SRNS-RP-2024-00003

2023

SAVANNAH RIVER SITE

Environmental Report

The cover of the *2023 SRS Environmental Report* features flowers representing some of the Site's most colorful and cheerful residents that emerge every spring and summer: the purple coneflower (top) and coreopsis (bottom). The name coneflower references the cone-shaped center of the flower. Both flowers attract pollinators such as butterflies, hummingbirds, and bees. The smooth purple coneflower grows onsite and is federally listed as endangered. The coreopsis is common throughout South Carolina and home in sandy soils, woodland margins, and along the roadsides at SRS.

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or go to the SRS Environmental Report webpage at
srs.gov/general/pubs/ERsum/index.html
and under the SRS Environmental Report 2023, complete the electronic
Customer Satisfaction Survey.

SRNS-RP-2024-00003

Savannah River Site

Environmental Report 2023

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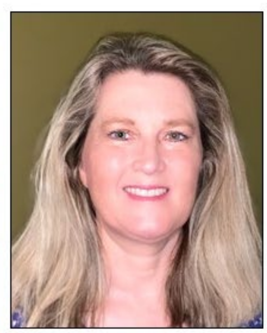

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To Our Readers

Highlights

The U.S. Department of Energy (DOE) Order 231.1B (Environment, Safety, and Health Reporting) requires Annual Site Environmental Reports (ASERs) assess both environmental program performance and sitewide environmental monitoring and surveillance effectiveness. ASERS also confirm that sites are complying with environmental standards and requirements.

ASERs are prepared in a manner that addresses likely public concerns and to solicit feedback from the public and other stakeholders. The Savannah River Site (SRS) began publishing ASERs in 1959.

Readers can find the *SRS Environmental Report* at the following address:

srs.gov/general/pubs/ERsum/index.html

The *SRS Environmental Report 2023* is an overview of environmental management activities conducted on and in the vicinity of the Savannah River Site (SRS) from January 1 through December 31, 2023. This report includes the following:

- A summary of implemented environmental management systems that facilitate sound stewardship practices and demonstrate compliance with applicable environmental regulations and laws intended to protect air, water, land, and other natural and cultural resources that SRS operations have impacted.
- A summary of measurement results of nonradiological parameters. These results are compared to permit limits and applicable standards.
- A summary of the results of effluent monitoring and environmental surveillance of air, water, soil, vegetation, biota, and agricultural products to determine radioactivity in these media. SRS compares the results with historical data and background measurements, and to applicable standards and requirements to verify that SRS does not adversely impact the environment or the health of humans or biota.
- A discussion of the potential dose to members of the public from radioactive releases from SRS operations compared to applicable standards and regulations, and from special-case exposure scenarios.
- An explanation of the quality assurance and quality control program, which ensures that samples and data SRS collects and analyzes are reported with utmost confidence.
- A discussion of per- and polyfluoroalkyl (PFAS) substances. Chapter 9 was created for the 2022 *SRS Environmental Report* in response to the challenges these emerging contaminants of concern present to SRS and the environment. This year's chapter discussion updates the Site's efforts to assess PFAS presence at the Site and to determine appropriate action.

The report addresses three general levels of reader interest:

1) The first is a brief summary with a "take-home" conclusion. This is presented in the "Highlights" text box at the beginning of each chapter. There are no technical tables, figures, or graphs in the "Highlights."

2) The second level is a more in-depth discussion with figures, summary tables, and summary graphs accompanying the text. The chapters of the annual report represent this level, which requires some familiarity with scientific data and graphs.

3) The third level includes supplemental and technical reports and websites that support the annual report. The Uniform Resource Locators (URLs) that lead to this information on the internet may be found in the "In-text Reference Links" section that precedes Chapter 1 of this report. Blue text in the report indicates that there is an associated URL that when copied into your browser will take you to additional information. Many of the reports mentioned in Chapter 3, *Compliance Summary*, are submitted to meet compliance requirements and are not available on the *SRS Environmental Report* 2023 webpage or through an "In-text Reference Links" section listing. These reports may be obtained through a Freedom of Information Act (FOIA) request. Similarly, the raw data used to prepare Appendices C and D, which support findings presented in Chapter 4, *Nonradiological Environmental Monitoring Program*, and Chapter 5, *Radiological Environmental Monitoring Program,* are submitted to the South Carolina Department of Health and Environmental Control and are available to the public through a FOIA request.

When a regulation or U.S. Department of Energy (DOE) Order requires reporting on a fiscal year (FY) basis, the information in this report is reported by FY. This allows for consistency with existing documentation. FY reporting is typically found in Chapter 2, *Environmental Management System*, and Chapter 3, *Compliance Summary*. The FY is from October 1 to September 30. Information not designated as applicable to the FY is reported for the calendar year (January 1 to December 31).

The SRS Environmental Report webpage contains reports from multiple years with the 2023 report being the latest. The report's webpage is broken down into the following:

- The full report with website addresses to supplemental information or reports
- Maps with environmental sampling locations for the various media samples. These figures are identified as "Maps Figure" within the text of the report
- Annual reports from SRS organizations

Savannah River Nuclear Solutions, LLC (SRNS) develops this report as the management and operations contractor to the DOE at SRS. In addition to SRNS, the contributors to the annual report include the U.S. Department of Energy, the Savannah River Operations Office (DOE-SR); Savannah River Mission Completion (SRMC); Centerra-SRS; Ameresco Federal Solutions; the Savannah River Ecology Laboratory (SREL); and the United States Forest Service-Savannah River (USFS-SR).

Note:

In 2023, SRS transitioned to a new comprehensive environmental database. This system replaced a suite of existing applications, systems, and databases and now allows for SRS to load and extract data from a consolidated data storage system. The *2022 SRS Environmental Report* was the first publication after this change. For the 2022 reporting year, data was housed in both the new and pre-existing databases, which made for a challenge in reporting data. In preparation of the *2023 SRS Environmental Report*, we identified some cases where the continuity of data across systems had not been perfect and, as such, there are corrections to be made to the 2022 report. These corrections do not influence the final dose values that were reported for 2022. The corrections can be found on the *2022 SRS Environmental Report* webpage.

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Acronyms and Abbreviations

A

ACS	American Chemical Society
AIM	American Innovation and Manufacturing
AFFF	Aqueous Film Forming Foam
AIP	Agreement in Principle
ALARA	As Low As Reasonably Achievable
ARP/MCU	Actinide Removal Process and Modular Caustic Side Solvent Extraction Unit
ASER	Annual Site Environmental Report
ATTA	Advanced Tactical Training Academy

B

BCF	Biomass Cogeneration Facility
BJWSA	Beaufort-Jasper Water and Sewer Authority
BLLDF	Barnwell Low-Level Disposal Facility
BSRA	Battelle Savannah River Alliance

C

C&D	Construction and Demolition
CA	Composite Analysis
CAA	Clean Air Act
CAB	SRS Citizens Advisory Board
CEC	Contaminant of Emerging Concern
CEDMS	Comprehensive Environmental Data Management System
CEI	Compliance Evaluation Inspection
CEPLT	Comprehensive Environmental Permits Linking Tool
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH-TRU	Contact Handled Transuranic Waste
CMP	Chemicals, Metals, and Pesticides
COC	Contaminant of Concern
COVID-19	Coronavirus Disease 2019
CSRA	Central Savannah River Area
CSWTF	Central Sanitary Wastewater Treatment Facility

CVN 65	Ex Enterprise (Former Aircraft Carrier USS Enterprise)
CWA	Clean Water Act
CX	Categorical Exclusion
CY	Calendar Year

D

DCS	Derived Concentration Standard
DL	Detection Limit
DMR	Discharge Monitoring Report
DoD	United States Department of Defense
DO	Dissolved Oxygen
DOE	United States Department of Energy
DOECAP	Department of Energy Consolidated Audit Program
DOE-EM	United States Department of Energy-Environmental Management
DOE-HQ	United States Department of Energy-Headquarters
DOE-SR	United States Department of Energy-Savannah River Operations Office
DON	Department of the Navy
DWPF	Defense Waste Processing Facility

E

EA	Environmental Assessment
ECA	Environmental Compliance Authority
ECHO	Enforcement and Compliance History Online
ECM	Energy Conservation Measure
ECPD	Environmental Compliance and Protection Division
E. coli	*Escherichia coli*
EDAM	Environmental Dose Assessment Manual
EEC	Environmental Evaluation Checklist
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EIS/OEIS	Environmental Impact Statement/Overseas Environmental Impact Statement
EJ	Environmental Justice
EM	Environmental Management
EMP	Environmental Monitoring Program
EMS	Environmental Management System

EnMS	Energy Management System
EOP	Education Outreach Program
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPEAT	Electronic Product Environmental Assessment Tool
EPP	Environmentally Preferable Product
ERO	Emergency Response Organization
ESA	Endangered Species Act
ESD	Explanation of Significant Difference
ESOP	Environmental Surveillance Oversight Program
ESPC	Energy Saving Performance Contracting
ETP	Effluent Treatment Project
ETF	Effluent Treatment Facility
EV	Electric Vehicle
E-85	85% Ethanol, 15% Unleaded Gasoline

F

FERC	Federal Energy Regulatory Commission
FFA	Federal Facility Agreement
FFCA	Federal Facility Compliance Act
FGR	Federal Guidance Report
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FOIA	Freedom of Information Request
FONSI	Finding of No Significant Impact
FR	Federal Register
FRS	Facility Register Service
FY	Fiscal Year

G

GHG	Greenhouse Gas
GIS	Geographic Information Service

H

HBCU	Historically Black Colleges and Universities
HFCs	Hydrofluorocarbons
HFPO-DA	Hexafluoropropylene Oxide Dimer Acid (commonly known as GenX Chemicals)
HLW	High-Level Waste
HQ	Headquarters
HWMF	Hazardous Waste Management Facility
HVAC	Heating, Ventilation, and Air Conditioning

I

IAEA	International Atomic Energy Agency
I&D	Industrial and Domestic
ICRP	International Commission on Radiological Protection
ILA	Industrial, Landscaping, and Agricultural
IOU	Integrator Operable Unit
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
IT	Information Technology

J, K

No Acronyms or Abbreviations for 2023 Reporting Year

L

LANL	Los Alamos National Laboratory
LED	Light-Emitting Diode
LLW	Low-Level Waste
LRP	L-Area Rubble Pit
LTR	Lower Three Runs
LUCs	Land Use Controls

M

MAPEP	Mixed Analyte Performance Evaluation Program
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
MCMEU	Mission-Critical Military End Use

MDC	Maximum Detected Concentration
MEI	Maximally Exposed Individual
Met Lab	Metallurgical Laboratory
MNR	Monitored Natural Recovery
MOX	Mixed Oxide (Fuel)
mrem	Millirem
MW	Mixed Waste
MWMF	Mixed Waste Management Facility
MWSB	Mixed Waste Storage Building

N

NA-1	Under Secretary for Nuclear Security and Administration
NA-MRF	North Augusta, South Carolina Material Recovery Facility
NARA	North Ash Remediation Area
NDAA	National Defense Authorization Act
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGB	National Guard Bureau
NHPA	National Historic Preservation Act
NNIPS	Non-native Invasive Plant Species
NNSA	National Nuclear Security Administration
NNSA-SRFO	National Nuclear Security Administration-Savannah River Field Office
NOAV	Notice of Alleged Violation
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
NSPS	New Source Performance Standards
NWP	Nationwide Permit

O

ORPS	Occurrence Reporting and Processing System
OSLD	Optically Stimulated Luminescence Dosimeters
OU	Operable Unit

P

PA	Performance Assessment
PAB	P-Area Ash Basin
PAR	P and R Reactor
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene
PFAS	Per- and Polyfluoroalkyl Substances
PFBS	Perfluorobutane Sulfonic Acid
PFHxS	Perfluorohexane Sulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
pH	Potential of Hydrogen
PIC	Potential Impact Category
PTSM	Principal Threat Source Material
PUE	Power Usage Effectiveness
PWG	PFAS Working Group

Q

QA	Quality Assurance
QC	Quality Control

R

RCRA	Resource Conservation and Recovery Act
RCW	Red-cockaded Woodpecker
RESRAD	RESidual RADioactivity
RICE	Reciprocating Internal Combustion Engine
RM	River Mile
ROD	Record of Decision
RPD	Relative Percent Difference
RPSEC	Ruth Patrick Science Education Center
RQ	Reportable Quantity
RSL	Regional Screening Levels

RSV	Regional Screening Values
RWM	M-Area Recovery Well

S

SA	Supplement Analysis
SARA	South Ash Retention Area
SARA	Superfund Amendment and Reauthorization Act of 1986
SCARNG	South Carolina Army National Guard
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCHWMR	South Carolina Hazardous Waste Management Regulations
SDF	Saltstone Disposal Facility
SDU	Saltstone Disposal Unit
SDWA	Safe Drinking Water Act
SLF	Sanitary Landfill
SME	Subject Matter Expert
SNAP	Significant New Alternatives Policy
SPDP	Surplus Plutonium Disposition Program
SQL	Standard Quantification Limit
SRARP	Savannah River Archaeological Research Program
SREL	Savannah River Ecology Laboratory
SRFO	Savannah River Field Office
SRMC	Savannah River Mission Completion
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions, LLC
SRPPF	Savannah River Plutonium Processing Facility
SRS	Savannah River Site
SRSCRO	Savannah River Site Community Reuse Organization
SRTE	Savannah River Tritium Enterprise
SSP	Site Sustainability Plan
SST	Solvent Storage Tanks
STEM	Science, Technology, Engineering, and Mathematics
STEP	Science and Technology Enrichment Program
STP	Site Treatment Plan

SU	Standard Unit
SWDF	Solid Waste Disposal Facility
SWPF	Salt Waste Processing Facility
SWPPP	Stormwater Pollution Prevention Plan

T

TA	Temporary Authorization
TCCR	Tank Closure Cesium Removal
TCE	Trichloroethylene
TED	Total Effective Dose
TFF	Tritium Finishing Facility
TNX	678-T Facilities
TOC	Total Organic Carbon
TRI	Toxic Release Inventory
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facilities
TSS	Total Suspended Solids

U

U	Unclassified
UGA	University of Georgia
UNICOR	Federal Prison Industries, Inc.
U.S.	United States
USACE	United States Army Corps of Engineers
USC	University of South Carolina
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFS-SR	United States Forest Service-Savannah River
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
UST	Underground Storage Tank

V

VEGP	Vogtle Electric Generating Plant
VOC	Volatile Organic Compound
VSDS	Visual Survey Data System

W

WADB	Wetland Area at Dunbarton Bay
WIPP	Waste Isolation Pilot Plant
WORC	Workforce Opportunities in Regional Careers
WSRC	Westinghouse Savannah River Company
WTP	Water Treatment Plant

X, Y, Z

No Acronyms or Abbreviations for 2023 Reporting Year

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In-text Reference Links

Note: This section contains links that are referenced in the text. Within the text, all link references are distinguished with blue coloring. To visit a link, please copy and paste it into a browser.

Chapter 1

Overview of the Savannah River Site: srs.gov/general/pubs/srs_overview_flip/mobile/index.html#p=1

SRS website: srs.gov/general/srs-home.html

Defense Programs: itwebacpt.srs.gov/general/programs/dp/index.htm

SREL: srel.uga.edu/

USFS-SR: fs.usda.gov/savannahriver

SRS Environmental Report 2023 webpage: srs.gov/general/pubs/ersum/index.html

Chapter 2

SRS Environmental Policy: srs.gov/general/pubs/envbul/documents/env_mgt_sys_policy.pdf

Environmental Surveillance Oversight Program (ESOP): scdhec.gov/savannah-river-site/monitoring-9

"Departmental Use of Environmental Management Systems": energy.gov/sites/default/files/2024-02/EMS%20Instructions%20Memo%20and%20Attachments%201-3%20Final%20-%209-18-23%20signed.pdf

WaterSense: epa.gov/watersense

biobased or BioPreferred®:biopreferred.gov/BioPreferred/faces/pages/BiobasedProducts.xhtml

Significant New Alternatives Policy (SNAP): epa.gov/snap

Electronic Product Environmental Assessment Tool (EPEAT): epa.gov/greenerproducts/electronic-product-environmental-assessment-tool-epeat

ENERGY STAR®: energystar.gov/

SRNS's Education Outreach Programs (EOPs): srs.gov/general/outreach/edoutrch/index.htm

SRS Citizens Advisory Board (CAB): cab.srs.gov/srs-cab.html

SRS Community Reuse Organization (SRSCRO): srscro.org/

webpage: srs.gov/general/pubs/envbul/ebindex.htm

Chapter 3

Federal Facility Agreement (FFA) for the Savannah River Site: srs.gov/general/programs/soil/ffa/ffa.pdf

SRS webpage: srs.gov/general/srs-home.html

SRS NEPA: srs.gov/general/pubs/envbul/nepa1.htm

EPA TRI Program: epa.gov/toxics-release-inventory-tri-program/what-toxics-release-inventory

EPA's Enforcement and Compliance History Online (ECHO): echo.epa.gov/

EPA website: epa.gov/

Chapter 4

No links

Chapter 5

Environmental Maps: srs.gov/general/pubs/ERsum/er23/docs/Maps-2023.pdf

Krypton-85: srs.gov/general/pubs/ERsum/er19/docs/Krypton-2019.pdf

Environmental Maps, *Radiological Air Surveillance Sampling Locations:* srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_1-Radiological_Air_Surveillance_Sampling.pdf

Environmental Maps, *SRS Optically Stimulated Luminescent Dosimeter [OSLD] Sampling Locations:* srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_2-Optically_Stimulated_Luminescence_Dosimeter_OSLD_Sampling.pdf

Environmental Maps, *Radiological Soil Sampling Locations:* srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_3-Radiological_Soil_Sampling.pdf

Environmental Maps, *Radiological Vegetation Sampling Locations:* srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_4-Radiological_Vegetation_Sampling.pdf

Environmental Maps, *Stream Systems:* srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_5-Stream_Systems.pdf

Environmental Maps, *Radiological Sediment Sampling Locations:* srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_6-Radiological_Sediment_Sampling.pdf

Environmental Maps*, Domestic Water Systems:* srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_7-Domestic_Water_Systems.pdf

Environmental Maps*, Fish Sampling Locations:* srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_8-Fish_Sampling.pdf

Chapter 6

No links

Chapter 7

Federal Facility Agreement (FFA) for the Savannah River Site: srs.gov/general/programs/soil/ffa/ffa.html

EPA: epa.gov/pfas

SCDHEC: scdhec.gov/BOW/perfluoroalkyl-substances-pfas

Interstate Technology Regulatory Council: itrcweb.org/Team/Public?teamID=78

Savannah River Site Groundwater Management Strategy and Implementation Plan: srs.gov/general/programs/soil/gen/gw_mgmt_strategy_and_implementation_plan.pdf

SRS Environmental Report webpage: srs.gov/general/pubs/ersum/index.html

Chapter 8

No links

Chapter 9

(PFAS) presence at DOE sites: energy.gov/pfas/pfas-and-polyfluoroalkyl-substances

surveys conducted by the Centers for Disease Control and Prevention: epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas

DOE Commitments to Action 2022-2025: energy.gov/pfas/articles/pfas-strategic-roadmap-doe-commitments-action-2022-2025

Appendix A

No links

Appendix B

No links

Appendix C

No links

Appendix D

SRS Optically Stimulated Luminescent Dosimeter [OSLD] Sampling Locations: srs.gov/general/pubs/ERsum/er23/docs/Maps-2023_2-Optically_Stimulated_Luminescence_Dosimeter_OSLD_Sampling.pdf

Appendix E

No links

Appendix F

USDA website: biopreferred.gov/BioPreferred/faces/pages/AboutBioPreferred.xhtml

ENERGY STAR website: energystar.gov/

EPEAT website: epeat.net/

ISO website: iso.org/home.html

SRSCRO website: srscro.org/

U.S. EPA website: epa.gov/watersense/

Appendix G

No links

Appendix H

No links

Sampling Location Information

Note: This section contains sampling location abbreviations used in the text and on the sampling location maps. It also contains a list of sampling locations known by more than one name. (See next page.)

Location Abbreviations	Location Name/Other Applicable Information
4M	Fourmile
4MB	Fourmile Branch (Fourmile Creek)
4MC	Fourmile Creek
BDC	Beaver Dam Creek
BG	Burial Ground
BLTW	Burke and Screven Counties Wells (Georgia)
EAV	E-Area Vaults
FM	Four Mile
FMB (FMC)	Fourmile Branch (Fourmile Creek)
GSTW	Burke and Screven Counties Wells (Georgia)
HP	HP (sampling location designation only; not an actual abbreviation)
HWY	Highway
KP	Kennedy Pond
L3R	Lower Three Runs
LTR	Lower Three Runs
MCQBR	McQueens Branch
MHTW	Burke and Screven Counties Wells (Georgia)
MPTW	Burke and Screven Counties Wells (Georgia)
MSB	SRS Boundary Wells
NSB L&D	New Savannah Bluff Lock & Dam (Augusta Lock and Dam)
PAR	“P” and “R” Pond
PB	Pen Branch
RM	River Mile
SC	Steel Creek
SWDF	Solid Waste Disposal Facility
TB	Tims Branch
TC	Tinker Creek
TNX	Multipurpose Pilot Plant Campus
TR	Burke and Screven Counties Wells (Georgia)
U3R	Upper Three Runs
VEGP	Vogtle Electric Generating Plan (Plant Vogtle)

Sampling Locations Known by More Than One Name
Augusta Lock and Dam; New Savannah River Lock and Dam
Beaver Dam Creek; 400-D
Fourmile Creek-2B; Fourmile Creek at Road C
Fourmile Creek-3A; Fourmile Creek at Road C
Lower Three Runs-2; Lower Three Runs at Patterson Mill Road
Lower Three Runs-3; Lower Three Runs at Highway 125
Pen Branch-3; Pen Branch at Road A-13-2
R Area downstream of R-1; 100-R
River Mile 118.8; U.S. Highway 301 Bridge Area; Highway 301, US 301, Georgia Welcome Center at Highway 301
River Mile 129.1; Lower Three Runs Mouth
River Mile 141.5; Steel Creek Boat Ramp
River Mile 150.4; Vogtle Discharge
River Mile 152.1; Beaver Dam Creek Mouth
River Mile 157.2; Upper Three Runs Mouth
River Mile 160.5; Demier Landing
Steel Creek at Road A; Steel Creek-4; Steel Creek-4 at Road A; Steel Creek at Highway 125
Tims Branch at Road C; Tims Branch-5
Tinker Creek at Kennedy Pond; Tinker Creek-1
Upper Three Runs-4; Upper Three Runs-4 at Road A; Upper Three Runs at Road A; Upper Three Runs at Hwy 125
Upper Three Runs-1A; Upper Three Runs-1A at Road 8-1
Upper Three Runs-3; Upper Three Runs-3 at Road C

Chapter 1: **Introduction**

The "Savannah River Site (SRS) Environmental Report" is the primary document that the U.S. Department of Energy (DOE) uses to inform the public of environmental performance and conditions at SRS. This report meets the requirements of DOE Order 231.1B, "Environment, Safety, and Health Reporting." It is also the principal document that demonstrates how the Site complies with the requirements of DOE Order 458.1, "Radiation Protection of the Public and the Environment."

The "SRS Environmental Report" summarizes the Site's environmental information and data to achieve the following:

- *Highlight significant Site programs*
- *Report environmental occurrences and responses*
- *Describe SRS's compliance with environmental standards and requirements*
- *Describe SRS's Environmental Management System and sustainability performance*
- *Provide the results of monitoring material containing residual radioactivity before its release from SRS*

Chapter Highlights

This chapter presents the following:

- A brief history of SRS, along with a summary of its current missions
- Highlights of SRS organizations and their primary responsibilities
- Descriptions of the physical characteristics and attributes of the environment in and around SRS
- Updates of SRS's primary mission and annual programs

1.1 HISTORY

On November 28, 1950, President Harry S. Truman tasked the E. I. DuPont de Nemours Company with designing, building, and operating what was to be the Savannah River Plant. The construction project relocated citizens, homes, and businesses from the six South Carolina towns that had existed on the land. By 1953, the Savannah River Site (SRS) began producing the basic materials used to create nuclear weapons for the nation's defense. The work performed during the Site's early days was key to the United States winning the Cold War. For the seven decades since the Site's beginning, SRS has been a leader in environmental protection within the U.S. Department of Energy (DOE) complex and a steward of water and energy conservation throughout the 310-square-mile site.

An *Overview of the Savannah River Site*, available on the SRS website, details much of the Site's history and accomplishments.

1.2 MISSION AND CURRENT OPERATION

The mission of the Savannah River Site is to safely and efficiently protect public health and the environment, while supporting the nation's nuclear deterrent programs and transforming the Site for future use. The Site is a recognized long-term national asset in the areas of environmental stewardship, innovative technology, national security, and energy independence. It acts with an inspired workforce and mature, efficient management processes, to sustain public confidence in its employees and capabilities. The SRS core values include performing safe and effective operations, along with maintaining good relations with Site stakeholders. The Site's main activities are environmental cleanup, nuclear waste management, and disposition of nuclear materials. Figure 1-1 highlights many of these programs as well as presents historical milestones chronologically.

The DOE Office of Environmental Management (DOE-EM) and the National Nuclear Security Administration (NNSA) oversee the Site mission. DOE-EM's primary mission through DOE-Savannah River (DOE-SR) is to ensure that SRS operations and the cleanup of legacy waste are done in a way that protects public health and the environment. DOE-EM executes this mission with the support of contractors and subcontractors, universities, and federal agencies. Additionally, DOE-EM has various agreements with the U.S. Department of Agriculture (USDA), the U.S. Forest Service-Savannah River (USFS-SR), the University of Georgia (UGA), the University of South Carolina (USC), and Ameresco Federal Services (via contract) to manage and conserve the Site's environmental resources. USFS-SR oversees SRS's natural resources through an interagency agreement with DOE-SR. UGA has operated the Savannah River Ecology Laboratory (SREL) since 1951, independently evaluating the environmental risk associated with Site activities. Since 1978, USC has overseen the Savannah River Archaeological Research Program (SRARP), a research unit that provides the technical expertise to manage SRS cultural resources. Ameresco Federal Solutions maintains a cogeneration power plant that uses renewable materials to supply steam, eliminating the need for coal.

NNSA's Savannah River Field Office (SRFO) is responsible for defense programs, and NNSA's Office of Defense Nuclear Nonproliferation is responsible for the nuclear nonproliferation elements of the national security missions.

Savannah River Nuclear Solutions (SRNS), Savannah River Mission Completion (SRMC), Centerra-SRS, and Battelle Savannah River Alliance (BSRA) contract with DOE to directly contribute to both the DOE-EM and NNSA missions. SRNS, as the management and operations contractor, oversees and ensures safe and efficient operations at SRS, managing landlord services and supporting both DOE-EM cleanup (excluding liquid waste operations) and NNSA activities. SRMC became the liquid waste operations contractor in February 2022 and is responsible for treating and disposing of radioactive liquid waste and tank closures. SRMC worked closely with Parsons Government Services, Inc., a limited-service contractor to DOE-EM, to design, construct, and commission the Salt Waste Processing Facility (SWPF) to accomplish SRMC's goals. Centerra-SRS provides a uniformed force to protect DOE and NNSA security interests at the Site. BSRA is the management and operations contractor for the Savannah River National Laboratory (SRNL), whose mission is applied research and development in environmental remediation and risk reduction, nuclear materials processing and disposition, nuclear detection and national security, and clean energy applications.

