Radiological Contaminants

Previous site investigations indicate that the WWTP contributed to gross alpha and gross beta contamination. In the early 1980s, five lagoons (West, West II, Sanitary, North, and South) were relined with 36-mil Hypalon liners, and underdrain systems were installed to detect leaks from the lagoons (NRC 1985). The WEC believes its process of removing solids from the bottom of the lagoons was damaging the liners and thus creating a potential for leaks (WEC 2017d). The WEC noticed an upward trend in groundwater contaminants, so it replaced four of the six lagoon liners again—this time with 80-mil HDPE liners (WEC 2017d). In 2011, WEC sampled the sludge in the East Lagoon and results ranged from 70 to 2,540 ppm total uranium. WEC suggested that the East Lagoon may be the source of a recently detected Tc-99 groundwater plume. The WEC intends to characterize the sludge to prepare a closure plan to SCDHEC for review and approval. Following the appropriate approvals, WEC intends to remove the East Lagoon and its liner and remediate the soil, if needed (WEC 2019g).

The WEC also cited manufacturing operations in plant buildings as contributing to groundwater contamination (WEC 2019b). Recent sampling results also showed high gross alpha and uranium concentrations above the 30 μg/L MCL (and 84 pCi/L WEC-derived concentration) in the subsurface area next to the exterior CWW line on the western side of the manufacturing building (WEC 2019a). The same set of sampling results also showed high gross beta above 50 pCi/L in two of these wells next to the CWW line and two wells, W-6 and W-11, south of the WWTP lagoons. The Tc-99 activities in wells W-6 and W-11 also measured higher than the 900 pCi/L MCL, with the highest values at 2,370 pCi/L and 4,200 pCi/L, respectively.

In 2018, WEC discovered a leak at one of the HF spiking stations inside the plant. Soil samples taken beneath and around the spiking station footprint showed total uranium concentrations as high as 10,000 ppm. The WEC subsequently initiated a remediation process to remove impacted soil below the spiking station to a depth of approximately 2.7 to 3.6 m (9 to 12 ft). Soil samples away from the footprint of the HF spiking station also showed high total uranium concentrations and indicate the impact of past WEC operations. The uranium contamination outside the HF spiking station footprint may impact the shallow groundwater aquifer when it travels through the vadose zone and reaches the groundwater table.

In 2019, WEC identified a roof leak of one intermodal (sea-land) container south of the WWTP, which stores waste drums awaiting uranium reclamation. The WEC's inspection noted that the waste drums were degraded, and contaminants may have leaked to soils under the container. The WEC subsequently transferred the waste drums to the plant main building and sampled the soils in the areas of the degraded drums. The sampling results indicated uranium concentrations mostly below 8 ppm except one sample with uranium measured at 21 ppm (WEC 2019f). The WEC subsequently added Addendum 1 to the RI Work Plan to address this area.

Gross Alpha and Uranium

Groundwater well sampling results from WEC's ongoing environmental monitoring program indicate that gross alpha still exceeds the 15 pCi/L MCL (AECOM 2013; NRC 2017a; WEC 2015a, 2018b). The WEC believes there is not a gross alpha plume but rather spikes in concentrations that appear at different wells during different sampling events. The WEC claims the gross alpha exceedances are random, and appear to be more characteristic of naturally occurring radionuclides (NRC 2017a). From 2007 until WEC started sampling all wells for uranium in 2018, there have been several instances of gross alpha exceeding the 15 pCi/L trigger for isotopic analysis in wells (such as W-7, W-22, and W-30). For those wells, WEC either did not perform isotopic analysis or the results showed uranium below the MCL/derived limit. Historically, only one well, W-18, showed a uranium concentration above the WEC-derived criterion of 84 pCi/L in 2007 (80-101 pCi/L), with a relatively high gross alpha of 115 pCi/L (WEC 2019a).

In 2008, a CWW line breach was discovered along the western side of the plant. The location of the 2008 breach is directly south of the 2011 leak area. Soil and water samples collected near the breach indicated radionuclides in the CWW line and the subsurface. While the CWW line was replaced, not all of the contaminated soil was removed (WEC 2019b). The WEC added nine new wells (W-51 to W-59) along the west flank of the main manufacturing building in

late 2018 (See Figure 3-8). The line of wells closely follow the buried CWW pipe. Above-MCL isotopic uranium activities and concentrations were detected in three of the wells (W-56, W-57, and W-59). These wells are located southwest-south of W-37 and the 2011 pipe leak area inside the plant building. Therefore, it is not immediately clear if the recent sampling results in 2018 and 2019 indicate that either or both of the CWW line leaks are the only sources of gross alpha and uranium.

The 2011 pipe leak that released uranium to the subsurface and into the environment should be considered a source of residual radioactivity and future groundwater and surface water contamination. The total volume of material released into the subsurface is not clear. One liquid sample taken from beneath the Uranium Recycling and Recovery Services area had a total uranium concentration of approximately 98,000 pCi/L. Based on the isotopic analysis, the uranium is from CFFF operations (mainly U-234). The two closest wells north and south of the leak (W-45 and W-37) were not routinely sampled. However, during a 2011 and 2012 investigation, samples collected at W-45 indicated gross alpha levels exceeded 15 pCi/L, whereas results for W-37 were less than 10 pCi/L (WEC 2018b). A sediment sample taken in 2013 at SW-5/SED-5, which is due west of the leak, showed an elevated level of uranium of 377 pCi/g, whereas the other sediment samples were all less than 25 pCi/g (AECOM 2013). The WEC added a new soil sampling location in the stormwater ditch near the West II Lagoon to monitor for potential groundwater migration of uranium to the ditch.

Beginning in late 2018, WEC also started monitoring isotopic uranium of the site's existing well network. During the investigation of the 2018 HF spiking station leak (WEC 2019e), uranium concentrations in soil underneath the concrete floor (that presumably was not impacted by the leak) showed high total uranium concentrations in the order of 3,000 to 3,500 ppm. The WEC concluded that the cause of these high uranium concentrations was previous plant operations (WEC 2019e).

In 2019, a waste drum stored in a shipping container leaked contaminated water into the soil. Subsequent sampling of soils under the shipping container (down to 30.5 cm [1 ft]) suggested near surface soils were contaminated with uranium up to 21 ppm. The WEC proposed sampling the areas where this and other shipping containers are located, and the sampling plan is included in the RI Work Plan Addendum 1 (SCDHEC 2019a, WEC 2019e). Thus, uranium is identified in the RI Work Plan as a potential COC for multiple OUs.

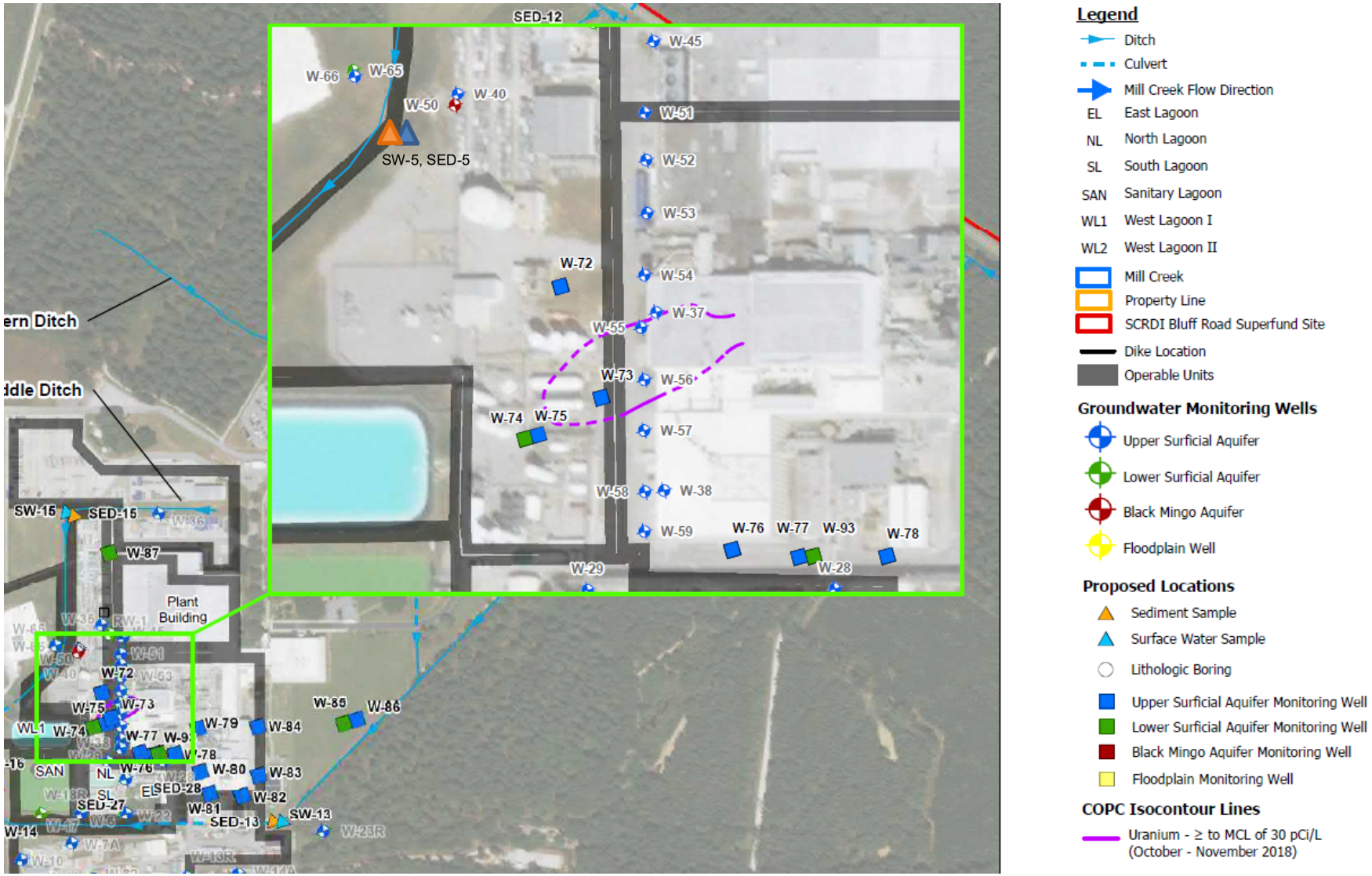


Figure 3-8 Uranium Groundwater Plume (Source: WEC 2019e, Adapted from Figure 12)

Gross Beta and Technicium-99

Gross beta has been found in groundwater wells since the early 1980s. In 2010, WEC observed elevated levels of gross beta that exceeded its investigation level of 50 pCi/L in two wells. The WEC determined that the gross beta was primarily due to Tc-99 based on beta/gamma scans of the samples. The WEC evaluated potential sources and causes and determined that the cylinder recertification building and surrounding concrete pad was the source of the Tc-99. A tank in the building overflowed onto the floor and spilled outside of the building and onto the grass. The WEC excavated the grass and topsoil. In 2011, WEC initiated further sampling and monitoring for Tc-99 in groundwater (WEC 2019b).

Sampling results through early 2019 indicate wells continue to exceed WEC's 50 pCi/L investigation limit for gross beta (AECOM 2013; NRC 2017a; WEC 2015a; WEC 2019e). Laboratory results for recent groundwater samples indicate the gross beta contamination is due to Tc-99. The MCL for Tc-99 (900 pCi/L) is derived from a calculated concentration that will yield a dose of 4 mrem/yr to the total body or any critical organ (EPA 2015). While most concentrations of Tc-99 are well below its MCL, recent sampling results may indicate a potential pool of gross beta/Tc-99 below and south of the WWTP lagoons in the shallow groundwater table aquifer near the aquitard-aquifer interface. Water samples from the two relatively deeper wells, W-6 and W-11, which are south of the WWTP lagoons, had high gross beta and Tc-99 concentrations. In the late 2018 and early 2019 sampling events, the gross beta activity at W-11 reached as high as 2,450 pCi/L, with the highest Tc-99 concentration at 4,200 pCi/L, while the gross beta activity at W-6 reached 1,615 pCi/L with the highest Tc-99 concentration at 2,370 pCi/L (WEC 2019c).

The WEC will monitor groundwater wells semiannually, during both the dry and wet seasons, for Tc-99 (WEC 2019c). The WEC will enter Tc-99 exceedances of its action level (i.e., State or Federal regulatory limits) into its CAP. Since late 2018, WEC also started analyzing Tc-99 concentrations for all the existing wells onsite. Tc-99 was identified as a potential COC for several OUs.

3.5 Ecological Resources

This section discusses the ecological resources—both terrestrial and aquatic—that could be present at the site or in the vicinity.

3.5.1 Terrestrial Resources

The CFFF site is located within the Southeastern Mixed Forest ecoregion, which is dominated by oak-hickory forests consisting of smaller tree and common shrub species. The undeveloped portions of the site provide a variety of habitats, including wetlands, woodland areas, and hardwood forests. The area around the facility includes various grasses, rushes, sedges, and weedy herbs and is maintained by mowing, which limits vegetation height.

Rodents, birds, reptiles, amphibians, and insects all potentially use the area as habitat. However, wildlife in the area is limited in species diversity and is likely tolerant of human activity because the area in and around the CFFF site has been used as an industrial facility for decades and because vegetation in the area is of limited height and diversity (AECOM 2014).

Appendix C of WEC's ER contains a list of species observed or having the potential to occur at CFFF or in the vicinity, based on surveys last completed in 1975 as part of the site evaluation (WEC 2019b).

3.5.2 Aquatic Resources

Aquatic habitats on the CFFF site include Sunset Lake, Mill Creek, and other small creeks, drainage ditches, and floodplains. Small fish and invertebrates likely inhabit onsite aquatic habitats. Organisms within the small creeks, drainage ditches, and floodplains are likely tolerant of extreme physical conditions given the lack of continuous connectivity with larger water bodies. The NRC staff is not aware of any field surveys that have been conducted on the site.

The CFFF site is located within the flood basin of the Congaree River, which flows approximately 4 mi (6 km) southwest of the main plant (NRC 2007). Surveys within the Congaree National Park indicate that Congaree River provides habitat to approximately 55 species of fish, 16 species of mussels, and 7 species of crayfish (Congaree Riverkeeper 2017). Common recreationally-fished species include Black Crappie (*Pomoxis nigromaculatus*), Bluegill (*Lepomis macrochirus*), Bowfin (*Amia calva*), Channel Catfish (*Ictalurus punctatus*), Largemouth Bass (*Micropterus salmoides*), Redbreast Sunfish (*Lepomis auritus*), Striped Bass (*Morone saxatilis*), and Yellow Perch (*Perca flavescens*) (NPS undated). To gather additional data regarding fish populations near the CFFF, the NRC staff reviewed survey data that were recorded in an online database, FishNet (2014). This database is a collaborative effort by natural history museums and biodiversity institutions to compile fish survey data. The database included one fish survey in the vicinity of CFFF that was conducted in June 2002. The NRC staff notes that the survey methodology, sampling protocols, and equipment were not specified. Therefore, a species may occur near CFFF but may not have been captured in the survey due to insufficient sampling effort and the various survey methods used. Table 3-2 describes fish species that were observed during the survey.

As part of its environmental monitoring program, WEC collects one fish each year from a location near or at the diffuser discharge into the Congaree River. Data indicates less than 1 pCi/g uranium was found in the fish samples (WEC 2019c).

Table 3-2 Fish Species near CFFF during the 2002 Survey

Species	Common Name	Number of Organisms Captured
Catostomidae		
Carpiodes spp.	River Carpsucker	20
Hypentelium nigricans	Northern Hogsucker	1
Moxostoma macrolepidotum	Shorthead Redhorse	6
Clupeidae		
Alosa sapidissima	American Shad	1
Cyprinidae		
Cyprinella nivea	Whitefin Shiner	2
Moronidae		
Morone americana	White Perch	1

Source: FishNet 2014: Survey conducted on June 19, 2002 on the Congaree River, from 1.0 to 1.5 mi south of Interstate-77, about 5.0 air mi south of the City of Columbia.

3.6 Protected Species and Habitat

The Endangered Species Act of 1973, as amended (ESA) was enacted to prevent further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7 of the ESA requires Federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) regarding actions that may affect listed species or designated critical habitats. This section discusses species listed under the ESA as well as species protected under other statutes such as the Migratory Bird Treaty Act of 1918, as amended (MBTA).

3.6.1 State-Listed Species

Table 3-3 describes the State-listed species that have the potential to exist within the CFFF action area. The NRC staff compiled this table from the SCDNR's database (SCDNR 2014), and the ecological studies conducted on and near the CFFF site (WEC 2019b). The last ecological surveys at CFFF were conducted in 1975. Based on those surveys, WEC (2019b) concluded that the southern bald eagle (*Haliaeetus leucocephalus*) and the red-cockaded woodpecker (*Dendrocopus borealis*) may occur on or near CFFF (WEC 2019b).

3.6.2 Endangered Species Act

3.6.2.1 Action Area

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

Table 3-3 State-Listed Species with the Potential to Occur in the CFFF Vicinity

Common Name	Scientific Name	State Status	Habitat
Amphibians			
Pine Barrens Treefrog	*Hyla andersonii*	T	Occurs in South Carolina in herb shrub bogs (a.k.a., pocosins) in the sandhills. Colonies are known to exist along power lines and gas line right-of ways (SCDNR 2006a)
Birds			
Bald eagle	*Haliaeetus leucoephalus*	T	Occurs in large trees with open views for nesting. Prefers perch and roost sites with minimal disturbance and fresh and brackish marine habitats suitable for foraging (SCDNR 2006b)
red-cockaded woodpecker	*Picoides borealis*	E	Occurs in mature pine forests; excavates cavities in living pine trees
Mammals			
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	E	Occurs in coastal plain habitat; roosts in dilapidated buildings or tree cavities near water (SCDNR 2006c)

T = Threatened
E = Endangered

For the purposes of the ESA analysis in this EA, the NRC staff considers the action area to include the 469-ha (1,151-ac) CFFF site and the surrounding area where runoff drains and site activities would be audible to wildlife. The NRC staff expects all direct and indirect effects of the proposed action to be contained within these areas.

The NRC staff recognizes that while the action area is stationary, Federally listed species can move in and out of the action area. For instance, a flowering plant known to occur near but outside of the action area could appear within the action area over time, if its seeds are carried into the action area by wind, water, or animals. Thus, in its analysis, the NRC staff considers not only those species known to occur directly within the action area, but those species that may passively or actively move into the action area. The NRC staff then considers whether the life history of each species makes the species likely to move into the action area where it could be affected by the activities associated with continued operations at CFFF.

3.6.2.2 Overview of Federally Protected Species

Table 3-4 describes the Federally listed species that have the potential to exist within the CFFF action area. The NRC staff compiled this table from FWS's online database and correspondence from FWS (2017, 2019), SCDNR's database (SCDNR 2014), and the ecological studies conducted on and near the CFFF site (WEC 2019b). The NRC staff did not identify any candidate species, proposed species, or designated critical habitat within the action area (FWS 2017). The last ecological surveys completed at CFFF were in 1975.