Milestones in Savannah River Site Construction and Missions History

1950s

November 28, 1950: President Truman tasks DuPont with designing, building, and operating the Savannah River Plant.

1951:
- Construction is complete on CMX pilot plant, the first working facility.
- Construction begins on the first waste tank.
- Ecological studies and environmental monitoring are initiated.

1953: The Savannah River Plant begins producing basic materials for nuclear weapons.

1953-55: R, P, L, and C Reactors start up.

1955: H Canyon starts recovering uranium and neptunium from reactor fuel tubes. Today, it processes weapons-grade nuclear materials for final disposition.

1959: SRP produces the first Pu-238 heat source, which was used in a space satellite in 1961.

1960s

1961: The Atomic Energy Commission establishes a permanent ecology laboratory onsite, later known as Savannah River Ecology Laboratory.

Savannah River Ecology Laboratory

The Heavy Water Components Test Reactor

1964: Reactor shutdown begins with R Reactor and the Heavy Water Components Test Reactor.

1970s

1972: SRP named the nation's first National Environmental Research Park in recognition of its unique value and habitat diversity.

SRS Alligator

1978: The Savannah River Archaeological Research Program is established to perform data analysis of prehistoric and historic sites.

Savannah River Archaeological Research Program

1980s

Effluent Treatment Facility

1983: Wackenhut Security International begins providing security.

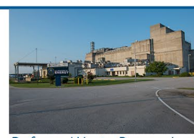
1988: Effluent Treatment Facility operations start up.

1989:
- The DuPont contract ends, and the Westinghouse contract begins.
- The name of the Site changes from the Savannah River Plant to the Savannah River Site.

1990s

1990: The Saltstone Facility starts up.

March 1996: The Defense Waste Processing Facility begins vitrification to convert radioactive liquid waste into glass suitable for long-term storage and disposal.



Defense Waste Processing Facility

1999: Washington Group International acquires the government services business of Westinghouse, changing the Westinghouse Savannah River Company name to Washington Savannah River Company.

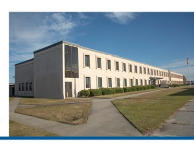
2000s

May 2001: The Savannah River Site begins shipping transuranic waste to the Waste Isolation Pilot Plant.

2004: The Savannah River Technology Center becomes the Savannah River National Laboratory.

Savannah River National Laboratory

2007: The Tritium Extraction Facility opens.



2008:
- The U.S. Department of Energy awards the management and operations contract to Savannah River Nuclear Solutions.
- Actinide Removal Process & Modular Caustic Side Solvent Extraction Unit begins operating.

2009:
- American Recovery and Reinvestment Act accelerates Area Completion Projects and transuranic waste disposition.
- Savannah River Remediation receives the contract for the Liquid Waste Operations.

2010s

D-Area Coal Pile and Runoff Basin

2012: Ameresco starts up the Biomass Cogeneration Facility.

2018: The Savannah River Site completes D-Area coal ash clean up.

August 2018: The first mega-sized Saltstone Disposal Unit becomes operational.

Saltstone Disposal Unit

2020s

October 2020: The Site transfers the first batch of radioactive waste to the Salt Waste Processing Facility.

June 2021:
- The National Nuclear Security Administration approves producing at least 50 plutonium pits per year at the Savannah River Plutonium Processing Facility.
- Savannah River National Laboratory transitions to management and operations under Battelle Savannah River Alliance.

October 2021: Savannah River Mission Completion becomes the Integrated Mission Completion Contractor.

October 2022: The Department of Energy-Savannah River and the National Nuclear Security Administration's Savannah River Field Office develop a plan to transfer primary authority, accountability, and Site stewardship for the Site to the Savannah River Field Office by October 1, 2024.

Figure 1-1 Timeline Depicting Key Milestones in SRS History

Given the steadily increasing NNSA mission requirements at SRS and the concurrent progression of the EM clean-up mission toward defined end state(s), EM and NNSA decided to transition SRS from EM to NNSA leadership.

On October 6, 2022, a joint EM and NNSA memorandum (EM-2022-000686) directed DOE-SR and SRFO to develop a plan to transfer primary authority, accountability, and Site stewardship responsibility for SRS from DOE-SR to SRFO. The transition will occur on October 1, 2024.

1.3 SITE LOCATION, DEMOGRAPHICS, AND ENVIRONMENT

SRS borders the Savannah River and encompasses about 310 square miles of Aiken, Allendale, and Barnwell counties in South Carolina. SRS is about 12 miles south of Aiken, South Carolina, and 15 miles southeast of Augusta, Georgia (Figure 1-2). The Savannah River flows along the Site's southwestern border.

Based on the U.S. Census Bureau's 2020 data, the population within a 50-mile radius of H Area—the Site's center, where most radiological releases occur—is 838,833 people. This equates to about 111 people per square mile outside the SRS boundary in Aiken, Allendale, and Barnwell counties in South Carolina and Richmond, Burke, and Screven counties in Georgia, with the largest concentration in the Augusta metropolitan area. Census tract analysis from the surrounding communities, as assessed by the Climate and Economic Justice Screening Tool (a product of the January 2021 issuance of Executive Order 14008), has identified many of the communities immediately surrounding the Savannah River Site as disadvantaged. SRS is committed to Environmental Justice (EJ) and provides opportunities for community engagement and decision-making through information sharing and empowering the communities around the Site. More information on SRS EJ programs, including educational opportunities, workforce development, and community advocacy and outreach, can be found in Chapter 2*, Environmental Management System* (Section 2.4.3, *Environmental Justice*).

1.3.1 Geology

SRS is on the southeastern Atlantic Coastal Plain in the Aiken Plateau. The center of SRS is about 25 miles southeast of the geologic fall line that separates the Coastal Plain from the Piedmont. The observed climate, surface drainage, and landforms on the Savannah River Site are typical of the southern part of the Atlantic Coastal Plain. The Aiken Plateau slopes gently to the southeast and is generally well-drained, although many poorly drained depressions exist. Elliptical-shaped Carolina bays, for example, are common on the Aiken Plateau. Carolina bays are important wetland habitats and refuge for many plants and animals. As many as 300 Carolina bays exist on SRS.

Upper Three Runs is a Southwest-flowing Tributary of the Savannah River.

All major streams on SRS originate onsite, except for Upper Three Runs, which begins north of the Site. All onsite streams drain southwesterly into the Savannah River (Denham 1995).

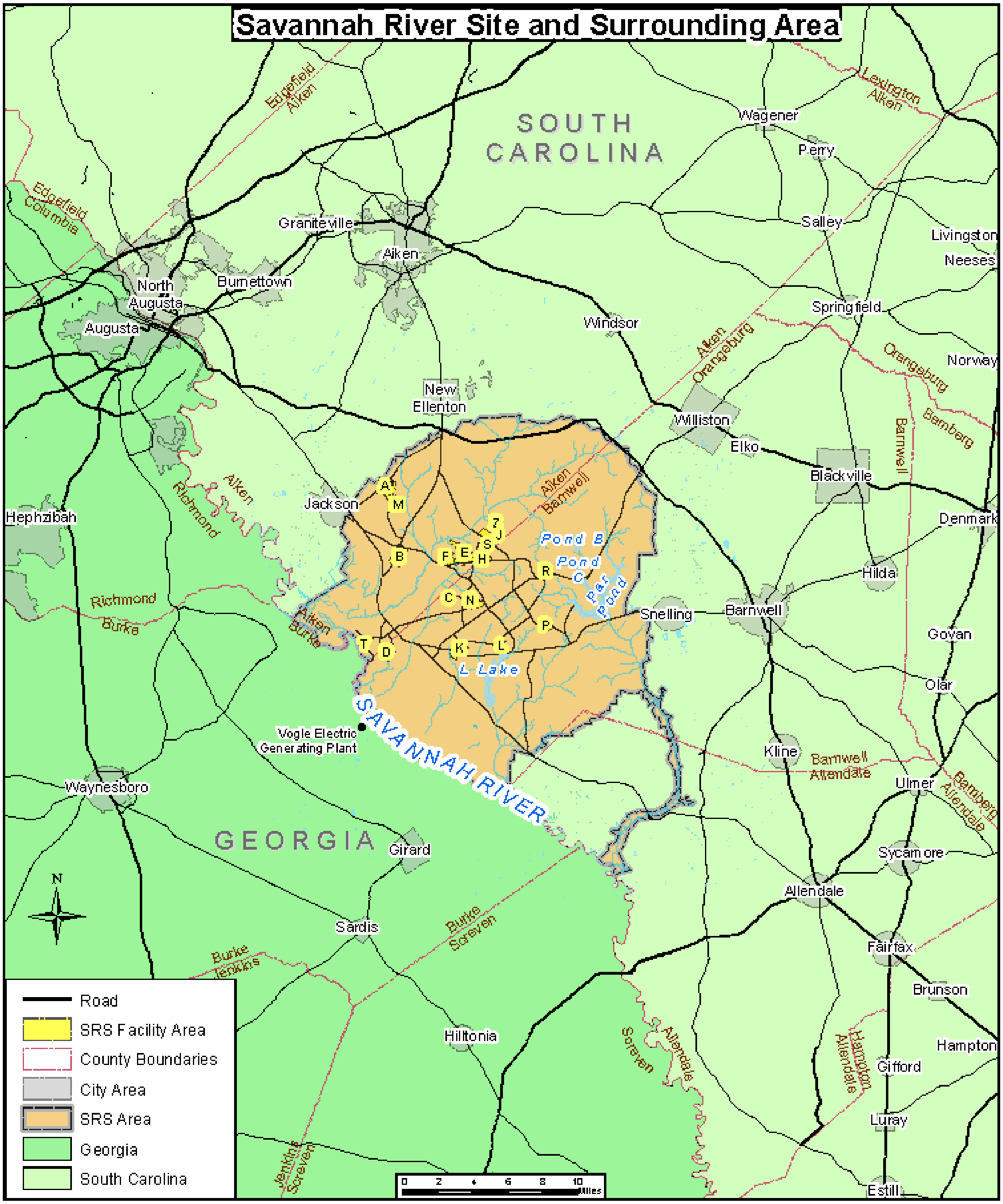


Figure 1-2 The Savannah River Site and Surrounding Areas
(The capital letters on the Figure 1-2 map reference the operational areas within the SRS borders.)

1.3.2 Water Resources

SRS activities potentially impact water resources, including the Savannah River, Site streams, and the underlying groundwater. The Savannah River bounds SRS on the southwest for 35 river miles. The upriver boundary of SRS is about 160 river miles from the Atlantic Ocean. The nearest downriver municipal facility that uses the river as a drinking water source (Beaufort-Jasper Water and Sewer Authority's Purrysburg Water Treatment Plant) is about 90 river miles from the Site. Commercial fishermen, sport fishermen, swimmers, and boaters also use the river. The Savannah River is not currently used for any large-scale irrigation projects downriver of the Site. The groundwater at SRS, which is used for both industrial processes and drinking water, migrates through the subsurface, primarily discharging into the Savannah River and its tributaries.

1.3.3 Land and Forest Resources

About 10% of SRS's land is industrial; the remaining 90% consists of natural and managed forests that the USFS-SR plants, maintains, and harvests. SRS consists of four major forests: 1) mixed-pine hardwoods, 2) sandhills pine savanna, 3) bottomland hardwoods, and 4) swamp floodplain forests. These forests, as well as Carolina bays, are accessible to the public when visiting the Crackerneck Wildlife Management Area and Ecological Reserve near Jackson, South Carolina.

Crackerneck Wildlife Management Area and Ecological Reserve Provides Public Access to Carolina Bays.

Animal and Plant Life

SRS is home to many varieties of plants and animals, including

- More than 100 species of reptiles and amphibians
- Approximately 50 species of mammals
- Nearly 100 species of fish
- Nearly 600 species of aquatic insects
- Approximately 1,500 species of plants, of which at least 40 are of state or regional concern
- More than 250 species of birds, some of which are migratory and do not make SRS their permanent home

The Gopher Tortoise is One of the Threatened Animal Species at Home on the Savannah River Site.

The Site also provides habitat for state or federally listed as threatened or endangered animal and plant species, including the wood stork, the red-cockaded woodpecker, the gopher tortoise, the pondberry, and the smooth coneflower. These species and SRS's programs that protect their existence are featured in an *SRS Environmental Report Summary* article that examines conservation efforts on the Savannah River Site.

1.4 PRIMARY SITE ACTIVITIES

SRS is a complex Site that DOE-SR currently manages. It is also the host to the NNSA-SRFO. DOE-SR partners with multiple contractors in technically sophisticated nuclear and non-nuclear facilities. Cleanup activities at SRS include addressing approximately 33 million gallons of radioactive liquid waste stored in 43 underground tanks; surplus plutonium down-blending with eventual disposition as transuranic (TRU) waste to the Waste Isolation Pilot Plant (WIPP), a geologic repository near Carlsbad, New Mexico; disposition of highly enriched uranium and receipt, storage, and processing of foreign and domestic research reactor spent nuclear fuel; excess facility deactivation and decommissioning; and soil and groundwater remediation.

1.4.1 DOE-EM Primary Site Activities

DOE's Environmental Management Program oversees many Site activities. The following sections highlight key programs occurring during the 2023 reporting year. Additional information is available on the SRS website.

1.4.1.1 Nuclear Materials Management

Nuclear materials management operations provide an interim storage location for a portion of the nation's surplus plutonium as well as the capability to disposition the plutonium into a nonproliferable form. Facility infrastructure and security upgrades are being addressed to ensure the safe storage of plutonium and to support the Surplus Plutonium Disposition Project, which will increase SRS's capacity for disposition of surplus plutonium.

1.4.1.2 Nuclear Materials Disposition

H Canyon is the only operating radiologically shielded chemical separations facility in the United States. From 2003 to 2019, H Canyon recovered highly enriched uranium from various sites across the DOE complex and from foreign test reactors to blend down into low-enriched uranium fuel. Known as the Accelerated Basin De-inventory Mission, H Canyon is now being used to dissolve spent nuclear fuel and is discarding this material directly into liquid waste sludge batches for disposition. This approach to operations began in 2020 and will continue until 2034, when the liquid waste program is no longer available to receive discarded material from H Canyon.

1.4.1.3 Spent Nuclear Fuel Storage

SRS supports DOE's National Security mission by safely receiving and storing spent fuel elements from foreign and domestic research reactors, pending disposition. Currently, SRS stores spent nuclear fuel at the L-Area Complex until final disposition.

1.4.1.4 Waste Management

SRS manages radiological and nonradiological waste created by legacy operations as well as newly generated waste from ongoing Site operations.

1.4.1.4.1 Radioactive Liquid Waste Management

SRS is Constructing the Final SDUs: SDU-10, SDU-11, and SDU-12.

SRS generates radioactive liquid waste as the by-product of processing nuclear materials for national defense, research, and medical programs. The Site safely stores approximately 33 million gallons of radioactive liquid waste underground in the F-Tank Farm and H-Tank Farm in F Area and H Area, respectively. Closing these tanks is a high priority for DOE-EM. To do this, SRS must first remove the waste from the tanks, which is mostly salt waste, and then process and treat the waste before disposing of it.

SRS mixes the salt solution at the Saltstone Production Facility to make saltstone and disposes of this low-activity liquid waste in cylindrical concrete tanks, known as Saltstone Disposal Units (SDUs). In 2023, SRS continued permanently disposing of waste, processing more than 4.2 million gallons into grout and disposing of it in the SDUs. In July 2023, DOE-EM authorized SDU-8 to begin operating at SRS, the last step before SDU-8 begins to receive decontaminated material for disposal. This unit was completed three years ahead of schedule. Construction and testing of the next unit, SDU-9, is slated for completion in spring 2024. In addition, SRS is also in various stages of constructing the final SDUs needed at SRS: SDU-10, SDU-11, and SDU-12.

SRS uses the Defense Waste Processing Facility (DWPF) to process high-activity waste from the F-Tank Farm and H-Tank Farm. Since DWPF began operating in March 1996, it has produced more than 17 million pounds of glass—immobilizing 72.4 million curies of radioactivity—and pouring more than 4,400 canisters. In 2023, DWPF produced 54 canisters of glass, weighing 198,916 pounds and immobilizing 5.14 million curies of radioactivity.

The Salt Waste Processing Facility (SWPF) is a major piece of the liquid waste system and will process most of the Site's salt waste inventory by separating the highly radioactive waste from the less radioactive salt solution. SWPF processed more than 2.6 million gallons of salt solution in 2023.

1.4.1.4.2 Solid Waste Management

SRS manages the following types of solid waste:

- Low-level waste: ordinary items—such as coveralls, gloves, and hand tools—contaminated with small amounts of radioactive material
- Transuranic waste (TRU) waste: protective clothing, equipment, and job waste containing alpha-emitting isotopes with an atomic number greater than that of uranium (92)
- Hazardous waste (nonradiological): toxic, corrosive, reactive, or ignitable material that could affect human health or the environment

- Mixed waste: construction debris, laboratory samples, and soils containing both hazardous and radioactive components
- Sanitary waste: office waste, other wastes similar to household waste, and industrial or construction waste that is neither radioactive nor hazardous

To meet environmental and regulatory requirements, SRS treats, stores, and disposes of all low-level radioactive and hazardous waste that it generates in offsite Resource Conservation and Recovery Act-permitted facilities. The Site also emphasizes recycling and minimizing waste to reduce the waste volume that SRS must manage.

SRS packages TRU waste and transports it in U.S. Department of Transportation-approved containers for underground disposal at WIPP. SRS began shipping TRU waste to WIPP in May 2001 and has made more than 1,729 shipments. SRS made 28 TRU shipments in 2023 (12 from E Area and 16 from K Area).

A Real Time Radiography Unit at the Solid Waste Management Facility Can Characterize and Certify TRU Waste Before Shipping to WIPP.

DOE conducts annual reviews to ensure Site operations are within DOE's performance standards. The annual reviews for the E-Area Low-Level Waste Facility Performance Assessment (PA) showed that SRS continued to operate these facilities in a safe and protective manner.

1.4.1.5 Environmental Remediation

SRS is responsible for investigating and remediating waste units, surface water, and groundwater at SRS. The U.S. Environmental Protection Agency and the South Carolina Department of Health and Environmental Control have oversight of the remedial programs that reduce the footprint of legacy wastes and contamination, treat and immobilize contamination in soil and groundwater, and slow contaminate transport. Cleanup can include capping inactive waste sites; installing and operating efficient groundwater treatment units; deactivating and decommissioning excessed facilities; and using natural remedies, such as bioremediation (employing naturally occurring microbes) and phytoremediation (using plants to clean up a contaminated environment).

1.4.1.6 Environmental Monitoring

SRS has an extensive environmental monitoring program, with records and documents dating to 1951, before the start of Site operations. Beginning in 1959, SRS made offsite environmental surveillance data available to the public. SRS reported onsite and offsite environmental monitoring separately until 1985, when it merged data from both programs into one publicly available document, the *U.S. Department of Energy Savannah River Plant Environmental Report for 1985.* The SRS Environmental Monitoring Program (EMP) serves the following two main purposes:

- Confirms compliance with applicable federal, state, and local regulations, as well as with DOE Orders
- Monitors any effects of SRS operations on the environment, both on and offsite

The SRS EMP is a living program due to requirement changes, program evaluations, continuous improvement initiatives, and deployment of new technology. SRS continues to maintain an extensive environmental monitoring program to determine impacts, if any, from SRS to the surrounding communities and the environment, both on and off the Site. In addition to the onsite environmental monitoring the Site conducts, SRS also monitors a 2,000-square-mile area beyond the Site boundary. This area includes neighboring cities, towns, and counties in South Carolina and Georgia. SRS collects samples of air, rainwater, surface water, drinking water, groundwater, food products, wildlife, soil, sediment, and vegetation. The Site evaluates these samples for radionuclides, metals, and other chemicals that could be in the environment because of SRS activities.

1.4.2 NNSA Primary Site Activities

The NNSA operates tritium facilities at SRS to supply and process tritium, a radioactive form of hydrogen gas that is a vital component of nuclear weapons. SRS tritium facilities are part of NNSA's Defense Program. SRS also plays a critical role in NNSA's nonproliferation missions, helping the United States meet its commitments to security and disposing of plutonium and uranium.

1.4.2.1 Tritium Processing

SRS has the nation's only facility for extracting, recycling, purifying, and reloading tritium. SRS replenishes tritium by recycling it from existing warheads and by extracting it from target rods irradiated in nuclear reactors that the Tennessee Valley Authority operates. SRS purifies recycled and extracted gases to produce tritium used by the Department of Defense for nuclear weapons. Additionally, helium-3 gas, a by-product of the tritium production process, is used for neutron-detection equipment. SRS is the sole producer of helium-3 gas in the United States.

In 2023, site preparation began for the new Tritium Finishing Facility (TFF) within the Savannah River Tritium Enterprise (SRTE). TFF is critical to the mission of the SRTE, which is the only facility in the nation capable of preparing tritium for the nuclear weapons stockpile. The Defense Programs page of SRS's website includes more information.

1.4.2.2 Nuclear Nonproliferation

In continued support of nonproliferation goals, SRS continued carrying out the Surplus Plutonium Disposition mission to permanently dispose of weapons-grade plutonium declared excess to national security, with a priority on disposition and removing plutonium previously consolidated onsite.

1.4.2.3 Pit Production

The plutonium pit production mission is an essential part of the NNSA's long-term strategy for nuclear stockpile sustainment. The Savannah River Plutonium Processing Facility (SRPPF) is one of two NNSA pit production sites in the nation, with the other at Los Alamos National Laboratory. Once constructed and operational, SRPPF will produce the bulk of the nation's supply of plutonium pits in support of sustainable nuclear deterrence. In June 2021, NNSA approved the recommended approach to produce at least 50 plutonium pits per year at SRPPF.

In January 2023, construction and craft employees hired through local trade unions began the dismantlement and removal phase at the SRPPF Main Process Building.

1.5 SPECIAL ENVIRONMENTAL STUDIES

SRS provides a unique setting for environmental studies. Several organizations at the Site—SREL, USFS-SR, SRARP, and BSRA—conduct research to support a better understanding of human impact on both plants and animals.

Since 1951, SREL and other researchers have been conducting ecological research at SRS. It's large size (310 square miles), habitat diversity, and mix of natural and industrial areas provide many opportunities to study both natural ecological processes and human impacts. In 1972, DOE recognized SRS as the nation's first National Environmental Research Park.

SREL and USFS-SR provide annual reports on the environmental studies and research they conduct on SRS. These reports, available on the *SRS Environmental Report 2023* webpage, present and discuss environmental studies and research that occurred during the reporting year. Special environmental studies and research directly impacting the SRS EMP and dose calculations are presented and discussed in their respective chapters: Chapter 4, *Nonradiological Environmental Monitoring Program*; Chapter 5, *Radiological Environmental Monitoring Program*; and Chapter 6, *Radiological Dose Assessment*.

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Chapter 2: **Environmental Management System**

The Savannah River Site (SRS) Environmental Management System (EMS) implements the U.S. Department of Energy (DOE) commitment to sound environmental stewardship policy and practices. These safeguards protect air, water, land, and natural resources as well as archaeological and cultural resources that SRS potentially affects.

The EMS plans and evaluates SRS construction, operations, maintenance, and decommissioning projects to protect public health and the environment, prevent pollution, and comply with applicable environmental and cultural resource protection requirements. The way SRS conducts its actions demonstrates the Site's commitment to minimize waste, manage water, foster renewable energy, reduce greenhouse gases, acquire sustainable services, remediate with a focus on sustainability, and observe best management practices. All these attributes are vital components of environmental management.

2023 Highlights

DOE sets objectives for carrying out its mission in an environmentally sustainable manner that supports a policy of national energy security and addresses global environmental challenges. SRS continues to make substantial progress in meeting Site goals. Below are the highlights of the EMS program:

Pollution Prevention and Waste Minimization

SRS recycled 79.4% (918 metric tons) of its nonhazardous solid waste.

Greenhouse Gas (GHG) Reduction

SRS continued to reduce emissions, exceeding federal goals. The Site has reduced Scope 1 and 2 GHG emissions by 54.4% and Scope 3 GHG emissions by 90.7% since 2008.

Transportation and Fleet Management

SRS continued to exceed its fleet management goals. Approximately 84.3% of the current light-duty fleet are electric, plug-in hybrids, or vehicles that use E-85 (85% ethanol, 15% unleaded gasoline) fuel.

2023 Highlights (continued)

Awards

SRS received the Global Electronics Council Electronic Product Environmental Assessment Tool Purchasers (EPEAT) Award in five product categories.

2.1 SRS ENVIRONMENTAL MANAGEMENT SYSTEM

U.S. Department of Energy (DOE) Order 436.1A, *Departmental Sustainability*, requires DOE sites (including the National Nuclear Security Administration [NNSA]) use an Environmental Management System (EMS) as a framework to implement programs to meet sustainability goals and fulfill environmental compliance obligations in accordance with approved instructions from the DOE Office of Environment, Health, Safety and Security. Sites must also maintain their EMS as being certified to or conforming to the International Organization for Standardization's (ISO) 14001:2015. The DOE Site Manager has determined the Savannah River Nuclear Solutions (SRNS) EMS, which includes Battelle Savannah River Alliance (BSRA) and Savannah River Mission Completion (SRMC), conform to ISO 14001. An accredited independent certification body has certified Centerra-SRS (the Site's protective force services contractor) to ISO 14001:2015. SRS implements an EMS that uses the ISO 14001:2015 standard to fulfill compliance obligations and address risks and opportunities. By design, the "Plan-Do-Check-Act" approach to meet the ISO 14001:2015 standard continually improves environmental performance.

The Savannah River Site (SRS) EMS is a process to manage environmental impacts, compliance obligations, and environmental performance. Environmental compliance obligations and monitoring programs set forth by federal, state, and local requirements; agreements; and permits address Site environmental impacts. Additionally, environmental objectives SRS sets forth to encompass both compliance and environmental sustainability goals address environmental impacts. These sustainability goals promote and integrate initiatives, including energy and natural resource conservation, waste minimization, green remediation, and using sustainable products and services.

Chapter 2—Key Terms

Environmental impacts *are any positive or negative changes to the environment caused by an organization's activities, products, or services.*

Environmental objectives *define the organization's environmental goals.*

Environmental sustainability *is interacting responsibly with the environment to conserve natural resources and promote long-term environmental quality. It includes reducing the amount of waste produced, using less energy, and developing processes that maintain the long-term quality of the environment.*

2.1.1 SRS Environmental Policy

The goal of the SRS Environmental Policy is to protect the public and future generations from any impacts from Site operations. SRS commits to this by doing the following:

- Promoting sound environmental stewardship
- Preventing pollution onsite and in surrounding communities
- Conducting science and energy research
- Continuing the national security mission

SRS accomplishes this through the following:

- Complying with environmental laws and regulations
- Continuing process improvements
- Conducting safe operations
- Communicating with the workforce, public, and stakeholders

2.1.2 Integration with the Integrated Safety Management System

SRS incorporates the Integrated Safety Management System (ISMS) with the EMS to provide a comprehensive framework under which it manages environmental, safety, and health programs. This makes it possible for the Site to accomplish all work while protecting the public, workers, and the environment. The integration confirms that SRS can evaluate work and associated hazards, and that the Site adapts standards, practices and controls in a DOE-approved safety management system. Figure 2-1 depicts the relationship between ISMS and EMS and how both management systems integrate.

ISMS execution involves five functions: 1) defining scope of work, 2) analyzing hazards, 3) developing and implementing controls, 4) performing work, and 5) providing feedback and improvement. Likewise, SRS accomplishes the EMS goals using the **Plan-Do-Check-Act** approach, where

- **Plan**—defines work scope and objectives, identifies environmental aspects and analyzes hazards, and develops controls
- **Do**—implements these controls and performs the work (operations)

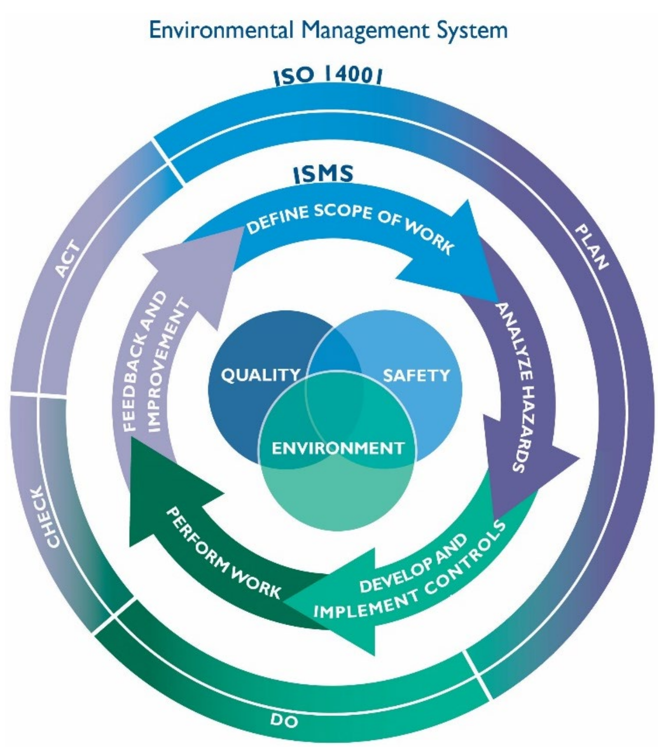


Figure 2-1 Integrated Safety Management System Continual Improvement Framework within the ISO 14001 Environmental Management System

- **Check**—evaluates performance (feedback) and management reviews
- **Act**—embodies corrective actions, improvements, and incorporates lessons learned into practices

2.2 EMS IMPLEMENTATION

The Plan-Do-Check-Act approach is interactive and iterative through the various work activities and functions, including policies, programs, and processes. It also is integral to the Site's overall management of environmental compliance and performance.

2.2.1 Plan-Do-Check-Act: Plan

The Site establishes environmental goals, objectives, and targets for each project and activity. Before SRS undertakes any actions or projects, it evaluates associated environmental aspects and their impacts (or potential environmental hazards) to ensure that SRS can control or mitigate the hazard or risk to reduce or eliminate impacts to the environment. The Site performs these evaluations against all applicable federal and state regulations, state permits, and local laws. These regulations and permits are the foundation for internal manuals, standard operating procedures, and standard requirement-implementing documents. Additionally, before DOE-Savannah River (DOE-SR) or the National Nuclear Security Administration-Savannah River Field Office (NNSA-SRFO) take any actions, the Site develops a National Environmental Policy Act (NEPA) checklist to identify potential environmental impacts and regulatory requirements (for example, federal and state permits) associated with proposed actions. This ensures proposed activities and projects consider the potential environmental aspects and provide mitigative solutions as necessary.

Another aspect of planning involves sitewide training for personnel and training to perform specific tasks and activities within a project's scope. SRS trains all employees on various policies and job-related requirements. The Site requires that every employee complete annual training. Employees must have General Employee Training upon beginning employment at SRS, and each year thereafter, they must pass Consolidated Annual Training. Both of these courses ensure all employees are aware of the potential hazards and risks associated with work onsite. Task- and project-specific training includes skills development and safe-work practices.

Incorporating training and evaluating environmental aspects and their impacts into work planning ensures SRS will perform activities in a manner that protects the public, workers, and the environment. Additionally, the Site generates regular and routine employee written and multimedia communications as a reminder of the SRS commitment to sustainability and the environment.

2.2.2 Plan-Do-Check-Act: Do

Environmental Compliance Authorities (ECAs) and Environmental Subject Matter Experts (SMEs) support facilities and programs in identifying and carrying out their environmental responsibilities. The SMEs communicate environmental regulatory requirements to the SRS workforce and submit required documents to the United States Environmental Protection Agency (EPA), the South Carolina Department of Health and Environmental Control (SCDHEC), and other stakeholders. ECAs work with the facilities to ensure that they implement the regulatory requirements.

DOE requires the Site to develop its *SRS Environmental Report* annually to inform the public of Site compliance with applicable environmental requirements and of the risk assessment of DOE operations. Chapter 3, *Compliance Summary,* of this report describes SRS's environmental compliance, provides the number of NEPA reviews, the number of SRS construction and operating permits, and the status of key federal and state environmental laws. Chapter 7, *Groundwater Management Program,* identifies SRS efforts to monitor, conserve, and protect groundwater and to restore contaminated SRS groundwater to EPA drinking-water quality standards while conforming to state and federal laws.

The Site plans and conducts emergency drills and exercises by implementing the EMS and ISMS principles and tools. Some of these drills include local, state, and federal emergency response organizations. Throughout the year, the Site performs safety drills for employees to ensure maximum participation through various weather, nuclear incident, environmental release, and fire scenarios.

2.2.3 Plan-Do-Check-Act: Check

2.2.3.1 Internal Checks

SRS assesses and evaluates Site work to ensure personnel are performing the work as planned and that Site operations are not adversely impacting worker and public health and the environment. The environmental monitoring and environmental surveillance programs at SRS follow applicable requirements to collect and analyze samples across SRS and within a 25-mile radius extending from the center of the Site. Both the environmental monitoring and surveillance programs ensure that potential exposure to the public and environment is minimal and as low as reasonably achievable. Chapter 3, *Compliance Summary*; Chapter 4, *Nonradiological Environmental Monitoring Program*; Chapter 5, *Radiological Environmental Monitoring Program*; Chapter 6, *Radiological Dose Assessment*; and Chapter 7, *Groundwater Management Program,* describe the SRS environmental monitoring and surveillance programs.

The Site also performs management field observations and program assessments to detect potential issues early to prevent performance shortfalls and identify processes, practices, behaviors, roles, responsibilities, and organizational expectations that SRS needs to improve. Chapter 8, *Quality Assurance,* documents how SRS ensures the accuracy of its environmental data.

2.2.3.2 External Checks

SRS uses external assessments to evaluate Site work to confirm that personnel are performing the work as planned and that Site operations are not adversely impacting worker and public health and the environment. Regulators from various state and federal government organizations perform external assessments of Site operations. SCDHEC conducts several inspections and audits annually to verify that the Site is complying with state permits. The EPA and SCDHEC participate in Federal Facility Act-driven inspections. The EPA may conduct compliance evaluation inspections or participate alongside SCDHEC inspections. Chapter 3, *Compliance Summary,* lists and gives results of the annual external agency audits and inspections of the SRS Environmental Program.

In 1995, SCDHEC enrolled in an Agreement in Principle (AIP) program with DOE at SRS. As a result, SCDHEC created the Environmental Surveillance Oversight Program (ESOP). Through the AIP grant, ESOP evaluates the adequacy of DOE activities related to environmental monitoring and reporting and confirms that DOE's activities have not adversely impacted public health and safety and the environment.

DOE Order 436.1A requires SRNS EMS to conform to ISO 14001:2015. Every three years, a qualified independent certification auditor performs a conformity assessment. Because the last audit was in 2021, the next formal SRNS EMS compliance audit will be in 2024. Because Centerra-SRS is certified to ISO 14001:2015, an accredited independent certification body conducts yearly certification assessments.

2.2.4 Plan-Do-Check-Act: Act

SRS enhances environmental performance and the health of the EMS through corrective actions and continual improvement. The Site establishes, implements, and maintains the corrective actions program in accordance with an internal manual for contractor assurance. It provides guidance to manage actual or potential conditions of nonconformity, for example, Notices of Violation (NOVs) or findings and opportunities for improvement from internal assessments and audits. Chapter 8, *Quality Assurance,* summarizes annual improvements to the Site's Environmental Monitoring Program and laboratory performance in various proficiency and certification programs.

Communication is vital throughout all programs and activities to facilitate feedback and to incorporate lessons learned for improvement. This report and the accompanying *SRS Environmental Report Summary* also serve as communication tools for stakeholders, including the public, academia, SRS Citizen's Advisory Board, regulators, and other DOE sites.

2.3 SUSTAINABILITY AND STEWARDSHIP GOALS AND IMPLEMENTATION

DOE Order 436.1A, *Departmental Sustainability*, defines DOE Sites' requirements and responsibilities to manage operations and activities necessary for sustainability and to ensure that they are carrying out the DOE mission in a manner that addresses sustainability goals (Greenhouse Gas Management, Facility Management, Fleet Management, Waste Management, Acquisitions, Electronics Stewardship) and environmental compliance obligations. To direct sites on how to meet the requirements of the order, DOE provided further guidance on September 18, 2023, in the memorandum, "Departmental Use of Environmental Management Systems." This memo and its attachments provide instructions on EMS annual reporting, triennial declaration of conformance, and integrating environmental justice (EJ). SRS ensures environmental compliance and stewardship are seamlessly incorporated into its remediation and closure projects and addresses requirements for resource conservation, pollution reduction, and environmental surveillance. Sustainability reporting in this chapter utilizes the DOE sustainability goals, which are driven by the executive orders. These sustainability goals, which Figure 2-2 identifies, represent those in the DOE Sustainability Dashboard that DOE's Sustainability Performance Division manages. The current DOE sustainability goals align with and are on target to reach those the following executive orders set forth:

Figure 2-2 SRS Environmental Management System and Sustainability Goals

- Executive Order No. 14008, *Tackling the Climate Crisis at Home and Abroad,* signed in February 2021, places the climate crisis at the forefront of the nation's foreign policy and national security planning, based on statutory requirements. It requires agencies to
  - Use the power of federal procurement and management of real property to support robust climate action and lead by example
  - Submit a Climate Action Plan that identifies agency climate vulnerabilities, steps to bolster adaptation, and increases climate resilience of facilities
  - Adhere to the requirements of the Made in America Laws in making clean energy, energy efficiency, and clean energy procurement decisions
- Executive Order No. 14057, *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability*, signed in December 2021, which sets new federal-level sustainability goals—based on statutory requirements—and requires agencies to
  - Reach 100% carbon pollution-free electricity on a net annual basis by 2030, including 50% 24-hour-a-day, 7-day-a-week carbon pollution-free electricity
  - Reach 100% zero-emission vehicle acquisition by 2035, including 100% light-duty acquisitions by 2027
  - Achieve net-zero building emissions by 2045, including a 50% reduction by 2032
  - Reduce Scope 1 and 2 GHG emissions by 65% from 2008 levels by 2030
  - Establish targets to reduce energy and potable water use intensity by 2030
  - Reduce procurement emissions to net-zero by 2050
  - Have climate-resilient infrastructure and operations
  - Develop a climate- and sustainability-focused workforce
  - Advance EJ and equity-focused operations
  - Accelerate progress through domestic and international partnerships

SRS uses the DOE Sustainability Dashboard and Site Sustainability Plan (SSP) to document the sustainability goals SRS plans to achieve and to provide a strategic roadmap for accomplishing those essential activities. The goals, which DOE sets annually for all sites, include the following:

- Reducing total energy use
- Increasing renewable energy use
- Reducing water use
- Purchasing environment-friendly, or “green,” products and services
- Generating less solid waste
- Increasing the number of sustainable buildings
- Reducing fleet and petroleum use
- Using energy-compliant electronic devices

ISO 14001:2015 requires SRS to establish and document measurable environmental objectives consistent with SRS’s Environmental Policy and SRS’s strategic direction. Appendix A presents the EMS goals and objectives for fiscal year (FY) 2023. This chart reflects sustainability goals and environmental compliance goals for 2023, identifies the related environmental objectives, and lists strategies used to achieve objectives. This chapter contains additional information on how SRS is making progress in supporting DOE-driven objectives. Chapter 3, *Compliance Summary,* documents and provides additional reference for the environmental compliance portion of the EMS goals and objectives.

Updated annually, the Sustainability Dashboard and SSP outline the strategies in place and identify the Site’s contributions to meeting DOE’s sustainability targets. DOE maintains an online DOE Sustainability Dashboard that tracks the progress of facilities in the complex in meeting their sustainability goals. The dashboard is the source of the goal performance information in Table 2-1. This table summarizes specific metrics and SRS’s FY 2023 performance against the sustainability goals to complement the more general discussion in the text that follows.

Table 2-1 FY 2023 Sustainability Goals, Metrics, and SRS Performance

Energy Management	
Goal: 50% energy intensity reduction by fiscal year (FY) 2030 from FY 2021 baseline. Per the FY 2024 Site Sustainability Plan (SSP), reduce energy intensity by 15% by FY 2025 from FY 2021 baseline.	**Goal at Risk**
Interim Target (FY 2023): 24% reduction from FY 2021 baseline	**Interim Target Not Met:** 13.8% energy intensity increase from FY 2021 baseline. This is due to a change to the goal's baseline from utilizing FY 2015 to FY 2021. The Savannah River Site (SRS) has developed a path forward for meeting this goal through various Energy Conservation Measures (ECMs).
Clean and Renewable Energy	
Goal: 30% renewable energy as a percentage of total agency electric use by FY 2025	**Goal on Track**
Interim Target (FY 2023): 25%	**Interim Target Met:** 29.2% of the electric energy in FY 2023 is from renewable resources.
Water Management	
Goal: 50% reduction in potable water intensity by FY 2030 from FY 2021 baseline. Per the FY 2024 SSP, reduce water intensity by 16% by FY 2024 from FY 2021 baseline	**Goal at Risk**
Interim Target (FY 2023): 18% reduction from FY 2021 baseline	**Interim Target Not Met**: 2.0% potable water intensity increase from FY 2021 baseline. This is due to a change to the goal baseline from utilizing FY 2007 to FY 2021. SRS has developed a path forward for meeting its goal.
Goal: 36% reduction in non-potable water intensity by FY 2025 from FY 2010 baseline	**Goal Exceeded**: 78.9% non-potable water intensity reduction
Interim Target (FY 2023): 26% reduction from FY 2010 baseline	**Interim Target Met**
Performance Contracting	
Goal: Implement life-cycle, cost-effective efficiency and conservation measures with appropriated funds and performance contracting, or both	**Goal Met**: SRS has one active energy-saving performance contract (ESPC), which is with Ameresco to operate the Biomass Cogeneration Facility (BCF), K-Area, and L-Area biomass plants.
Sustainable Buildings	
Goal: 17% of existing owned buildings comply with Guiding Principles for Sustainable Buildings by FY 2025.	**Goal at Risk**
Interim Target (FY 2023): 16.3%	**Interim Target Not Met**: 0% of SRS's buildings qualify as sustainable. This is due to a recent Guiding Principles guidance update, which increased the square footage requirements to be greater than 25,000 square feet.

Table 2-1 FY 2023 Sustainability Goals, Metrics, and SRS Performance (continued)

Waste Management	
Goal for Municipal Solid Waste: Divert at least 50% of nonhazardous solid waste (excluding construction and demolition [C&D] debris) **Interim Target (FY 2023)**: 50%	**Goal Exceeded**: SRS diverted 79.4% of municipal solid waste from the waste stream through recycling. **Interim Target Met**
Goal for C&D Waste: Divert at least 50% of C&D material and debris **Interim Target (FY 2023)**: 50%	**Goal Not Met**: SRS diverted 4.4% of waste from the onsite C&D landfill. However, this value can be further offset by recycling totals reported in Table 2-2, including, but not limited to, concrete, asphalt, and office furniture. **Interim Target Not Met**
Fleet Management	
Goal for Petroleum Reduction: 20% reduction in petroleum use by FY 2015 and thereafter relative to FY 2005 baseline **Interim Target (FY 2023)**: 20% reduction from FY 2005 baseline	**Goal Exceeded**: 71.6% reduction in petroleum consumption relative to the FY 2005 baseline **Interim Target Met**
Goal for Alternative Fuel Use: 10% increase in alternative fuel use by FY 2015 and thereafter relative to FY 2005 baseline **Interim Target (FY 2023)**: 10%	**Goal Exceeded**: 37.9% alternative fuel usage increased, relative to the FY 2005 baseline. **Interim Target Met**
Acquisition and Procurement	
Goal: 95% of new contract actions for products and services meet sustainable acquisition requirements. **Interim Target (FY 2023)**: 95%	**Goal Exceeded**: SRS reviewed 100% of purchase order line descriptions of eligible contract actions to determine whether the products met the BioPreferred® definition. **Interim Target Met**
Electronics Stewardship	
Goal for Environmentally Sustainable Electronics Acquisition: 100% of eligible electronics procurements must be environmentally sustainable (for example, Electronic Product Environmental Assessment Tool [EPEAT]). **Interim Target (FY 2023)**: 95%	**Goal Not Met** **Interim Target Not Met**: 80.3% of eligible electronics procured are environmentally sustainable, meeting EPEAT standards. However, 100% of eligible electronics were ENERGY STAR® qualified.
Goal for Disposal of Electronics: 100% of electronics disposed of through government programs and certified recyclers **Interim Target (FY 2023)**: 100%	**Goal Met**: SRS recycled 100% of used electronics using authorized recycling companies. **Interim Target Met**

Table 2-1 FY 2023 Sustainability Goals, Metrics, and SRS Performance (continued)

Electronics Stewardship (continued)	
Goal for Power Management: 100% of eligible computers (desktops and laptops) and monitors implement and actively use power management features. **Interim Target (FY 2023)**: 100%	**Goal Met**: 100% of eligible desktops, laptops, and monitors have power management enabled. **Interim Target Met**
Goal for Duplex Printing: 100% of eligible printers implement and actively use duplex printing features. **Interim Target (FY 2023)**: 100%	**Goal Met**: 100% of eligible printers have duplex enabled. **Interim Target Met**
Data Center Efficiency	
Goal: Implement practices that promote energy-efficient management of servers and federal data centers	**Goal Met**: SRS utilizes power usage effectiveness (PUE) for data centers that have meters to obtain a baseline of energy use effectiveness.
Adaptation and Resiliency	
Goal: Enhance the resilience of the federal infrastructure and operations and enable more effective accomplishment of its mission	**Goal Met**: SRS utilized a Vulnerability Assessment and Climate Change Resilience Plan and Active Risk Manager tool to address resilience of infrastructure and operations for the future.
Greenhouse Gas (GHG) Management	
Goal for Direct (Scope 1 and 2) Greenhouse Gas (GHG) Emissions: 65% reduction in direct GHG emissions by FY 2030 from FY 2008 baseline **Interim Target (FY 2023)**: 45% reduction in direct GHG emissions from FY 2008 baseline	**Goal on Track** **Interim Target Met:** 54.4% reduction in direct GHG emissions relative to FY 2008 baseline
Goal for Indirect (Scope 3) GHG Emissions: 25% reduction in indirect GHG emissions by FY 2025 from FY 2008 baseline **Interim Target (FY 2023)**: 21% reduction in indirect GHG emissions from FY 2008 baseline	**Goal Exceeded**: 90.7% reduction in indirect GHG emissions relative to FY 2008 baseline **Interim Target Met**

2.3.1 Energy Management

The DOE Sustainability Dashboard and SSP track energy intensity metrics. SRS has a goal to reduce the amount of energy per square foot (energy intensity) used in an identified class of buildings annually. By the end of FY 2023, SRS increased its energy intensity by 13.8% relative to the FY 2021 baseline. Per the FY 2024 SSP, this puts the Site at risk of not reducing energy intensity by 15% in FY 2025 relative to the FY 2021 baseline. This is due to a recent change in the goal's baseline from FY 2015 to FY 2021. SRS demonstrated continued success in FY 2023 by completing the following energy efficiency efforts:

- Upgraded building exterior lighting by utilizing light-emitting diodes (LEDs)
- Upgraded building interior lighting by utilizing LEDs

- Upgraded heating, ventilation, and air conditioning (HVAC) units by using more energy-efficient units
- Reduced the footprint of SRS infrastructure through right-sizing
- Performed utility isolations and deactivation actions for high-priority facilities to support right-sizing efforts

One key challenge to energy management at the Site is the inability to accurately measure, monitor, and control energy usage of individual buildings. Of the thousands of buildings and structures at the Site, only 46 buildings have individual meters. The most effective way to monitor and reduce overall energy consumption and reduce or shift the peak load of a building is by installing an Energy Management System (EnMS). An EnMS allows automated control of a building's energy usage. Once installed, multiple buildings can be controlled through one central hub. For an EnMS to function, it must connect to "smart" meters, which use Wi-Fi technology to "communicate." Currently, the 46 building meters onsite are analog, and readings must be made manually. The sensitive nature of some of the missions at the Site does not currently allow for smart meters. This also impacts benchmarking of a facility, which would need to utilize individual metering to be effective.

SRS conducted energy audits of buildings under Section 432 of the Energy Independence and Security Act of 2007 (EISA). Under this program, SRS has identified 64 Site buildings that are subject to EISA audits because each one helps to constitute 75% of the Site's energy use. The number of buildings subject to EISA audits may change annually as buildings are constructed, repurposed, or removed from service. Identified buildings must undergo a comprehensive energy and water evaluation once every four years. The Site completed the fourth cycle of audits in FY 2023, thereby completing 100% of the audits. Although 19 buildings were reviewed in FY 2023, 3 of those buildings were either decommissioned or demolished, so only 16 buildings were audited. Focusing on these buildings allows EISA audits, which identify energy conservation measures (ECMs), to be most effective. Of the 16 buildings audited, 15 ECMs were identified, including conversions to LED lighting, replacement of end-of-life HVAC units, and roof replacements that utilize cool-roof technology. Since FY 2022, SRS's contract requires that all roof replacements and retrofitting use cool-roof technology.

2.3.2 Clean and Renewable Energy

The Sustainability Dashboard and SSP track renewable energy and consumption metrics. SRS has the goal to increase renewable energy as a percentage of total agency electric consumption. By the end of FY 2023, SRS used 29.2% renewable energy, thereby meeting the FY 2023 interim target of 25%. The Site has achieved the interim target by generating power onsite from the Biomass Cogeneration Facility (BCF); A-Area, K-Area, and L-Area biomass plants; and through the energy portfolio for Dominion Energy. SRS no longer uses coal to generate energy from onsite producers. Using renewable energy at the Site is a high-level priority. The BCF, which uses wood chips as its primary fuel source and fuel oil and tires as a secondary fuel source, plays a significant role in supporting renewable goals. Additionally, the Dominion Energy mix for South Carolina (published 2022) is 5% total renewable energy (either hydro, solar, wind or biomass, or all), 43% nuclear, 41% natural gas, and 11% coal.

2.3.3 Water Management

The Sustainability Dashboard and SSP track potable and non-potable water consumption metrics. It is SRS's goal to reduce potable and non-potable water use.

By the end of FY 2023, SRS increased potable water use by 2%, thereby not meeting the FY 2023 interim target of an 18% reduction relative to the FY 2021 baseline. Per the FY 2024 SSP, this puts the Site at risk of not reducing potable water intensity by 16% in FY 2025 relative to the FY 2021 baseline. This is due to a recent change in the goal's baseline from FY 2007 to FY 2021. However, the Site has been significantly decreasing its potable water use over the last 15 years. By installing a primary domestic water system and continuing to replace old and leaky piping, the Site has saved several hundred million gallons of water annually.

In a multiyear project, SRS has outlined a strategic plan to replace at-risk sections of pipe to mitigate leaks resulting from aged and degrading underground pipe. SRS routinely monitors for leaks and maintains response crews that quickly and efficiently respond and conduct necessary repairs to minimize service interruptions and water waste. SRS continuously monitors water pressure across the Site and routinely conducts physical examinations of above-ground piping.

SRS also has installed water meters on the main supply lines and periodically conducts a water balance to monitor use and help detect leaks. SRS has been using WaterSense, an EPA-sponsored program for water-efficient products, and other water-conserving products, including low-flow toilet flush valves, low-flow urinal flush valves, and low-flow faucets. In recent years, the Site has substituted several hundred less-efficient faucets and flush valves with more-efficient low-flow units as they needed replacing.

However, retrofitting with low-flow flush valves and faucets is not cost effective outside of repairs. This will pose a further challenge to reaching the FY 2025 goal, due to increased demand from events, such as constructing additional buildings, increased headcount, and water-dependent processes being added to the Site as part of new missions associated primarily with National Nuclear Security Administration (NNSA) initiatives. Additionally, DOE Order 436.1A requires life-cycle, cost-effective analysis for water conservation opportunities. The water management sustainability goal also does not account for potable water conservation measures, such as the primary domestic water system, installed prior to the baseline. It will be more difficult for SRS to decrease potable water usage in the future because it has already achieved large decreases in the programs that have the biggest impact. Potable water use can also fluctuate from year to year based on various factors, for instance, the number of employees and the amount of potable water used for non-potable purposes.

By the end of FY 2023, SRS decreased non-potable water use by 78.9% relative to the FY 2010 baseline, thereby meeting the FY 2025 goal of a 36% reduction. The Site has reduced non-potable water consumption, mostly industrial, landscaping, and agricultural (ILA) water. SRS reduced ILA water consumption to 495 million gallons, which is a 78.9% reduction, against the baseline FY 2010 consumption of 2.34 billion gallons. The utilization of the biomass facility, which uses significantly less water than the previously utilized coal-fired power plants, dramatically improved ILA water consumption.

2.3.4 Performance Contracting

The SSP describes how performance contracting is utilized to achieve energy, water, building modernization, and infrastructure goals.

SRS has used Energy Saving Performance Contracting (ESPC) to engage Ameresco Federal Solutions in several projects that conserve energy and water. ESPC funds energy- and water-saving building improvements with future energy savings. Ameresco Federal Solutions operates the BCF at SRS. This facility produces steam and electricity on a 24-hour-a-day, full-time basis. The BCF was constructed and completed in 2012 and replaced the more than 50-year-old coal-fired steam and electrical-generation plant. The BCF is in the 11th year of a 21-year ESPC period. Realization of cost savings will increase significantly after year 21, when the facility's mortgage debt has been satisfied. Ameresco also operates steam-only biomass plants for heating buildings in K Area and L Area at SRS.

2.3.5 Sustainable Buildings

The Sustainability Dashboard and SSP track sustainable buildings metrics. SRS has the goal for new construction and major renovations to conform to applicable building energy-efficiency requirements and sustainable design principles, consider building efficiency when renewing or entering leases, and implement space utilization and optimization practices. By the end of FY 2023, SRS had 0% of its building count as complying with the Guiding Principles for sustainable buildings, thereby not meeting the FY 2023 interim target of 16.3%. The Guiding Principles address the following six sustainable principles for new construction and modernization and for existing buildings:

- Employ integrated design principles
- Optimize energy performance
- Protect and conserve water
- Enhance the indoor environmental quality
- Reduce the environmental impact of materials
- Assess and consider building resilience

The updated Guiding Principles include a new requirement that the square footage must be greater than 25,000 square feet for a project to be considered a sustainable building. Therefore, the two buildings SRS historically claimed no longer count toward the goal due to the square footage being less than 25,000 square feet. However, SRS has identified several buildings that can meet the Guiding Principles with minor renovations within the next five years. The Site is also planning to review proposed building projects for possible future inclusion.

Most buildings at SRS are aging and are not cost effective to upgrade. This is based on the type of construction (process facilities) and budget constraints required to modify existing facilities. However, the SRS emphasis on maintenance, repairs, and ECMs identified in EISA audits (LED lighting upgrades and more efficient HVAC systems) supports the goals detailed in the directive.

2.3.6 Waste Management

The Sustainability Dashboard tracks municipal solid waste (nonhazardous solid waste excluding construction and demolition [C&D] debris) and C&D materials and debris metrics. SRS has the goal to implement waste prevention and recycling measures.