Table 3-4 Federally Listed Species with the Potential to Occur in the CFFF Action Area

Common Name	Scientific Name	Federal Status	Habitat
Birds			
Red-cockaded woodpecker	*Picoides borealis*	E	Mature pine forests; excavates cavities in living pine trees.
Wood stork	*Mycteria Americana*	T	Freshwater and estuarine wetlands; foraging habitat includes freshwater marshes, narrow tidal creeks, or flooded tidal pools.
Fish			
Shortnose Sturgeon	*Acipenser brevirostrum*	E	Spawns in coastal rivers, and forages along riverbed or other bottom habitats.
Clams			
Carolina heelspitter	*Lasmigona decorate*	E	Cool, silt-free, well-oxygenated stream bottoms; pollution-intolerant and generally occur in areas with well-vegetated stream banks.
Flowering Plants			
Canby's dropwort	*Oxypolis canbyi*	E	Coastal plain habitats, including natural ponds with a high proportion of pond cypress, Carolina bays dominated by grass-sedges, wet pine savannas, shallow pineland ponds and cypress-pine swamps or sloughs.
Rough-leaved loosestrife	*Lysimachia aperulaefolia*		Areas in between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil) on moist to seasonally saturated sands and on shallow organic soils overlaying sand.
Smooth coneflower	*Echinacea laevigata*		Magnesium and calcium rich soils in open woods, glades, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and power line rights-of-way.

Sturgeon Species

On March 11, 1967, the Shortnose Sturgeon was listed as an "… endangered species threatened with extinction" under the ESA, and the species remained on the list of endangered species with the enactment of the ESA in 1973. Construction of dams during the period of U.S. industrial growth; pollution of many large northeastern river systems; habitat alterations from discharges, dredging, or disposal of material into rivers; and development activities involving estuarine and riverine mudflats and marshes are the primary factors that have contributed to this species' decline (NMFS 2015).

Based on the available information, the NRC staff concludes Shortnose Sturgeon likely occurs within the CFFF action area. The NRC (2017b) provided detailed information about the Shortnose Sturgeon in its Biological Evaluation submitted to NMFS for their concurrence. The NMFS said the NRC should consider the impacts on the Atlantic Sturgeon, because even though it was not present in the Congaree River now, it could be within the next 40 years. The results of the staff's consultation on the Sturgeon is discussed in Section 4.6.

3.6.3 Migratory Bird Treaty Act

The FWS administers the MBTA, which prohibits anyone from taking native migratory birds or their eggs, feathers, or nests. Regulations under the MBTA define a "take" as "… to pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to…." carry out these activities (50 CFR 10.12). A "take" under the MBTA does not include significant habitat alteration or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, such as breeding, feeding, or sheltering.

The MBTA protects a total of 1,007 migratory bird species (75 FR 9282). The FWS (2017) indicated that 22 migratory birds of concern may occur on or near the action area (Table 3-5). Near the proposed site, migratory birds rely on riparian, forested, grassland, and wetlands as important areas for foraging, resting, and avoiding predators and for breeding for some species. Based on the amount of continuous habitat and the limited ongoing human activity that occurs onsite, the CFFF site and surrounding area likely provide quality habitat for migratory birds.

3.6.4 Bald Eagles

The bald eagle is protected under the Bald and Golden Eagle Protection Act. This Federal act prohibits anyone from taking or disturbing bald eagles or golden eagles (*Aquila chrysaetos*), including their nests or eggs, without an FWS-issued permit. The bald eagle is also a State-listed threatened species. Suitable habitat for the bald eagle occurs within the CFFF, but no observations of this species have been documented (FWS 2017; WEC 2019b).

3.6.5 Magnuson-Stevens Fishery Conservation and Management Act

Magnuson-Stevens Fishery Conservation and Management Act, as amended, requires Federal agencies to consult with NMFS on actions that may adversely affect essential fish habitat. There is no essential fish habitat in the project area and therefore no consultation with NMFS was necessary (NRC 2017c).

Table 3-5 Migratory Birds of Concern that May Occur near CFFF (Source: FWS 2017)

Scientific Name	Common Name	Occurrence in Project Area
Botaurus lentiginosus	American bittern	Wintering
Falco sparverius Paulus	American kestrel	Year-round
Aimophila aestivalis	Bachman's sparrow	Year-round
Haliaeetus leucocephalus	bald eagle	Year-round
Sitta pusilla	brown-headed nuthatch	Year-round
Caprimulgus carolinensis	Chuck-will's-widow	Breeding
Passerella iliaca	fox sparrow	Wintering
Oporornis formosus	Kentucky warbler	Breeding
Ixobrychus exilis	least bittern	Breeding
Lanius ludovicianus	loggerhead shrike	Year-round
Ictinia mississippiensis	Mississippi kite	Breeding
Passerina ciris	painted bunting	Breeding
Falco peregrinus	peregrine falcon	Wintering

Scientific Name	Common Name	Occurrence in Project Area
Dendroica discolor	prairie warbler	Breeding
Protonotaria citrea	prothonotary warbler	Breeding
Melanerpes erythrocephalus	red-headed woodpecker	Year-round
Euphagus carolinus	rusty blackbird	Wintering
Cistothorus platensis	sedge wren	Migrating
Asio flammeus	short-eared owl	Wintering
Limnothlypis swainsonii	Swainson's warbler	Breeding
Hylocichla mustelina	wood thrush	Breeding
Helmitheros vermivorum	worm eating warbler	Breeding

3.7 Climatology, Meteorology, and Air Quality

3.7.1 Climatology and Meteorology

Richland County has a temperate climate, characterized by moderate rainfall, high relative humidity, moderate winds, and diurnal temperature changes. The county experiences four distinct seasons, which is representative of its mid-latitude location. The average annual mean temperature is 19.3°C (66.7°F), with mild winters and freezing temperatures occurring only 77 days per year (WEC 2019b). Due to the influence of the Appalachian Mountains, winds are predominantly from the southwest, but change seasonally, with winds from the northeast in fall and winter. The region experiences severe weather, such as thunderstorms accompanied by lightning and hail, as well as tornadoes occasionally. Most precipitation in Richland County is in the form of rainfall. Winter precipitation such as snow, sleeting and freezing rain, does occur from November through March, although greater than trace amounts only occur one to three times per year. Meteorological data from the National Weather Service station at Columbia Metropolitan Airport, located 19 km (12 mi) west-northwest of the site, was used to characterize the site in the ER. This meteorological data was compiled by the South Carolina State Climatology Office (SCDNR 2019c).

3.7.1.1 Temperature

According to the South Carolina State Climatology Office compilation of 30-year climate normals (three decade averages of climatological variables), the average annual temperature for the period 1981–2010 ranges from a minimum of 13°C (55.5°F) to a maximum of 25°C (78.0°F), with an annual average mean temperature of 19.3°C (66.7°F). According to a temperature summary over the period 1954–2016, the highest maximum temperature of 45°C (113°F) occurred on June 29, 2012 (SCDNR 2019c). The lowest minimum temperature over the same period was –20°C (–5°F) on January 16, 1994 (SCDNR 2019c).

3.7.1.2 Precipitation

In Richland County, according to a precipitation summary over the period 1954–2016, the annual average rainfall was 121.29 cm (47.75 in.), recorded at the University of South Carolina–Columbia (SCDNR 2019c). The highest recorded precipitation occurred in 1959 and was 189.2 cm (74.49 in.), and the lowest precipitation was 68.94 cm (27.14 in.) occurring in 1933. The highest snowfall was 31.75 cm (12.5 in.), occurring in 1973 (SCDNR 2019c), but the

average annual snowfall is 3 cm (1.2 in.) (WEC 2019b). Normal annual precipitation in Richland County during the period 1971–2000 recorded at Columbia Metropolitan Airport is 122.6 cm (48.3 in.), and monthly precipitation recorded over this same period ranges from 7.31 cm (2.88 in.) in November to 14.1 cm (5.54 in.) in July (WEC 2019b).

3.7.1.3 Severe Weather

Severe weather in Richland County occurs mostly as thunderstorms, commonly occurring during summer months. On average, thunderstorms occur 53 days per year, mainly during June, July, and August (WEC 2019b). Hail greater than 1 in. in diameter occurs infrequently, only 112 times between January 1950 and December 2018 with no injuries or deaths reported, according to the National Centers for Environmental Information, formerly the National Climatic Data Center (WEC 2019b). Lightning occurring during thunderstorms resulted in three injuries but no deaths between 1994 and 2006. There were 15 recorded damaging lightning events between January 1950 and December 2018 (WEC 2019b). These data are consistent with data reported by the South Carolina State Climatology Office. There were 310 recorded occurrences of thunderstorms with high winds between January 1950 and December 2015, causing two deaths and seven injuries, with only nine of the recorded high wind events having gusts great than 70 knots (WEC 2019b).

From 1950 to 2018, tornadoes averaged about 1.8 per year in the State, mostly occurring between May and August (WEC 2019b). For Richland County, 36 tornadoes occurred between 1950 and 2018, causing 20 injuries and 1 death. Fourteen of these tornadoes had a Fujita (F) Scale for Tornado Damage rating of F0 (64–116 kilometers per hour [kph] [40–72 mph] sustained winds), 11 had a rating of F1 (117–180 kph [73–112 mph]), 7 had a rating of F2 (182–253 kph [113–157 mph]). Since 2007, the Enhanced Fujita (EF) scale has been used in the for United States for expressing tornado damage, with two tornadoes being rated EF0 (105–137 kph [65–85 mph]) and two rated EF1 (138–177 kph [86–110 mph]) according to National Centers for Environmental Information data (WEC 2019b).

Hurricanes commonly occur off the coast in the Atlantic Ocean, but hurricane-force winds typically dissipate before reaching the inland location of the site, becoming tropical storms. The South Carolina coast has experienced 38 tropical cyclones during the 1851–2016 period. These storms have included 24 hurricanes, 9 tropical or subtropical storms, and 5 tropical depressions (WEC 2019b). Ten of the 24 hurricanes were between Category 2 and Category 4, with no Category 5 hurricanes occurring in South Carolina since 1900. The three Category 4 hurricanes were Hazel in 1954, Gracie in 1959, and Hugo in 1989. In 1999, Hurricane Floyd made landfall near Cape Fear, North Carolina, causing mandatory coastal evacuations for South Carolina and more than 15 in of rain in Horry County, resulted in flooding of the Waccamaw River in and around the city of Conway, South Carolina, for one month (WEC 2019b). Since 1930, Richland County has experienced three tropical storms and two Category 1 hurricanes.

Historic flooding occurred in October 2015 after Columbia received 20.8 cm (8.19 in.) of rain in 12 hours, with a total of 31.5 cm (12.4 in.) in four days. The Congaree River near the CFFF crested at 37.6 m (123.3 ft) above MSL, causing flooding of low-lying areas near the CFFF (WEC 2019b). During that flooding event, roads to the CFFF were closed, and the city water

supply was interrupted, leading to a 3-day closure of the CFFF. The main manufacturing building was not impacted by the flood, and there were no safety issues due to flooding (WEC 2019b).

3.7.2 Air Quality

Onsite meteorological data recorded August 1, 1972 to July 31, 1973 for wind speed, wind direction and atmospheric stability indicated stable conditions exist at the site 47 percent of the time, neutral conditions 43 percent, and unstable conditions 10 percent. Wind rose data from the Columbia Metropolitan Airport from 1948–1981 was in general agreement (WEC 2019b).

Richland County is designated as unclassifiable/in attainment for all criteria pollutants for which National Ambient Air Quality Standards (NAAQS) have been established (40 CFR 81.341). Criteria pollutants include ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. Previously, portions of Richland County and the neighboring Lexington County had exceeded the 1997 8-hour ozone NAAQS, but EPA deferred designating the counties as nonattainment due to participation in the Early Action Compact. As part of this Compact, Richland and Lexington Counties reduced ozone concentrations to meet the NAAQS by the December 31, 2007, deadline specified in the Compact. On April 15, 2008, both Richland and Lexington Counties were designated as being in attainment of the 1997 8-hour ozone NAAQS (40 CFR 81.341). Richland County is designated as unclassifiable/in attainment for all NAAQSs; therefore, a conformity analysis for direct and indirect emissions is not required (40 CFR 93.153). On September 30, 2016, SCDHEC submitted to EPA a recommendation that all counties in South Carolina be designated as in attainment for the revised 2015 8-hour ozone NAAQS (SCDHEC 2019b). The SCDHEC is awaiting a response from EPA, and all counties are currently listed as “attainment/unclassifiable” in 40 CFR 81.341 for the 2015 8-hour ozone standard.

The SCDHEC, Bureau of Air Quality, issued an air permit for CFFF operations in May 2003, documenting that the CFFF is neither a “major” source nor a “significant minor” source regarding criteria pollutant emissions. The CFFF is classified as a minor-source operator by the State (WEC 2019b). The WEC’s air permit addresses NAAQS pollutants, nitric acid, and opacity. The WEC’s operating permit limits are based on process throughputs at rated capacities as outlined by SCDHEC in South Carolina Air Quality Control Regulation 61-62. Emission rates are calculated based on these throughputs because the permit does not require monitoring for any of the six criteria pollutants under the NAAQs (WEC 2019). The most recent emissions modeling from SCDHEC in 2018, which is provided in Table 3-6, demonstrates that all nonradiological gaseous effluent concentrations were below regulatory limits, with sulfur dioxide (SO_2) having the highest concentration (WEC 2019b).

The WEC monitors radiological gaseous emissions from 47 stacks for compliance with the National Emission Standards for Hazardous Air Pollutants under 40 CFR Part 61. In accordance with 40 CFR Parts 50 and 61 and 10 CFR Part 20, stacks are outfitted with scrubbers, high efficiency particulate air filters, or both to minimize the discharge of gaseous effluents. Offsite dose is calculated based on the combined emissions concentrations. Ambient air also is monitored at four onsite locations for the presence of radioactive material.

Table 3-6 Nonradiological Air Pollutants Released at CFFF

Constituent	Tons Per Year
PM	5.74
PM_{10}	5.39
$PM_{2.5}$	5.39
SO_2	43.04
NOx	28.47
CO	16.01
VOC	4.11
Nitric acid	0.77

Source: Taken from WEC 2019b
The air permit is currently being processed under timely renewal with SCDHEC.

Recent improvements in the emissions and the science of climate change have enabled the U.S. Global Change Research Program to estimate regional climate changes in the United States (GCRP 2018). Projected changes in the climate for the southeastern United States include more frequent and lengthier summer heat waves, increasing precipitation, and increased extreme events such as drought and heavy rainfall. Extreme heavy precipitation events are expected to increase in both frequency and intensity. Ecosystems in the southeast may be transformed by the combination of drought and heavy rainfall, leading to impacts on forests and aquatic and wetland ecosystems (GCRP 2018). Across the southeast, there has been an increase in the number of days with high minimum temperatures (night time temperatures that stay above 24°C [75°F]), and this trend is projected to intensify, impacting the ability of some people to recover in cooler temperatures at night. Stagnant air masses occur more often in the southeast than in other regions of the country, and higher levels of fine particulate matter such as $PM_{2.5}$ [particulate matter with an aerodynamic diameter of 2.5 microns or less], which cause heart and lung disease (GCRP 2018). Increasing temperatures may cause an increase in ground level ozone, and longer and drier fall seasons may result in a longer ozone exposure period, resulting in human health impacts.

3.8 Noise

3.8.1 Noise Guidelines

The EPA has identified an equivalent continuous noise level (24-hour) of 70 decibels or less as adequate to protect against hearing loss over a lifetime and a day-night average sound level outdoors of 55 decibels or less to be adequate to protect against activity interference and annoyance (EPA 1974, Table 1). The EPA identifies noise at/or greater than 55 A-weighted decibels (a weighted measure used to approximate the noise response of the human ear), with a margin of safety determined to protect hearing, as causing outdoor-activity interference and annoyance. As points of comparison, heavy highway traffic at 91 m (300 ft) has a noise level of 60 A-weighted decibels and a gas-powered lawn mower at 30 m (100 ft) has a noise level of 70 A-weighted decibels. Noise levels lessen with increasing distance from the source.

The Federal Highway Administration has codified noise abatement criteria levels (Categories A to E) for noise-sensitive receptors based on types of land use and human activity. Table 3-7 gives some of the categories and their associated noise abatement criteria.

Table 3-7 Federal Highway Administration Noise Abatement Criteria Levels

Category	Location	Description	Level (dBA)[(a)]
A	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.	57
B	Exterior	Residential.	67
C	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, park lands, wildlife and waterfowl refuges, historic sites, schools, television studios, trails, and trail crossings.	67
D	Interior	Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.	52
E	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A through D or F.	72
F	(b)	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.	(b)
G	(b)	Undeveloped lands that are not permitted.	(b)

Source: 23 CFR Part 772, "Procedures for Abatement of Highway Traffic Noise and Construction Noise," Table 1
(a) Hourly A-weighted sound level decibels.
(b) Not identified in the regulation.

Richland County, South Carolina, has promulgated noise standards in Section 18-3, "Noise," of its Code of Ordinances (Richland County 2019c). These standards deem it "… unlawful for any individual within any residential zone of the unincorporated areas of the county to use or operate any radio, receiving set, musical instrument, phonograph set, television set, or other machine or device for the producing or reproducing of sound, or to create, assist in creating, permit, continue, or permit the continuance of any noise, including vehicular noise, in excess of sixty-two (62) decibels between the hours of 7:00 a.m. and 10:00 p.m. of one day and in excess of fifty-five (55) decibels between the hours of 10:00 p.m. of one day and 7:00 a.m. of the following day, or in a manner which is deemed to be excessive by the county sheriff's department." The standards further state that these noise level limits do not apply to industrial, commercial, or manufacturing noise.

3.8.2 Existing Noise Levels at the CFFF Site

Noise generated at the CFFF is that associated with operations of a large manufacturing facility. Sources of noise at CFFF include various industrial machines and equipment such as materials-handling equipment, paging and alarm systems, and engines. The primary source of noise at

the site boundary is vehicular traffic. The NRC staff is not aware of any noise surveys that have been conducted at the CFFF site.

The distance from the CFFF to potential receptors helps mitigate any offsite noise impacts from facility operations. Eight individuals live within 1.6 km (1 mi) of the CFFF and one church (WEC 2019b, Figure 3.10-2). There are no other noise-sensitive receptors (e.g., schools, hospitals, etc.) in close proximity.

3.9 Historic and Cultural Resources

The South Carolina Department of Archives and History commented during the 2007 license renewal that the WEC site has a very high probability of significant archeological properties. However, there is no record of any archeological surveys being completed.

Prehistoric inhabitants and historic Indian groups used the Congaree River region's diverse plant and animal resources. The Congaree Indians were a small tribe that farmed and built houses along the banks of the Congaree River next to other small Indian groups. In 1545, Spanish explorer Hernando De Soto provided an early account of the local inhabitants and natural setting of the region. By 1700, the population of Congaree Indians had been significantly reduced by smallpox and tribal warfare. Eventually the few remaining Congaree Indians were assimilated into the Catawba tribe (NRC 2007).