Pollution prevention is a commitment in the SRS Environmental Policy as required under the ISO 14001:2015 standard. Environmentally safe and cost-effective reuse or recycling diverts pollutants and wastes from the waste stream. Pollution prevention at SRS reduces wastes, mitigates health risks, and protects the environment.

By the end of FY 2023, SRS diverted 79.4% of municipal solid waste, thereby surpassing the annual goal of 50% diversion. SRS diverted 918 metric tons of municipal solid waste out of 1,156.8 metric tons. The Site recycled 230 metric tons of routine waste (typically office- and municipal-type waste) through the North Augusta Material Recovery Facility (NA-MRF). SRS works with the NA-MRF to enhance the process to attain and improve upon a 50% recovery rate. SRS continues to monitor this waste stream for opportunities to recycle materials. In addition, SRS shredded and recycled 688 metric tons of sensitive office paper through its contract with Augusta Data Storage. Increased shredding has had a large impact on the diversion rate. The quantity of sensitive paper shredding is variable from year to year. Since the height of the COVID-19 pandemic, shredding rates and office waste have fluctuated depending on the amount of remote work, telework, and onsite personnel. The paper-shredding rate may also vary depending on the sensitivity of missions. There may be challenges maintaining this goal in the future.

By the end of FY 2023, SRS diverted 4.4% of C&D materials and debris, thereby not meeting the 50% diversion goal. C&D debris includes waste generated from constructing, remodeling, repairing and deconstructing buildings, roads, bridges, and drainage and sewage systems. This debris is often concrete, asphalt, glass, metal, plastic, and land-clearing scrap. In FY 2023, the Site diverted 1,750.3 metric tons of the 40,095.2 metric tons of C&D waste generated. A limited amount was recovered during each year (2020−2023).

Future road projects and construction projects may present opportunities for diverting C&D waste. However, the low cost of onsite C&D landfill services and limited cost-effective reuse options for scrap debris significantly challenge cost-effective recycling options beyond what is already executed.

SRS has improved the diversion rate of waste streams from landfills through initiatives, such as removing items that include nonradioactive scrap metal and scrap furniture from the waste stream and creating avenues for recycling. Universal waste is another source that includes batteries, mercury-containing equipment, and light bulbs. Universal waste must be recycled when generated by businesses; otherwise, the waste must be sent to a Resource Conservation and Recovery Act-permitted facility. Table 2-2 breaks down the recycled waste amounts for FY 2023.

Table 2-2 SRS Recycling and Sustainability in FY 2023 by Amount

Items Recycled in FY 2023	Amount Recycled
Concrete and Asphalt	20,140,800 pounds
Clean Lead Salvage	0 pounds
Lead Acid Batteries	53,088 pounds
Scrap Metal	2,058,860 pounds
Silver Fixative	788.5 pounds
Consumer Electronics (including cell phones)	136,511 pounds
Toner Cartridges	12,433 pounds
Office Paper	1,521,600 pounds
Furniture and Cabinets	206,360 pounds
Used Tires	61,480 pounds
Used Motor Oil	28,883 gallons
Refrigerants	0 pounds
Universal Waste—Fluorescent Lamps	14,047 pounds
Universal Waste—Rechargeable Batteries	4,104 pounds
Universal Waste—Mercury-Containing Devices	32 pounds
Universal Waste—Aerosol Cans	4,208 pounds
Industrial Sludge (land-applied)[a]	0 cubic yards

[a] Industrial sludge is being generated, but land application only occurs periodically.

2.3.7 Fleet Management

The Sustainability Dashboard and SSP track fleet petroleum use, alternative fuel use, GHG emissions per mile metrics, and fleet inventory. SRS has the goal to improve energy and environmental performance of vehicles in a manner that increases efficiency, optimizes performance, and reduces waste and costs.

SRS installed two 85% ethanol (E-85) fueling stations in FY 2000 and added a third in FY 2015. In FY 1999, the year before installing the first two fueling stations, the Site consumed more than 700,000 gallons of unleaded gasoline and no E-85 alternative fuel. As Figure 2-3 shows, the total fuel consumption in FY 2023 was less than the FY 2005 baseline. SRS has continued to decrease unleaded gasoline and diesel use and consume more E-85.

By the end of FY 2023, SRS had achieved all Site fleet management goals specifically related to using less petroleum and more alternative fuels. Figure 2-4 shows SRS FY 2023 performance in meeting key fleet management goals.

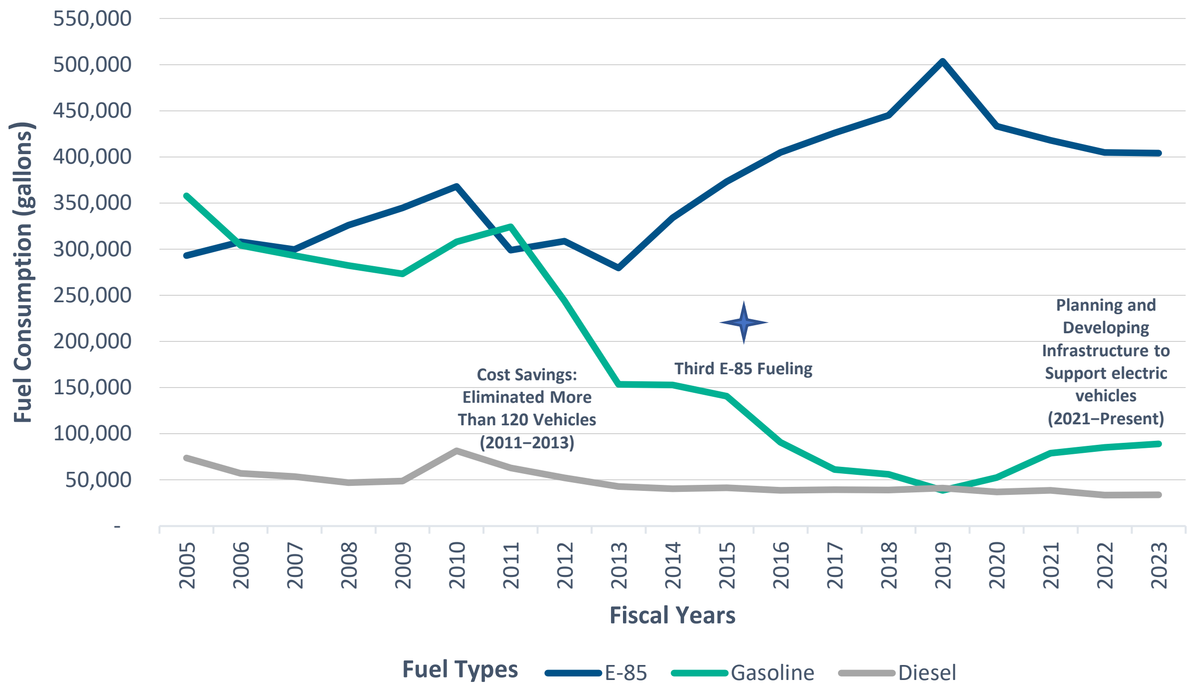


Figure 2-3 U.S. General Services Administration Fuel Consumption by Type for FY 2005 to FY 2023

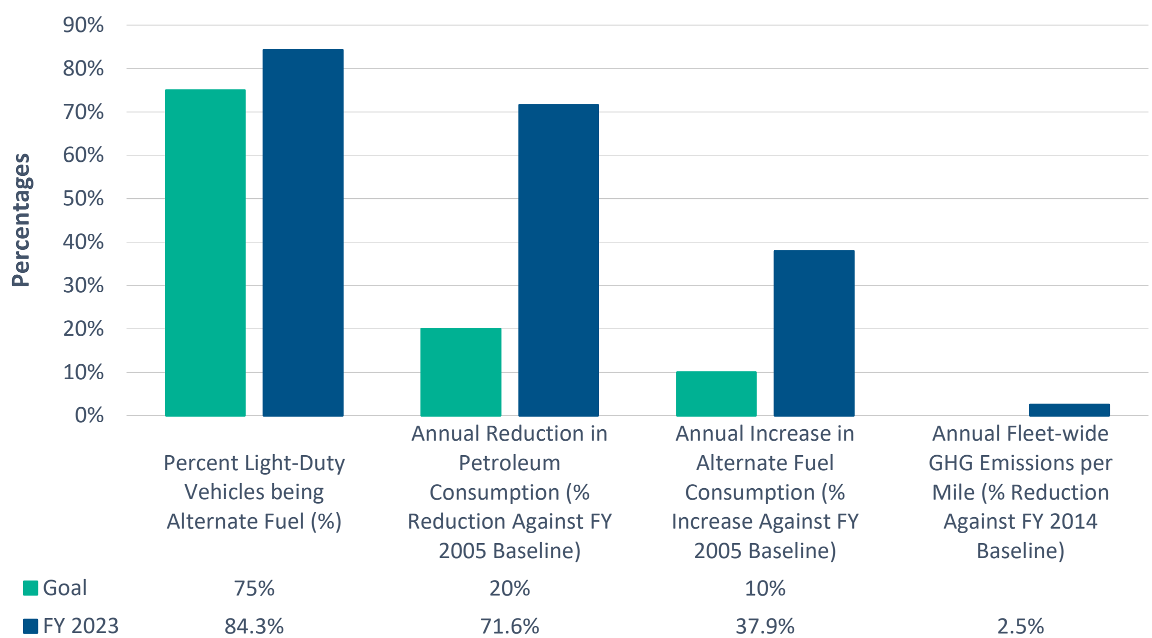


Figure 2-4 SRS Performance in Meeting Fleet Management and Transportation Goals for FY 2023

Each year, SRS emphasizes leasing alternative fuel vehicles in the light-duty fleet. At the end of FY 2023, Savannah River Nuclear Solutions (SRNS) managed an inventory of 964 vehicles for itself, DOE, and Savannah River Mission Completion (SRMC). In this fleet, 813 (84.3%) were either E-85, hybrid, or electric, which accounted for the reduction in petroleum consumption. In FY 2023, SRS continued working on developing the infrastructure to support transition of the light-duty fleet to electric vehicles (EVs). SRS has 24 charging ports in service at 3 strategically placed charging locations constructed across the Site.

2.3.8 Acquisition and Procurement

The Sustainability Dashboard and SSP track sustainable acquisition metrics. SRS has the goal to track and make improvements for acquiring, using, and disposing of products and services (including electronics). SRS maximizes acquisition of designated products by procuring

- Products that meet minimum requirements for recycled content as the EPA identifies
- Products that the United States Department of Agriculture (USDA) designates as biobased or BioPreferred®
  - SRS procurement personnel review line descriptions of eligible contract actions on purchase orders to determine whether the product meets the definition of BioPreferred.
- Products that maximize substituting alternatives to ozone-depleting substances the EPA's Significant New Alternatives Policy (SNAP) identifies
- Products that meet Electronic Product Environmental Assessment Tool (EPEAT) standards or those that the EPA's ENERGY STAR® program designates as having the potential to generate significant energy savings

Procurement continues to support the subsequent actions and initiatives of other SRS entities (engineering, maintenance, and infrastructure organizations) by procuring environmentally preferable product (EPP) alternatives as recommended for Site utilization. The EPP purchases have led to the practices outlined below:

- The SRS Chemical Management Center reviews and approves chemical acquisitions. This review monitors hazardous chemicals use and, where appropriate, recommends EPPs.
- SRS has procured EPP substitutions under various new and existing contracts, including bulk janitorial supplies (cleaners, paper products) and safety items (earplugs, filters).

In FY 2023, SRS Procurement increased its purchase of biobased products by 17%, from $4.2 million in FY 2022 to $4.9 million in FY 2023. In addition to responsible purchasing, SRS made a concerted effort in FY 2023 to repurpose and reuse equipment. Recognizing supply chain issues, SRS was able to reuse six pole-mount transformers for various projects around the Site. SRS also isolated two river water surge tanks to be earmarked for repurposing through a third-party agency. In FY 2023, SRNS reviewed its supply chain processes. SRNS will continue to conduct mission-critical supply chain vulnerability assessments. The assessments are incorporated into the procurement process, reducing risk, while continuing to support sustainability efforts.

2.3.9 Electronics Stewardship

The Sustainability Dashboard tracks electronic acquisitions, electronic recycling, power management, and duplex printing metrics. SRS has the goal to manage electronics and the environmental impacts and to reduce energy use.

SRS implements many strategies to reduce energy use, waste, and costs associated with electronics by

- Purchasing computers rather than leasing
- Procuring desktops, laptops, and monitors that meet EPEAT standards and copiers that are ENERGY STAR-compliant
- Setting up all eligible computers and imaging equipment to automatically print on both sides of paper (duplex printing)
- Programming all eligible desktops, laptops, and monitors to default to power-save mode when in standby

By the end of FY 2023, 80.3% of eligible electronics procurements were EPEAT products, thereby falling short of the FY 2023 interim target of 95%. Of the 13,841 electronic acquisitions 11,121 met EPEAT standards, and the remaining 2,720 were ENERGY STAR-compliant. This was due primarily to supply chain shortages. However, the Site did receive the 2023 EPEAT Purchaser Award in five categories.

The Site either recycles or reuses electronics in an environmentally sound manner by donating to schools and nonprofit organizations or by recycling through authorized vendors. SRS recycled 100% of its electronics through a certified recycler, thereby meeting the goal of 100% recycling or donating.

In FY 2023, 100% of eligible computers and monitors implemented and actively used power management features, and 100% of eligible printers implemented and actively used duplex printing features.

Additionally, SRS's extension of the time frame for replacing a computer from three to five years has significantly reduced the number of computers being retired and the amount of scrap electronics generated.

2.3.10 Data Center Efficiency

The Sustainability Dashboard tracks data center efficiency goals and metrics. SRS's goal is to implement practices that promote managing servers and federal data centers in an energy-efficient manner. Data centers are energy-intensive operations that contribute to agency energy and water use and costs.

One measure of energy efficiency for data centers is power usage effectiveness (PUE), which is the ratio of total energy used by a computer data center facility to the energy delivered to the computing equipment. While no specific target PUEs have been set, agencies are collecting data. Of the nine data centers at SRS, only the Central Computing Facility has an electrical meter to determine actual power consumption. Therefore, determining the actual power consumption (and thus, PUE) is not currently possible.

2.3.11 Adaptation and Resiliency

The SSP tracks resiliency goals and metrics. SRS has the goal to prioritize actions that enhance the resilience of federal infrastructure and operations. Resilience is the ability of an agency to adapt to changing conditions and withstand or recover from disruptions. SRS ensures that federal operations and facilities can continue to protect and serve citizens in a changing climate.

SRS has collected weather data onsite for decades to define extreme events and make decisions regarding extreme weather event procedures for resilience-planning scenarios. The Savannah River National Laboratory (SRNL) Atmospheric Technologies Group developed a Vulnerability Assessment and Climate Change Resilience Plan in 2022. This report analyzed the impacts of climate change on SRS assets and operations. The report also presented results from a vulnerability analysis of energy requirements for mission-critical infrastructure and the health, safety, and productivity of the outdoor workforce.

SRS utilizes the Active Risk Manager tool to manage the risks and opportunities of each organization. Once the Site evaluates these risks and opportunities, it puts into place the appropriate strategies and executable plans to prioritize and mitigate or eliminate the risks. Throughout this process, SRS identifies and tracks climate-related vulnerabilities and solutions for implementation. The FY 2023 review identified additional resilient solutions, which were added to the Sustainability Dashboard.

SRS supports emergency situations through the Emergency Response Organization (ERO). The ERO provides an in-command response to emergencies and recoveries as applicable. The organization also has regularly scheduled facility and sitewide drills and exercises involving accidents, spills, and natural disaster scenarios to better respond to and recover from such disruptions should they occur.

2.3.12 Greenhouse Gas Management (GHG)

SRS has the goal to track and report on GHG emissions. The Sustainability Dashboard and the SSP track direct (Scope 1 and 2) GHG metrics, indirect (Scope 3) GHG metrics, and fugitive emissions from refrigerants. By the end of FY 2023, SRS reduced direct emissions by 54.4% relative to the FY 2008 baseline, thereby meeting the interim goal of 45% reduction. Scope 1 GHG emissions consist of direct emissions from sources that SRS owns or controls, including onsite combustion of fossil fuels and fleet fuel consumption. Scope 2 GHG emissions consist of emissions from sources that SRS owns or controls, such as emissions from generating electricity, heat, or steam SRS purchases from a utility provider.

The following inventoried sources at SRS currently generate Scope 1 and 2 emissions:

- Purchased electricity
- Wood (biomass)
- Fuel oil
- Propane
- Gasoline
- Diesel

- E-85 (ethanol)
- Jet fuel
- Fugitive emissions

The Biomass Cogeneration Facility is One of the Facilities that Generate Power Onsite.

SRS continues to substantially reduce Scope 1 and 2 GHGs due to the BCF and the three additional biomass facilities. SRS tracks GHG data from various impact sources, for instance, Site energy use, alternative workplace arrangements and space optimization, and vehicle and equipment use.

By the end of FY 2023, SRS reduced indirect emissions by 90.7% relative to the FY 2008 baseline, thereby meeting the goal of 25% reduction by FY 2025. Scope 3 GHG emissions are from sources SRS does not own or directly control but are related to SRS activities, such as employee travel and commuting. SRS continues to reduce Scope 3 GHG emissions in part by using webinars and conference calls to reduce business travel and by promoting employee carpooling. Increased employee teleworking has also contributed to reducing Scope 3 GHG emissions.

2.4 EMS BEST PRACTICES

2.4.1 2023 Awards and Recognitions

The Global Electronics Council recognized SRS at a virtual ceremony in July 2023 for its efforts in procuring sustainable technology. SRS received the EPEAT Purchaser Award in five electronics categories. This award recognizes the SRS Information Technology and Procurement groups and demonstrates the Site's commitment to purchase sustainable electronics that meet voluntary environmental performance criteria to conserve energy, utilize environmentally sensitive materials and packaging, and have a greener life cycle. Using EPEAT products helps the Site fulfill the mission of protecting the environment for future generations.

2.4.2 Environmental Justice (EJ)

SRS is committed to continuing to support programs and activities to secure EJ for disadvantaged communities that have been historically marginalized and overburdened by climate-related impacts. The threshold for identifying disadvantaged communities uses parameters the NEPA process establishes. Past NEPA evaluations and analyses for EJ have identified SRS's disadvantaged communities within 50 miles of the center of SRS. The population distributions of the potentially affected areas were calculated using data at the block-group level of spatial resolution from U.S. Census Bureau population estimates to be consistent with human health analysis. The identified disadvantaged communities include Burke, Columbia, Emanual, Jefferson, Jenkins, McDuffie, Richmond, and Screven counties in Georgia and Allendale, Aiken, Bamberg, Barnwell, Calhoun, Colleton, Edgefield, Hampton, Jasper, Lexington, Orangeburg, and Saluda counties in South Carolina.

SRS provides opportunities for community engagement and decision making through information sharing and empowering the disadvantaged communities around the Site. SRS continues to expand its outreach with educational opportunities and access to information on SRS operations and environmental and public health risk assessments. DOE's Office of Legacy Management funds the EJ program, which encourages groups to express concerns that influence the decision-making process. EJ programs at the Site include educational opportunities, workforce development, and community advocacy and outreach.

2.4.2.1 Educational Opportunities

DOE-SR partners with SRNS's Education Outreach Programs (EOPs) to provide a variety of science and literacy outreach programs that focus on enhancing interest in Science, Technology, Engineering and Mathematics (STEM) and to support improvements in education in the Central Savannah River Area (CSRA) service area by using the unique resources available at the Site.

Additionally, SRNS's EOPs provide employees the opportunity to support the education community through volunteering. These initiatives help build programs and partnerships with regional educational institutions that encourage a diverse mix of students to pursue careers in STEM disciplines. Through these efforts, the intent is to create a local pool of job candidates with the necessary core competencies to support future missions at SRS and other regional industries.

Typically, EOPs reach students and teachers in an eight-county area within the CSRA through a variety of programs and events mostly aimed at a diverse population of students and teachers. The service area includes Aiken, Allendale, Bamberg, Barnwell, Edgefield, and Orangeburg counties in South Carolina and Columbia and Richmond counties in Georgia. In 2023, EOPs reached CSRA students through the various outreach programs intended to expand educational achievement. The following are some of the educational programs offered in 2023:

- The **SC Regional Future City Competition** returned to an in-person event on January 21 for the first time since COVID-19 restrictions. This middle school competition introduces students to the various fields of engineering through a hands-on challenge to create a city of the future. Using the engineering design process, students submit a project plan, build a model, write an essay, and present to judges. In 2023, nine teams competed, impacting 27 students and 9 educators. One hundred and thirty volunteers supported the event by judging competition deliverables and through special awards. The South Carolina Regional Future City Competition is sponsored and coordinated by SRNS EOPs, in partnership with the Ruth Patrick Science Education Center (RPSEC) and with support of professional engineering societies. McCracken Middle School's team, "New Eden," from Spartanburg, South Carolina, won the regional competition and represented South Carolina at the International City Finals in Washington, DC.
- Education Outreach coordinated the 33rd annual **Savannah River Regional Science Bowl** in-person competition on February 11. Many of the country's future scientists and engineers participated in a timed competition of fast-paced questions and answers covering a range of academic disciplines in science and math. This year's winning team Lakeside High School-Team 1, from Evans, Georgia, earned the right to compete nationally in late April. Students not

in the double-elimination matches participated in a *Brain Teaser* activity sponsored by SRNS and the American Chemical Society. The Science Bowl impacted 90 students and 19 educators. SRS is one of only three DOE sites that have participated since inception.

- The **CSRA Regional Science and Engineering Fair** was held on March 11, with 89 students and 42 volunteers attending the event. Local first place school winners with exemplary projects in inquiry-based learning attended the regional level to showcase their efforts and compete for science and math awards. The first place overall school winner, from Lakeside High School, competed at the Regeneron International Science and Engineering Fair in May.
- The **SRNS Innovative Teaching Mini Grants Program** is a competitive program that recognizes and celebrates innovative teaching methods by providing funds to enhance elementary, middle, and high school classroom instruction. SRNS funded grants of $500, $750, and $1,000 to purchase STEM equipment, materials, and supplies for the classroom for educators in Aiken, Allendale, Bamberg, Barnwell, Edgefield, and Orangeburg counties in South Carolina and Columbia and Richmond counties in Georgia. In 2023, SRNS increased funding from $50,000 to $75,000, and, for the first time, high school educators were eligible to apply, expanding a continuum of support for kindergarten through 12th grade. Awarded grants impacted 18,635 students and 114 educators. Forty-one volunteer SRS judges supported the program.
- The **Science and Technology Enrichment Program (STEP)** is a cooperative effort between SRNS and RPSEC environmental science field trips for teachers and students. STEP lessons correlate with academic standards for 3rd through 12th grade students and utilize real-world investigations that focus on responsible environmental stewardship. Educators have two styles of field trip options: traditional in-person, which utilizes outdoor settings at SRS; or virtual, which brings SRS resources to the student. Educators may select the programs that best correlate with their grade and state standards as identified on the RPSEC website. In-person field trips impacted 372 students and 50 educators. Virtual field trips impacted 5,892 students and 27 educators.
- The SRS STEM **Job Shadow Program** is a company best practice that fosters students developing career literacy before making a career choice. Participants engage in career exploration in STEM fields and critical skill needs at SRS. At the present time, the program is offered to high school students who are 16 years or older and college students. The Job Shadow Program provides an opportunity to observe the work environment and occupational skills in practice. The students spend a day, or specified time, with an employee or workplace host to gain insight and exposure to real-world work. In 2023, job shadowing impacted 24 students and the numerous volunteers who supported it.
- SRNS EOPs partnered with Augusta University, Savannah River Site Community Reuse Organization (SRSCRO), and Richmond County Schools for the 2023 SRNS Workforce Opportunities in Regional Careers (WORC) **WORCshop** at Augusta University. SRS volunteers mentored classes at A.R. Johnson Health Science and Engineering Magnet School in Richmond County, Georgia, to bring real-world application to teaching standards. Classroom projects were showcased at a final WORCshop event on December 9. This event was open to the public,

allowing community involvement in STEM-related SRS career events. This event included 142 students with 8 mentors and 8 educators.

- The **Traveling Science Program** is a partnership between SRNS and the RPSEC at the University of South Carolina Aiken. Through this program, STEM professionals from the Site interact with students and educators, offering hands-on learning and career discussions that shape the workforce. This also includes mentor support through programs such as the SRNS WORCshop. The partnership impacted 3,133 students and 68 educators in 2023.
- The SRS event **Introduce a Girl to Engineering–STEM Like a Girl,** organized and managed for the first time since COVID-19 restrictions, was held in October at the RPSEC as part of Nuclear Science Week. The event encouraged 64 eighth-grade girls from middle schools in the CSRA service area to pursue STEM career fields, such as engineering or information technology (IT). Forty-seven SRS female STEM volunteers interacted with the girls, mentoring them through six different activities: *Robotics, Building Contest, Protect the Pringle,* the planetarium show *"Dream Big," Graphite Circuits,* and *Animate Your Name.* The day ended with a discussion on the connection between art and engineering and a career question and answer session. Follow-up surveys indicated a positive impact, with most girls expressing a new interest in pursuing STEM career fields as a result of the activities.
- **Student and Educator Career Tours, Fairs, and Expos** in 2023 worked with public school districts, local colleges and universities, Aiken Works, the Lower Savannah Workforce Development Area, and the South Carolina Department of Commerce. Several high school events focused solely on students from the low country counties of the service area. Fairs and expos targeted primarily high school students, informing them of critical skill careers at SRS and providing valuable information on internships and apprenticeships. During multiple events, 2,140 students and 81 educators were impacted.
  - The Aiken County Career & Technology Center career tour had students from the Emergency and Fire Management Program tour SRS to observe a drill organized by the SRS Fire Department. This event partnered SRNS EOPs with the Apprenticeship School. The drill involved a simulated injury on the second level of a Site structure. SRNS has "adopted" programs at the Aiken County Career & Technology Center in emergency and fire management and IT, offering this unique experience to encourage students to pursue their interest in such careers. These efforts support the SRNS goal to build a workforce for SRS and surrounding communities.
  - Additional visits as part of National Science Week were made to Aiken Technical College; Augusta Technical College; Barnwell Career Center; Aiken Career & Technology Center; and an educator tour for South Carolina teachers from Aiken, Allendale, Bamberg, Barnwell, and Edgefield counties. Tours included discussions with subject matter experts from various critical skill areas, which allowed students and educators to explore the wide variety of nuclear career opportunities found at SRS. Opportunities, such as these held in 2023, bring real-world experience and a clear path from the classroom to the workforce.

- SRNS EOPs coordinated the **2023 CSRA College Night** at the James Brown Arena in Augusta. DOE-SR, SRNS, SRP Federal Credit Union, Probe, South Carolina Society of Professional Engineers-Midlands Chapter, iHeart Media, Centerra-Savannah River, and Bridgestone sponsored the event. More than 3,000 students, parents, and members of the community had the opportunity to meet with representatives from more than 115 colleges and universities, professional societies, and 4 branches of the military. Career Lane, an education consultant, offered discussions on workforce opportunities from DOE and SRS contractors. SRS contractor and federal agencies included DOE, SRNS Engineering, SRNS IT, SRNS Savannah River Plutonium Processing Facility, SRNS Fire and Emergency Management Services, SRNL, Centerra, and the USDA's Forest Service (USFS-SR). Seminars on financial aid in South Carolina and Georgia, SRS apprenticeships, and financial literacy were offered to students and parents to ensure success following high school. Fifteen seniors were awarded $1,000 scholarships in random drawings for them to apply to higher education goals. To date, more than $215,000 in scholarships has been awarded, and more than 103,000 residents have attended the recruiting fair since its start 30 years ago.