There is a small, fenced cemetery, the Denley Cemetery, (Figure 3-9) which operated from approximately 1890 to 1940. The cemetery was discovered in 2003 and contains less than 100 graves of African-Americans (WEC 2019b). Members of the Denley and Washington families of Lower Richland are buried there (South Carolina State Library 2008). The cemetery is located onsite approximately 304 m (1,000 ft) southeast of the main CFFF building, and its footprint is approximately 24 × 49 m (80 × 160 ft).

There are no historic properties located on the CFFF site registered on the National Register of Historic Places (NRHP). The NRHP database shows 11 prehistoric and historic properties located within an 8-km (5-mi) radius of the CFFF site. There are six prehistoric mound sites located on bluffs along the Congaree River in the Congaree Swamp National Park, and five sites are located near the town of Hopkins, South Carolina—Barber House, Bridge Abutments, Dead River Dike, Northwest Boundary Dike, and the Southwest Boundary Dike. During the 2007 license renewal review, the South Carolina Department of Archives and History noted five other sites located within 8 km (5 mi) of CFFF that are considered to have historical significance (NRC 2007).

Figure 3-9 Denley Cemetary (Photo provided by WEC)

3.10 Visual and Scenic Resources

As shown in Figure 2-2, the CFFF manufacturing facilities are located about 490 m (1,600 ft) from the nearest point on the site boundary. The main manufacturing building is set back approximately 760 m (2,500 ft) from the roadway. Access for vehicle and truck traffic from the CFFF to Bluff Road is provided by the main plant road (WEC 2019b). The area around the site is forested.

3.11 Socioeconomics

The CFFF site is in Richland County, approximately 13 km (8 mi) southeast of Columbia, the nearest population center. According to the 2010 Census, the State of South Carolina's population was 4,625,364, of which 384,504 resided in Richland County (USCB 2017a). The American Community Survey 5-year estimates that the total population for South Carolina is 4,893,444, of which 404,869 are in Richland County (USCB 2017b). Table 3-8 provides a comparison of income and earnings for South Carolina and Richland and Calhoun counties.

Table 3-8 Economic Characteristics for Richland County, Calhoun County, and South Carolina

Characteristic	Richland County	Calhoun County	South Carolina
Median Households Income	$52,082	$44,010	$48,781
Per Capita Income	$28,018	$24,766	$26,645
Median Earnings for Workers	$27,026	$31,337	$28,857
Percent in Labor Force	66.9%	55.4%	60.7%

Source: U.S. Census Bureau (USCB) 2017b

There are 8 people living within 1.6 km (1 mi) of the CFFF, 1,327 within 4.8 km (3 mi), and 8,668 within an 8-km (5-mi) radius. Those residents live primarily to the northeast along Bluff Road and Atlas Road and in the Hopkins, South Carolina, area (WEC 2019b).

Currently, 1,250 people are employed at the CFFF, which represents less than 1 percent of Richland County employment in 2017.

3.12 Environmental Justice

Under Executive Order (EO) 12898 (59 FR 7629), Federal agencies are responsible for identifying and addressing, as appropriate, disproportionately high and adverse human health and environmental impacts on minority and low-income populations. Independent agencies, such as the NRC, are not bound by the terms of EO 12898 but are, as stated in paragraph 6-604 of the executive order, "requested to comply with the provisions of [the] order." In 2004, the Commission issued the agency's "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions" (69 FR 52040), which states, "The Commission is committed to the general goals set forth in EO 12898, and strives to meet those goals as part of its NEPA review process." The NRC's environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority or low-income populations that could result from activities associated with the

continued operation of the CFFF. Such effects may include human health, biological, cultural, economic, or social impacts. Minority and low-income populations are subsets of the general public residing in the vicinity of the CFFF, and all are exposed to the same health and environmental effects generated from activities at the CFFF. However, unique characteristics of minority or low-income communities could create opportunities for disproportionately high and adverse impacts.

Staff guidance in NUREG-1748 (NRC 2003) recommends evaluating potential human health and environmental effects in a 4-mi (6.4-km) radius around CFFF. Demographic data for the area has been collected from the U.S. Census Bureau at the census block group[3] level. Minority and low-income populations are identified by determining the percentages of these populations within each of the census block groups. The percentages of minority and low-income populations are compared to the percentages at the county and State levels. Five census block groups are located within a 4-mi (6.4-km) radius of the CFFF site (Figure 3-10). Table 3-9 shows that four of the five block groups had greater than 50 percent minority populations, primarily comprised of Black or African-Americans, and one of the block groups has a greater than 50 percent low-income population. The CFFF site is located in a block group with an 83 percent minority population and next to a block group where minority and low-income populations are both greater than 50 percent. When minority or low-income populations in a block group exceed the State or county percentages by 20 percent or are more than 50 percent of the total population in a 4-mi radius from the facility seeking relicensing, the NRC will consider environmental justice in greater detail to determine whether there is a clear potential for significant offsite impacts to those communities. (NRC 2003). This analysis is presented in Section 4.12.

[3] Census block group is a geographical unit used by the U.S. Census Bureau. It is the smallest geographical unit for which the U.S. Census Bureau publishes sample data (USCB 2018).

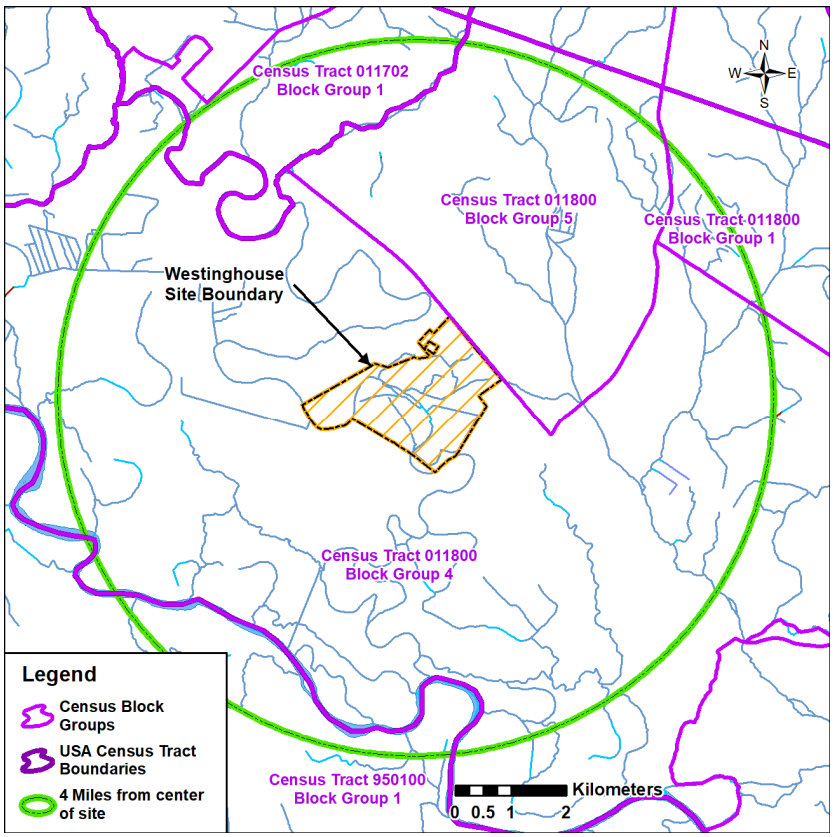


Figure 3-10 Census Block Groups within a 4-mi radius of the CFFF site

Table 3-9 Populations and Percentages of Minority and Poverty Status at State, County, and Block Group Levels

Census Level	Percent Minority	Percent Poverty	Total Population
Block Group 1, Census Tract 950100, Calhoun County, South Carolina	11%	9%	2265
Block Group 1, Census Tract 0117-02, Richland County, South Carolina	89%	18%	2518
Block Group 1, Census Tract 011800, Richland County, South Carolina	86%	11%	1748
Block Group 4, Census Tract 011800, Richland County, South Carolina	83%	25%	1452
Block Group 5, Census Tract 011800, Richland County, South Carolina	67%	60%	577
Richland County	57%	16.7%	404,869
Calhoun County	46%	18.3%	14,808
South Carolina	36%	16.6%	4,893,444

Source: USCB 2017b

3.13 Public and Occupational Health

The continued operation of CFFF would result in the potential direct exposure and release of radiological and hazardous materials resulting in potential health impacts on members of the public and occupational workers. During normal facility operations, occupational workers would be expected to be exposed to radiological and hazardous materials that are within regulatory limits. The workers are monitored for radiation exposure (WEC 2019b). Offsite effluent releases are monitored at release points and reported to the NRC on a semiannual basis. In addition, doses to the public are estimated on an annual basis.

3.13.1 Background Radiation Characteristics

Based on the most recent National Council of Radiation Protection and Measurements (NCRP) Report No. 160, *Ionizing Radiation Exposure of the Population of the United States* (NCRP 2009), for a U.S. resident, the effective dose per individual from ubiquitous background radiation is 311 mrem/yr (3.11 mSv/yr). The sources of this exposure are naturally occurring radionuclides, anthropogenic radionuclides (human produced), external radiation, and internal radiation (radionuclides in the body) (NCRP 2009). This value is important to compare to the estimated dose to a member of the public and to the occupational worker from CFFF operations.

The NRC noted in its 1985 environmental review that background radiation, expressed in terms of average gross alpha contamination, in the vicinity of the CFFF were 3.9×10^{-6} pCi/L in ambient air, 2.2 pCi/L in the Congaree River, and 1.0 pCi/L in offsite well water and drinking water (NRC 1985). The radiological monitoring data of onsite soil resulted in a 3-year average of 0.23 to 0.65 pCi/g of total uranium. The locations of the samples are in the same location as the ambient air monitors (NRC 1985).

3.13.2 Public Health and Safety

Potential public health impacts could result from release of radiological materials and nonradiological hazardous materials that are transported from the site through the air, surface water, or groundwater. According to WEC, the potential contaminants include uranium, ammonia, calcium fluoride, and hydrofluoric acid. The WEC conducts a radiological effluent monitoring program to meet the regulatory requirements in 10 CFR 70.59 “Effluent Monitoring Requirements.” Data from this monitoring program are used by WEC to perform annual assessments of dose to members of public from liquid and gaseous effluents to ensure that limits to the public given in 10 CFR 20.1301 are met and are ALARA (WEC 2014b). Doses at the CFFF site have been under 2 mrem/yr (e.g., WEC 2019d).

The radiological materials potentially released from the CFFF into the environment would be transported through the environment in a variety of ways and would expose the public through both internal and external exposure pathways. For the liquid exposure pathway, dose to the public would be through ingestion of drinking water and aquatic food, exposure from shoreline activities as well as swimming and boating, and ingestion of irrigated crops. For potential releases to the air, the exposure pathway would include direct radiation from deposited radioactivity on the ground and ingestion of crops and animal products that come in contact with radioactive material in the air.

WEC is required to meet the dose limits for individual members of the public as stated in 10 CFR 20.1301 (see Table 3-10) and demonstrate compliance with the dose limits at the site boundary as required in 10 CFR 20.1302. In addition, WEC uses guidance in Regulatory Guide 8.37, *ALARA Levels for Effluents from Materials Facilities* to demonstrate the offsite doses are ALARA (NRC 1993).

Table 3-10 Dose Limits for Individuals Members of the Public

Annual Dose Limit from Licensed Operations	
Individual member of the public	**0.1 rem/yr (1 mSv/yr)**
Dose in any unrestricted area from external sources	0.002 rem/hr (0.02 mSv/hr)
ALARA constraint per 10 CFR 20.1101(d)	0.01 rem/yr (0.1mSv/yr) from emissions of airborne radioactive material, excluding radon

3.13.3 Occupational Health and Safety

Occupational workers are exposed to health and safety risks at CFFF, including exposure to industrial hazards, hazardous materials, and radioactive materials. The types of industrial hazards at CFFF are typical of similar industrial facilities and include exposure to chemicals and accidents ranging from minor cuts to industrial machinery accidents. According to the ER, no serious injuries or deaths have occurred at the CFFF site since operations began in 1969 (WEC 2019b).

Health impacts to CFFF workers would be through chronic exposure or improper handling of nonradiological materials including ammonia, nitric acid, nitrates, and hydrofluoric acid. Other less toxic hazardous materials used at CFFF include degreasing solvents, miscellaneous lubricating and cutting oils, and spent plating solutions. The ER states that the CFFF Chemical Safety Program is designed to assure that all current and proposed chemical-use hazards are evaluated, and appropriate measures are taken to assure safe operations. Use of anhydrous ammonia at CFFF was eliminated in August 2011, and replaced by the use of aqueous ammonium hydroxide. This resulted in a reduction in chemical hazard risk (WEC 2019b).

The WEC is required to meet the occupational dose limits for workers as stated in 10 CFR 20.1201 and noted in Table 3-11. Workers are monitored for radiation exposure to ensure the occupational doses limits are met and maintained ALARA. The WEC is also required to limit risk to workers from accident conditions in accordance with 10 CFR 70.61.

Table 3-11 Occupational Dose Limits for Adults Established by 10 CFR 20.1201(a)

Tissue	Annual Dose Limit
Whole body or any individual organ or tissue other than the lens of the eye	More limiting of 5 rem/yr (0.05 Sv/yr) TEDE to whole body or 50 rem/yr (0.5 Sv/yr) sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye
Lens of the eye	15 rem/yr (0.15 Sv/yr) dose equivalent
Extremities, including skin	50 rem/yr (0.50 Sv/yr) shallow dose equivalent

3.14 Transportation

The CFFF site can be accessed by S 48 (or Bluff Road). The major transportation corridors in the Columbia area include interstates highways I-20 (east-west), I-26 (northwest to southeast), and I-77 (north to south). Other roads include US-21, US-76/378, and S 37. See Figure 2-1.

CSX Railroad runs two train lines within 8 km (5 mi) of the CFFF, but there are no rail lines or spurs on the CFFF site. The closest airport is the Columbia Metropolitan Airport, located 26 km (16 mi) away, northwest of the site. The Congaree River supports commercial barge traffic.

The SCDOT provides annual average daily traffic (AADT) counts by highway and highway segment. The AADT counts for two stations along Bluff Road decreased from 2017 to 2018, from 6,800 to 6,700 and 4,300 to 4,200 (SCDOT 2017, 2018). Since 2007, the counts have been decreasing.

There are approximately 1,250 employees at the CFFF, working in one of three shifts. The annual average daily workforce is 859 workers resulting in approximately 1,700 vehicles on the road (WEC 2019b).

The WEC approximates 1,342 shipments of chemicals, radioactive material, and waste annually which equates to approximately 7 vehicles per day (WEC 2019b). Therefore, vehicles either carrying workers or shipments represent 25 to 40 percent of the AADT count for the two Bluff Road stations.

Completed fuel assemblies are shipped to customers in NRC-approved packages. Low-level radioactive waste (LLRW) is shipped to NRC-licensed or NRC Agreement State-licensed LLRW disposal sites. The WEC must follow NRC, DOT, and SCDOT requirements for shipment of nuclear materials.

3.15 Waste Generation and Management

The WEC will continue to generate several types of solid waste from continued operation of the CFFF—combustible, hazardous, mixed, industrial, and radioactive wastes. The WEC manages these wastes by a combination of onsite processing, onsite storage, offsite disposal, incineration, and recycling.

Combustible wastes are generated through the manufacturing process. Combustible wastes containing uranium are either incinerated and leached to recover the uranium or shipped offsite to other licensed facilities for recovery. Noncombustible wastes and selected combustible wastes are packaged in compatible containers, compacted when appropriate, measured to verify the uranium content, and placed in storage to await shipment for further treatment, recovery, or disposal (WEC 2019b). The WEC stores drums of combustible waste containing uranium, waiting for uranium recovery via onsite incineration, in intermodal containers (sea-land containers) in an outdoor storage area. There are approximately 60 sea-land containers onsite that hold up to 150 drums each. During an inspection in May 2019, a hole in the roof of the sea-land container was discovered. Rain water that passed through the hole in the roof entered the containers and compromised the flooring and the drum lids. The compromised sea-land container was removed, and the drums were moved inside the main building for storage. The WEC created a CAP entry for the storage containers. (WEC 2019f).

The WEC is a large-quantity generator of hazardous wastes that include oils, solvents, plating solutions, and zirconium-laden wastes. The wastes are stored on an onsite storage pad until they are shipped for disposal offsite through permitted contractors. In 2017, WEC generated 105,607 kg (232,824 lb) of hazardous waste (WEC 2019b). The amount of waste generated in 2017 was significantly higher than that generated in 2013 (48,289 kg/yr) because of an increased amount of waste from the plating process. The WEC stated that it believes the amount of hazardous wastes at the CFFF have leveled out (NRC 2019b).

The WEC recently identified a small stream of mixed waste, a category of waste that is both hazardous and radioactive. Mixed waste is generated from batteries, PCB-containing ballasts, contaminated lamps, and lead shielding (WEC 2019b). The WEC expects to generate 5 to 10 drums of mixed waste per year (NRC 2019b).

Generation rates of nonhazardous waste (consisting of batteries, computers, oil filters and rags) have increased since 2013, from 4,218 kg/yr to 178,446 kg/yr in 2017, respectively, as result of changing recycling markets. Industrial trash waste from office areas and lunch rooms has decreased since 2013, from 292 MT to 201 MT in 2017. These wastes are stored on the onsite storage pad and disposed of offsite at a State-permitted landfill (WEC 2019b). In 2012, WEC implemented a recycling program for wood, corrugated cardboard, and rigid plastics. The WEC also implemented a food composting program to reduce food waste (NRC 2017a).

Calcium fluoride, removed from West Lagoon I and West Lagoon II, is either recycled or disposed of offsite. The WEC is currently permitted to release calcium fluoride with less than 30 pCi/g of uranium to an offsite concrete plant (WEC 2019b). The calcium fluoride is shipped offsite approximately every 2 years, as part of the lagoon dewatering process. The 2-year cycle includes dredging the lagoons of the calcium fluoride and then storing it nearby to dry. The average amount, based on data from 2014 to 2018, is 4,152 tons (WEC 2019b). The calcium fluoride is sampled to ensure it meets the free release criteria (<30 pCi/g). If it does not meet the criteria, WEC must either request a license exemption or ship offsite for disposal as LLRW (NRC 2019b). CFFF operations produce a variety of LLRW, including used packaging, clothing, paper, and tools. After sorting, the LLRW is transferred to an onsite waste processing station, where radiation surveys are conducted. The waste may then be decontaminated for free release or reuse, or shipped offsite for disposal at the Waste Control Specialists facility in Andrews, Texas. The LLRW is shipped offsite for disposal in 55-gallon drums or sea-land containers. The WEC stated that the amount shipped offsite, between 2010 and 2018 has ranged from 12,000 ft^3 to 38,000ft^3, respectively, with an annual average of 24,000 ft^3 (WEC 2019b).