2.4.2.2 Workforce Development

SRS engages the local workforce to create a capable workforce through funding, outreach programs, and hands-on training. These programs provide individuals in the local communities with technical skillsets necessary for DOE mission-critical careers. This outreach allows for meaningful involvement of individuals from the surrounding communities affected by Site operations. The following are some of the programs in 2023 related to workforce development:

- SRNS partners with Hiring Our Heroes, an organization that helps companies provide on-the-job training to active-duty members of the U.S. Military who are transitioning out of service.
- Local universities and colleges partnered with DOE and SRS are educating the workforce on DOE-Environmental Management (DOE-EM) and National Nuclear Security Administration (NNSA) missions. The WORC Grants discussed above also fund this mission and partner with various local colleges to ensure its success. WORC I academic partners are Aiken Technical College, University of South Carolina Aiken, University of South Carolina Salkehatchie, Augusta Technical College, and Augusta University. WORC II academic partners are Aiken Technical College, Augusta Technical College, Augusta University, Claflin University, University of South Carolina Aiken, and University of South Carolina Salkehatchie.
- Internships offered at the SRS during the summer and year-round provide technical skills and workplace experience in the student's field of study. This allows students in schools across the country, but specifically in South Carolina and Georgia, to gain technical experience, creating a conduit for transitioning from internships to jobs at SRS. Additionally, the internship program educates students on historical and current operation missions at SRS and provides opportunities for students to network and volunteer in the community. In 2023, SRNS hosted its first Intern Signing Day, providing many interns with full-service contingent offers.
- The apprenticeship program, partnered with Apprenticeship Carolina and the Lower Savannah Council of Governments, is developing a viable workforce in the counties neighboring SRS. The

program provides apprentices paid on-the-job experience as they pursue a technical education. Unlike internships, apprenticeships promote and document knowledge transfer and provide participants with proof of skill mastery as portable U.S. Department of Labor credentials. The program also consists of youth- and collegiate-levels, which provide an important avenue into employment for students who are facing social, educational, and economic barriers.

- SRS attended local technical schools, university, and veteran outreach recruiting events, specifically ensuring representation in South Carolina low country counties (Barnwell, Allendale, Denmark, Bamberg, and Orangeburg).
- SRS hosted a low country region recruiting event in Blackville, South Carolina, for radiological protection and control, maintenance, and production operators. Additionally, in-person recruiting events for IT, engineering, and project controls, resulted in successful hires in critical skill areas.
- SRS increased its number of memoranda of understanding to support SRS workforce development needs and missions that bridge the gap between academic study and professional practice. SRNS now has agreements with 13 different educational institutes, 9 of which are Historically Black Colleges and Universities (HBCUs)
- In support of pipeline development efforts by assisting NNSA with the Higher Education Workforce Development funding initiative, SRS facilitated the award of $5.9 million in funding through collaboration with local HBCUs.

2.4.2.3 Community Advocacy and Outreach

SRS engages the community by working with advocacy groups, updating the community on current operations, and providing resources and materials. SRNS continues to support community outreach initiatives to foster a climate of trust and partnership with diverse stakeholders on a variety of community- and SRS-related issues. Through direct corporate sponsorship and responding to community and regional needs, SRNS and its employees are active leaders in community service. SRS has a significant economic development impact across the region, and the company supports local colleges and schools, nonprofits, and many other worthwhile causes in both Georgia and South Carolina.

Since 2008, SRNS and its parent companies—Fluor and Huntington Ingalls Industries—have contributed more than $13 million to the CSRA service area in corporate philanthropic charitable causes; education outreach investments in kindergarten through 12th grade schools and regional two- and four-year colleges and universities; and economic development and community partnerships. More than 50 SRNS employees serve in leadership roles in nonprofit, education, and economic development organizations in both South Carolina and Georgia. Specifically, employees are volunteer leaders and top contributors to the United Way, the American Heart Association's regional Heart Walk, and the Marine Corps Reserve Toys for Tots and Salvation Army Angel Tree holiday campaigns in South Carolina and Georgia.

These and other programs provide individuals in the community with decision making, educational opportunities, and tangible resources. The following are some of the programs related to community advocacy and outreach:

- The SRS Citizens Advisory Board (CAB) is a stakeholder group of individuals from diverse backgrounds in South Carolina and Georgia counties affected by Site operations. The SRS CAB provides advice, information, and recommendations to DOE on issues that affect environmental management at SRS.
- The SRS Community Reuse Organization (SRSCRO) is a private, nonprofit organization that develops and implements a comprehensive strategy to diversify the economy around the Site. SRSCRO ensues that SRS excess and operating resources benefit the economic well-being of the surrounding areas. It also assists new and expanding businesses and industries through its programs. SRSCRO has several grants from DOE that help advance education, training, and historical preservation in the region. Additionally, the organization has two WORC grants in effect to strengthen the local workforce pool needed to support DOE-EM and NNSA missions, particularly at SRS.
  - For the WORC I Grant (2016-2026), SRSCRO is the fiscal agent coordinating the WORC program with regional colleges and universities to support training in various science, technology, and engineering-based fields.
  - For the WORC II Grant (2020-2025), SRSCRO received an additional grant to boost workforce development to support the NNSA-proposed plutonium pit mission, the long-standing tritium mission, and the surplus plutonium disposition missions at SRS. SRSCRO accomplishes this through partnerships with local colleges and universities.
- The SRS Tour Program offers both virtual and onsite tours to the public. The tours allow visitors to gain an understanding of the DOE facilities, missions, and the workforce that changed the face of nearby counties and helped the United States during the Cold War. Guests to the Site will also learn about current and future DOE-EM and NNSA missions at SRS. The tour includes a visit to the University of Georgia's Savannah River Ecology Laboratory (SREL), where participants learn about the laboratory's history and mission and get an up-close view of animals found on the Site.
- SRNS Corporate Communications mails *Environmental Bulletins* to neighboring landowners. This makes certain the property owners, who wish to receive a bulletin, are aware of activities occurring at the Site. SRS also publishes the document on its webpage.

2.4.3 Earth Day

For 2023, SRS held an Earth Day celebration with the theme “Invest in our Planet.” SRS Earth Day celebrations increase awareness of Environmental Stewardship and, more specifically, the Environmental Management System program. Earth Day booths were available during the SRS 2023 Safety Exposition.

The SRNS booths represented Environmental Compliance, Environmental Monitoring, Site Services, Strategic Planning, and Supply Chain Management. SRNS Environmental Compliance presented information on recycling and waste minimization and introduced individuals to the Environmental Compliance Authorities at each facility. The group also conducted a haiku and photography contest for Site employees to encourage engagement in 2023 Earth Day. Environmental Monitoring displayed an electrofishing boat to demonstrate how sampling is done on fish and discussed surveillance monitoring around SRS. Site Services displayed one of the first electric vehicles (EVs) to arrive at SRS. Supply Chain Management presented on how attendees could purchase sustainably at home and reduce their carbon footprint.

Outside organizations with booths included the South Carolina Department of Health and Environmental Control (SCDHEC) State Office and the SCDHEC Aiken County Office, which discussed local environmental concerns. The Aiken Beekeepers also participated and presented on the importance of pollinators and protecting the environment.

Additionally, SRS senior leadership presented Site EVs at the Earth Day event held in Aiken for members of the community.

2.4.4 Reuse or Recycling of Equipment and Materials

SRS partnered with SRSCRO to turn excess equipment and material into revenue that benefits Aiken, Allendale, and Barnwell counties in South Carolina and Richmond and Columbia counties in Georgia. Surplus equipment and materials include the following:

- Small items, such as office equipment, valves, and glassware for laboratory experiments
- Large items of potentially much greater value, such as electrical turbines, diesel-powered pumps, and fire engines
- Hundreds of thousands of tons of metal

SRSCRO is the interface organization that, in addition to coordinating the WORC grants discussed above, takes in items that the Site no longer needs through the Asset Transition Program and Asset Removal Projects. In its 30th year, the organization, sells these items and uses the proceeds for the economic good of numerous businesses throughout the large region surrounding SRS. SRSCRO helps technology-based startups, business expansion, and new ventures across the Aiken, Allendale, and Barnwell counties in South Carolina and Columbia and Richmond counties in Georgia. The program has had an estimated savings from the SRS asset transition program (since 2013) of $12 million.

SRS utilizes the Federal Prison Industries, Inc. (UNICOR) services to recycle electronics. UNICOR operates electronics recycling centers that convert electronics into recyclable materials for resale to registered vendors. UNICOR vendors must abide by an environmental commitment that requires signing no-landfill certifications, following restrictive export policies, and agreeing to site inspections. UNICOR's services directed 100% (136,511 pounds) of SRS scrap electronics for recycling in FY 2023.

The Site Excess Operations team arranged for the reuse or disposal of nearly $11 million in government assets (equipment and supplies) in FY 2023. Excess equipment is reused by SRS workers, offsite state and federal government agencies, and community organizations and programs, such as SRSCRO and the Laboratory Equipment Donation Program, which donates surplus and available used laboratory equipment to college and universities for educational programs.

2.4.5 Sustainable Environmental Remediation

SRS continues to excel in sustainable remediation. Of the 41 remediation systems currently operating, 21 are completely passive, requiring no energy to implement, and 17 are low-energy systems. These low-energy systems use sustainable technologies, such as solar-powered microblowers and barometric pressure-driven BaroBalls™, to pump volatile organic contaminants from the subsurface, thus reducing contamination in soils and groundwater. SRS is also using the HydraSleeve™ sampling methodology for more than 240 wells, which significantly reduces excess groundwater that needs to be managed as waste.

In 2023, SRS continued monitoring to ensure the effectiveness of the lower-energy, innovative methods to address groundwater cleanup implemented in 2019. These included

- Injecting a vegetable-oil microbe mixture into the subsurface to intercept a groundwater plume and break down trichlorethylene (TCE)
- Injecting recycled iron into a series of wells to form these *in situ* remediation systems that intercept the groundwater plume and breaks down TCE

In both examples, using these *in-situ* remediation systems utilizes the natural flow of the groundwater plume. The systems are low energy and do not require pumps or equipment to move groundwater. SRS anticipates the vegetable oil to be effective for three to five years before it needs to be reinjected into the subsurface, and the iron by design is effective for decades with little maintenance.

Zero-Valent Iron Filings Undergo Preparation Before Being Injected into Wells during the P-Area Reactive Barrier Installation.

Additionally, the Lower Three Runs (LTR) project was the first stream system at SRS to reach a final remediation decision. The remedial decision for the LTR Integrator Operable Unit was a significant step in environmental stewardship at SRS, protecting both ecological habitats and field research opportunities associated with the LTR stream system. The Record of Decision resulted in the long-term protection of approximately 30 miles of aquatic stream system habitat and more than 3,000 acres of wetlands. This avoided significant environmental disturbance and construction costs. For example, capping and covering all areas elevated above permissible thresholds would have entailed an additional $4 million in cleanup costs. Excavating contaminated sediments would have exceeded $1 billion. With regulator approval, the final remedial action consists of Land Use Controls (signage and permits), long-term monitoring of environmental media, inspections and maintenance associated with two dams, and only a small excavation in one of the canals within the LTR system that is easily accessible. In FY 2023, the accelerated remediation was completed by removing cesium-137 contaminated sediments from a discharge canal and installing all Land Use Controls signage.

SRS continues to use remotely operated devices (drones and wireless stormwater sampling equipment) discussed in *SRS Environmental Reports* from previous years. Not only do these devices address environmental remediation, improve worker safety, and increase productivity, but they also decrease vehicle and fuel use, thereby supporting fleet management goals.

2.4.6 Innovative Environmental Compliance

SRS continues to deploy innovative methods to address compliance efforts. From 2019 to 2023, Environmental Compliance implemented a commercially available Comprehensive Environmental Permits Linking Tool (CEPLT) to track regulatory and DOE commitments. During the initial search for a CEPLT, SRS established implementing objectives that were central to developing the CEPLT's scope and requirements. To qualify as SRS's CEPLT, the linking tool must 1) be a unifying tool for environmental permit management and compliance, 2) be able to map Site permits to their governed locations and regulatory requirements, and 3) be capable of being implemented sitewide to include all Site tenants. After a comparison of a few off-the-shelf products, the Site determined that Benchmark ESG I Gensuite (Benchmark) would be utilized as SRS CEPLT.

SRS utilizes three web application tools from Benchmark:

- Compliance Calendar—This allows SRS users to create and track regulatory commitments (tasks) that can be assigned to an SRS Benchmark user.
- Permit Manager—This organizes permits, regulations, and other environmental requirement documents (for example, consent orders, DOE Orders) and links to Compliance Calendar.
- Mapper (custom built application)—This provides Geographic Information System-capability for mapping Permit Manager and Compliance Calendar data to associated Site locations (compliance points).

In 2019, during the implementation of Phase I, SRS integrated one of multiple site tenants (SRNS) in Benchmark by creating Compliance Calendar tasks; identifying, uploading, and linking Compliance Points to Compliance Calendar tasks; and adding SRS's regulatory documents into Permit Manager. For 2020-

2023, during the implementation of Phase II, III, and IV, SRS integrated remaining Site tenants into Benchmark. This included DOE (Environmental Compliance and Protection Division [ECPD]), SRNL (BSRA), Area Completion Projects (Federal Facility Agreement), Liquid Waste Operator Contractor (SRMC), Savannah River Tritium Enterprises (SRTE), United States Forest Service-Savannah River (USFS-SR), SREL, AMERESCO Biomass Cogeneration Facility, NNSA Capital Projects, and Security Operations (Centerra). Additionally, several air-, water-, and waste-related permits were linked to specific permit requirements and conditions using Permit Manager and Compliance Calendar. Using Benchmark increases accountability and awareness of regulatory and DOE Order commitments and helps improve environmental compliance.

In FY 2023, CEPLT allowed all Compliance Calendar task metric reporting to be tracked, completed, and supplied to DOE-SR ECPD on or ahead of schedule.

2.4.7 Challenges and Barriers to Implementation

In 2023, SRS continued to conserve and manage resources to meet the sustainability goals in the Sustainability Dashboard and SSP. However, infrastructure continually presents challenges, such as sustainable buildings that meet the Guiding Principles, to initiating sustainable projects. Achieving new goals is becoming significantly difficult with the high cost of implementing sustainability upgrades at SRS's many aging facilities (administrative, shops, laboratories, warehouses). SRS reduces energy intensity, when possible, in maintenance and repair situations through actions including replacing fluorescent lighting with a more energy-efficient LED lighting, replacing HVAC systems with higher Seasonal Energy Efficiency Ratio units, and right-sizing pumps. Retrofitting entire buildings or systems is not typically cost effective. Likewise, SRS reduces potable water use when feasible by continuing to install water-efficient toilet systems when repairs indicate the need. However, sitewide retrofitting with low-flow flush valves and faucets is not cost effective. Additionally, affordable landfill disposal of construction and demolition waste and supply chain problems for electronic acquisitions will continue to pose a reasonable challenge in the future.

SRS continues to study, track, and discuss sustainability requirements to ensure implementation. While SRS is inserting sustainable acquisition clauses in all applicable solicitations, there is work to be done tracking sustainable acquisition purchases (biobased, the EPA's SNAP program, and others). SRS continues to determine and implement ways to increase end-user awareness of sustainable acquisitions.

SRS identified the following programmatic opportunities for improvement during the 2021 ISO 14001:2015 conformity assessment:

- An environmental scope and policy that is more organizationally focused
- Criteria that are more rigorously defined to determine significant environmental aspects
- Sustainability initiatives that are more systematically integrated with the EMS
- Personnel who are more aware and well-informed of ISO 14001:2015 programmatic requirements

SRS continued to make progress on these opportunities for improvement in 2023 by formalizing the integration of EMS principles and promoting awareness across the Site. This was done through the following mechanisms:

- Providing EMS awareness training course
- Utilizing a stringent template to determine significant environmental aspects
- Collaborating routinely with sustainability personnel on Site sustainability initiatives
- Integrating sustainability into EMS through continual initiatives.

Chapter 3: **Compliance Summary**

The Savannah River Site (SRS) implements programs to meet the requirements of applicable federal and state environmental laws and regulations, as well as U.S. Department of Energy (DOE) Orders, notices, directives, policies, and guidance. The Site's goal is to comply with regulatory requirements and eliminate or minimize any environmental impacts. SRS has a decades-long commitment to environmental compliance and protecting human health and the environment.

2023 Highlights

Permitting

SRS managed 613 operating and construction permits. SRS received one Notice of Violation (NOV) as discussed below and in Section 3.3.7.1.1.

Remediation (Environmental Restoration and Cleanup)

At the end of Fiscal Year (FY) 2023, SRS had completed the surface and groundwater cleanup of 412 of these units and was in the process of remediating an additional 8 units containing or having contained solid or hazardous waste.

Radioactive Waste Management

- The annual reviews for the E-Area Low-Level Waste Facility Performance Assessment (PA) and the Saltstone Disposal Facility (SDF) PA showed that SRS continued to operate these facilities in a safe and protective manner.
- In calendar year 2023, SRS sent 16 transuranic waste shipments of downblended plutonium from K Area to the Waste Isolation Pilot Plant (WIPP) for deep geologic disposal. The number of shipments to WIPP in 2023 was 28.

Resource Conservation and Recovery Act (RCRA)

- The South Carolina Department of Health and Environmental Control (SCDHEC) conducted the unannounced RCRA Compliance Evaluation Inspection (CEI) for FY 2023 at select RCRA facilities on March 15−16, 2023. The inspection identified container management deficiencies, which were corrected prior to receiving SCDHEC's CEI Report.
- The U.S. Environmental Protection Agency (EPA) and SCDHEC conducted the unannounced RCRA CEI for FY 2024 at select RCRA facilities on October 30 to November 1, 2023. The inspection noted container management deficiencies.
- SCDHEC performed a RCRA Comprehensive Groundwater Monitoring Evaluation on May 9, 2023, inspecting groundwater monitoring systems and corrective actions at the M-Area and Metallurgical Laboratory Hazardous Waste Management Facilities (HWMFs), Sanitary Landfill, Mixed Waste Management Facility, and F- and H-Area HWMFs. The inspection did not note any deficiencies.

2023 Highlights (continued)

Air Quality and Protection

- SRS met all Clean Air Act requirements.

Water Quality and Protection

- Industrial stormwater outfalls are covered by the National Pollutant Discharge Elimination System (NPDES) Permit (SCR000000) for Stormwater Discharges Associated with Industrial Activities (Except Construction) (the Industrial Stormwater General Permit) and are included in the Site's Stormwater Pollution Prevention Plan (SWPPP). All 33 SRS industrial stormwater outfalls complied with the SWPPP.
- In April 2023, SRS received an NOV for not conducting a sampling requirement of its NPDES Industrial Wastewater Permit. SRS identified and completed corrective actions (Section 3.3.7.1.1).

Radiation Protection of the Public and the Environment

- SRS air and water discharges containing radionuclides were well below the DOE public dose limit of 100 millirem (mrem) per year. (Chapter 6, *Radiological Dose Assessment*, explains the public dose.)

Environmental Protection and Resource Management

- SRS conducted 913 National Environmental Policy Act (NEPA) reviews to identify potential environmental impacts from proposed federal activities. SRS identified 843 of these as Categorical Exclusions (CXs) that did not require action from the Site under NEPA.
- SRS continued to comply with many other federal laws, including the Emergency Planning and Community Right-to-Know Act; the Superfund Amendments and Reauthorization Act, Title III; the Endangered Species Act; the Federal Insecticide, Fungicide, and Rodenticide Act; the National Historic Preservation Act; and the Migratory Bird Treaty Act.

Release Reporting

- SRS did not have any releases exceeding the Comprehensive Environmental Response, Compensation, and Liability Act Reportable Quantity.

External Environmental Audits and Inspections

- In addition to site visits, the EPA and SCDHEC audited and inspected various SRS environmental programs to ensure regulatory compliance.
- The Federal Energy Regulatory Commission performed a dam safety inspection on May 24, 2023.

2023 Highlights (continued)

Tank Closure (Radioactive Liquid Waste Processing and Dispositioning)

- The Salt Waste Processing Facility (SWPF) treated more than 2.6 million gallons of salt solution.
- More than 4.2 million gallons of waste was processed into grout and disposed of in the SDF.
- The Defense Waste Processing Facility filled 54 canisters with 198,916 pounds of glass waste mixture, immobilizing approximately 5.14 million curies of high-level radioactive waste.
- The F- and H-Area Effluent Treatment Facility processed approximately 1.32 million gallons of treated wastewater.

3.1 INTRODUCTION

Complying with environmental regulations and U.S. Department of Energy (DOE) Orders is integral to Savannah River Site (SRS) operations. This chapter summarizes how SRS complies with applicable environmental regulations and programmatic requirements.

3.2 FEDERAL FACILITY AGREEMENT

The 1993 *Federal Facility Agreement (FFA) for the Savannah River Site*—a tri-party agreement between DOE, the U.S. Environmental Protection Agency (EPA), and South Carolina Department of Health and Environmental Control (SCDHEC)—integrates Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) requirements for a comprehensive remediation strategy and to coordinate administrative and public participation requirements. The FFA governs remedial actions, sets annual work priorities, and establishes milestones for cleanup and tank closure. SRS conducts remediation and closure activities as the FFA identifies and in accordance with applicable regulations, whether they are from the state, the federal government, or both. Additional information regarding the FFA commitments discussed in Chapter 3 can be found on the SRS webpage.

3.2.1 Remediation (Environmental Restoration and Cleanup)

SRS has 515 operable units (OUs), also known as waste units, subject to the FFA. These include RCRA and CERCLA units, site evaluation areas, and facilities included in the SRS RCRA permit. At the end of fiscal year (FY) 2023, SRS had completed the surface and groundwater cleanup of 412 of these units and was in the process of remediating an additional 8 units. Appendix C, *RCRA/CERCLA Units List*; Appendix G, *Site Evaluation List*; and Appendix H, *Solid Waste Management Units,* of the FFA list all of SRS's 515 OUs. The *Federal Facility Agreement Annual Progress Report for Fiscal Year 2023* explains the status of FFA activities at SRS for FY 2023.

CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan require remedy reviews every five years for sites that have hazardous substances remaining at levels that do not allow for unrestricted use of the area after a remedy is in place. Due to the rising number of SRS remedial decisions requiring five-year remedy reviews and new EPA guidance and format requirements, DOE, the EPA, and SCDHEC agreed in 2014 to submit future SRS Five-Year Remedy Review Reports in phases rather than combining all OU reviews into a single document. The OUs are in groups of the following five remedy types: 1) native soil cover or land use controls, or both; 2) groundwater; 3) engineered cover systems; 4) geosynthetic or stabilization and solidification cover systems; and 5) operating equipment. To ensure that SRS completes reviews of all remedy types within five years, it looks at a different remedy type each year. The Site evaluates remedies to determine whether they are functioning as designed and are still protecting human health and the environment.

In 2023, SRS prepared the following reports to satisfy CERCLA requirements:

- *Sixth Five-Year Remedy Review Report for Savannah River Site Operable Units with Operating Equipment*. DOE submitted the Revision 0 report to SCDHEC and the EPA on December 20, 2022. SRS received comments from the EPA and SCDHEC on March 17, 2023, and March 21, 2023, respectively. DOE submitted the Revision 1 report on July 12, 2023. The EPA and SCDHEC approved the report on August 24, 2023. DOE, SCDHEC, and the EPA signed the report on October 13, 2023, November 1, 2023, and December 6, 2023, respectively. SRS issued the report to the public on December 22, 2023.
- *Seventh Five-Year Remedy Review Report for Savannah River Site Operable Units with Native Soil Covers and/or Land Use Controls.* DOE submitted the Revision 0 report to SCDHEC and the EPA on December 21, 2023.

Lower Three Runs Integrator Operable Unit

The Lower Three Runs (LTR) Integrator Operable Unit (IOU) is one of six IOUs on SRS. SRS IOUs are defined as surface water bodies (for example, stream, lakes, and ponds) and associated wetlands and floodplains, including surface water; either sediment or soil or both (stream channel or floodplain sediment and floodplain or wetland soil); and related biota that correspond to a respective watershed. A watershed describes an area of land that contains a common set of streams and rivers that all drain into a single larger body of water, such as a river, a lake, or an ocean. For SRS, the larger body of water is the Savannah River.

The LTR IOU originates in the northeast portion of SRS and consists of a series of cooling water ponds (including PAR Pond) and canal systems that meander approximately 25 miles along a southerly direction, ultimately discharging into the Savannah River (Figure 3-1). The LTR watershed drains about 180 square miles and includes 2 main industrial OUs: P-Area OU including P Reactor, and R-Area OU including R Reactor. The LTR IOU was predominately contaminated with cesium-137 from historical releases associated with reactor operations in P and R Areas.

The LTR IOU is delineated into Upper, Middle, and Lower subunits for administrative purposes (Figure 3-2). The Upper subunit is located upgradient of the PAR Pond Dam and includes PAR Pond, the precooler ponds, and the canal systems that received P- and R-Area Reactor cooling water discharges during operations. The Middle and Lower subunits are below the PAR Pond Dam and consist of the LTR stream.

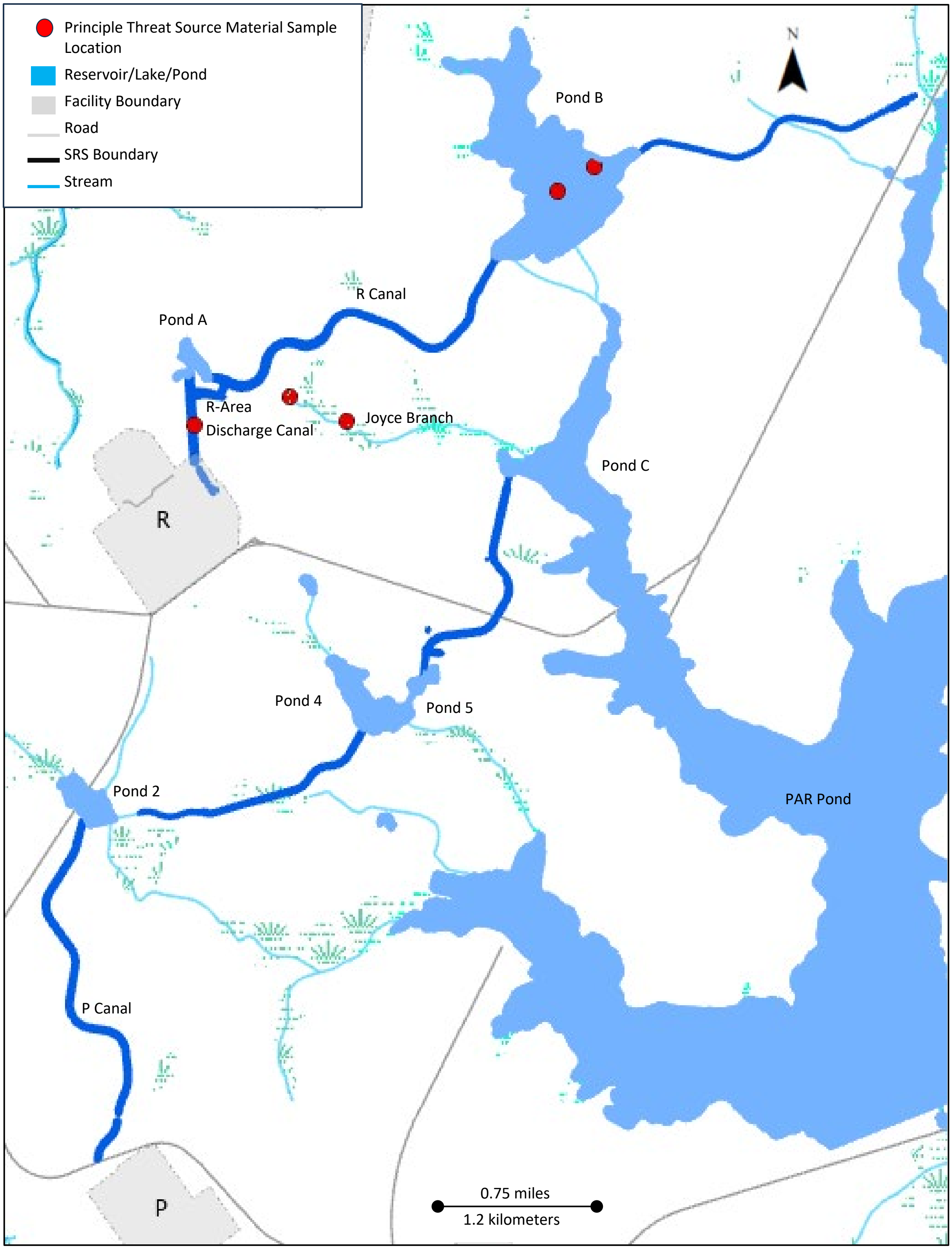


Figure 3-1 Lower Three Runs IOU Ponds and Canal System

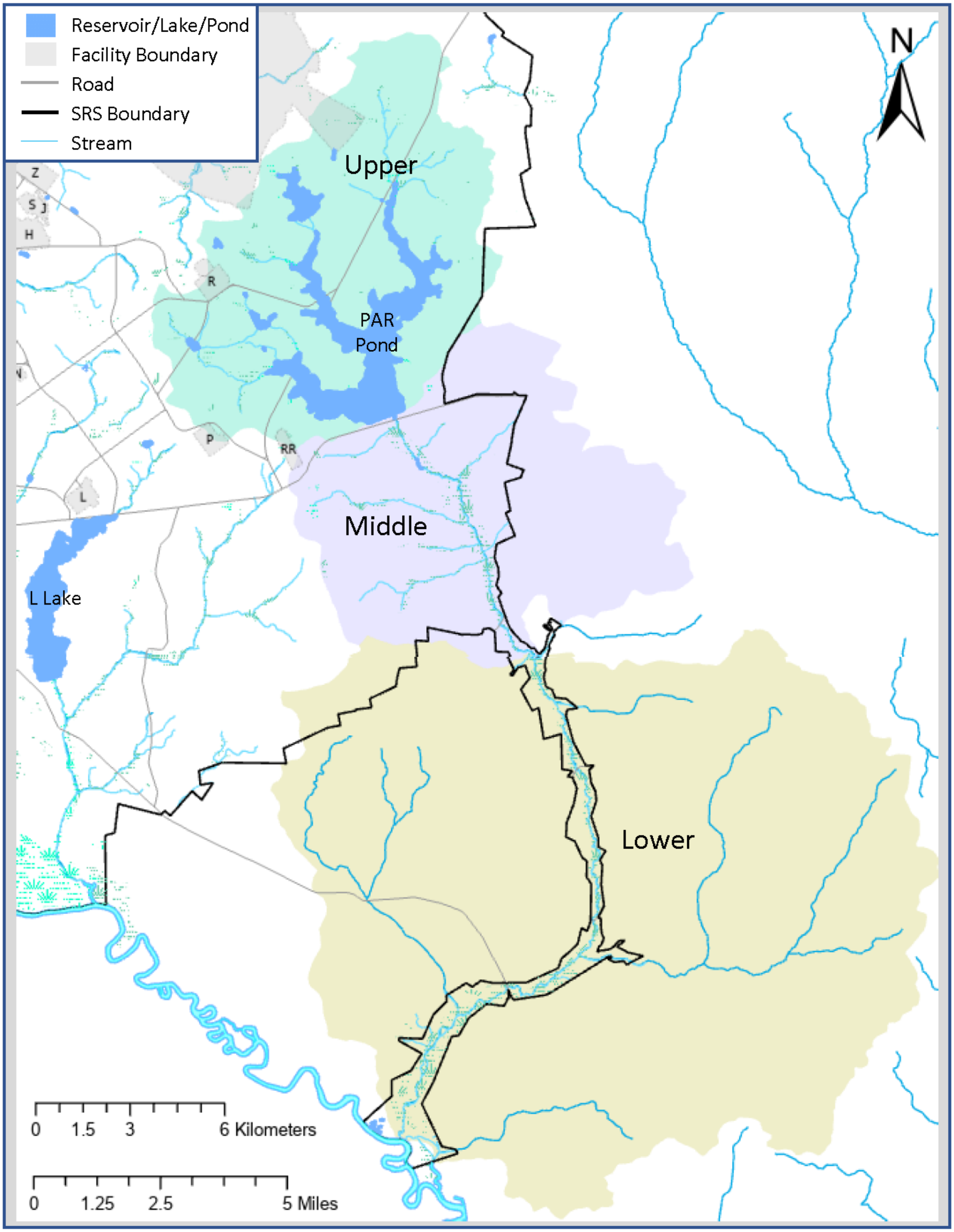


Figure 3-2 Lower Three Runs IOU Subunits

The remedial decision for the Middle and Lower subunits, excavation and disposal of sediment or soil or both from three locations (approximately 1 acre each) and land use controls (LUCs), was previously addressed and documented in the *Explanation of Significant Differences (ESD) for the Revision 0 Interim Action Record of Decision Remedial Alternative Selection: PAR Pond Unit Lower Three Runs Integrator Operable Unit Tail Portion (Middle and Lower Subunits) (U).* As documented in the ESD, no additional data collection, risk assessment, or response evaluation was necessary for the Middle and Lower subunits. LUCs were documented as the final action for the Middle and Lower subunits in the LTR IOU Record of Decision that was issued in December 2021.

In 2022, the SRS completed planning and documentation for implementing the LTR IOU Upper subunit remedial action. A remedial action was needed because cesium-137 and cobalt-60 (to a lesser degree) are present in sediment, soil, or both, and cesium-137 and mercury are present in fish tissue at levels that may pose a threat to human health and the environment.

Due to the complexity of the Upper subunit, multiple remedial actions were implemented to address the nature and extent of contamination within the subunit. These remedial actions include:

- LUCs with Monitored Natural Recovery (MNR) for the entire Upper subunit
- Excavation, treatment, and disposal of principal threat source material (PTSM) sediment, soil, or both from one location within Pond A, including the R-Area Discharge Canal exposure area, to reduce exposure and mitigate migration of sediment, soil, or both
- Maintain Water in Ponds (Pond B, PAR Pond, and Pond C) to reduce exposure and mitigate migration of sediment, soil, or both

SRS began implementing the remedial actions on January 24, 2023, and was physically complete on June 20, 2023.

<u>LUCs remedial action</u>—includes engineering controls such as signs, gates, or both at access points and administrative measures (deed restrictions and other SRS worker protection programs) to effectively reduce exposure of contaminated media to human receptors. MNR is a component to the remedy that uses the ongoing, naturally occurring recovery process to contain, destroy, or reduce the bioavailability or

SRS Uses Signs to Control Access to Lower Three Runs IOU.

toxicity of contaminants in sediment, soil, or both. The MNR component will assess the natural decay of cesium-137 in the Upper subunit over time. Cesium-137 levels are expected to decay below the PTSM threshold (144 picoCuries/gram) in the Upper subunit in approximately 50 years; the need to continue with the MNR component of the remedy will be reevaluated at that time. PTSM is described as highly toxic materials that would present a significant risk to human health or the environment should exposure occur.

<u>Excavation, Treatment, and Disposal of PTSM sediment, soil, or both remedial action</u>—reduces toxicity, mobility, or volume of contaminants through treatment and adding a drying agent for the excavated sediment, soil, or both. The treatment technology was applied to reduce contaminant mobility and allow for safe transport and disposal.

<u>Maintain Water in Ponds remedial action</u>—includes inspections and periodic maintenance of the physical attributes of the dam structures, such as dams, weirs, and control gates so that water retention is viable and allows for natural fluctuations of water levels. The presence and maintenance of the dam structures also controls sediment movement downstream of the Upper subunit.

Because contaminants have been left in place at the LTR IOU at levels that do not allow for unlimited use and unrestricted exposure, LUCs manage the entire IOU (Upper, Middle and Lower subunit), which is subject to five-year remedy reviews to ensure the remedy remains protective of human health and the environment.

Wetland Area at Dunbarton Bay

SRS began early infrastructure development between 1951 and 1955, including constructing P Reactor, which operated between 1954 and 1991. Similar to each reactor at SRS, P Area used a coal-fired powerhouse to generate steam and electricity, producing coal ash (coal combustion products) as a waste of boiler operations. In P Area, this ash was disposed of via a sluice line to the P-Area Ash Basin (PAB) (188-P). During characterization of the PAB in summer of 2010, an area of ash overflow was initially discovered and named the Wetland Area at Dunbarton Bay (WADB).

An Aerial Photograph Shows the Wetland Area at Dunbarton Bay.

WADB is southeast of the PAB within the Steel Creek IOU boundary near the headwaters of Meyers Branch and extends approximately 2,500 feet into Dunbarton Bay. Dunbarton Bay is a designated wetland because it is a Carolina Bay, a unique wetland environment found in the southeastern United States.

Based on the evaluation of characterization data, the only problems warranting action at WADB are those related to human receptors exposed to coal-related metals and radionuclides in surface soil and ash that exceed a risk greater than 1E-06. The risk threshold of 1E-06 indicates a probability of 1 in 1,000,000 individuals developing cancer. No problems warranting action were identified for the ecological receptors or contaminant migration pathway.

On June 20, 2018, the *Record of Decision Remedial Alternative Selection for the Wetland Area at Dunbarton Bay in Support of the Steel Creek Integrator Operable Unit (U)* was issued to the public. The selected remedial action described in the Record of Decision (ROD) was excavation of 22,000 cubic yards of ash and contaminated soil media, extending from the PAB to the edge of a 100-foot buffer around the Dunbarton Bay (wetland area), and disposing of the excavated material in an approved off-SRS permitted disposal facility. The remedy also included LUCs for approximately 25 acres of ash and contaminated soil that were not excavated with a 100-foot buffer along the northern edge of the bay to protect the sensitive Carolina Bay ecosystem.

An Access Control Sign at Dunbarton Bay Limits Entry to the Wetland Area.

The selected remedy for WADB consisted of two distinct areas of ash excavation: the North Ash Remediation Area (NARA) and the South Ash Remediation Area (SARA). The volume of ash removed from the NARA and SARA (Zone 1) was approximately 22,670 cubic yards. Excavation for these areas began in January 2019 and was completed in November 2019. The LUC boundary access warning signs were installed in January 2020. These activities supported unrestricted land use in NARA and LUCs in SARA (Zone 1).

During the initial stages of excavation at SARA, the presence of shallow perched water and additional ash (approximately 1 acre) outside the limits of the SARA ash boundary were discovered. Due primarily to the saturated conditions in the remediation area, but also to the discovery of additional ash and restrictions on disposal volume and moisture content that were imposed by the disposal facility, DOE, the EPA, and SCDHEC decided to suspend excavating the remaining SARA (Zones 2 to 4) until disposition alternatives for all coal combustion residual units listed in the FFA were evaluated.

The saturated conditions and additional ash volume made continued excavation impracticable. In 2022, instead of further excavation, DOE, the EPA, and SCDHEC agreed to expand the LUCs for the remaining ash at WADB, including the ash deposits remaining in SARA and the additional ash discovered outside of the boundary of SARA. This decision was documented in the *Explanation of Significant Difference for the Revision 1 Record of Decision Remedial Alternative Selection for the Wetland Area at Dunbarton Bay in Support of the Steel Creek Integrator Operable Unit (U),* which was issued to the public on August 20, 2023. Adding LUC signs and repositioning existing LUC warning signs to encompass the expanded area were completed in October 2023.

Because contaminants have been left in place at WADB at levels that do not allow for unlimited use and unrestricted exposure, the unit is subject to five-year remedy reviews to ensure the remedy in place remains protective of human health and the environment.

3.2.2 Tank Closure: Radioactive Liquid Waste Processing and Dispositioning

SRS generates liquid radioactive waste as a byproduct of processing nuclear materials. The waste is stored in underground waste tanks grouped into two tank farms (F-Tank Farm and H-Tank Farm). Sludge settles on the bottom of the tanks, and liquid salt waste rises to the top. The waste removed from the tanks feeds the sludge and salt waste processing programs, as Figure 3-3 depicts.

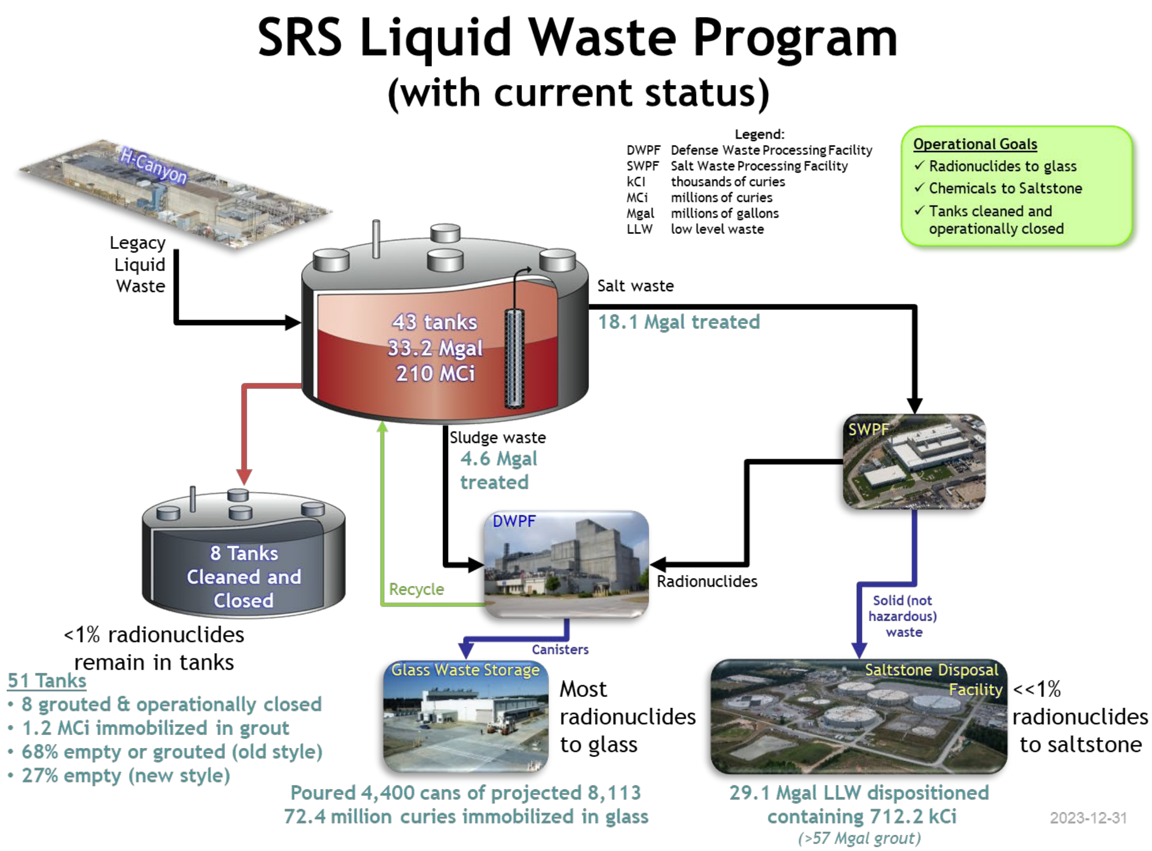


Figure 3-3 Processing and Dispositioning Radioactive Liquid Waste at SRS

3.2.2.1 <u>Tank Closure</u>

SRS operates F-Tank Farm and H-Tank Farm under SCDHEC industrial wastewater regulations; however, FFA Section IX, *High-Level Radioactive Waste Tank System(s)*, establishes requirements to prevent and mitigate releases from these tank systems. The FFA also contains enforceable closure schedules for the liquid waste tanks. Tank closures are subject to DOE Order 435.1, *Radioactive Waste Management*; federal regulations; and Section 3116 of the *Ronald W. Reagan National Defense Authorization Act (NDAA) for Fiscal Year 2005.*

NDAA Section 3116(a) is legislation that allows the Secretary of Energy to consult with the Nuclear Regulatory Commission (NRC) to determine that certain waste from spent fuel reprocessing is not high-level radioactive waste and does not need to be disposed of in a deep geologic repository. The NRC coordinates with SCDHEC to monitor the steps DOE takes to dispose of the waste to assess whether it is complying with the performance objectives of 10 Code of Federal Regulations (CFR) Part 61, Subpart C.

Additionally, the EPA may participate in the NRC monitoring. *Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site* (DOE 2012) and *Section 3116 Determination for Closure of H-Tank Farm at the Savannah River Site* (DOE 2014) demonstrate that the stabilized tanks and ancillary structures in F-Tank Farm and H-Tank Farm meet the necessary criteria and will not need to be permanently isolated at a deep geologic repository.

During 2023, DOE supported the NRC monitoring of F-Tank Farm and H-Tank Farm under Section 3116 of the NDAA by providing routine documentation (for example, groundwater monitoring reports and Performance Assessment [PA] maintenance plan), as the NRC requested. The NRC did not conduct onsite observation visits for the liquid waste tank farms in 2023; however, several virtual meetings were held between the NRC, DOE, and DOE Contractor staff. Before SRS closes the tanks, they undergo an extensive waste removal process that includes specialized mechanical cleaning and isolation from the waste transfer and chemical systems. Once these steps are complete, DOE receives regulatory confirmation that the tanks are ready to be stabilized by grouting.

No FFA waste tank closure commitments were required for 2023. In 2022, DOE, SCDHEC, and the EPA signed the *2022 High Level Waste Tank Milestones Agreement*, which has since been added to the FFA. The agencies agreed on new Preliminary Cease Waste Removal dates and Operational Closure dates for a specified number of tanks as well as additional issues. The Preliminary Cease Waste Removal dates and new Operational Closure dates replace the previously suspended Bulk Waste Removal Efforts and operational closure dates.

3.2.2.2 Salt Processing

SRS is using several processes to dispose of the salt waste from the liquid waste tanks. The Actinide Removal Process and Modular Caustic Side Solvent Extraction Unit (ARP/MCU) was an interim salt waste processing system. SCDHEC permitted ARP/MCU under South Carolina industrial wastewater regulations. The salt form of the liquid waste is 90% of the waste volume stored in the tanks and contains about half of the radioactivity. Before the Salt Waste Processing Facility (SWPF), the ARP/MCU process removed actinides, strontium, and cesium from the salt waste taken from the liquid waste tank farms. The facilities underwent lay-up activities to be placed in a safe, stable suspended operations state in 2019, which allowed SRS to complete final SWPF tie-ins. ARP/MCU has remained in a suspended operations state since that time.

With construction of the SWPF project complete, SRS received approval to begin facility operations in 2020. Hot commissioning of SWPF was completed in January 2021, and Parsons Corporation, which designed and built the first-of-a-kind facility, completed its first year of operations on January 17, 2022. Savannah River Mission Completion (SRMC) took over management of the Liquid Waste program in late February 2022 and management of SWPF in late March 2022. SWPF processed more than 2.6 million gallons of salt solution in 2023.

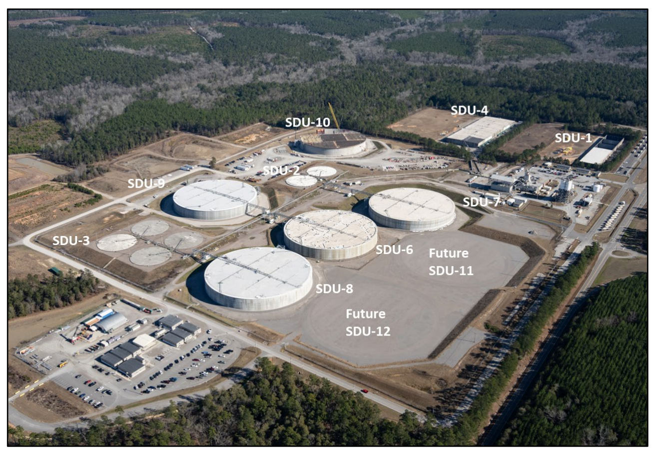
SRS procured the Tank Closure Cesium Removal (TCCR) system to treat salt waste, increase salt processing capability, and to expedite tank closure. The Site completed TCCR design and fabrication in 2017 and installation and readiness assessments in 2018. The TCCR started operating in January 2019. It processed more than 71,700 gallons of salt solution in 2022. In July 2022, SRS suspended TCCR operations and initiated lay up of the TCCR Unit to accelerate overall risk reduction (removal of waste) for several waste tanks submerged in the water table. The TCCR Unit was deinventoried in 2023 and has been placed in a safe state. In 2023, significant progress was made in removing waste from several tanks that are submerged in the water table. Of the six remaining tanks fully or partially submerged in the water table, three of the tanks were actively going through waste removal activities in 2023, two others continued with field activities to prepare them for waste removal, and one was supporting waste removal activities for other tanks in the water table.

3.2.2.3 Salt Disposition

After SWPF processing, the decontaminated salt solution is processed into grout waste at the Saltstone Production Facility and disposed of in the Saltstone Disposal Facility (SDF). SCDHEC permits the SDF to operate under South Carolina solid waste industrial landfill regulations. SRS disposes of treated low-level salt waste in the SDF, based on the Secretary of Energy's determination pursuant to *Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (DOE 2006). NDAA Section 3116(b) requires the NRC, in coordination with SCDHEC, to monitor the disposal actions DOE takes to assess whether it is complying with the objectives of 10 CFR Part 61.

During 2023, DOE supported the NRC in monitoring SDF under Section 3116 of the NDAA by providing routine documentation (groundwater monitoring reports and PA maintenance plan), as requested. The NRC conducted an onsite observation visit for salt waste disposal during 2023. In addition, several virtual meetings between the NRC, DOE, and DOE contractor staff took place.

In 2023, SRS continued permanently disposing of waste, processing more than 4.2 million gallons into grout and disposing of it in cylindrical concrete Saltstone Disposal Units (SDUs). These include SDU-6, the 375-foot in diameter rubber-lined mega-vault with a capacity of 32.8 million gallons; SDU-7, with a capacity of 34.5 million gallons; and SDU-3 Cells A and B, which are 150 feet in diameter vaults having a capacity of 2.8 million gallons each. In 2023, SRS completed constructing SDU-8 and continued constructing SDU-9 and SDU-10, all with capacities of 34.5 million gallons. In addition, excavation and groundwork were completed for SDU-11 and SDU-12, the final mega-vaults currently planned.



An Aerial Photograph Depicts Construction in Progress on SDU-9, SDU-10, SDU-11, and SDU-12.

3.2.2.4 Sludge Waste Processing—Vitrification of High-Activity Waste

SCDHEC permits the Defense Waste Processing Facility (DWPF) to operate under South Carolina industrial wastewater regulations. The sludge waste makes up less than 10% of the waste volume stored in the tanks and contains about half of the radioactivity, as Figure 3-3 shows. At DWPF, SRS combines the high-activity portion of both the sludge and salt waste from the tank farms with frit before sending the mixture to the plant's melter. The melter heats the mixture to nearly 2,100 degrees Fahrenheit, until molten, and pours the resulting glass-waste mixture into stainless steel canisters to cool and harden. This process, called "vitrification," immobilizes the radioactive waste into a solid glass form suitable for long-term storage and disposal. SRS stores these canisters temporarily in the Glass Waste Storage Buildings to prepare for final disposal in a federal repository.

DWPF produced 54 canisters, collectively containing 198,916 pounds of glass and immobilizing approximately 5.14 million curies of radioactivity during 2023. Since DWPF began operating in March 1996, it has produced more than 4,400 canisters collectively, containing 17.0 million pounds of glass and immobilizing 72.4 million curies of radioactivity.

3.2.2.5 Low-Level Liquid Waste Treatment

The F- and H-Area Effluent Treatment Facility (ETF) treats low-level radioactive wastewater from the tank farms. The ETF removes chemical and radioactive contaminants from the water before releasing it into Upper Three Runs Creek, an onsite stream that flows to the Savannah River. The point of discharge is a South Carolina National Pollutant Discharge Elimination System (NPDES)-permitted outfall. The ETF processed approximately 4.8 million gallons of treated wastewater in 2023. SCDHEC permitted the ETF under the South Carolina industrial wastewater regulations. The ETF remained in compliance with the industrial wastewater permit and the NPDES permit throughout 2023.

3.3 REGULATORY COMPLIANCE

This section summarizes how SRS complies with the applicable federal and state environmental laws and regulations.

3.3.1 Atomic Energy Act/DOE Order 435.1, "Radioactive Waste Management"

SRS waste and materials management is complex and includes numerous facilities that DOE Orders and federal and state regulations govern. DOE Order 435.1 covers all radioactive waste management (low-level waste [LLW], high-level waste [HLW], and transuranic [TRU] waste) to protect the public, workers, and the environment. LLW is the only radioactive waste SRS disposes of onsite, at the E-Area LLW Facility and the SDF. LLW is radioactive waste not classified as HLW or TRU waste and not containing any Resource Conservation and Recovery Act (RCRA) hazardous waste.

DOE Manual 435.1-1, *Radioactive Waste Management Manual,* requires DOE to prepare PAs to evaluate the potential impacts of low-level radioactive waste disposal and closure (the tank farms) to the workers, the public, and the environment. The PAs provide the technical basis and evaluation needed to demonstrate compliance with DOE Order 435.1. The Order also requires a composite analysis (CA) to assess the combined impact of multiple LLW disposal facilities and other interacting sources of radioactive material after closure.

SRS performs a comprehensive annual PA review for disposal facilities. This review ensures any developing information does not alter the original PA conclusions and that there is a reasonable expectation the facility will continue to meet the performance objectives of the DOE Order. In addition, SRS performs an annual CA review to evaluate the adequacy of the 2010 SRS CA and verify that SRS conducted activities within the bounds of the 2010 analysis. The FY 2022 annual reviews for the E-Area Solid Waste Management Facility, the SDF, and the SRS CA determined that SRS continues to comply with the performance objectives of DOE Order 435.1. Based on the reporting and approval cycle for the PA and CA annual reviews, there is a one-year lag in reporting this information in the *SRS Environmental Report,* which is published yearly.

TRU waste is another category of radioactive waste that SRS generates. DOE Orders define TRU waste as waste containing more than 100 nanocuries of alpha-emitting TRU isotopes (elements with atomic numbers greater than uranium) per gram of waste with radiological half-lives greater than 20 years. At SRS, TRU waste consists of down-blended excess plutonium material from K Area and job waste such as clothing, tools, rags, residues, debris, and other items contaminated with trace amounts of plutonium. SRS sends TRU waste to the Waste Isolation Pilot Plant (WIPP), a deep geologic repository located near Carlsbad, New Mexico, for permanent disposal. Many different federal and state agencies (the EPA, the NRC, DOE, and the State of New Mexico), along with multiple regulations, govern TRU waste management and disposal. SRS manages TRU waste under DOE Orders and federal and state hazardous waste regulations. SRS sent 28 TRU shipments to WIPP for disposal in 2023.