4. ENVIRONMENTAL IMPACTS

In this section, the NRC staff presents its evaluation of the potential environmental impacts from continued operation of the CFFF for 40 years. In performing this evaluation, the NRC staff reviewed the WEC's LRA including the ER and supplemental information, visited the site, collected information from other State agencies, and considered information presented in previous environmental reviews prepared by the NRC for the CFFF.

4.1 Land Use Impacts

Under the proposed action, WEC does not expect any new construction or changes to current facility operations or buildings. The WEC will be conducting characterization and environmental investigations required by the CA and RI Work Plan in several areas of the site, including areas that were previously undisturbed. Installation of groundwater monitoring wells and collection of soil samples are temporary activities and involve minimal land disturbance. The use of the land in the surrounding area is not expected to change from its current uses. Therefore, the NRC does not expect a significant impact on land use during continued operations at CFFF.

4.2 Geology and Soil Impacts

The WEC did not propose any facility expansion to support continued operations for an additional 40 years. The WEC is conducting investigations into site contamination, which will involve installing groundwater monitoring wells and lithographic borings.

As noted in Section 3.2, there has been soil contamination from VOC, inorganic, and radiological contaminants. Contaminants can leach from the subsurface soil and migrate with the groundwater (AECOM 2014). The concentration of uranium in the surface soil has slightly increased from less than 1 pCi/g in the late 1970s to 2–4 pCi/g in 2015. Uranium in the surface soil, most likely from deposition of gaseous effluents, would continue through the license renewal period and has the potential to increase the concentration of uranium in the surface soil and potentially groundwater through infiltration of rainwater. The WEC has initiated an effort to collect surface soil samples from the entire CFFF site to gather additional data on radionuclide concentrations in the surface soil (NRC 2019b). For decommissioning purposes, NRC guidance provides surface soil screening values for common uranium isotopes that range from 8–14 pCi/g, which would be deemed in compliance with the 25 mrem/yr unrestricted dose limit in 10 CFR 20.1402 (NRC 2006).

As discussed in Section 3.2, multiple releases at the CFFF have resulted in uranium entering into the subsurface and into the environment. Because the levels are below WEC's criterion for immediate remediation and/or there is limited access to most impacted soils, the contaminated soil will not be remediated until decommissioning. As such, the contaminated material may continue to be a source of future groundwater and/or surface water contamination if the material leaches into the water table. The impacts of the releases on groundwater are addressed in Section 4.4.

Results from ongoing monitoring and site investigations will help WEC develop mitigative or corrective actions, if needed, to address the impacts of past or future leaks or spills on the

subsurface and surficial soil. The NRC will continue its oversight and inspection activities at the CFFF, including the environmental monitoring program. The WEC also must consider contamination, including subsurface contamination involving residual radioactivity, when periodically evaluating whether it has set aside sufficient funding to cover remediation efforts that will be necessary for decommissioning. Therefore, with ongoing monitoring, NRC oversight, and decommissioning funding and planning, the NRC does not expect significant impacts on soil as a result of continued operations at CFFF.

4.3 Surface Water Impacts

In this section, the NRC considers potential impacts on both the use and quality of surface water as a result of CFFF's continued operations.

4.3.1 Surface Water Consumptive Use

As noted in Section 3.3, WEC gets its service water from the City of Columbia, which takes water from the Congaree River. The WEC discharges its treated liquid effluent directly into the Congaree River in accordance with its NPDES permit. The WEC does not use any onsite surface water. The renewal of the CFFF operating license for an additional 40 years does not involve changes to current operating practices, including expected water usage or discharge amounts. Therefore, the NRC does not expect any impact on the consumption of surface water during the license renewal period.

4.3.2 Surface Water Quality

4.3.2.1 Congaree River

Potential impacts on water quality of the Congaree River include those related to the continued discharge of liquid effluents directly into the river. The content and amount of liquid effluent to be discharged into the river would be similar to current discharges. The WEC would continue to be governed by its NPDES permit for discharge into the Congaree River and the NRC expects that WEC would comply with the conditions set forth in that NPDES permit. The WEC has submitted a timely renewal application for its NPDES discharge permit, and SCDHEC currently is reviewing the application (WEC 2017d). The NPDES permit must be renewed every 5 years and, therefore, the conditions in the permit could be adjusted as necessary. The WEC also would be expected to continue to comply with NRC limits on liquid effluents. Therefore, the NRC does not expect significant impacts to the Congaree River from continued operations.

4.3.2.2 Onsite Surface Water

Onsite surface water bodies include Mill Creek, Sunset Lake, and Gator Pond. Onsite surface water is not a source of drinking water. The WEC has a NPDES permit for stormwater. Surface water and stormwater drainage is released through a single outfall ("C" valve), which is attenuated by its movement through Mill Creek and Sunset Lake before reaching the Congaree River. Contamination can enter the surface water either by groundwater discharge or surface water flow. At Gator Pond, the water will evaporate, recharge to the groundwater aquifer, or be entrained in the pond sediment. For Sunset Lake, the water could migrate into Mill Creek, evaporate, or be entrained in the sediment. It is possible that contamination in the surface

water of Mill Creek and Sunset Lake, after a portion of it absorbed in bed sediment and the remainder diluted in the relatively large water volume in the Creek and Lake, could eventually empty into the Congaree River.

The WEC has a sampling and monitoring program for surface water as part of its NRC license requirements (summarized in Section 2.4.1). The monitoring program previously required three surface water samples to be taken quarterly and analyzed for gross alpha and gross beta (WEC 2007). However, going forward, WEC will sample seven surface water locations (see Figure 2-7) to better monitor for migration of existing contamination or new unintended abnormal releases. The WEC also added two additional sediment collection points from within Lower Sunset Lake and Gator Pond. This new annual sampling requirement will help demonstrate whether any contaminants are potentially accumulating in Sunset Lake or Gator Pond, into which shallow groundwater discharges.

Future episodes of significant rainfall, such as the rain event in October 2015, could again cause the lagoons to overflow, possibly resulting in an uncontrolled release of their contents into nearby surface water bodies. However, the NRC expects that as happened during the October 2015 event, WEC would notify SCDHEC of such an event, and if needed, SCDHEC could require immediate corrective actions. The WEC also would inform the NRC within 30 days of any violations of their NPDES permit (WEC 2019c).

The RI Work Plan (WEC 2019e) lays out additional investigations of the site's surface water and sediments that WEC will perform to better understand migration pathways and connections between groundwater and surface water. The RI Work Plan includes performing slug tests during installation of floodplain wells to determine the hydraulic conductivity of the sediments and lithologic borings to understand the subsurface characteristics. Depth profile (bathymetric) surveys will be taken of the Upper and Lower Sunset Lakes and Gator Pond to help understand connectivity between the surface water and groundwater. In addition, the RI Work Plan calls for additional surface water and sediments samples to be collected from the onsite ditches and water bodies. Based on the results of those samples, further investigation may be necessary.

The WEC is expected to continue to comply with its NPDES permit requirements for stormwater runoff as regulated by the SCDHEC. The WEC has an environmental monitoring and sampling program for surface water and sediments that can help identify potential migration pathways and indicate if there is an upward trend in existing contaminants. The NRC will continue to inspect WEC's compliance with its NRC-licensed environmental monitoring program. The WEC's ongoing site investigation under the CA will help fill data gaps in migration pathways and address the impacts of past or future leaks or spills on the surface water. Once either SCDHEC approves WEC's RI Report or within five years of the license renewal, whichever comes first, WEC will be required to resubmit its environmental sampling and monitoring program for NRC review and approval. The WEC has developed a CSM and procedures to help make informed decision on changes to its monitoring protocols based on information learned from investigations and sampling data. A license condition requires WEC to enter groundwater and surface water results above Federal and State limits into its CAP. Therefore, the NRC expects that, although there is existing surface water contamination onsite at CFFF, potential impacts on surface water quality as a result of continued operations would be noticeable but not significant.

4.4 Groundwater Impacts

As part of its analysis of the impacts on groundwater, the NRC considers the potential impacts on the consumption of and quality of groundwater.

4.4.1 Groundwater Consumptive Use

The WEC does not currently use groundwater nor are there any plans to use groundwater in the future; therefore, there are no potential impacts from consumptive use of groundwater.

4.4.2 Groundwater Quality

Groundwater at the CFFF site is classified by South Carolina as a source of drinking water, even though WEC is not currently using groundwater as a source of drinking water. As described in Section 3.4, the groundwater has been contaminated with VOCs, inorganics, gross alpha, uranium, and Tc-99 from past activities, including spills and leaks.

The SCDHEC stated in its March 22, 2018, letter, the groundwater is classified GB, which means the groundwater is a current or potential source of drinking water, therefore, the groundwater must meet the MCLs established in the State's primary drinking water regulations (R.61-58) (SCDHEC 2018a).

The WWTP has been a source of groundwater contamination and likely will continue to be a source of contamination. Therefore, the NRC finds it likely that during the 40-year license renewal period, the liners of the wastewater lagoons will need to be replaced again. The liner of the East Lagoon has passed its expected lifespan, and the lagoon itself has accumulated sediment that contains uranium and Tc-99 and efforts to characterize the sediment are planned (WEC 2019e). Leak events since 2008 and their subsequent investigations also suggest previous plant operations may have contributed to unknown amounts of contamination to unknown areas of the site, including inorganic and radiological elements that could potentially impact onsite groundwater resources in the future.

4.4.2.1 Nonradiological Contaminants

Volatile Organic Compounds

The former oil house, previously a source of VOC contamination, has been removed. Studies conducted by WEC since the assessment in 1994 indicated that the source area is near the West II Lagoon, although not the West II Lagoon itself (WEC 2019b). Currently, the VOC plume is within the boundaries of the CFFF property. The WEC had entered into a VCC with SCDHEC to address VOCs in the groundwater (SCDHEC/WEC 2016). However, WEC and SCDHEC have replaced the VCC with the comprehensive CA. In the RI Work Plan required by the CA and submitted to and approved by SCDHEC, WEC identified vapor intrusion in an area where VOCs have been detected in shallow groundwater as a potential exposure pathway for workers. The WEC, based on the CSM required by the CA, also identified additional data needs regarding the extent of VOCs in areas upgradient from the known existing plume and the western portion of the CFFF property. The NRC expects that WEC will comply with any requirements established by the CA. The NRC also expects that WEC will follow through on

actions laid out in the RI Work Plan and subsequent corrective actions, if necessary, as required by SCDHEC. Therefore, although there is VOC contamination in the groundwater, NRC staff does not expect the impacts on groundwater to be significant because WEC is continuing to investigate the source of VOC contamination and will take corrective actions if necessary and/or as required by SCDHEC through the CA.

Inorganics

Concentrations of nitrates and fluoride exceed their respective MCLs, and ammonia concentrations are still elevated. Groundwater data indicate that the plumes remain within the boundaries of the CFFF property, primarily around the WWTP and the Gator Pond and Sunset Lake areas. Four out of the six WWTP lagoons, which WEC determined were the sources of the inorganics, have been relined. Based on WEC's previous experience with the performance of the lagoon liners, there is the potential that the lagoons will have to be relined within the license renewal period. Through the CA RI Work Plan, WEC also proposes to investigate sediment that has accumulated in the East Lagoon and explore potential corrective actions; for example, relining the lagoon or removing it from service to reduce the likelihood that the lagoon sediment will continue to contribute to onsite groundwater inorganic contamination. Further, the NPDES permit requires sampling for nitrates and fluoride. Therefore, although the groundwater is contaminated with inorganics, NRC staff but does not expect the impacts on groundwater to be significant because WEC is continuing to investigate the source of inorganics and will take corrective actions if necessary and/or as required by SCDHEC.

4.4.2.2 Radiological Contaminants

Operations have resulted in abnormal leaks and spills that allowed the release of uranium and Tc-99 to the environment. Section 2.4 describes the environmental monitoring program and Section 3.4 discusses the existing radiological contamination in the groundwater.

Recent sampling results (WEC 2019a, c) from the newly installed CWW line wells indicate there is an existing uranium plume southwest of the main plant building. The plume is very likely a direct result of previous plant operations and the extent of the plume, particularly beneath the plant buildings, cannot be fully delineated until decommissioning. The 2018 HF spiking station leak could potentially result in future uranium contamination in the groundwater. The WEC has installed sentinel wells that may identify contamination from the building. The sampling results from the intermodal (sea-land) container leak suggested low concentrations of uranium in the top 30.5 cm (1 ft) of soil. The depth to which the leaked contaminants might have migrated has not been determined but further sampling and analyses is planned, as noted in RI Work Plan Addendum 1 (WEC 2019f). The composition and amount of contaminants, including uranium and Tc-99, accumulated in the sediment of the East Lagoon remain to be characterized (WEC 2019e). It is likely that the contaminants have leaked through the 40-year old liner and migrated into the vadose zone beneath the lagoon.

There is also a plume of Tc-99 in the lower portion of the shallow groundwater aquifer based on recent groundwater sampling results. The source and extent of the Tc-99 plume has not been fully delineated. The likely source of the Tc-99 is the recertification building and/or the WWTP lagoons, but the RI Work Plan identifies additional investigations to determine the source of the Tc-99 contamination.

At this time, the groundwater contamination is onsite and has not migrated offsite. The monitoring data indicate the contamination is only present in the shallow water-table aquifer. Data from the three deep Black Mingo Aquifer wells do not indicate the presence of any radiological element contamination. Although the deeper Black Mingo Aquifer is likely confined, groundwater level data has indicated that both upward and downward gradients may exist between the shallow aquifer and the Black Mingo Aquifer beneath the CFFF site. The likelihood of water, and potentially contaminant, exchange is relatively small but cannot be completely ruled out (e.g., improperly abandoned wells in the Black Mingo Aquifer). However, there is no currently known pathway or scenario for exposure to the public because there are no onsite drinking water wells. According to the RI Work Plan, there are hunt club property owners to the east, south, and west of the CFFF property, within a one-mile radius, however, there is no information about domestic or irrigation wells on these properties. The WEC states that its contractor will contact the hunt club owners and will perform a reconnaissance of residences within a one-mile radius of the site (WEC 2019e). According to the August 2019 status update to SCDHEC, WEC intends to start reaching out for the offsite well surveys in September 2019 (SCDHEC 2019a). Exposure pathways through soil and groundwater to onsite workers, particularly those that perform work related to subsurface utilities, do exist during the renewal license period.

The groundwater monitoring program required for WEC's license will include sampling 59 groundwater wells twice a year during both the wet and dry seasons for both uranium and Tc-99. The groundwater wells are grouped into four types: (1) those that monitor the perimeter of the site to indicate offsite migration; (2) those that monitor the WWTP lagoons as identified in the NPDES permit; (3) those that monitor current plumes of uranium and Tc-99; and (4) those that act as sentinel wells for each OU. The wells monitored could change through the license renewal period based upon evaluation by WEC, particularly the monitoring wells for existing or newly discovered plumes that will be used to delineate the boundary of the plumes and identify their center of mass. The WEC created several procedures that outline their decision-making process for evaluating the results of its environmental monitoring program. The procedures outline how WEC will manage and interpret the sampling data, how to maintain and use its CSM, and how to determine when remediation is necessary and what remedial activities should be undertaken. The NRC has added two license conditions related to the environmental monitoring program. First, if Federal or State limits for groundwater or surface water are exceeded, a license condition requires WEC to enter the exceedance into its CAP. Second, upon SCDHEC's approval of the RI Report as required by the CA or within five years of the most recent NRC license renewal, WEC will submit their monitoring and sampling program to NRC for review and approval.

The SCDHEC also requires groundwater monitoring as part of WEC's NPDES permit requirements, including monitoring for radionuclides. The draft NPDES permit currently out for public comment (September 12 through October 11, 2019) has requirements for lagoon liner inspections. The WEC reports the groundwater monitoring results to SCDHEC annually. Based on results of the annual sampling or during a NPDES renewal review, SCDHEC could adjust monitoring requirements if deemed necessary, including requiring additional assessment.

As part of the CA with SCDHEC, WEC will continue to assess and address releases of radiological and nonradiological contamination at the site. The RI Work Plan indicates that 29

monitoring wells, 16 lithographic borings, 56 soil samples, 13 surface water samples, and 18 sediment samples will be installed/collected during the initial phase of the RI Work Plan. Subsequent addenda prepared by WEC address contamination released from one of the intermodal (or sea-land) storage containers within the southern storage area OU and to characterize the sediment in the East Lagoon.

The NRC, through continued oversight, will inspect WEC's compliance with its environmental monitoring program, documented in Chapter 10 of its LRA and that WEC follows its procedures for managing its environmental monitoring program.

To meet the criteria for unrestricted release, WEC must remediate the site to meet the public dose standard in 10 CFR 20.1402 (i.e., less than 25 mrem/yr), including dose from groundwater. The WEC also must consider the volume of onsite subsurface material containing residual radioactivity that will require remediation when it is preparing its detailed cost estimate in the DFP for NRC review and approval.

Nonradiological and radiological contamination exists in groundwater in the shallow aquifer at CFFF at concentrations above EPA's drinking water standards, and that it is also likely there will be more leaks and spills during the 40-year license renewal term. However, the impacts would not be significant because of the following factors and mitigation measures:

- The groundwater contamination currently remains onsite and is not present in the deeper Black Mingo Aquifer.
- There is no known current pathway for human consumption of the onsite groundwater.
- As a requirement of the CA with SCDHEC, WEC is undertaking site investigations required in the RI Work Plan.
- The WEC has made substantial changes to its environmental monitoring program by increasing the number of groundwater wells and increasing the number of sediment, soil, surface water, and groundwater samples collected.
- The WEC has developed a CSM and procedures to help make informed decisions on changes to its monitoring protocols and need for remediation.
- The WEC must keep records of subsurface contamination and maintain sufficient funds to decommission the site as required by NRC regulations.
- The NRC will continue to inspect WEC's compliance with its NRC-licensed environmental monitoring program.
- The WEC must meet NRC regulations regarding dose to the public and to workers.
- The WEC will complete the CA and RI Work Plan.
- The WEC will submit its environmental monitoring and sampling program to NRC for review and approval upon either SCDHEC's approval of the RI Report as required by the CA or within five years of the most recent license renewal.
- When Federal or State radiological contaminant levels are exceeded in groundwater or surface water, WEC is required to enter the exceedance into its CAP.

4.5 Ecological Resources

During continued operations, impacts on ecological resources could result from elevated noise levels from daily operational activities and increased turbidity or introduction of pollutants from site runoff and discharges. Disturbance from daily activities or elevated noise levels are likely to have minimal impacts on wildlife, given that the species closest to the developed areas of the site are generally tolerant of human disturbances because the facility has been in operation for the past several decades. In response to any disturbances, birds and wildlife could move out of the immediate area and find an adequate, similar habitat within the vicinity.