3.3.2 Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) establishes regulatory standards to generate, transport, store, treat, and dispose of solid waste, hazardous waste (such as flammable or corrosive liquids), and underground storage tanks (USTs). SRS has a RCRA hazardous waste permit, multiple solid waste permits, and multiple UST permits, as Section 3.3.10, *Permits*, identifies.

3.3.2.1 Hazardous Waste Permit Activities

Under RCRA, the EPA establishes requirements for treating, storing, and disposing of hazardous waste. The EPA authorizes SCDHEC to regulate hazardous waste and the hazardous components of mixed waste. SCDHEC also issues permits to implement RCRA.

Through the SCDHEC-issued RCRA hazardous waste permit, SRS closed Solvent Storage Tanks (SSTs) S33–S36 and submitted the final certification of closure to SCDHEC in October 2019 (Figure 3-4). In November 2020, SCDHEC conducted the onsite verification of the closure. SCDHEC recognized that SRS had satisfied the conditions of the approved closure plan in early 2022. The SST Facility was added to the postclosure portion of the SRS Hazardous and Mixed Waste Permit SCDHEC issued on November 30, 2022 (effective December 15, 2022). This section of the permit requires the SST Facility to submit a postclosure plan and a plan to implement a groundwater monitoring system to SCDHEC by December 2022. To satisfy this requirement, SRS reevaluated the SST soil data used to generate the *SST Closure Certification Report* to determine the constituents to monitor during the postclosure care period. The reevaluation of the data concluded that the soil associated with the closed SST Facility meets the threshold for unrestricted land, and the detected concentration of constituents were less than residential thresholds or were indistinguishable from SRS background concentration. After review and discussion of the reevaluated data, SCDHEC concluded that the SST postclosure plan would not need to include implementing a groundwater monitoring system. In December 2022, SRS submitted the SSTs S33–S36 Postclosure Plan to SCDHEC. SCDHEC responded in November 2023 with comments on the Postclosure Plan. SRS is drafting comment responses to be submitted to SCDHEC in 2024.

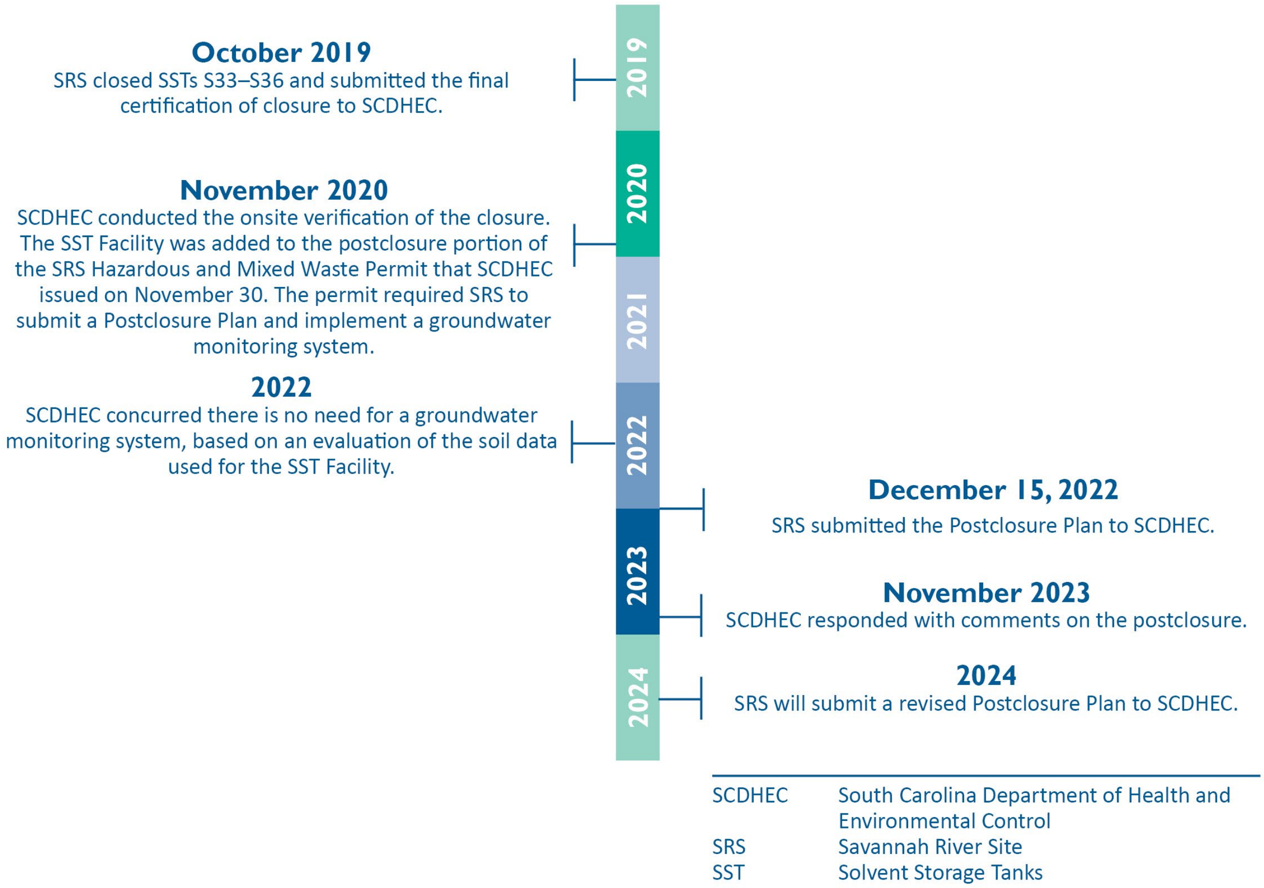


Figure 3-4 SST Closure Plan, from Certification to Postclosure

The Savannah River Site submitted Revision 3 of the 2013 RCRA Permit Renewal Application, M-Area and Metallurgical Laboratory (Met Lab) Hazardous Waste Management Facility's (HWMFs) Postclosure (Volume III), to SCDHEC on September 26, 2022 (Figure 3-5). This submittal was in accordance with the schedule for corrective action in the Final Permit Decision that was issued on November 30, 2021, and effective on December 15, 2021. The revision included recommendations for the permanent shutdown of Met Lab HWMF recovery well RWM-17B, long-term monitoring of Met Lab HWMF groundwater protection standard and monitoring constituents, and future operations of various M-Area and Met Lab HWMFs soil vapor extraction systems. Two recovery wells, RWM-17B and RWM-17D, were installed within the Met Lab HWMF area in May 1996 as a corrective action system in that area. With SCDHEC approval, RWM-17D was abandoned in 2016, based on historic data trends being less than the groundwater protection standard and dry conditions in the area. Based on data trends and the expansion of the monitoring well network near RWM-17B, SCDHEC approved the temporary shutdown of the recovery well in September 2017, and the well was shut down in February 2018. Groundwater concentration standards continued to decline since 2018, and future operation of recovery well RWM-17B is not needed. Therefore, the well was proposed for abandonment. The Revision 3 submittal also proposed expanding the A-Area Burning/Rubble Pits/Miscellaneous Chemical Basin/Metals Burning Pit OU 1,4-dioxane characterization program, updates to the status of the Southern Sector recirculation wells, and changes to the status of the A-2 Air Stripper recovery wells because the stripper was approved for permanent shutdown in 2021. Four wells were

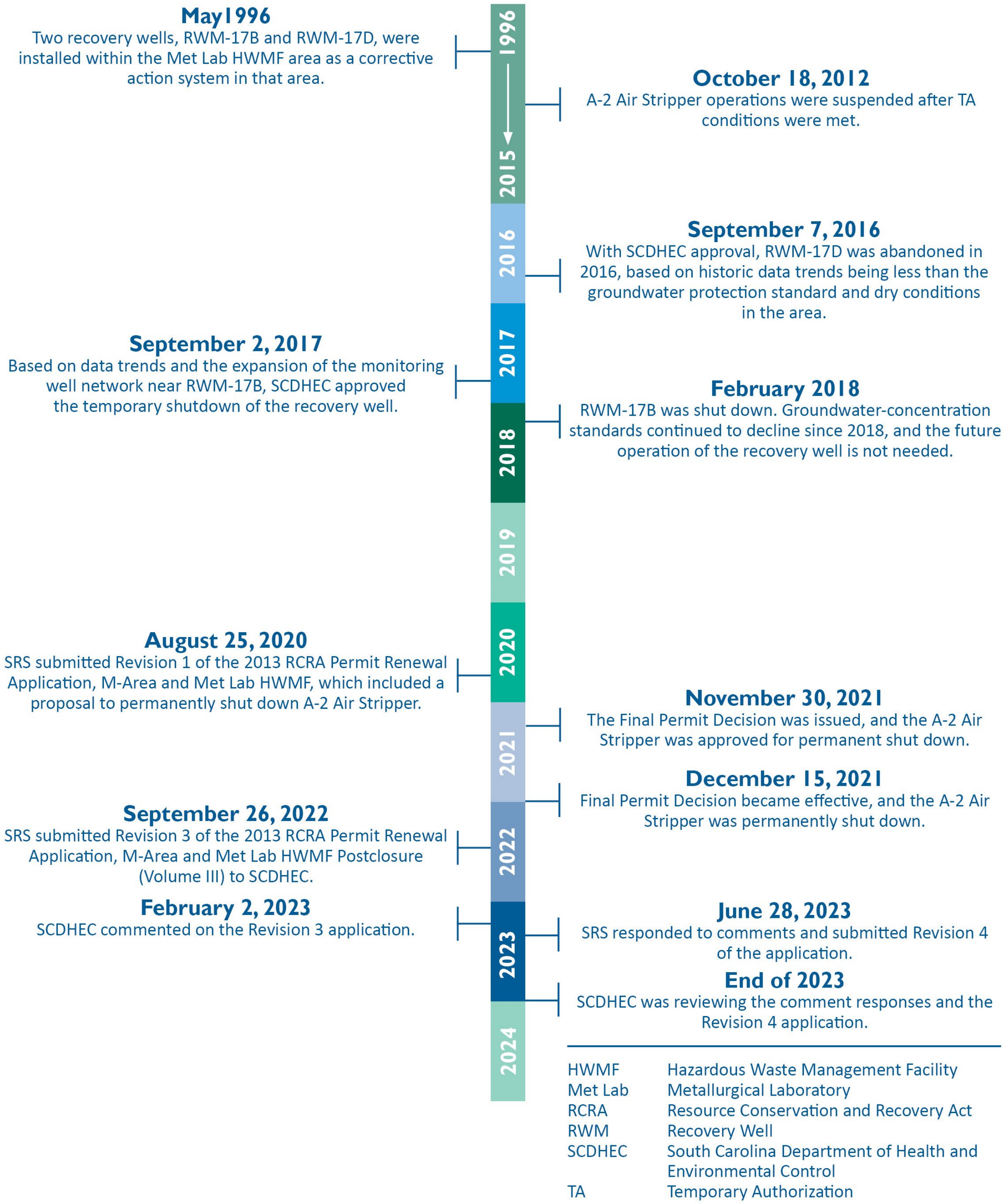


Figure 3-5 RCRA Permit Renewal

abandoned, and two wells were converted to monitoring wells. SCDHEC provided comments on the Revision 3 application on February 2, 2023. SRS responded to the comments and submitted Revision 4 of the application on June 28, 2023. At the end of 2023, SCDHEC was in the process of reviewing the comment responses and the Revision 4 application.

The current RCRA permit for General Information, Mixed Waste Management Facility (MWMF), Mixed Waste Storage Buildings (MWSBs), and Sanitary Landfill (SLF) expires on March 13, 2024. To follow South Carolina regulations, a renewal request must be submitted 180-days before the expiration date of the effective permit. This requirement was met by the submittal of the 2023 RCRA Permit Renewal Application, Revision 0, on September 12, 2023.

The renewal application is divided into four volumes: General Information (Volume I), MWMF (Volume II), MWSBs (Volume VIII), and SLF (Volume XXIII).

The General Information volume contains information common to all of the facilities at SRS. It includes descriptions of the Site emergency services, security, regional hydrogeology, and much of Part A of the application. Part A consists of required EPA Form 8700-23, maps, drawings, and photographs. Several of the more significant changes from the previous 2013 renewal application included updating the Part A information, the general introduction and process information for each facility's current operation status, and the hydrogeologic and groundwater monitoring information to reflect current conditions.

The MWMF landfill, which was originally 58 acres, received waste until 1985. It was certified closed in 1991. The landfill accepted lead gloves, coveralls, soils, construction debris, waste oils, solvent rags, and irradiated scrap metals. An additional 13 acres of the facility received waste until 1990 and was certified closed in 1999. This area received solvent rags. Groundwater below the MWMF contains a variety of contaminants, mostly tritium, solvents, and some heavy metals. There are no significant changes from the previous 2013 renewal application. Minor changes include updating text in Section E with current contaminant levels and revising maps with up-to-date data. There are no proposed changes to the existing corrective actions being implemented at the MWMF.

The MWSBs volume contains information on two buildings located in E Area near the center of the Site. They temporarily store hazardous waste, mixed waste, nonhazardous radioactive waste, and polychlorinated biphenyl (PCB) wastes. There are no significant changes from the previous 2013 renewal application. Minor changes include updated figures and text.

The SLF was built in 1974, received waste until 1994, and was certified closed in 1997. Originally 32 acres, the landfill was expanded to approximately 70 acres before it was closed. It generally accepted solid waste from administrative areas, cafeterias, and industrial activities, but it also received some solvent rags. The groundwater associated with the SLF contains a variety of contaminants, primarily solvents. In 1999, SRS performed an *in situ* bioremediation corrective action for the contaminated groundwater. Based on the regulatory agreement, the corrective action ceased operations in 2005. SRS is currently monitoring the groundwater to ensure that no further remediation of the groundwater is needed. The only significant change from the previous 2013 renewal application includes proposing to move 1,1-dichloroethane and cobalt from the compliance monitoring list to the corrective action list due to reductions in their respective groundwater protection standards. No additional corrective actions were proposed based on this change.

On November 14, 2023, SCDHEC stated that based on its review, the four volumes of the 2023 RCRA Permit Renewal Application are administratively complete with respect to the regulatory requirements of RCRA and the South Carolina Hazardous Waste Management Regulations (SCHWMR). At the end of 2023, SCDHEC continued its review to determine if the four volumes were technically accurate with respect to the specific requirements of SCHWMR.

3.3.2.2 Solid Waste Permit Activities

The Site has solid waste permits for the 632-G Construction and Demolition (C&D) Debris Landfill; the 288-F Industrial Solid Waste Landfill; and the SDF, identified as the Z-Area Saltstone Industrial Solid Waste Landfill in its permit (Section 3.2.2.3). These solid waste landfills are active and operated in compliance with their permits during 2023. SCDHEC conducted quarterly landfill inspections of the 632-G and 288-F landfills and monthly SDF inspections in 2023 and found no issues of noncompliance. In addition, SRS has two closed solid waste landfills: the Interim Sanitary Landfill and the F-Area Crosstie Landfill. SCDHEC conducted an annual inspection of these closed landfills in 2023 and found no issues of noncompliance.

3.3.2.3 Underground Storage Tank (UST) Permits

Subtitle I of RCRA regulates USTs containing usable petroleum products. Currently, SRS has 17 USTs managed under seven permits. Each UST requires an annual compliance certificate from SCDHEC. SCDHEC performed its annual inspection on May 8, 2023, finding all tanks in compliance. This annual inspection also confirmed the USTs supporting emergency power generators for DWPF, H Canyon, and Utilities and Operating Services successfully completed system testing and upgrades to meet the SCDHEC UST Release Detection regulations.

3.3.3 Federal Facility Compliance Act (FFCA)

The Federal Facility Compliance Act (FFCA) was signed into law in October 1992 as an amendment to the Solid Waste Disposal Act. It adds provisions to apply certain requirements and sanctions to federal facilities. SRS obtained and implemented a Site Treatment Plan (STP) Consent Order (95-22-HW, as amended) in 1995, as required by the FFCA. The consent order requires annual updates to the STP.

Personnel from SRS and SCDHEC met on May 12, 2023, to discuss the 2023 update. Consistent with prior years, the parties agreed to a reduced scope update for 2023, consisting of only revised appendices to Volumes I and II. SRS submitted the STP 2023 Update to SCDHEC on November 15, 2023. SCDHEC approved the STP 2022 Update on July 7, 2023. The 2006 update of the STP serves as the archive reference for STP Volumes I and II.

In October 2003, SCDHEC executed a Statement of Mutual Understanding for Cleanup Credits, allowing SRS to earn credits for certain accelerated cleanup actions. Credits can then be applied to the STP commitment schedules. In 2023, SRS and SCDHEC held STP Cleanup Credit validation meetings in February, May, August, and October. SRS earned 427 validated Cleanup Credits during FY 2023.

3.3.4 Toxic Substances Control Act (TSCA)

SRS complies with Toxic Substances Control Act (TSCA) regulations when storing and disposing of lead, asbestos, and organic chemicals, including polychlorinated biphenyl (PCBs). SRS disposes of routinely generated nonradioactive PCBs at an offsite EPA-approved disposal facility within the regulatory-defined period of one year from the date of generation. SRS made one shipment of PCB waste to offsite hazardous waste facilities in 2023.

SRS also generates PCBs waste contaminated with radionuclides. SRS disposes of low-level radioactive PCB bulk product and remediation waste onsite. PCB waste contaminated with transuranic (TRU) radionuclides requires disposal at WIPP. SRS made three shipments of PCB-TRU waste to WIPP in 2023, disposing of five containers of PCB-TRU waste.

As required by TSCA regulations, SRS must prepare an annual written log by July 1 covering the previous calendar year (January through December). From the written annual log, SRS prepares an annual report to submit to the EPA by July 15 of each year for the preceding calendar year. SRS submitted the 2023 annual report to the EPA for this reporting period on July 8, 2024.

On April 13, EPA Region 4 PCB staff toured SRS and met in person to discuss PCB topics specifically relevant to the Site. This is the second year for this annual dialogue to improve communication and knowledge transfer**.**

3.3.5 South Carolina Infectious Waste Management Regulation

The Site is registered under the SCDHEC Infectious Waste Management Program as a large-quantity generator of infectious waste. SRS contracted with a permitted vendor to pick up infectious waste every four weeks. In 2023, the vendor picked up 13 shipments. Once offsite, the vendor treats and disposes of the waste in accordance with SCDHEC regulations. In 2023, SRS managed all infectious wastes in compliance with state regulations.

3.3.6 Air Quality and Protection

3.3.6.1 Clean Air Act (CAA)

The EPA has delegated regulatory authority to SCDHEC for most types of air emissions. SRS is required to comply with SCDHEC Regulation 61-62, *Air Pollution Control Regulations and Standards*. SRS facilities currently have the following air permits regulating activities on the Site:

- Part 70 Air Quality Operating Permit (TV-0080-0041)
- Ameresco Federal Solutions, Inc. ("Ameresco") Biomass Facilities Permit (TV-0080-0144)
- Surplus Plutonium Disposition Project Construction Permit (TV-0080-0041-C4)
- Synthetic Minor Construction Permit to switch from formic acid to glycolic acid in the DWPF (TV-0080-0041-C4)
- Savannah River National Laboratory 791-A Stack Upgrade to a Potential Impact Category (PIC) 1 Construction Permit (CP-50000078 v.1.0, Air Agency Number 0080-0041)
- National Nuclear Security Administration (NNSA) Savannah River Plutonium Processing Facility (SRPPF) Project Construction Permit (CP-50000085 v.1.0, Air Agency Number 0080-0194)

The CAA considers SRS a "major source" of nonradiological air emissions and, therefore, the Site falls under the CAA Part 70 Operating Permit Program. The Part 70 Operating Permit regulates stationary sources with the potential to emit 5 tons or more per year of any criteria pollutant. Six of the most common air pollutants are ozone precursors, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. These major stationary sources are subject to operating and emission limits, emissions monitoring, and record-keeping requirements.

The EPA sets the National Ambient Air Quality Standards air pollution control standards, and SCDHEC regulates them. The Air Quality Permit requires SRS to demonstrate compliance through air dispersion modeling and by submitting an emissions inventory of air pollutant emissions every three years.

SRS received a renewal to its CAA Part 70 Air Quality Operating Permit (TV-0080-0041), which became effective April 1, 2021. The Site also has four active construction permits (listed at the beginning of this section). The NNSA SRPPF construction permit is not considered colocated with the SRS Title V permit (TV-0080-0041) because SRPPF does not share the same industrial grouping or falls under common control.

3.3.6.2 Accidental Release Prevention Program

The CAA Amendments of 1990, Section 112(r) require any facility that maintains specific hazardous or extremely hazardous chemicals in quantities above specified threshold values to develop a risk management plan. SRS has maintained hazardous and extremely hazardous chemical inventories below each threshold value; therefore, the CAA does not require SRS to develop a risk management plan. Additionally, no reportable 112(r)-related hazardous or extremely hazardous chemical releases occurred at SRS in 2023.

3.3.6.3 Refrigerants

Section 608 of the CAA prohibits knowingly releasing refrigerant during maintenance, service, repair, or disposal of air-conditioning and refrigeration equipment. Refrigerants include ozone-depleting substances and substitute refrigerants such as hydrofluorocarbons (HFCs). Releases of chemical gases widely used as refrigerants, insulating foams, solvents, and fire extinguishers cause ozone depletion or contribute to greenhouse gas emissions. SRS complied with 40 CFR Part 82 in 2023 to ensure it did not knowingly or willfully release refrigerants into the atmosphere.

The EPA issued 40 CFR 84 on October 5, 2021, to implement certain provisions of the American Innovation and Manufacturing (AIM) Act, as enacted on December 27, 2020. The AIM Act mandates phasing down HFCs, which are potent greenhouse gases, by 85% over a period ending in 2036. The requirements of 40 CFR 84 focus on reducing HFC manufacturing and importing. SRS does not manufacture or import HFCs; however, refrigerant-containing appliances and fire-suppression systems contain HFCs, thereby affecting the Site.

The EPA took several regulatory actions in managing HFCs in 2023. The Site provided comments and requested clarifications concerning these actions throughout 2023 and continuing into 2024. The Site provided comment in January 2023 to a proposed 40 CFR 84 Subpart B rulemaking. This subpart set forth dates by which manufactures could manufacture and sell equipment containing HFCs. When this regulation was published as final on October 24, 2023, the term “install” was first defined. (It had not been included in the proposed regulation.) On November 15, 2023, the Site submitted a request for concurrence to the EPA on its interpretation of this term and outlined multiple scenarios where a manufacturer would have provided the initial full charge but the completion of the circuit or the need to add refrigerant once received (due to damage, line loss, or other situations) would be necessary.

The EPA published a proposed rule in the Federal Register on October 19, 2023, which will be a new regulation under 40 CFR 84 Subpart C. This regulation will primarily address leak rate calculations, inspection, and repair requirements for equipment (refrigerant and fire suppression systems) containing HFCs. In December 2023, SRS provided comments on this proposed regulation to ensure its requirements were understandable and did not confuse certified technicians that currently work on ozone-containing systems regulated under 40 CFR 82 Subpart F because these same technicians will perform the work regulated under the future 40 CFR 84 Subpart C.

The Site continues to manage and operate equipment containing HFCs in an environmental and technically sound manner. The environmental regulations do not prohibit storing HFCs when production is being phased down. Actions have been taken to procure and safely store inventories to ensure uninterrupted processes that rely on using equipment containing these HFCs.

Savannah River Tritium Enterprise (SRTE) established a relationship with the Department of Defense (DoD) to identify a pathway to request a Mission-Critical Military End Use (MCMEU) application-specific allowance from the DoD. An MCMEU is the use of a regulated HFC, which has a direct impact on mission capability, by a federal agency responsible for national defense. Under the regulation, the DoD has the authority to issue, manage, and assign MCMEU-specific allowances. MCMEU allowance requests are made annually for the following calendar year (CY) and do not guarantee the availability of the regulated HFC covered. They allow only for the quantity to be manufactured and imported under EPA regulations.

3.3.6.4 Air Emissions Inventory

SCDHEC Regulation 61-62.1, Section III (*Emissions Inventory*), requires SRS to compile an air emissions inventory to locate all sources of air pollution and to define and characterize the various types and amounts of pollutants.

The schedule for submitting the inventory is either every year or every three years, depending upon the emission thresholds in the regulations. SRS reviews emissions against these thresholds annually. SRS has been on the three-year cycle, but as of CY 2022, it anticipates submitting an inventory every year. The inventory for CY 2022 emissions was submitted March 28, 2023. SRS submitted the inventory for CY 2023 emissions on March 21, 2024.

3.3.6.5 National Emission Standard for Hazardous Air Pollutants (NESHAP)

The National Emission Standard for Hazardous Air Pollutants (NESHAP) is a CAA-implementing program that sets air quality standards for hazardous air pollutants, such as radionuclides, benzene, reciprocating internal combustion engines (RICE) emissions, and asbestos.

3.3.6.5.1 NESHAP Radionuclide Program

SRS complies with the NESHAP Radionuclide Program by performing all required inspections and maintaining monitoring systems. Additionally, Subpart H of NESHAP regulations requires SRS to determine and report annually the highest effective radiological dose from airborne emissions to any member of the public at an offsite point. The report is due by June 30 each year. The 2023 annual report was submitted on June 26, 2024. SRS transmitted the *SRS Radionuclide Air Emissions Annual Report for 2022* on June 29, 2023, to the EPA, SCDHEC, and DOE Headquarters.

There were no unplanned radiological releases to the atmosphere during 2023.

SRS estimated the maximally exposed individual effective dose equivalent during 2023 to be less than 1% of the EPA standard of 10 mrem per year. Chapter 6, *Radiological Dose Assessment*, contains details on this dose calculation.

3.3.6.5.2 NESHAP Asbestos Abatement Program

Work involving asbestos at SRS falls under SCDHEC and federal regulations. These activities—which include operation and maintenance repairs, removing asbestos, and demolishing buildings—require an asbestos notification, a renovation permit, or a demolition permit.

SRS issued 258 asbestos notifications and conducted 13 permitted renovations and demolitions involving asbestos in 2023. Table 3-1 summarizes these removals. Certified personnel removed and disposed of friable (easily crumbled or pulverized) and nonfriable asbestos. All disposal sites for nonradiological asbestos waste are SCDHEC-approved landfills for disposing of regulated and nonregulated asbestos.

SRS maintains a SCDHEC Temporary Storage Containment Area License that facilitates removing and disposing of waste generated from nonradiological operations and maintenance, as well as smaller projects. Additionally, SRS maintains a SCDHEC Asbestos Group License that allows Savannah River Nuclear Solutions (SRNS) and Savannah River Mission Completion (SRMC) to operate as long-term, in-house asbestos abatement contractors for DOE-Savannah River.

Table 3-1 Summary of Quantities of Asbestos Materials Removed in 2023

Asbestos Type	Nonradiological, Friable	Nonradiological, Nonfriable	Radiologically Contaminated Asbestos
Linear Feet Disposed	247	431	37
Square Feet Disposed	61	8,705	42
Cubic Feet Disposed	30	10	0
Disposal Site	Three Rivers Solid Waste Authority Landfill	SRS Construction and Demolition Landfill	SRS E-Area Low-Level Waste Facility

3.3.6.5.3 Other NESHAP Programs

In 2013, New Source Performance Standards (NSPS) under NESHAP were added (or became effective) for RICE equipment such as portable generators, emergency generators, and compressors. In 2023, SRS continued to operate in compliance with NSPS and NESHAP standards. The Site also complies with 40 CFR 63 Subpart DDDDD for its boilers.