Operation of the CFFF would result in some degradation of aquatic habitats due to direct impacts (e.g., effluent discharges into the Congaree River) and indirect impacts from site runoff. Direct impacts from the discharge of effluents into the Congaree River would be limited due to the chemical and quantity limits described in the NPDES permit (WEC 2014b), to which CFFF must adhere. In addition, the volume of discharged effluent would be a small percentage of the overall flow of the Congaree River, and therefore, the concentration of discharged effluent would be quickly diluted. Mobile biota could likely swim around the effluent plume to avoid contact with chemical and other pollutants. A small portion of drifting or weakly swimming biota (e.g., fish eggs and larvae) could be exposed to the effluent plume, but exposure times while moving through the effluent plume likely would be limited because of the relatively small discharge rate compared to the flow rate of the river. Additional direct impacts on aquatic biota and habitats would be limited given that WEC would not directly obtain water from surface water bodies.

Indirect impacts on aquatic habitats and biota during operations could include runoff that may contain sediments, contaminants from road and parking surfaces, or herbicides. However, impacts on aquatic resources are expected to be minimal because of the distance to the Congaree River and site-specific programs to prevent pollution from stormwater runoff. The SCDHEC intends to conduct a fish tissue study, collecting Bluegill Sunfish (Brim) from the Congaree River in the vicinity of the CFFF site to determine if the fish are up-taking uranium and fluoride at levels that could impact human health (SCDHEC/WEC 2019). There has been no biota sampling from onsite water bodies.

Continued operation of the CFFF could have beneficial impacts for some wildlife. The WEC volunteered to participate in the Wildlife and Industry Together program, which is sponsored by South Carolina Wildlife Federation (SCWF 2017). Members of the program establish conservation and education goals to improve wildlife health (WEC 2014b). To become certified by South Carolina Wildlife Federation, WEC agreed to conduct wildlife habitat enhancement projects on or near the CFFF site, environmental education for employees, and community outreach.

Given that habitat disturbances during operations would be negligible, any disturbed wildlife could find similar habitat in the vicinity, and direct and indirect impacts on aquatic habitats and biota would be minimal, the NRC staff concludes that impacts on ecological resources during continued operations would not be significant.

4.6 Special Status Species and Habitats

Section 3.6 discusses the seven Federally-listed species that may occur near the CFFF. Six of the seven species are under FWS's jurisdiction. On May 12, 2015, the NRC staff sent a letter to the FWS describing the proposed action and requested FWS's concurrence with NRC's determination that impacts on Federally listed protected species at the CFFF were unlikely (NRC 2015d). In a letter dated May 20, 2015, FWS concurred with the NRC's determination that the proposed activity is not likely to adversely affect the Federally-listed species under FWS's jurisdiction (FWS 2015).

The NRC (2019e) informed FWS of the additional site investigation activities—installation of groundwater wells—and stated that those activities were short-term and involved minimal land disturbance. The NRC also confirmed that the list of species remained the same (see Table 3-4). The FWS responded that they had no objections to the NRC's finding (FWS 2019).

One of the Federally-listed species—the Shortnose Sturgeon—is under NMFS jurisdiction. On August 16, 2017, the NRC submitted a Biological Evaluation to the Southeast Regional Office of NMFS (NRC 2017b). In its evaluation, the NRC determined that the potential impacts would be insignificant and therefore concluded that the proposed action may affect, but is not likely to adversely affect, the Shortnose Sturgeon. The NMFS (2017a, b) submitted several questions to the NRC staff concerning the license renewal and its potential impacts on the Shortnose Sturgeon, and the NRC provided NMFS the supplemental information it requested (NRC 2018c, 2017c, d, e). Included in NRC's responses was the NRC's effect determination for the Atlantic sturgeon, which was a no effect determination because the Atlantic sturgeon and its critical habitat do not occur in the action area (NRC 2017e). The NMFS responded on April 12, 2018, concurring with the NRC's determination regarding the Shortnose Sturgeon (NMFS 2018).

The NRC staff recently informed NMFS of WEC's additional site investigation activities and changes made to its draft NPDES permit (NRC 2019f). The NMFS responded and confirmed that its position on the NRC staff's finding of *may affect, but is not likely to adversely affect* remained the same, and that re-initiation of consultation with NMFS was not required.

4.7 Air Quality

Under the proposed action, there would be no new construction or change in operations. The WEC would continue to comply with permit limits for criteria pollutants, nitric acid, and opacity set by SCDHEC and the stationary source standards set by the National Emission Standards for Hazardous Air Pollutants. The CFFF is located within an attainment area for the NAAQSs. The proposed action does not involve changes to equipment operations, workforce size, or truck shipments.

On September 22, 2009, the EPA issued a final rule for mandatory greenhouse gas (GHG) reporting from large GHG emission sources in the United States (74 FR 56260). In general, the threshold for reporting is 25,000 tons carbon dioxide equivalent (CO^2eq) emissions per year, excluding mobile-source emissions. On May 13, 2010, the EPA issued the GHG Tailoring Rule. This rule set the thresholds for a phase-in approach to regulating GHG emissions under the prevention of significant deterioration (PSD) and Title V permitting programs (75 FR 31514).

Beginning on January 2, 2011, operating permits issued to major sources of GHGs under the PSD or Title V Federal permit programs must contain provisions requiring the use of best available control technology to limit the emissions of GHGs, if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 tons/yr of CO^2eq.

Based on its review of previous large construction and operation projects that did not reach these thresholds, the NRC staff estimates that the GHG emissions from the proposed continued operation of CFFF would be below the 25,000 tons/yr threshold and would not be significant.

The WEC would also continue its sampling and monitoring program to ensure radiological emissions meet 10 CFR Part 20 limits. The program includes 47 stacks as well as 4 onsite locations monitored for the presence of radioactive material. According to the air permit issued by SCDHEC, monitoring of air emissions for NAAQS criteria pollutants is not required (WEC 2019b).

As discussed in Section 3.7 of this EA, projected changes in the climate for the southeastern United States include more frequent and lengthier summer heat waves, increasing temperatures, increasing precipitation, and an increase in extreme events such as drought and heavy rainfall. In a higher temperature environment, the formation of ozone due to emissions of nitrogen oxides from onsite equipment may increase. However, air emissions due to equipment operation are localized and temporary and unlikely to contribute measurably to ozone formation. Therefore, the NRC expects that the impacts on air quality from continued operation at the CFFF would not be significant.

4.8 Noise

Under the proposed action, WEC does not plan any new construction or any changes to the CFFF operations. Given the distance of the CFFF from the site boundary, noise from CFFF operations is not detectable at the boundary. Therefore, the NRC expects that there would be no significant impacts due to noise as a result of continued operation.

4.9 Historic and Cultural Resources

Under Section 106 of the National Historic Preservation Act (NHPA), the NRC must evaluate the impact of the license renewal on historic and cultural resources. In accordance with 36 CFR 800.8, “Coordination with the National Environmental Policy Act,” the NRC is using the NEPA process to coordinate its obligations under NHPA Section 106. Because no land was going to be disturbed outside of previously disturbed areas, the NRC had preliminarily concluded that there would be *no effect* to historic properties, if present. The NRC staff contacted the Catawba Nation about its *no effect* determination and asked for comment (NRC 2015d) but did not receive a response. On May 12, 2015, the NRC staff issued its determination that no historic and cultural resources would be affected by the proposed 40-year licensing renewal to the South Carolina State Historic Preservation Office (SHPO) (NRC 2015b). On May 28, 2015, the SHPO concurred with the NRC’s determination that no properties listed in or eligible for listing in the NRHP will be affected by the proposed action (SCAHC 2015).

The SHPO has indicated that the CFFF site has a high probability of significant archeological properties, however, no archeological surveys have been conducted at the site. There are no NHRP-listed properties within the CFFF boundary. The Denley Cemetery is currently maintained by WEC and it is expected that WEC will continue its upkeep. The WEC must follow state laws regarding burial sites and cemeteries.

Although WEC did not propose new construction, as a result of site investigations it was installing groundwater monitoring wells and conducting sampling in areas of the property that were previously undisturbed. The location and number of wells to be installed could change as WEC continues to implement the RI Work Plan. Contractors installing new groundwater wells will follow procedures and use technology such as ground penetrating radar to avoid subsurface objects (e.g., underground utilities) and thus should be able to avoid digging in an area that might have remains or artifacts. The WEC's Environmental Protection Guidelines and Checklist includes considerations for archeological or historical sites when doing new onsite work (NRC 2017a). In July 2019, the NRC informed the Catawba Indian Nation Tribal Historical Preservation Officer (THPO) and the SHPO of the additional site investigation activities, and requested their concurrence that the NRC's previous no effects determination remained the same (NRC 2019g, h). To date, the NRC has not received a response from the SHPO or THPO.

4.10 Visual and Scenic Resources

The CFFF is an existing facility set back from Bluff Road. Under the proposed action, no new construction would take place and no changes are planned for existing structures. The CFFF site is expected to remain similar in appearance throughout the proposed 40-year license period. Therefore, no impacts on visual and scenic resources are expected because of continued operation.

4.11 Socioeconomics

The proposed license renewal does not involve any changes in operations or staffing levels. Staffing levels are expected to remain the same, therefore no change in socioeconomic impacts would be expected in Richland County as a result of CFFF continuing to operate for an additional 40 years.

4.12 Environmental Justice

In this section, the NRC staff describes the potential human health and environmental effects of the proposed action (license renewal) on minority and low-income populations.

The NRC addresses environmental justice matters for license renewal by (1) identifying the location of minority and low-income populations that may be affected by the continued operation of the CFFF during the license renewal term, (2) determining whether there would be any potential human health or environmental effects to those populations and special pathway receptors (groups or individuals with unique consumption practices and interactions with the environment), and (3) determining whether any of the effects may be disproportionately high and adverse. Adverse health effects are measured in terms of the risk and rate of fatal or

nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionately high environmental effects refer to impacts or risks of impacts on the natural or physical environment in a minority or low-income community that are significant and appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts.

Table 3-9 and Figure 3-10 shows the location and percentages of minority and low-income population block groups residing within a 4-mi (6.4-km) radius of CFFF. The 4-mi (6.4-km) area of impact is consistent with identifying (or defining) the geographic area of analysis in NRC's policy statement on environmental justice. Information presented in Table 3-9 shows that four of the five affected block groups had greater than 50 percent minority populations, primarily comprised of Black or African-Americans, and one block group has a greater than 50 percent low-income population.

The community does not have access to public water or sewer, and solely use groundwater for its water source. Residents in the Hopkins community have expressed concerns about groundwater quality impacts from operations at WEC. To help address those concerns, Richland County and the SCDHEC both sampled private wells for contaminants found at WEC. Richland County sampled 62 wells and all results were below the EPA standards for uranium (Richland County Council 2019). The SCDHEC sampled 13 private wells between August and September 2018, and those results did not indicate the presence of uranium (SCDHEC 2019a). The results support a conclusion that groundwater contamination from WEC has not migrated upgradient toward the Hopkins community. The WEC, as part of the CA, has begun to reach out to residences within a 1-mile radius of the site to conduct sampling of private wells (SCDHEC 2019a).

The NRC is aware that the local community uses surface water for recreation and fishing. Concentrations in the Congaree River have been within the NRC limits for liquid effluents and dose calculations based on those effluents have been below regulatory limits. As discussed in Section 4.5, SCDHEC is also undertaking a fish tissue study to determine if uranium and fluoride are concentrating in fish (Bluegill Sunfish or Brim) at levels that could be harmful to the public (SCDHEC 2019a). Although WEC does not collect any biota samples from onsite surface water bodies, there is currently no public access to those water bodies for fishing or recreation.

The WEC is also required to comply with the CA and RI Work Plan and its NRC license. The SCDHEC, through the CA, could require WEC to remediate if investigations and sampling indicate it is necessary. The WEC has increased the number of groundwater monitoring wells, including a new set of wells around the perimeter of the site.

The assessment of human health and environmental effects for each resource area presented in this chapter of the EA concluded there would be no significant impacts from continued CFFF operations. Based on this information, except for groundwater, overall human health and environmental conditions during the period of continued operations are not expected to change

appreciably beyond what has already been experienced by people living near the CFFF. As discussed in Sections 4.3 and 4.4, the impacts of continued operations on surface water and groundwater near the CFFF would be noticeable, but with the mitigation imposed by the CA and groundwater monitoring, impacts are not expected to be significant. The NRC recognizes that because the CFFF is located in a block group with an 83 percent minority population and next to a block group where minority and low-income populations are both greater than 50 percent, minority and low-income people living near the CFFF could be at disproportionately higher risk from continued facility operations during the renewal term. However, based on the analyses presented in this chapter of this EA, human health and environmental effects from the continued operation of the CFFF on those populations are not expected to be disproportionately high and adverse.

4.13 Public and Occupational Health

Renewal of the CFFF operating license for an additional 40 years does not involve changes in current operating practices; therefore, changes in public and occupational health are not expected. The dose to members of the public and workers would continue, and WEC would continue to be bound to its license and regulatory requirements.

Radioactive and nonradioactive materials released from CFFF may migrate in the environment through a variety of transport pathways that could result in both internal and external exposures. For atmospheric releases, internal exposures may occur through inhaling radioactive material dispersed in the air or ingesting crops and animal products that come in contact with radioactive material deposited from the air. External exposures may occur through direct radiation from an airborne plume or from particulates deposited on the ground from the plume. For liquid releases, internal exposures could result from ingesting water or irrigated crops, while external exposures may result from recreational activities, such as swimming.

4.13.1 Public Health Impacts

As discussed in Section 2.3, WEC monitors its liquid and gaseous effluents. The WEC reports the results of the stack releases and Congaree River discharges to the NRC semiannually. These reports include the estimated source terms and activity for radiological effluents (based on sampling results) and uses them to calculate inhalation and ingestion doses. The dose from gaseous effluents represents 99 percent of the offsite public dose (WEC 2019b). Assessment of estimated radiological doses to the public from the CFFF operations were reviewed and compared to regulatory limits given in 10 CFR 20.1301 for the years 2014 through 2018. Data were obtained from the Annual Assessment of Public Doses from Liquid and Gaseous Effluents, which is required to be submitted annually (WEC 2019d). The whole body dose to a member of the public (modeled at the nearest site boundary) was 0.16 mrem/yr (1.6×10^{-3} mSv) and was primarily from direct inhalation of air emissions. This is well below WEC's ALARA goal of 1 mrem/year dose to members of the public from gaseous and liquid effluent (WEC 2019b). If compared to the dose limit in 10 CFR 20.1301, this is less than 1 percent of the 100 mrem/yr (1 mSv/yr) limit. That dose also represents less than 2 percent of the (10 mrem/yr) ALARA constraint from air emissions discussed in 10 CFR 20.1101. Compared to the ubiquitous background dose given in NCRP Report 160 of 311 mrem/yr (NCRP 2009), the 0.16 mrem/yr is only a small fraction of that amount.

Based on this review, and the continued requirement to meet NRC dose limits to the public, NRC does not expect a significant impact on members of the public from renewing the CFFF license for an additional 40 years.

4.13.2 Occupational Worker Impacts

Workers at CFFF also have occupational health and safety risks from exposure to industrial hazards, hazardous materials, and radioactive materials. Typical industrial hazards include chemical exposures, heavy-machinery accidents, crush injuries, and cuts and abrasions. There have been no deaths at the CFFF since it began operations in 1969. According to WEC, its Occupational Safety and Health Administration total recordable incident rate for 2017 and 2018 were 0.83 and 2.10, respectively (WEC 2019b). The WEC's 2018 rate was similar to the total recordable case incident rate for 2017 was 2.8, according to the U.S. Bureau of Labor Statistics (BLS 2018).

Workers are exposed to nonradiological materials that could pose a hazard from improper handling or chronic exposure to chemicals. The WEC uses toxic and hazardous chemicals in its processes. The WEC has a chemical safety program to evaluate hazards and take appropriate measures to keep workers safe (WEC 2019b).

According to WEC, from 2005 to 2011, the average annual total effective dose to the occupational worker from the combined effluent releases ranged between 197 mrem (1.97 mSv) (0.197 rem) and 327 mrem (3.27 mSv) (0.327 rem) (WEC 2014b). In its updated ER, WEC noted that average annual total effective dose for a worker from 2014 through 2018 was lower, and ranged from 98 to 143 mrem (0.98 mSv to 1.43 mSv)(0.098 to 0.143 rem). These doses are less than 1 percent of the 5.0 rem (50 mSv) annual occupational dose limits in 10 CFR 20.1201. The average worker dose (TEDE) at a fuel fabrication facility in 2017 was 90 mrem (0.9 mSv) (0.09 rem) (NRC 2019d). In 2017, there were 339 workers at CFFF with measurable committed effective dose equivalent (CEDE); the collective CEDE at WEC was 40.153 person-rem, the highest CEDE of the fuel fabrication facilities (NRC 2019d).

Standard measures of radiological occupational health are the TEDE and the CEDE received by workers. The TEDE is the sum of the CEDE (for internal exposures) and the deep-dose equivalent (for external dose). At a fuel cycle facility, the CEDE can be a significant contribution to the TEDE.

Total Effective Dose Equivalent
The sum of the effective dose equivalent (for external exposure) and the committed effective dose equivalent (for internal exposure).

Committed Effective Dose Equivalent
The sum of products of committed dose equivalents for each of the body organs or tissues that are irradiated multiplied by the organ's weighting factor.

Worker radiological dose exposures would be expected to remain below 10 CFR Part 20 regulatory limits, therefore, the NRC does not expect a significant impact on occupational workers from renewing the CFFF license for an additional 40 years. The NRC is performing a safety review (documented in a separate SER) that will include detailed radiation safety analyses.

With the continued requirement to meet NRC dose limits for workers and expectation that WEC will comply with Occupational Safety and Health Administration regulations, NRC does not expect a significant impact on workers from renewing the CFFF license for an additional 40 years.

4.14 Transportation

The proposed action does not involve any increase in workforce size or a significant increase in material or waste shipments. All material shipments will be conducted in accordance with applicable regulations from NRC, DOT, and the State of South Carolina. Operational activities will remain at current staffing levels. Therefore, the NRC does not expect any significant transportation impacts as a result of continued operation.

4.15 Waste Management

Section 3.15 provides a description of the types and amounts of waste generated and how they are managed. The proposed action would allow the CFFF to operate for another 40 years; therefore, WEC would continue to generate and dispose of waste. Under the proposed action, WEC does not plan any changes in CFFF operations.

The WEC recently identified a new mixed waste stream and has seen an increase in its solid and hazardous waste streams. The NRC expects that during the license renewal period WEC will continue to re-evaluate and assess its processes and waste streams and thus changes in the volume and types of waste may change. The WEC has waste minimization practices in place and is expected to continue under the proposed action. These practices involve waste reduction, reuse, and recycling.

The NRC expects that WEC will follow all applicable State and Federal regulations as they indicated in their LRA and ER. LLRW is shipped in DOT-approved packages, and shipments are made in compliance with applicable State and Federal regulations (WEC 2019b).

The NRC staff expects that capacity will remain available for the disposal of nonhazardous solid waste, hazardous waste, and construction and demolition wastes. The NRC staff recognizes the uncertainty for the long-term availability of commercial offsite storage of LLRW. While this uncertainty exists, the NRC staff assumes that sufficient LLRW capacity would be made available when needed. Historically, the demand for LLRW disposal capacity has been met by private industry and the NRC expects that this trend would continue in the future (NRC 2014).

Under the proposed action, WEC does not plan any changes in the CFFF operations. The NRC expects that waste generation and management over the license renewal period would be similar to current generation rates and management practices. Shipment and disposal of solid wastes would also follow State and Federal regulations. Therefore, the NRC does not expect significant impacts from solid waste management during the license renewal period.

4.16 Accidents

The term “accident,” as used in this section, refers to any abnormal event that results in a radiological and nonradiological release of radioactive materials into the environment. The

focus of this review is on events that could lead to releases substantially in excess of permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, and regulations that apply to the control of radiological and nonradiological risks from accidents are also in 10 CFR Part 70.

Subpart H of 10 CFR Part 70, requires certain fuel cycle facilities licensed under Part 70 to perform an Integrated Safety Analysis (ISA). Subpart H of 10 CFR Part 70 applies to the WEC's CFFF. An ISA is defined in 10 CFR 70.4 as "… a systematic analysis to identify facility and external hazards and their potential for initiating accident sequences, the potential accident sequences, their likelihood and consequences, and the items relied on for safety." The ISA evaluates compliance with 10 CFR 70.61 performance requirements, which require that controls be implemented to make credible high-consequence events highly unlikely or the consequences less severe than those in 10 CFR 70.61(b)(1)-(4) and to make credible intermediate-consequence events unlikely or the consequences less severe than those in 10 CFR 70.61(c)(1)-(4). In addition, the risk of nuclear criticality accidents must be limited by assuring that all nuclear processes are subcritical in compliance with 10 CFR 70.61(d). The engineered or administrative controls and measures necessary to meet these performance requirements are known as items relied on for safety (IROFS). The WEC performed an ISA and submitted a summary to the NRC for review as part of the license renewal review.

Radiological and Nonradiological Risk Regulations

As noted in NUREG-1520 (NRC 2010), the specific regulations related to radiological risk are as follows:

***10 CFR 20.1101** states that licensees shall apply procedures and engineering controls to achieve exposures to workers and the public that are ALARA.*

***10 CFR 20.1406** states that licensees shall design and develop procedures for operation that will minimize contamination of the facility and the environment, facilitate eventual decommissioning, and minimize the generation of radioactive waste.*

***10 CFR 70.22(i)(1)** requires either an evaluation that the maximum dose to a member of the public resulting from a release of materials would not exceed 1 rem or 2 milligrams soluble uranium intake or the submission of an emergency plan for responding to the radiological hazards of a postulated accident.*

***10 CFR Part 70, Subpart H**, contains requirements for performing ISAs, designating IROFS, and having management measures in place, both to ensure that IROFS are readily available and reliable in the context of the performance requirements and to provide facility change management and configuration control.*

The purpose of the NRC's review of the ISA summary is to establish reasonable assurance that the licensee has conducted an adequate ISA that meets 10 CFR 70.62(c)(1) and (2) requirements; for each applicable process, using methods and qualified staff adequate to achieve the requirements of 10 CFR 70.62; identified and evaluated all credible events (accident sequences) internal to the facility (e.g., explosions, spills, fires), and credible external events that could result in facility induced consequences to workers, the public, or the environment, that could exceed the performance requirements of 10 CFR 70; and evaluated the designated engineered and administrative controls and IROFS for preventing or mitigating the applicable accident sequences, and applied management measures to provide reasonable assurance that the performance requirements of 10 CFR 70.61 are met. Neither the ISA nor the summary are incorporated into the license (NRC 2010).

In its ER, WEC (2019b) discussed several accidents that could potentially result in the release of large quantities of material—criticality accident, a uranyl nitrate release, radioactive and chemical releases from a UF_6 cylinder, a major fire and a transportation accident. As discussed in the ER, the bounding maximum consequence basis accidents for the CFFF are as follows:

- Liquid system criticality
- Dry system criticality
- Soluble uranium release
- Insoluble uranium release
- Aqueous ammonia release
- Hydrofluoric acid release
- Nitric acid release
- Chlorine release
- Hydrogen explosion
- Fuel oil fire
- Natural phenomena hazards

Both chemical and radioactive materials are present in the fuel fabrication operations at the CFFF. The exposure and hazards from these materials are discussed in the ISA performed for the facility. The examples of accident scenarios included in the ER are consistent with those in the ISA Summary.

In Chapter 4 of its license application, WEC discussed its ISA methodology, including consideration of the effects on workers and members of the public from chemical hazards, fire hazards, criticality accidents, and radiological hazards. Table 4.2 of Chapter 4 of the license application identifies WEC's accident consequence levels implemented for complying with the performance requirements in 10 CFR 70.61 (WEC 2019c). The NRC's analysis of accidents will be covered by the safety review to ensure that the ISA Summary provides reasonable assurance that the potential failures, hazards, accident sequences, and scenarios have been evaluated.

The NRC staff, as part of its safety review of the LRA, will make the determination of whether the IROFSs are available and reliable to reduce the likelihood of occurrence and consequences of the accident sequences to acceptable levels in accordance with the performance requirements of 10 CFR 70.61. Additionally, as part of the safety review, the NRC will determine if WEC has committed to an acceptable radiation protection program that meets requirements set forth in 10 CFR Parts 19, 20, and 70.

4.16.1 Nonradiological Accidents

Accidents involving chemicals could also happen at the CFFF. In its ER, WEC describes three categories of nonradiological accidents—minor liquid spills within the chemical processing area and process-equipment leaks outside of the manufacturing building; rupture or failure of bulk chemical storage tanks; and catastrophic accidents (e.g., natural disaster, fire) (WEC 2019b). Operators inside the building would be expected to quickly identify, stop, and clean up spills and leaks. For larger spills or leaks from equipment that could contaminate the soil or water resources, WEC has an environmental monitoring program and would take the appropriate corrective actions, as necessary. Processes, procedures, and training that WEC implements to prevent the risk of radiological accidents would also help minimize the risk of nonradiological accidents.

4.17 Impacts of Alternative 1 – License Renewal for Less than 40 Years

If the NRC were to approve WEC's license (SNM-1107) for a period of less than 40 years, there would be less potential for contamination from future leaks and spills. The WEC also would start decommissioning earlier. The types of impacts discussed would be the same but they would occur for a shorter period of time. Thus, the NRC would similarly expect no significant impact from issuing a license renewal for less than 40 years. However, whether WEC operates for 40 years or less or more, WEC must maintain the necessary funding to assure they can successfully complete decommissioning and meet NRC's regulatory requirements.

5. CUMULATIVE IMPACTS

Cumulative effects are defined as "… the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). The potential impacts from the proposed action are discussed in the preceding sections of this EA.

Since the 2007 EA was published, WEC has made changes to its facility and operations, which are discussed in Section 2.2.1. Changes include the increase in UF_6 storage limits, installation of a concrete pad for auxiliary storage, and the CFFF no longer using anhydrous ammonia in its process. These changes notwithstanding, the NRC staff does not expect these changes to noticeably contribute to the cumulative impacts of continued operation through the renewal term.

Since 2007, there have been several leak and spill events that have resulted in contamination of the groundwater and surface water. However, the SCDHEC-required investigation activities will provide critical information about contamination migration and exposure pathways for those historical leaks and spills and well as potentially requiring remediation. The WEC has indicated it intends to remove the East Lagoon from service and remediate the soil as necessary (WEC 2019g). Since WEC has identified the East Lagoon as a potential source for groundwater contamination, removal of the lagoon and remediation of the soil could be a beneficial impact as a potential ongoing source of contamination would be removed. The WEC has replaced four of the WWTP lagoon liners and its expected that they would need to replace them again during continued operations, or possibly remove lagoons. In light of SCDHEC's actions and the NRC-imposed license condition on WEC's operating license, the NRC staff does not expect a reasonably foreseeable noticeable impact from these past and present leak and spill events.

As mentioned in Section 2.2.2, WEC could submit to the NRC a license amendment to remodel its administration building. Any land disturbance would require WEC to follow its procedures to ensure potential artifacts or remains are avoided. The NRC would conduct a safety and environmental review for that request. A current and expected future activity on the undeveloped portions of the CFFF site is logging and farming. Logging operations have been practiced on the undeveloped parcels of the WEC property for decades and have not been incompatible with CFFF operations. Transportation associated with logging operations is negligible compared to the CFFF's 1,100 employees already commuting daily to and from the site. Dominion is installing a natural gas pipeline along Bluff Road that will be within 335 m (1,100 ft) northwest of the CFFF site. An EA was prepared for the pipeline that indicated the impacts would not be significant for this particular portion of the route and that impacts on groundwater resources would be minor and temporary (FERC 2016).

Continued land use near the CFFF site, which is rural, could result in continued soil, nutrients, and other pollutants washing into the Congaree River from residential and agricultural storm-water runoff, continued conversion and fragmentation of wildlife habitat from development, and the introduction of invasive species. Species with threatened, endangered, or declining populations are likely to be more sensitive to declines in habitat availability and quality and the

introduction of invasive species. However, impacts are likely to remain similar given that Richland County does not expect increased growth in the area (Richland County 2015).

National parks and wildlife refuges located near the CFFF site provide valuable habitat to native wildlife and migratory birds. If agricultural activities, development, and urbanization continue to result in habitat conversion and fragmentation, these protected areas will become ecologically more important because they provide continuous areas of minimally disturbed habitat.

Planning documents for future growth in Richland County as a whole (Richland County 2015) and for the southern or "lower" part of the county (Richland County 2014) have recently been issued. The county-wide document provides guidance relative to Richland County's growth over the next 20 years and direction for future decisions so that the county can achieve its vision regarding that growth. The CFFF site is located in an area designated as the "southeast" in the county-wide plan, and Richland County expects that land use around the CFFF site will not change over the assessed upcoming 20 years (Richland County 2015). Additionally, development over the next 20 years in the area around the CFFF site is constrained by limited water and sewer service and by environmental constraints (Richland County 2014). Within 24 km (15 mi) to the northwest of the CFFF site, several road expansion projects are planned off of and along Bluff Road to encourage development within an existing industrial park. A fiberglass manufacturing facility is planned and land clearing for it has already started (SCDOC 2016). These projects could result in an increase in local traffic.

A 1.6-ha (4-ac) Superfund site—South Carolina Recycling and Disposal, Inc.—is located on the north side of Bluff Road across from the CFFF site. The site was used for storage, recycling, and disposal operations until 1982. The site has contaminated groundwater and soil, primarily from VOCs, resulting from past activities. According to the EPA, the migration of contaminated groundwater has stabilized, there is no unacceptable discharge to surface water, and the site's contamination does not currently threaten people living and working near the site (EPA 2017). The WEC indicated no concern about contaminant contribution from the Superfund site at this time (NRC 2017a).

Other facilities within an 80.5-km (50-mi) radius of the site produce and may release radiological materials to the environment. These facilities include the decommissioned Carolinas-Virginia Tube Reactor and hospitals that may be using medical isotopes. Based on the low levels of radiation exposure from these facilities and the distance to CFFF, the NRC does not expect these facilities would noticeably contribute to the cumulative radiological impacts from CFFF's continued operation.

In the future, it is possible that WEC could undertake activities that do not require prior NRC approval under 10 CFR 70.72, which could potentially result in new construction or land disturbance, such as new concrete storage pads or onsite landowners changing the current use of the land (agricultural, logging). For some requests, WEC might need a license amendment, in which case the NRC would then evaluate the potential environmental impacts of that action.

Continued operation of the CFFF for another 40 years increases the amount of time for radioactive and nonradioactive contaminants to build up in the environment, which could affect WEC's plans for site decontamination and decommissioning as well as the amount of funding

needed for decommissioning. It is also possible that WEC could request another license renewal, which would further increase the amount of the amount of contamination and its migration. The NRC would have to review any request for license renewal.

Once operations have ceased, the CFFF will be decommissioned. The WEC would be required to decontaminate and decommission the site to levels that would allow for the release of the facility under the NRC's regulations in 10 CFR Part 20. After completing decommissioning activities, WEC must complete radiation surveys to verify that the site met the release criteria. Although there are no specific plans for decommissioning at this time, activities associated with decommissioning could cause impacts on the environment. During decommissioning, there could be increased transportation impacts due to increased shipments offsite and additional workers; increases in waste generated for disposal associated with removal of buildings and equipment; and temporary increases in dust and particulate emissions from demolition and emissions from equipment. Other potential impacts include effects on tax revenue and employment, changes in worker and public dose, and increased noise from demolition activities.

The NRC staff has assessed the potential incremental impacts of the proposed action in consideration with the current and reasonably foreseeable activities discussed above and has determined that there would be no significant cumulative impacts based on incremental impacts from the proposed action for most resources.

In the case of groundwater, the incremental impact of the onsite contaminant plumes to the groundwater resources within the Congaree River–Mill Creek Basin is expected to be minimal. Based on available data, the plumes are limited to the shallowest aquifer, which is not used currently or expected to be used as a major supply of water. Additionally, based on continued monitoring, the plumes are not expected to migrate offsite. The other known or potential impacts to the groundwater resources include the South Carolina Recycling and Disposal, Inc. Superfund site and the major manufacturing facilities described in Section 3.1.2.

In the case of surface water, the incremental impact of CFFF discharges to the Congaree River's water quality is expected to be minimal. In addition to the CFFF NPDES discharge permit, five other discharges are permitted to the Congaree River. Based on SCDHEC (2019), the Congaree River is impaired for *e. coli* and mercury in its headwaters within the City of Columbia, and impaired for copper and *e. coli* downstream of the CFFF discharge. The CFFF discharge does not contribute to impairments of those constituents.

6. AGENCIES AND PERSONS CONSULTED

The NRC will issue the Draft EA for public review and comment, initiated by a notice published in the *Federal Register* that will provide the details on how the public can submit comments and the timeframe for commenting. The NRC will summarize and address comments on the Draft EA in an appendix to the Final EA. Copies of the Draft EA were sent to several State and Federal agencies for their review and comment. Those agencies and the NRC's interactions with them are summarized below.

6.1 NHPA Section 106 Consultation

On May 12, 2015, the NRC staff requested the Catawba Indian Nation's concurrence on its determination that historic and cultural resources at the CFFF would not be adversely affected by the 40-year licensing renewal because no land disturbing activities were being proposed as part of the action (NRC 2015c). The NRC did not receive a response from the Catawba Indian Nation .

On May 12, 2015, the NRC staff issued its determination that no historic and cultural resources would be affected by the proposed 40-year licensing renewal to the South Carolina SHPO (NRC 2015b). On May 28, 2015, the SHPO concurred with the NRC's determination that no properties listed in or eligible for listing in the NRHP will be affected by the proposed action (SCAHC 2015). The SHPO's letter stated that the WEC site has a very high probability of significant archeological properties and any future proposed expansion or ground disturbance in undisturbed areas should be submitted to their office for review and comment. The SHPO also noted that if archeological materials are encountered during construction, procedures described in 36 CFR 800.13(b) would apply and the Federal agency should contact the SHPO office immediately.

After determining it would re-open its environmental review, the NRC informed the Catawba Indian Nation THPO and the South Carolina SHPO of the additional site investigation activities and requested their concurrence that the NRC's previous determination—no impacts to any historic or cultural resources expected—remains the same (NRC 2019g, h). The NRC also met with SHPO staff during a site visit in July 2019 (NRC 2019b). To date, the NRC has not received a response from the SHPO or Catawba's THPO.

6.2 ESA Section 7 Consultation

Section 3.6 describes the Federally listed species that may occur near the CFFF. Six of the seven species are under FWS's jurisdiction. On May 12, 2015, the NRC staff sent a letter to the FWS describing the proposed action and requested FWS's concurrence with NRC's determination that impacts on Federally listed protected species at the CFFF *may affect, but are not likely to adversely affect* Federally listed species (NRC 2015d). In a letter dated May 20, 2015, FWS concurred with the NRC's determination that the proposed activity *may affect, but is not likely to adversely affect* the six Federally listed species under FWS's jurisdiction (FWS 2015).

After determining it would re-open its environmental review, the NRC requested that FWS re-concur on its *may affect, but not likely to adversely affect* finding. The NRC informed the FWS of the additional site investigation activities and confirmed the list of species was still the same (NRC 2019e). The FWS offered no objections to the NRC's finding (FWS 2019).

One of the Federally listed species—the Shortnose Sturgeon—is under NMFS jurisdiction. Section 3.6 provides information about the sturgeon. On August 15, 2017, the NRC submitted a Biological Evaluation to the Southeast Regional Office of NMFS with the NRC's determination that license renewal *may affect, but is not likely to adversely affect* the Shortnose Sturgeon (NRC 2017b). The NMFS requested additional information from the NRC regarding the project so the NRC submitted supplemental information (NRC 2018c; 2017c, d, e). On April 12, 2018, NMFS responded with their concurrence on the NRC's determination (NMFS 2018).

Although re-initiation of consultation is not required, the NRC requested that NMFS re-concur on its *may affect, but not likely to adversely affect* finding for the Shortnose Sturgeon in light of the new information (NRC 2019f). The NMFS responded and confirmed that its position on the NRC staff's finding of *may affect, but is not likely to adversely affect* remained the same, and that re-initiation of consultation with NMFS was not required.

6.3 Congaree National Park

The Congaree National Park provided technical information during the NRC's environmental review. During a site visit to the CFFF site, staff from SCDHEC and NRC met with park staff to discuss the various reviews being undertaken and to discuss local hydrogeology at the site. Park staff provided geology plates of the Congaree River Basin, which helped provide further evidence of the heterogeneity of the site's subsurface.

6.4 SCDHEC

The NRC staff remained engaged with SCDHEC staff from the various bureaus (waste, water, air) regarding the status and progress of ongoing investigations and permit reviews. The SCDHEC staff attended NRC site visits and participated in discussions on environmental monitoring and investigations.

7. CONCLUSION

Based on its review, the NRC staff has determined that the proposed action—renewal of license SNM-1107 authorizing continued operations at WEC's CFFF in Hopkins, South Carolina, for a period of 40 years—would not result in significant impacts to most resource areas. The WEC is not proposing changes in authorized operations or activities. The WEC does plan to install additional groundwater wells and collect lithographic borings but those activities would cause minimal land disturbance. Therefore, no significant impacts on land use, visual resources, ecological resources, air quality, transportation, waste management, or socioeconomics are expected. The NRC expects that WEC will continue to comply with regulatory limits for public and worker dose.

Although minority and low-income populations were identified within an 8-km (4-mi) radius of the CFFF site, the NRC did not identify any special circumstances that would cause disproportionately high and adverse human health and environmental effects on those populations.

The FWS concurred with the NRC's determination that license renewal *may affect, but is unlikely to affect*, special status species and habitat under its jurisdiction. The NMFS concurred with the NRC's determination that license renewal *may affect, but is unlikely to affect*, the Shortnose Sturgeon.

The SHPO concurred that the continued operation would not affect historic properties. The NRC re-engaged with the South Carolina SHPO and Catawba Indian Nation THPO when the NRC re-opened its environmental review. The NRC has not yet received a response from either Offices. The Final EA will be updated to reflect the status of the Section 106 consultation.

Past and current activities at the site have resulted in soil, surface water, and groundwater contamination from nonradioactive and radioactive pollutants. Based on the data currently available, the groundwater contamination remains onsite and has not migrated into the deeper aquifer. Future leaks and spills are likely during the period of license renewal. Through its CA and RI Work Plan with SCDHEC, WEC will continue to characterize its site and the subsurface to better understand the migration of the contamination and potential pathways to receptors. The WEC has proposed substantial changes to its environmental monitoring program by increasing the number of groundwater wells and increasing the number of sediment, soil, surface water, and groundwater samples collected and analyzed. The monitoring requirements of the NRC license and the NPDES permit will help detect the movement of existing contamination and potential new plumes. The WEC has a CSM and a program and procedures in place to make informed decisions on necessary changes to its monitoring protocol to address new leaks or spills and the migration of current contamination. The NRC will continue to inspect WEC's compliance with its NRC-licensed environmental monitoring program. The WEC must keep records of subsurface contamination and maintain sufficient funds to decommission the site. Further mitigation measures include WEC's completion of the CA with SCDHEC and its entry of all groundwater and surface water results that exceed Federal or State levels as stated in its LRA into the CAP. The WEC will also submit their environmental monitoring program to the NRC for review and approval upon either approval of the RI Report, as required by the CA, or within five years of the license renewal.

Based on the analysis in this EA, in accordance with 10 CFR 51.31, “Determination Based on Environmental Assessment,” the NRC preliminarily concludes that the preparation of an EIS is not required for the proposed action, and pursuant to 10 CFR 51.32, “Finding of No Significant Impact,” a FONSI is appropriate.

8. LIST OF PREPARERS

The NRC staff from the Offices of Nuclear Material Safety assisted in the preparation and review of this Draft EA. The names of the staff and the resources they evaluated are listed below.

Diana Diaz-Toro, NMSS/REFS, accidents

Briana Grange, NMSS/REFS, Section 7 consultation with NMFS

Jin-Ping Gwo, NMSS/DFM, surface and groundwater resources

Stacey Imboden, NMSS/REFS, air quality, climate change

Marilyn Diaz Maldonado, NMSS/REFS, accidents

James Park, NMSS/REFS, noise, visual resources, and land use

Christine Pineda, NMSS/REFS, waste management

Jessie Muir Quintero, NMSS/REFS, socioeconomics, environmental justice, historic and cultural resources, transportation, waste management, public and occupational health, cumulative impacts

Jeff Rikhoff, NMSS/REFS, environmental justice

John Saxton, NMSS/DUWP, geology, cumulative impacts

9. REFERENCES

References used in the preparation of this EA are available for public review through the NRC's electronic reading room (ADAMS [Agencywide Documents Access and Management System]) at http://www.nrc.gov/reading-rm/adams.html. To begin the search, select "Begin Web-Based ADAMS Search." The ADAMS accession numbers are provided for all references. The references are also available for public inspection and copying at NRC's Public Document Room, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852. For those references available online, a web address is provided.

10 CFR Part 19. Code of Federal Regulations, Title 10, *Energy*, Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations."

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection against Radiation."

10 CFR Part 40. Code of Federal Regulations, Title 10, *Energy*, Part 40, "Domestic Licensing of Source Material."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 70. Code of Federal Regulations, Title 10, *Energy*, Part 70, "Domestic Licensing of Special Nuclear Material."

23 CFR Part 772. Code of Federal Regulations, Title 23, *Highways*, Part 772, "Procedures for Abatement of Highway Traffic Noise and Construction Noise." Table 1.

40 CFR Part 50. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 61. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 61, "National Emissions Standards for Hazardous Air Pollutants."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 93. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 93, "Determining Conformity of Federal Actions to State or Federal Implementation Plans."

40 CFR Part 261. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 261, "Identification and Listing of Hazardous Waste."

40 CFR Part 262. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 262, "Standards Applicable to Generators of Hazardous Waste."

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

50 CFR 10. Code of Federal Regulations, Title 50, *Wildlife and Fisheries*, Part 10, “National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce.”

50 CFR 17. Code of Federal Regulations, Title 50, *Wildlife and Fisheries*, Part 17, “Endangered and Threatened Wildlife and Plants.”

50 CFR 402. Code of Federal Regulations, Title 50, *Wildlife and Fisheries*, Part 402, “Interagency Cooperation – Endangered Species Act of 1973, As Amended.”

59 FR 7629. February 16, 1994. “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.” *Federal Register*.

69 FR 52040. August 24, 2004. "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions." *Federal Register*, U.S. Nuclear Regulatory Commission, Washington, D.C.

74 FR 56260. October 30, 2009. “Mandatory Reporting of Greenhouse Gases; Final Rule.” *Federal Register*, U.S Department of Interior, Washington, D.C.

75 FR 9282. March 01, 2010. “General Provisions; Migratory Birds Revised List and Permits; Final Rules.” *Federal Register*, U.S Department of Interior, Washington, D.C.

75 FR 31514. June 3, 2010. “Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule; Final Rules.” *Federal Register*, U.S Department of Interior, Washington, D.C.

83 FR 28014. June 15, 2018. “WEC Electric Company, LLC; Columbia Fuel Fabrication Facility, Environmental Assessment and Finding of No Significant Impact; issuance.” *Federal Register*, U.S. Nuclear Regulatory Commission, Washington, D.C.

AECOM. 2013. Remedial Investigation Report. ADAMS Accession No. ML16166A141.

AECOM. 2014. Preliminary Baseline Risk Assessment. February 7, 2014. ADAMS Accession No. ML17275A619.

AECOM. 2017. CVOC Field Screening Report. December 14, 2017. ADAMS Accession No. ML18085A975.

American Industrial Hygiene Association. 2013. Emergency Response Planning Guidelines.

Aucott, W.R., Davis M.E., and G.K. Speiran. 1987. Geohydrologic Framework of the Coastal Plain Aquifers of South Carolina, USGS Water-Resources Investigations Report 85-4271, 7 plts.

Bald and Golden Eagle Protection Act of 1940, as amended. 16 U.S.C. § 668–668c.

BLS. 2018. U.S. Department of Interior Bureau of Labor Statistics. Employer-Reported Workplace Injuries and Illnesses -2017. November 8, 2018. Accessed on August 2, 2019. Available at: https://www.bls.gov/news.release/pdf/osh.pdf.

Bollinger, G.A. 1972. Historical and Recent Seismic Activity in South Carolina. Bulletin of the Seismological Society of America, Vol 62, No. 3, pp851-864. June 1972.

Campbell, B.G. and A.L. Coes, eds. 2010. Groundwater Availability in the Atlantic Coastal Plain of North and South Carolina, USGS Professional Paper 1773, 241 p., 7 pls.

Clean Water Act (CWA) of 1972, as amended (formerly Federal Water Pollution Control Act). 33 U.S.C. 1251 et seq.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended. 42 U.S.C. § 9601 *et seq*.

Congaree Riverkeeper. 2017. "Congaree River." Available at: http://congareeriverkeeper.org/congaree-river. Accessed on July 6, 2017.

Cooke, C. Wythe. 1936. Geology of the Coastal Plain of South Carolina, USGS Bulletin 867. 218 p. 18 plts. Available at: https://pubs.usgs.gov/bul/0867/report.pdf.

Eisenbud Merril and Thomas Gesell. 1997. Environmental Radioactivity from Natural, Industrial, and Military Sources, Fourth Ed. Academic Press. San Diego, CA.

Endangered Species Act (ESA), as amended. 16 U.S.C 1531 *et seq*.

EPA (U.S. Environmental Protection Agency). 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. U.S. Environmental Protection Agency, March. Accessed May 14, 2019. Available at: http://www.nonoise.org/library/levels74/levels74.htm. ADAMS Accession No. ML18214A802

EPA (U.S. Environmental Protection Agency). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA: Interim Final. October. Available at: https://nepis.epa.gov/Exe/ZyNET.exe/10001VGY.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1986+Thru+1990&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C86thru90%5CTxt%5C00000003%5C10001VGY.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL.

EPA (U.S. Environmental Protection Agency). 2015. Derived Concentrations (pCi/L) of Beta and Photon Emitters in Drinking Water. Available at: https://www.epa.gov/sites/production/files/2015-09/documents/guide_radionuclides_table-betaphotonemitters.pdf.

EPA (U.S. Environmental Protection Agency). 2017. Superfund Site: SCRDI Bluff Road Columbia, SC. Available at: https://cumulis.epa.gov/supercpad/Cursites/csitinfo.cfm?id=0403212&msspp=med. Accessed on August 3, 2017.

EPA (U.S. Environmental Protection Agency). 2019. Radionuclides Basics: Radium. Last Updated March 28, 2019. Accessed on August 1, 2019. Available at: https://www.epa.gov/radiation/radionuclide-basics-radium.

ESRI. 2019. State boundaries layer provided as part of ESRI Data & Maps for use with ESRI ArcGIS software delivered with the software on DVD. ESRI created the file from U.S. Department of Commerce, Census Bureau data.

FERC (Federal Energy Regulatory Commission). 2016. Environmental Assessment – Columbia to Eastover Project, Dominion Carolina Gas Transmission, LLC. Docket No. CP15-504-000. February 2016. Available at: https://www.ferc.gov/industries/gas/enviro/eis/2016/CP15-504-000-EA.pdf.

FishNet. 2014. FishNet2, Search FishNet. Accessed on July 6, 2017. Available at http://www.fishnet2.net.

FWS (U.S. Fish and Wildlife Service). 2015. Letter from T. McCoy, U.S. Fish and Wildlife Service, to L. Chang, NRC, regarding Westinghouse Fuel Fabrication Facility, Columbia, Richland County, South Carolina FWS Log No. 2015-I-0359. May 20, 2015. ADAMS Accession No. ML15161A543.

FWS (U.S. Fish and Wildlife Service). 2017. Letter from FWS to NRC. List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project. July 25, 2017. ADAMS Accession No. ML17208A668.

FWS (U.S. Fish and Wildlife Service). 2019. Email from FWS to NRC regarding Re-concurrence on ESA Findings for the WEC Columbia Fuel Fabrication Facility – FWS Log No. 2015-I-0359. June 27, 2019. ADAMS Accession No. ML19178A011.

GCRP (U.S. Global Change Research Program). 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment. Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (editors). U.S. Government Printing Office, Washington, D.C. Accession No. ML19008A414.

Greene, M.R. and P.L. Gori. 1982. Earthquake Hazards Information Dissemination: A Study of Charleston, South Carolina. USGS Open-File Report 82-233, 62 p. Available at: https://pubs.er.usgs.gov/publication/ofr82233.

Hockensmith, B.L. 2003. Potentiometric Surface of the Middendorf Aquifer in South Carolina: November 2001. South Carolina Department of Natural Resources Water Resources Report 28, 1 plt.

Fishery Conservation and Management Act, as amended. 16 U.S.C. § 1801 *et seq*.

Migratory Bird Treaty Act of 1918, as amended. 16 U.S.C. § 703 *et seq*.

National Environmental Policy Act of 1969, as amended. 42 U.S.C. § 4321 *et seq*.

National Historic Preservation Act of 1966, as amended. 16 U.S.C. § 470 *et seq*.

NCRP (National Council of Radiation Protection and Measurements). 2009. *Ionizing Radiation Exposure of the Population of the United States*. NCRP Report No. 160, Bethesda, Maryland. Available at https://ncrponline.org/publications/reports/ncrp-report-160/.

NMFS (National Marine Fisheries Service). 2015. "Shortnose Sturgeon (*Acipenser brevirostrum*)." Available at <https://www.fisheries.noaa.gov/species/shortnose-sturgeon>.

NMFS (National Marine Fisheries Service). 2017a. Email from NMFS, to Briana Grange, NRC, regarding request for additional information. September 22, 2017. ADAMS Accession No. ML17276A076.

NMFS (National Marine Fisheries Service). 2017b. Email from NMFS, to Briana Grange, NRC, regarding request for additional information. October 12, 2017. ADAMS Accession No. ML17292A087.

NMFS (National Marine Fisheries Service). 2018. Letter from Roy E. Crabtree, Regional Administrator, NMFS to Briana Grange, NRC, regarding Shortnose Sturgeon consultation. April 12, 2018. ADAMS Accession No. ML18103A020.

NPS (National Park Service). Undated. National Park Service. Congaree National Park Fishing Regulations. Hopkins, South Carolina. Available at: https://www.nps.gov/cong/upload/CONG_Fishing_Regulations.pdf. Accessed on July 6, 2017.

NPS (National Park Service). 2015. National Park Service. "Congaree National Park, South Carolina, Nature and Science." Last updated April 14, 2015. Accessed on July 10, 2017. Available at: https://www.nps.gov/cong/learn/nature/index.htm.

NRC (U.S. Nuclear Regulatory Commission). 1977. Environmental Impact Appraisal of the Westinghouse Nuclear Fuel Columbia Site (NFCS) Commercial Nuclear Fuel Fabrication Plant. April 1977. ADAMS Accession No. ML17292A037.

NRC (U.S. Nuclear Regulatory Commission). 1985. *Environmental Assessment for renewal of Special Nuclear Material License No. SNM-1107.* NUREG-1118. May 1985. ADAMS Accession No. ML17219A167.

NRC (U.S. Nuclear Regulatory Commission). 1993. Regulatory Guide 8.37, "ALARA Levels for Effluents from Materials Facilities." Available at: https://www.nrc.gov/docs/ML0037/ML003739553.pdf. ADAMS Accession No. ML00373955.

NRC (U.S. Nuclear Regulatory Commission). 1995. Environmental Assessment and Finding of No Significant Impact. July 12, 1995. ADAMS Accession No. ML17219A168.

NRC (U.S. Nuclear Regulatory Commission). 2003. *Environmental Review Guidance for Licensing Actions Associated With NMSS Programs—Final Report*, NUREG–1748, Washington, D.C. August 2003. ADAMS Accession No. ML032450279.

NRC (U.S. Nuclear Regulatory Commission). 2006a. Staff Requirements - SECY-06-0186 - Increasing Licensing Terms for Certain Fuel Cycle Facilities. ADAMS Accession No. ML062700110.

NRC (U.S. Nuclear Regulatory Commission). 2006b. *Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria*. NUREG-1757, Volume 2, Revision 1. Washington, DC.

NRC (U.S. Nuclear Regulatory Commission). 2007. Final Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM-1107 for Westinghouse Columbia Fuel Fabrication Facility. April 19, 2007. ADAMS Accession No. ML070510647.

NRC (U.S. Nuclear Regulatory Commission). 2010. *Standard Review Plan for Fuel Cycle Facilities License Applications.* NUREG-1520, Revision 1. May 2010. ADAMS Accession No. ML101390110.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel.* NUREG-2157. September 2014. ADAMS Accession No. ML14198A440.

NRC (U.S. Nuclear Regulatory Commission). 2015a. Letter from Robert K. Johnson, NRC, to Nancy Parr, WEC, regarding, *Amendment 18 – Exemption from 10 CFR Part 30, Appendix A, Section II.C.I; Exemption from 10 CFR, PART 20.1703(c)(5); Change in the Calibration Interval of Portable Radiation Survey Instrumentation; Increase in Possession Limits; Approval of Physical Security Plan, Revision 45; Change in Principal Officers; Removal of Completed License Conditions (TAC No. L33353).* November 2, 2015. ADAMS Package Accession No. ML15125A279.

NRC (U.S. Nuclear Regulatory Commission). 2015b. Letter from L. Chang, NRC, to E. Johnson, South Carolina State Historic Preservation Office, regarding *Request Concurrence Under the National Historic Preservation Act, Section 106 Consultation on the U.S. Nuclear Regulatory Commission's Determination of Effect for the Proposed 40-Year License Renewal of Westinghouse's Columbia Fuel Fabrication Facility.* May 12, 2015. ADAMS Accession No. ML15104A268.

NRC (U.S. Nuclear Regulatory Commission). 2015c. Letter from L. Chang, NRC, to W. Haire, Tribal Historic Preservation Officer, Catawba Indian Nation, regarding *Request Concurrence Under the National Historic Preservation Act, Section 106 Consultation on the U.S. Nuclear Regulatory Commission's Determination of Effect for the Proposed 40-Year License Renewal of Westinghouse's Columbia Fuel Fabrication Facility*. May 12, 2015. ADAMS Accession No. ML15104A250.

NRC (U.S. Nuclear Regulatory Commission). 2015d. Letter from L. Chang, NRC, to Thomas McCoy, U.S. Fish and Wildlife Service regarding *Request for Concurrence for Endangered Species Act, Section 7 Consultation on the U.S. Nuclear Regulatory Commission's Determination of Effects for the Proposed 40-Year License Renewal of Westinghouse's Columbia Fuel Fabrication Facility.* May 12, 2015. ADAMS Accession No. ML15104A238.

NRC (U.S. Nuclear Regulatory Commission). 2015e. FCSE Interim Staff Guidance-14, Revision 0, *Acute Uranium Exposure Standards for Workers*. June 8, 2015. ADAMS Accession No. ML15147A682.

NRC (U.S. Nuclear Regulatory Commission). 2016a. Approval of Decommissioning Funding Plan Date May 12, 2016 (Cost Activity Code L33419). October 14, 2016. ADAMS Package Accession No. ML16277A591.

NRC (U.S. Nuclear Regulatory Commission). 2016b. Letter from NRC to WEC, regarding NRC Augmented Inspection Team Report No. 70-1151/2016-007. October 26, 2016. ADAMS Accession No. ML16301A001.

NRC (U.S. Nuclear Regulatory Commission). 2016c. Letter from NRC to WEC, regarding Confirmatory Action Letter – Westinghouse Electric Company, Columbia Fuel Fabrication Facility. August 11, 2016. ADAMS Accession No. ML16224B082.

NRC (U.S. Nuclear Regulatory Commission). 2016d. Letter from NRC to WEC, regarding NRC Confirmatory Action Letter Inspection Report No. 70-1151/2016-008. November 16, 2016. ADAMS Accession No. ML16323A011.

NRC (U.S. Nuclear Regulatory Commission). 2017a. Summary of Audit Activities Related to the NRC's Environmental Review for the Westinghouse Columbia Fuel Fabrication Facility License Renewal Application. October 30, 2017. ADAMS Package Accession No. ML17356A096.

NRC (U.S. Nuclear Regulatory Commission). 2017b. Request for Concurrence from NMFS with NLAA Determination for Columbia Fuel Fabrication Facility License Renewal and Transmittal of Biological Evaluation of Impacts to Shortnose Sturgeon. August 15, 2017. ADAMS Accession No. ML17227A378.

NRC (U.S. Nuclear Regulatory Commission). 2017c. Summary of July 28, 2017 call with NMFS regarding EFH and Shortnose Sturgeon consultation for Westinghouse renewal project. ADAMS Accession No. ML17275B071.

NRC (U.S. Nuclear Regulatory Commission). 2017d. Email response to NMFS request for additional information. October 2, 2017. ADAMS Accession No. ML17276A077.

NRC (U.S. Nuclear Regulatory Commission). 2017e. Email response to NMFS request for additional information. October 19, 2017. ADAMS Accession No. ML17292A089.

NRC (U.S. Nuclear Regulatory Commission). 2017f. Letter from NRC to WEC, regarding Westinghouse Columbia Fuel Fabrication Facility Authorization to Restart Conversion Process

Equipment and S-1030 Scrubber System – Docket No. 70-1151. October 20, 2016. ADAMS Accession No. ML16294A296.

NRC (U.S. Nuclear Regulatory Commission). 2017g. Letter from NRC to WEC, regarding Westinghouse Electric Company – Nuclear Regulatory Commission – Inspection Report No. 70-1151/2017-007. February 27, 2017. ADAMS Accession No. ML17058A448.

NRC (U.S. Nuclear Regulatory Commission). 2017h. Letter from NRC to WEC, regarding Confirmatory Order (Nuclear Regulatory Commission Inspection Report 70-1151/2017-007). August 9, 2017. ADAMS Package Accession No. ML17221A103.

NRC (U.S. Nuclear Regulatory Commission). 2018a. Final Environmental Assessment for the Renewal of SNM-1107 Columbia Fuel Fabrication Facility in Richland County, South Carolina. June 2018. ADAMS Accession No. ML18120A318.

NRC (U.S. Nuclear Regulatory Commission). 2018b. WEC Electric Company - Nuclear Regulatory Commission Integrated Inspection Report Number 70-1151/2018-004 and Notice of Violation. October 5, 2018. ADAMS Accession No. ML18278A197.

NRC (U.S. Nuclear Regulatory Commission). 2018c. NRC Response to NMFS Questions regarding Sturgeon Consultation for WEC CFFF. January 24, 2018. ADAMS Accession No. ML18025A295.

NRC U.S. Nuclear Regulatory Commission). 2018d. Summary for Public Meeting and Enclosures 1-3: Held November 8, 2018 to Discuss the License Renewal, Environmental Analysis and Leaks at the Westinghouse Columbia Fuel Fabrication Facility. December 18, 2018. ADAMS Accession No. ML18330A255.

NRC (U.S. Nuclear Regulatory Commission). 2019a. Letter to WEC: RAIs Regarding the Environmental Review for the Proposed Renewal of the WEC Columbia Fuel Fabrication Facility. January 18, 2019. ADAMS Accession No. ML18308A008.

NRC (U.S. Nuclear Regulatory Commission). 2019b. Site Visit Summary. October 21, 2019. ADAMS Accession No. ML19283A811.

NRC (U.S. Nuclear Regulatory Commission). 2019c. License Amendment No. 21. June 21, 2019. ADAMS Accession No. ML19112A045.

NRC (U.S. Nuclear Regulatory Commission). 2019d. *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2017: Fiftieth Annual Report.* NUREG-0713, Volume 39. March. Available at: https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713/v39/.

NRC (U.S. Nuclear Regulatory Commission). 2019e. Email to FWS regarding updated activities. June 25, 2019. ADAMS Accession No. ML19178A010.

NRC (U.S. Nuclear Regulatory Commission). 2019f. Email to NMFS regarding Update on NRC Review of WEC CFFF License Renewal. July 10, 2019. ADAMS Accession No. ML19191A074.

NRC (U.S. Nuclear Regulatory Commission). 2019g. Letter to Wenonah Haire, Catawba Indian Nation regarding Section 106 Consultation for Westinghouse Columbia Fuel Fabrication Facility. July 12, 2019. ADAMS Accession No. ML19191A131.

NRC (U.S. Nuclear Regulatory Commission). 2019h. Email to Elizabeth Johnson, South Carolina Department of Archives and History regarding Section 106 Consultation for Westinghouse Columbia Fuel Fabrication Facility. July 09, 2019. ADAMS Accession No ML19219A242.

NRCS (Natural Resources Conservation Service). 2019. Gridded Soil Survey Geographic (gSSURGO) Database for South Carolina. Downloaded from U.S. Department of Agriculture, Natural Resources Conservation Service, Geospatial Data Gateway at https://gdg.sc.egov.usda.gov/ on July 22, 2019. Online metadata: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/nc/soils/?cid=nrcs142p2_053628#metadata.

Richland County. 2014. Richland County Strategic Community Master Plan. Dated March 28, 2014. Accessible at: http://www.rcgov.us/Portals/0/Departments/Planning/NeighborhoodPlanning/MasterPlans/LowerRichlandFinal.pdf.

Magnuson-Stevens Richland County. 2015. Richland County Comprehensive Plan – Putting the Pieces in Place. Adopted March 17, 2015. Available at: http://www.rcgov.us/Portals/0/Departments/Planning/ADOPTED_RC_2015CompPlan.pdf/.

Richland County. 2017. Floodplain Mapping and Local Hazards. Accessed on July 12, 2017. Available at: http://www.rcgov.us/Government/Departments/Planning/FloodplainManagement/Mapping.aspx.

Richland County. 2019a. Richland County GIS, Richland County, South Carolina. Accessed on July 25, 2019. Available at www.richlandmaps.com/.

Richland County. 2019b. WEC Columbia Site Boundary digitized boundary from map downloaded from Richland County, SC Internet Mapping site. Accessed on July 18, 2019. Available at http://www.richlandmaps.com/apps/dataviewer/?lat=33.88241&lon=-80.92943&zoom=15&base=aerial&expanded=53759|52088|18518|38669|39665&layers=33844|24029.

Richland County. 2019c. Chapter 18, Offenses. Section 18-3, Noise. Accessed on May 14, 2019. Available at: http://library.amlegal.com/nxt/gateway.dll/South%20Carolina/richco/codeofordinancesofrichlandcountysouthcar?f=templates$fn=default.htm$3.0$vid=amlegal:richlandco_sc.

Richland County Council. 2019. Regular Session Meeting Minutes for February 5, 2019. Accessed on July 30, 2019. Available at:

http://www.richlandcountysc.gov/Portals/0/Departments/CountyCouncil/Minutes/Reg__02_05_19.pdf.

SCAHC (South Carolina Archives and History Center). 2015. Letter from E. Johnson, South Carolina State Historic Preservation Office to L. Chang, NRC, regarding Westinghouse Columbia Fuel Fabrication Facility (CFFF) 40-Year License Renewal, Richland County, South Carolina, SHPO Project No. 15-EJ0022. Dated May 28, 2015. ADAMS Accession No. ML15161A537.

SCDOC (South Carolina Department of Commerce). 2016. "China Jushi Bringing 80,000-Ton Fiberglass Production Line to Richland County". May 31, 2016. Available at: https://www.sccommerce.com/news/china-jushi-bringing-80000-ton-fiberglass-production-line-richland-county.

SCDHEC (South Carolina Department of Health and Environmental Control). 2016. State of South Carolina Integrated Report for 2016 Part I: Section 303(d) List of Impaired Waters. May 25, 2016. Available at: http://www.scdhec.gov/sites/default/file/docs/HomeAndEnvironment/Docs/tmdl_16-303d.pdf.

SCDHEC (South Carolina Department of Health and Environmental Control). 2017a. National Pollutant Discharge Elimination System Permit for Discharge to Surface Waters for Westinghouse Electric Company LLC Columbia Fuel Site. Permit No. SC0001848. Effective Date. Expiration Date March 31, 2018. ADAMS Accession No. ML17283A098.

SCDHEC (South Carolina Department of Health and Environmental Control). 2017b. General Description of Congaree River 03050110-03. Accessed on August 7, 2017. Available at: http://www.scdhec.gov/sites/default/file/docs/HomeAndEnvironment/Docs/03050110-03.pdf.

SCDHEC (South Carolina Department of Health and Environmental Control). 2018. Letter from Addie Walker regarding proposed groundwater action level for uranium. March 22, 2018. ADAMS Accession No. ML18117A129.

SCDHEC (South Carolina Department of Health and Environmental Control). 2019a. Westinghouse. Available at: https://www.scdhec.gov/environment/ongoing-projects-updates/westinghouse.

SCDHEC (South Carolina Department of Health and Environmental Control). 2019b. South Carolina's Nonattainment Areas. Accessed on May 16, 2019. Available at: https://www.scdhec.gov/environment/your-air/most-common-air-pollutants/south-carolinas-nonattainment-areas.

SCDHEC/WEC (South Carolina Department of Health and Environmental Control/Westinghouse Electric Company, LLC). 2016. Voluntary Cleanup Contract 16-4948-RP. August 23, 2016. Available at: http://www.scdhec.gov/HomeAndEnvironment/Docs/cleanUpPrograms/4948_51377_rpvcc.pdf.

SCDHEC/WEC (South Carolina Department of Health and Environmental Control/Westinghouse Electric Company, LLC). 2019. Consent Agreement 19-02-HW.

February 26, 2019. Available at: https://www.scdhec.gov/sites/default/files/media/document/BLWM_WestinghouseCA%2019-2-HW.pdf.

SCDNR (South Carolina Department of Natural Resources). 2006a. Pine Barrens Treefrog. Available at: http://dnr.sc.gov/cwcs/pdf/PineBarrensTreefrog.pdf.

SCDNR (South Carolina Department of Natural Resources). 2006b. Bald Eagle. Available at http://www.dnr.sc.gov/wildlife/baldeagle/biology.html.

SCDNR (South Carolina Department of Natural Resources). 2006c. Rafinesque's Big-Eared Bat. Available at: http://dnr.sc.gov/marine/mrri/acechar/speciesgallery/Mammals/RafinesquesBig-earedBat/index.html.

SCDNR (South Carolina Department of Natural Resources). 2014. Rare, Threatened, and Endangered Species and Communities Known to Occur in Richland County. Dated June 11, 2014. Accessed on August 4, 2014. Available at: http://www.dnr.sc.gov/species/pdf/Richland2014.pdf.

SCDNR (South Carolina Department of Natural Resources). 2017. Well Records Locator – Richland County. Accessed on August 12, 2017. Available at: http://www.dnr.sc.gov/water/hydro/WellRecords/locatewells/index.html.

SCDNR (South Carolina Department of Natural Resources). 2019a. Fall Line (500k) in SC from USGS Open-File Report 01-298. Downloaded from South Carolina Department of Natural Resources at http://www.dnr.sc.gov/GIS/gisdnrdata.html on July 22, 2019. Online metadata: http://www.dnr.sc.gov/GIS/metadata/fall_line_500k.htm.

SCDNR (South Carolina Department of Natural Resources). 2019b. General Geologic Map Data of South Carolina. Downloaded from South Carolina Department of Natural Resources at http://www.dnr.sc.gov/GIS/gisdnrdata.html on July 22, 2019. Metadata embedded in the downloaded geodatabase file.

SCDNR (South Carolina Department of Natural Resources). 2019c. Richland County Climate Data. Accessed on May 20, 2019. Available at http://www.dnr.sc.gov/climate/sco/ClimateData/countyData/county_richland.php).

SCDOT (South Carolina Department of Transportation). 2017. Average Daily Traffic for AADT Year 2017. Available at: https://www.scdot.org/travel/pdf/trafficcounts/2017/Richland.pdf.

SCDOT (South Carolina Department of Transportation). 2018. Average Daily Traffic for AADT Year 2018. Available at: https://www.scdot.org/travel/pdf/trafficcounts/2018/Richland.pdf

SCDOT (South Carolina Department of Transportation). 2019. Columbia City Boundary extracted from South Carolina Municipal Areas file downloaded from the South Carolina Department of Transportation at http://info2.scdot.org/GISMapping/Pages/GIS.aspx on July 18, 2019.

South Carolina Code of Regulations. Chapter 61 Department of Health and Environmental Control. R61-62 Air Pollution Control Regulations and Standards. Accessible at: http://www.scstatehouse.gov/coderegs/Chapter%2061-62.pdf.

South Carolina Code of Regulations. Chapter 61 Department of Health and Environmental Control. R61-68 Water Classifications and Standards. Accessible at: http://www.scstatehouse.gov/coderegs/Chapter%2061-68.pdf.

South Carolina Code of Regulations. Chapter 61 Department of Health and Environmental Control. R61-79 Hazardous Waste Management Regulations. Accessible at: http://www.scstatehouse.gov/coderegs/Chapter%2061-79%20part%201.pdf.

South Carolina State Library. 2008. The 2008 South Carolina Historic Preservation Awards. Accessed on August 13, 2019. Available at: https://dc.statelibrary.sc.gov/bitstream/handle/10827/7514/DAH_SC_Historic_Preservation_Awards_2008.pdf?sequence=1&isAllowed=y.

SCWF (South Carolina Wildlife Federation). 2017. "South Carolina Wildlife Federation Recertifies 30 Wildlife and Industry Together sites." Columbia Star. June 9, 2017. Available at: http://www.thecolumbiastar.com/news/2017-06-09/Business/South_Carolina_Wildlife_Federation_recertifies_30_.html. Accessed on July 10, 2017.

USCB (U.S. Census Bureau). 2017a. Quick Facts: South Carolina. Accessed on August 6, 2019. Available at: https://www.census.gov/quickfacts/SC.

USCB (U.S. Census Bureau). 2017b. American FactFinder. Selected Economic Characteristics 2013-2017 American Community Survey 5-Year Estimates. Accessed on August 2, 2019. Available at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_DP03&prodType=table.

USCB (U.S. Census Bureau). 2018. "Accessing American Community Survey Block Group Data Webinar." Accessed on October 8, 2019. Available at: https://www.census.gov/programs-surveys/acs/news/events/accessing-block-group-data-2016.html.

USGS (U.S. Geologic Service). 2014. Two-percent probability of exceedance in 50 years map of peak ground acceleration. Accessed on July 25, 2019. Viewed at https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/2014pga2pct.pdf.

USGS (U.S. Geologic Service). 2019a. Information by Region-South Carolina at https://earthquake.usgs.gov/earthquakes/byregion/southcarolina.php; Data download on July 18, 2019.

USGS (U.S. Geologic Service). 2019b. Magnitude/Intensity Comparison. Accessed on July 25, 2019. Viewed at https://earthquake.usgs.gov/learn/topics/mag_vs_int.php.

USGS (U.S. Geologic Service). 2019c. Physiographic Divisions of the Conterminous U.S. Downloaded from the USGS at https://water.usgs.gov/GIS/dsdl/physio_shp.zip on July 22, 2019. Online metadata: https://water.usgs.gov/GIS/metadata/usgswrd/XML/physio.xml

WEC (Westinghouse Electric Company, LLC). 2012. Letter from WEC to NRC. Subject: Westinghouse Columbia Plant License Application Page Changes. Dated September 27, 2012. ADAMS Accession No. ML12277A165.

WEC (Westinghouse Electric Company, LLC). 2014a. SNM-1107 License Renewal Application. July 31, 2014. ADAMS Accession No. ML14213A105.

WEC (Westinghouse Electric Company, LLC). 2014b. SNM-1107 License Renewal Application – Supplemented. December 17, 2014. ADAMS Accession No. ML14352A111.

WEC (Westinghouse Electric Company, LLC). 2015a. Westinghouse 40-Year License Renewal Summary of Site Visit on August 18 - 19, 2015. ADAMS Accession No. ML16173A308.

WEC (Westinghouse Electric Company, LLC). 2016. Letter from WEC to NRC regarding Commitments to Address the Columbia Fuel Fabrication Facility Scrubber Event. August 9, 2016. ADAMS Accession No. ML16223A003.

WEC (Westinghouse Electric Company, LLC). 2017. Westinghouse Responses to Requests for Additional Information (Cost Activity Codes L33317 and L00926). December 12, 2017. ADAMS Accession No. ML17346B295.

WEC (Westinghouse Electric Company, LLC). 2018a. Summary of Pre-Application Call with WEC CFFF for Removal of the Administration Building from the Controlled Access Area. December 21, 2018. ADAMS Accession No. ML18352B104.

WEC (Westinghouse Electric Company, LLC). 2018b. WEC Consolidated Responses to Request for Additional Information with Revised SNM-1107 License Renewal Application. March 28, 2018. ADAMS Package Accession No. ML18087A400.

WEC (Westinghouse Electric Company, LLC). 2018c. Summary for Public Meeting held November 8, 2018, to discuss License Renewal, Environmental Analysis and Leaks at the Westinghouse Columbia Fuel Fabrication Facility. December 18, 2018. ADAMS Accession No. ML18330A255.

WEC (Westinghouse Electric Company, LLC). 2019a. Transmittal of Responses to Request for Additional Information Regarding the Environmental Review of the Columbia Fuel Fabrication Facility License. March 28, 2019. ADAMS Package Accession No. ML19088A095.

WEC (Westinghouse Electric Company, LLC). 2019b. Enclosure 4 – Revised Environmental Report. March 28, 2019. ADAMS Accession No. ML19088A100.

WEC (Westinghouse Electric Company, LLC). 2019c. Westinghouse Revised SNM-1107 License Renewal Application. August 22, 2019. ADAMS Package Accession No. ML19234A077.

WEC (Westinghouse Electric Company, LLC). 2019d. NRC Semi-Annual Discharge Report July-December 2018. February 27, 2019. ADAMS Accession No. ML19059A323.

WEC (Westinghouse Electric Company, LLC). 2019e. Final Remedial Investigation Work Plan Submission. June 18, 2019. Available at: https://www.scdhec.gov/sites/default/files/media/document/BLWM_Westinghouse_RIWORKPLAN%20JUNE%202019.pdf.

WEC (Westinghouse Electric Company, LLC). 2019f. Southern Storage Area Operable Unit Sampling Work Plan – Remedial Investigation Work Plan Addendum 1. June 18, 2019. Available at: https://www.scdhec.gov/sites/default/files/media/document/BLWM_Westinghouse_%20Addendum%201RIWorkPlan%2006182019.pdf.

WEC (Westinghouse Electric Company, LLC). 2019g. Wastewater Treatment Area Operable Unit East Lagoon Sludge Characterization – Remedial Investigation Work Plan Addendum 2, Revision 1. September 26, 2019. Available at: https://www.scdhec.gov/sites/default/files/media/document/09-26-2019%20East%20Lagoon%20Sludge%20Characterization%20RI%20work%20plan.pdf.

WEC (Westinghouse Electric Company, LLC). 2019h. Westinghouse Submittal of Triennial Update of Decommissioning Funding Plan. July 25, 2019. ADAMS Accession No. ML19206A195.

Willoughby, R.H., Nystrom, P.G. Jr., Campbell, L.D., Katuna, M.P., 1999. Cenozoic Stratigraphic Column of the Coastal Plain of South Carolina, South Carolina Department of Natural Resources and Geological Survey General Geologic Chart 1, 1 plt.