On December 22, 2022, the EPA removed the RCRA/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) exemption from 40 CFR 63 Subpart GGGGG—Site Remediation NESHAP. SRS applied for, and was granted, a one-year compliance extension and has started the design and procurement processes for a control device to be installed on the M-1 Air Stripper.

3.3.7 Water Quality and Protection

3.3.7.1 Clean Water Act (CWA)

The Site operated pursuant to the following Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) permits in 2023:

- Land Application Permit (Permit No. ND0072125)

- NPDES Permits for Discharge to Surface Waters (Permit No.: SC0000175)—covers Industrial Wastewater discharges
- NPDES General Permit for Stormwater Discharges Associated with Industrial Activities (except construction) (Permit No. SCR000000)
- NPDES General Permit for Stormwater Discharges from Construction Activities (Permit No. SCR100000)
- NPDES Permit for Discharge to Surface Water Permit for Utility Water Discharges (Permit No. SCG250000)
- NPDES General Permit for Discharges from Application of Pesticides (Permit No. SCG160000)
- NPDES General Wastewater Construction Permit (SCG580000)

Ameresco has its own NPDES permit and is not included in the above-mentioned SRS permits.

3.3.7.1.1 National Pollutant Discharge Elimination System (NPDES)

SCDHEC administers the NPDES program, which protects surface waters by limiting releases of pollutants into streams, reservoirs, and wetlands. As the previous section explains, several different SCDHEC-issued permits for different types of discharges to surface water govern SRS operations. A major goal of the NPDES program is to control or eliminate discharges of toxic pollutants, oil, hazardous substances, sediment, and contaminated stormwater to protect the quality of the nation's water. To achieve this goal, SCDHEC requires SRS to prepare the following plans:

- Best Management Practices Plan to identify and control the discharge of hazardous and toxic substances
- Industrial Stormwater Pollution Prevention Plan (SWPPP) to address the potential discharge of pollutants in stormwater
- Spill Prevention, Control, and Countermeasures Plan to minimize the potential for discharges of oil, including petroleum, fuel oil, sludge, and oily wastewater

SRS has one NPDES permit for industrial activities that discharge to surface water (SC0000175). SRS monitors 21 NPDES-permitted industrial wastewater outfalls. Throughout the year, SRS monitors the outfalls across the Site on a frequency specified by the permits. Eight of the outfalls have no current flow and will be removed when the Industrial Wastewater NPDES Permit SC0000175 is renewed. Monitoring frequency requirements vary from as often as once a day at some locations to once a quarter at others, although typically they are conducted once a month. For each outfall, SRS measures physical, chemical, and biological parameters and reports them to SCDHEC in SRS monthly Discharge Monitoring Reports, as the permits require. Chapter 4, *Nonradiological Environmental Program,* provides additional information about NPDES permit-required sampling at SRS to remain compliant.

The following are highlights of the NPDES program at SRS:

- The SRS SWPPP for the 33 SRS industrial stormwater outfalls and related facilities was updated in 2023, following completion of the Comprehensive Site Inspection.
- SCDHEC did not require construction stormwater monitoring on any of the active construction projects underway at SRS during 2023.
- SRS undertook permitting for industrial wastewater treatment facilities pursuant to the CWA and the South Carolina Pollution Control Act. Facilities permitted are broad in scope and include those

involved with groundwater remediation, radioactive liquid waste processing, and nuclear nonproliferation. In 2023, SCDHEC issued the construction permit to consolidate the Effluent Treatment Facility and Saltstone Production Facility control rooms into one and the approval to place it into operation following completion of construction.

- In April 2023, SRS submitted a Discharge Monitoring Report for Industrial Stormwater Outfall H-07B, which indicated it did not monitor discharge during the previous year.

Chapter 4 of this report, *Nonradiological Environmental Monitoring Program,* summarizes the sampling results of both industrial and stormwater outfalls.

In April 2023, SRS received a Notice of Violation (NOV) from SCDHEC for not conducting Whole Effluent Toxicity sampling by February 2023. SRS conducted the sampling and reported the results in its October Discharge Monitoring Report. SRS also completed corrective actions to prevent reoccurrence.

3.3.7.1.2 Section 404(e) Dredge and Fill Permits

SRS wetlands make up 25%, or 48,973 acres, of the Site and account for more than 80% of the wetlands across the entire DOE complex. CWA Section 404 requires SRS to obtain a permit when it will conduct work in a wetland area. The U.S. Army Corps of Engineers (USACE) authorizes development in wetlands through a Nationwide Permit (NWP) program, which is for projects that have minimal impact on the aquatic environment.

SRS reviewed 72 site-use applications for potential wetland impacts in 2023. During this time, SRS permitted the following actions under the NWP program—Scientific Measurement Devices:

- Weir Construction for Wildfire Severity Study
- Cesium Separation Study
- Operations and Maintenance Activities for Environmental Monitoring Station L3R-1A
- Construction of Invasive Mammal Enclosures
- Concrete Pad Installation at Stream Gage Stations
- Operations and Maintenance Activities for Environmental Monitoring Station FM-6
- Operations and Maintenance Activities for Environmental Monitoring Station PB-3
- Rock Installation to Replace Boardwalk for Sampling Well HPZ-003

3.3.7.2 Safe Drinking Water Act (SDWA)

SCDHEC regulates drinking water facilities under the Safe Drinking Water Act (SDWA). SRS uses groundwater sources to supply drinking water to onsite facilities. The A-Area drinking water system supplies most Site areas. Remote facilities, such as field laboratories, barricades, and fire stations, use small drinking water systems or bottled water. SCDHEC requires SRS to collect 10 bacteriological samples each month from the domestic water system that supplies drinking water to most areas at SRS. The Site exceeds this requirement by collecting and analyzing approximately 15 samples each month throughout the system. All 2023 bacteriological samples for the A-Area drinking water system that SRS collected met state and federal drinking water quality standards.

SRS samples the A-Area drinking water system for lead and copper on a three-year cycle. The most recent lead and copper sampling was conducted in 2022. The sampling results met all state and federal drinking water standards. The next sampling will be in 2025.

SCDHEC inspected the SRS A-Area and Advanced Tactical Training Academy (ATTA) drinking water systems in 2023. Both systems received SCDHEC's highest rating of "Satisfactory." It is expected that the A-Area system as well as the three "state" systems (Par Pond Lab, L-Area Fire Station, and Central Sanitary Wastewater Treatment Facility [CSWTF]) will be next inspected in 2025. State systems refer to water systems that SCDHEC has issued Public Water System Operating Permits for and performs compliance inspections and monitoring on but do not meet the federal definition of a public water system because they have fewer than 15 service connections or serve fewer than 25 people 60 or more days a year.

3.3.7.3 Water Withdrawal

The South Carolina Groundwater Use and Reporting Act protects and conserves groundwater resources of the state. The act allows SCDHEC to designate certain geographic areas of the state as Capacity Use Areas, requiring a groundwater withdrawal permit be in place to withdraw or use groundwater equal to or greater than 3 million gallons in any month in these areas. The Western Capacity Use Area comprises all of Aiken, Allendale, Bamberg, Barnwell, Calhoun, Lexington, and Orangeburg counties. As the Site is within the Western Capacity Use Area, it has groundwater withdrawal permits from SCDHEC for systems (water supply, process, and remedial) located in A, B, D, H, S, T, and Z Areas. The act and permits require SRS to report annual water use to SCDHEC. In 2023, SRS groundwater use was within permitted limits.

The South Carolina Surface Water Withdrawal, Permitting Use, and Reporting Act regulates surface water withdrawals. This act applies to anyone withdrawing more than 3 million gallons of surface water during any one month. SRS has a surface water withdrawal permit and reports annual water use to SCDHEC. In 2023, SRS surface water use was within permitted limits.

SRS is participating in the newly formed Lower Savannah-Salkehatchie River Basin Planning Council, which is associated with South Carolina Department of Natural Resources (SCDNR). The council is responsible for developing a comprehensive water usage plan for the basin to ensure current and future needs are met.

3.3.8 Environmental Protection and Resource Management

3.3.8.1 National Environmental Policy Act (NEPA)

The NEPA process identifies the potential environmental consequences of proposed federal activities and the alternatives that support informed and environmentally sound decision-making regarding designing and implementing the proposed activities.

The SRS NEPA program complies with 10 CFR 1021, DOE regulations for compliance with NEPA. SRS initiates the required NEPA evaluation by completing an Environmental Evaluation Checklist (EEC) for new projects or changes to existing ones. SRS uses the EEC to review the proposed action, identify any potential environmental concerns, and determine the appropriate level of NEPA review required for the proposed activity. SRS conducted 913 NEPA reviews of proposed activities in 2023 (Table 3-2). Categorical Exclusion (CX) determinations accounted for more than 92% of completed reviews. The SRS NEPA web page contains additional information on SRS NEPA activities.

Table 3-2 Summary of 2023 NEPA Reviews

Type of National Environmental Policy Act (NEPA) Review	Number
Categorical Exclusion (CX) Determinations[a]	843
"All No" Environmental Evaluation Checklist (EEC) Determinations[a]	17
Previous NEPA Review[a]	48
Environmental Impact Statement (EIS)	2
Supplement Analysis (SA)	2
Interim Action	0
Revised Finding of No Significant Impact (FONSI)	0
Environmental Assessment (EA)	1
Total	**913**

[a] Proposed action that requires no further NEPA action

The following major NEPA reviews were either completed or in progress in 2023:

- **Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) for *Disposal of Decomissioned, Defueled Ex-Enterprise (CVN 65) and Its Associated Naval Reactor Plants* (DOE/EIS-0524).** On June 30, 2023, the Department of the Navy (DON), with DOE as a cooperating agency, announced it had prepared a Final EIS/OEIS to evaluate the potential environmental impacts of alternatives for disposal of the decommissioned and defueled ex-Enterprise (CVN 65) aircraft carrier, including its reactor plants.
- **Record of Decision (ROD) for *Disposal of Decommissioned, Defueled Ex-Enterprise (CVN 65) and Its Associated Naval Reactor Plants* (DOE/EIS-0524).** On September 5, 2023, the DON announced its decision to implement Alternative 3 (dismantlement of the ex-Enterprise at an authorized commercial dismantlement facility) because this alternative safely disposes of the ex-Enterprise, including its hazardous materials, in approximately 5 years compared to the 15 or more years for other analyzed alternatives. Additionally, this alternative will have the lowest greenhouse gas emissions and will be executed at approximately half the cost to the taxpayer compared to the other alternatives.
- **Amended ROD for the Final Supplemental Environmental Impact Statement (EIS) for the *Production of Tritium in a Commercial Light Water Reactor* (DOE/EIS-0288-S1),** which supplements DOE's 1999 Final EIS (DOE/EIS-0288). On September 14, 2023, NNSA amended its June 22, 2016, ROD for the Final Supplemental EIS, which was published in February 2016. NNSA's new decision is to choose the previously analyzed Alternative 4, which assumes that the Tennessee Valley Authority would irradiate up to a total of 5,000 tritium-producing burnable absorber rods every 18 months at the Watts Bar Nuclear Plant using its Watts Bar Unit 1 and 2 reactors.
- **Final Environmental Assessment (EA) for *Commercial Disposal of Savannah River Site Contaminated Process Equipment* (DOE/EA-2154).** On July 20, 2023, DOE announced the availability of DOE/EA-2154, which evaluated the potential impacts from a proposed action to dispose of certain SRS-contaminated process equipment at a commercial low-level waste (LLW)

disposal facility outside of South Carolina, licensed by an NRC Agreement State pursuant to the NRC's regulations for land disposal of radioactive waste.

- **Finding of No Significant Impact (FONSI) on the EA for *Commercial Disposal of Savannah River Site Contaminated Process Equipment* (DOE/EA-2154).** On July 20, 2023, DOE issued a FONSI announcing that, for both alternatives analyzed, the potential environmental impacts of disposing of certain SRS-contaminated process equipment at a commercial LLW disposal facility outside of South Carolina would entail minor impacts and low risks and would not constitute a major Federal action significantly affecting the quality of human environment.
- **Supplement Analysis (SA) for *Centralization and Upgrading of the Sanitary Wastewater System at the Savannah River Site* (DOE/EA-0878-SA-01).** On June 28, 2023, DOE published the SA to include the connection of K Area to the Central Sanitary Wastewater Treatment Facility (CSWTF) and closure of the existing K-Area Wastewater Treatment Plant. DOE concluded that the changes to the project described in the SA did not require a new EA, revised FONSI, or preparation of an EIS. No further NEPA documentation was required.
- **SA for *Domestic Water Supply Upgrades and Consolidation on the Savannah River Site* (DOE/EA-0943-SA-01).** On June 28, 2023, DOE published the SA to include installing a domestic water line to CSWTF and removing a groundwater well from use. DOE concluded that the changes to the project described in the SA did not require a new EA, revised FONSI, or preparation of an EIS. No further NEPA documentation was required.
- **Final Environmental Impact Statement for the *Surplus Plutonium Disposition Program* (Final SPDP EIS) (DOE/EIS-0549).** The SPDP EIS would employ the dilute and dispose strategy to safely and securely dispose of up to 34 metric tons of plutonium that is surplus to the nation's defense needs, using new, modified, or existing facilities at sites across the nation. The 34 metric tons of surplus plutonium covered in the EIS was previously intended for use in fabricating mixed oxide (MOX) fuel. After irradiation in commercial power reactors, the fuel would have been stored pending disposal in a deep geologic repository for spent nuclear fuel. DOE cancelled the MOX project in 2018. NNSA's preferred alternative, the dilute and dispose strategy, also known as "plutonium downblending," includes converting pit and non-pit plutonium to oxide, blending the oxidized plutonium with an adulterant, compressing it, encasing it in two containers, then overpacking and disposing of the resulting contact-handled transuranic (CH-TRU) waste underground in the Waste Isolation Pilot Plant (WIPP) in New Mexico. The approach would require new, modified, or existing capabilities at SRS in South Carolina, Los Alamos National Laboratory (LANL) in New Mexico, the Pantex Plant in Texas, and WIPP. Under the No Action Alternative, up to 7.1 metric tons of non-pit plutonium would be processed at either LANL or SRS. If the processing occurs at LANL, then the resulting plutonium oxide would be transported to SRS. If it occurs at SRS, then the resulting material would remain there. In both cases, the processed material would be diluted, characterized, packaged, and transported as CH-TRU defense waste to WIPP for disposal. The Under Secretary for Nuclear Security and Administrator, NNSA, (NA-1) approved the Final SPDP EIS for release on December 19, 2023.

The following draft was terminated and not included in Table 3-2:

- In October 2023, the South Carolina Army National Guard (SCARNG) concurred with DOE to cancel the action to draft an EA, *Proposal to Permit 750 Acres and New Training Operations at the*

Savannah River Site for Use by the State of South Carolina National Guard, (DOE/EA-1999) due to uncertainty of SCARNG resolving additional requirements imposed by the National Guard Bureau (NGB). DOE will prepare a new document if and when internal SCARNG and NGB issues are resolved.

3.3.8.2 Emergency Planning and Community Right-to-Know Act (EPCRA)/Superfund Amendment Reauthorization Act (SARA) Title III

The Emergency Planning and Community Right-to-Know Act (EPCRA) requires facilities to notify state and local emergency planning entities about their hazardous chemical inventories and to report releases of hazardous chemicals. The Pollution Prevention Act of 1990 expanded the EPCRA-mandated Toxic Release Inventory (TRI) report to include waste management. SRS complies with the applicable EPCRA-reporting requirements and incorporates the applicable TRI chemicals into its pollution prevention programs.

As required by Section 312, Chemical Inventory Reporting of EPCRA, SRS completes an annual Tier II Chemical Inventory Report for all hazardous chemicals exceeding specified quantities present at SRS during the calendar year. The inventory is due by March 1 each year. SRS submitted the 2022 hazardous chemical storage information to state and local authorities on February 28, 2023. The February 2022 report included 87 reportable chemical categories. Due to necessary edits, the 2022 SRS Tier II chemical inventory report was resubmitted on September 28, 2023. The updated September 2022 report included 50 reportable chemical categories. SRS submitted the 2023 report on February 28, 2024. The February 2023 report included 55 reportable chemical categories.

As required by Section 313, Toxic Chemical Release Inventory of EPCRA, SRS must file an annual TRI facility report each year by July 1 for the previous year. SRS calculates chemical releases to the environment for each regulated chemical and reports to the EPA those above each threshold value. SRS submitted the annual report for this reporting period in June 2024. SRS submitted the 2022 annual report on June 28, 2023, for each of the following regulated chemicals: ammonia, chromium compounds, lead compounds, mercury compounds, naphthalene, nickel, nitrate compounds, nitric acid, and sulfuric acid. Details are on the EPA TRI Program website.

3.3.8.3 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

The objective of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is to provide federal control of pesticide distribution, sale, and use. The EPA must register all pesticides used in the United States. Use of each registered pesticide must be consistent with directions contained on the package’s label. SRS must comply with FIFRA and, on a state level, the South Carolina Pesticide Control Act.

SRS must also comply with the South Carolina NPDES General Permit for Discharges From Application of Pesticides. This permit authorizes applying pesticides to surface water according to limitations set forth in the NPDES general permit.

SRS procedures implement the FIFRA requirements for pesticide application, application recordkeeping, storage, and disposing of empty containers and excess pesticides. General-use pesticides (ready-to-use products that are available for public use) are applied at SRS according to the label instructions. SRS applies restricted-use pesticides on a limited basis, following label requirements and using state-certified pesticide applicators. SRS generates and maintains application records for general-use and restricted-use pesticides for each application.

3.3.8.4 Endangered Species Act (ESA)

Since 1973, the Endangered Species Act (ESA) has protected fish, wildlife, and plant species in danger of, or threatened with, extinction and strives to conserve the ecosystems upon which they depend. Several federally listed animal species exist at SRS, including the wood stork, the red-cockaded woodpecker (RCW), the shortnose sturgeon, and the Atlantic sturgeon, as well as plant species, including the pondberry and the smooth coneflower. Additionally, SRS is home to the gopher tortoise, a reptile species the state of South Carolina lists as endangered.

SRS is the only DOE site to conduct experimental translocations of gopher tortoises. The Site captures, transports, and releases tortoises to other locations. A study by the University of Georgia's Savannah River Ecology Laboratory (SREL) demonstrated that long-term (12 months) penning was an effective way to promote site fidelity, dramatically increasing the number of tortoises that settled into the release site. Conservation organizations use protocols developed from these SRS translocation studies to establish viable populations elsewhere in the species' range.

South Carolina's State Wildlife Action Plan of 2015 recognizes additional plants and animals not on the federal list to encourage conservation of these species. Those found on SRS include the Carolina gopher frog and the southern hognose snake, as well as numerous other animals and plants considered species of conservation concern. South Carolina lists gopher frogs as endangered, with SRS being one of two population strongholds in the state. The United States Forest Service-Savannah River (USFS-SR) considers these species sensitive. (The U.S. Fish and Wildlife Service [USFWS] lists some as at-risk species.) and evaluates potential impacts to them when developing forest management plans. SREL's head-starting program aims to increase survival of captive-bred gopher frogs released into the wild, and wetland assessments define ideal habitats for the frogs and aid informed management decisions. In 2023, USFS-SR, SREL, and SCDNR partnered to restore wetland and upland habitats to maintain viable gopher frog populations onsite.

While the bald eagle is no longer federally listed, the Bald and Golden Eagle Protection Act protects nesting bald eagles and wintering golden eagles. Bald eagles nest on SRS and are year-round residents; golden eagles use SRS as wintering habitat. In 2023, one golden eagle was recorded at SRS. The mid-winter bald eagle survey shows an active nest site and eight bald eagles present on both Par Pond and L Lake.

The USFS-SR actively manages more than 65,000 acres in the RCW habitat management areas. It further improved RCW habitat in 2023 by prescribed burning of 18,203 acres and thinning forests. It also removed brush and small hardwoods from more than 590 acres through mechanical or chemical treatments. Restoring the natural fire regime improves native plant diversity in the understory, which enhances the native longleaf pine and wiregrass communities. Additionally, USFS-SR personnel insert artificial cavities into living pine trees to increase the number of available cavities for roosting and nesting. From 1985 through 2023, active RCW clusters increased from 5 to 160 due to successful habitat restoration. As of 2023, the USFS-SR managed 185 cluster sites for the RCW, with an average expected population growth rate of 5% each year. The average growth rate over the past five years at SRS has been an outstanding average of 6%. In addition to managing endangered wildlife species, the USFS-SR actively manages two populations of the federally endangered plant pondberry and four populations of the federally threatened plant smooth coneflower.

The USFS-SR continues to perform biological evaluations to determine whether forest project plans are likely to cause beneficial, insignificant, or discountable effects to proposed, endangered, threatened, sensitive, and at-risk plant and animal species.

3.3.8.5 Migratory Bird Treaty Act (MBTA)

The MBTA prohibits taking, possessing, importing, exporting, transporting, selling, purchasing, bartering, or offering for sale any migratory bird or its eggs, parts, and nests, except as the U.S. Department of the Interior authorizes under a valid permit. To support migratory bird monitoring, a one-day bird count—the Audubon Christmas Bird Count—is conducted annually in December. The 2023 SRS count, which was hosted by the USFS-SR, found 87 species with more than 13,500 individual birds observed. The Audubon Christmas Bird Count has been conducted annually in the Western Hemisphere since 1900.

In 2023, SRS conducted walkdowns of 85 bird nests at 73 locations for MBTA compliance. The walkdowns identified 57 active nests with incubating eggs or chicks and 14 nests without eggs or chicks. The active nests belonged to Northern Mockingbirds (*Mimus polyglottos*), Barn Swallows (*Hirundo rustica*), House Finches (*Haemorhous mexicanus*), Common Grackles (*Quiscalus quiscula*), Mourning Doves (*Zenaida macroura*), Killdeer (*Charadrius vociferus*), Eastern Bluebird (*Sialis sialis*), Carolina Wrens (*Thryothorus ludovicianus*), Eastern Phoebe (*Sayornis phoebe*), and Eastern Kingbirds (*Tyrannus tyrannus*).

SRS allowed active nests to complete the nesting cycle and barricaded them when deemed appropriate. SREL relocated one active nest and removed one active nest in active work areas under an USFWS permit authorization.

Also in 2023, the USFS-SR found an Osprey (*Pandion haliaetus*) nest on a platform staff built in 2014. The Osprey nesting platform was constructed to deter power pole conflicts, which occurred before platform construction. This marked the eighth year that Ospreys nested on the platform after their nest had been moved from a power pole at the L-Lake Dam.

3.3.8.6 Invasive Species Management

The purpose of Executive Order 13751, *Safeguarding the Nation from the Impacts of Invasive Species,* is to prevent the introduction and spread of invasive species, and to support efforts to eradicate and control established invasive species. The Site is surveying invasive plant and animal species and taking steps to control their populations.

Many of the former home and community sites that area residents left more than 70 years ago to allow for the government to construct SRS have since become primary sources of non-native invasive plant species (NNIPS). Escaping cultivation and containment for decades, aggressive plant species such as Chinese privet (*Ligustrum sinensis*), wisteria (*Wisteria sinensis*), chinaberry (*Melia azedarach*), Japanese climbing fern (*Lygodium japonicum*), and kudzu (*Pueraria montana*) now threaten native species onsite. Invasive species such as these are a major threat to national forests in the 21st century. NNIPS contribute to long-term ecosystem degradation due to the loss of diversity and their direct competition with native species. They also provide unwanted ladder fuels that can increase fire intensity during prescribed burning or wildfire.

Before 2012, there had been no sitewide effort to document NNIPS as part of the watershed prescription process. However, recently conducted plant surveys include recording observations and locations for NNIPS. This information is now being captured geospatially to include in compartment stand maps and geographic information system layers for management planning. Historical records and image interpretations from photos and maps, compartment folders, and stand exam data helped identify developed openings, old home sites, and community places (churches, schools, cemeteries) that may contain robust sources of introduced NNIPS communities.

The USFS-SR conducts annual botanical surveys of 5,000 to 7,000 acres, which include 40-50 species of plants considered to be non-native and invasive. The USFS-SR chemically treats an average of 72 acres each year to control across target areas that either contain former homesites and community areas or that are close to RCW colony sites. When a forest stand is cut and regenerated, the USFS treats NNIPS populations discovered as part of the site preparation for replanting. In 2023, the USFS-SR applied chemical and mechanical treatment, using contracts and internal resources, to 124 acres of NNIPS infestations to support RCW habitat improvement. Additionally, USFS-SR employees treated nine new infestations as part of early detection and rapid response efforts. All 2022 treatments were monitored in 2023 to assess treatment efficacy and retreatment needs.

Wild hogs are an invasive species in the United States and abroad. As of 2016, the U.S. Department of Agriculture estimated that in the United States alone, these animals cost $1.5 billion each year in damages and control costs. At SRS, wild hogs present safety hazards due to vehicle collisions and disease transmission. They cause ecological impacts by negatively affecting water quality, disturbing soil, and constantly threatening rare and endangered plant populations. Two USFS-SR wildlife technicians are dedicated to oversee contractors who trap and remove wild hogs onsite. In 2023, the USFS-SR removed 1,490 hogs primarily through baiting and trapping. Additionally, the USFS-SR and the Southern Research Station, part of the USFS Research and Development organization, collaborate with SREL to further wild hog control options.

3.3.8.7 National Historic Preservation Act (NHPA)

The NHPA requires all federal agencies to consider the impacts to historic properties in all their undertakings. SRS ensures it complies with the NHPA through several processes. For example, SRS uses the Site Use Program, the *Cold War Programmatic Agreement,* and *SRS's Cold War Built Environment Cultural Resource Management Plan* to ensure it is complying with NHPA. The Savannah River Archaeological Research Program (SRARP) guides DOE in managing its cultural resources to ensure it fulfills its compliance commitments. SRARP also serves as a primary organization to investigate archaeological research problems associated with cultural development within the Savannah River valley. DOE uses the results to manage more than 2,000 known archaeological sites at SRS.

SRARP evaluates and documents all locations DOE is considering for activities, such as construction, to ensure that they do not affect archaeological or historic sites. In 2023, SRARP investigated 266 acres onsite for cultural resource management, including conducting 39 field surveys and testing. It recorded 7 newly discovered sites and revisited 11 previously recorded sites.

3.3.9 Release Reporting

Releases to the air, water, and land must comply with legally enforceable licenses, permits, regulations, or DOE Orders. SRS reports routine releases through implementation of the environmental monitoring program. If an unpermitted release to the environment of an amount greater than or equal to a Regulatory Limit or Reportable Quantity (RQ) of a substance (including radionuclides) occurs, multiple regulations—

such as the Emergency Planning and Community Right-to-Know Act (EPCRA); the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the Clean Water Act (CWA); and the Clean Air Act (CAA)—require SRS to send a notice to either the National Response Center or applicable state agencies, or both. SRS did not have any releases exceeding the CERCLA RQ in 2023.

3.3.10 Permits

SRS had 613 construction and operating permits in 2023 that specified operating levels to each permitted source. Table 3-3 identifies the number of permits by the permit type.

Table 3-3 SRS Permits

Type of Permit	Number of Permits
Air	6[a]
U.S. Army Corps of Engineers (USACE—Nationwide Permits)	8
Asbestos Demolition Licenses/Abatement Licenses/Temporary Storage of Asbestos Waste Notices	276
Asbestos Abatement Group License	1
Asbestos Temporary Storage of Waste License	1
Domestic Water	101
Industrial Wastewater Treatment	57
National Pollutant Discharge Elimination System (NPDES) Permits	9[b]
Construction Stormwater Grading Permit	10
Resource Conservation and Recovery Act (RCRA) Hazardous and Mixed Waste	1
Solid Waste	3
Underground Storage Tank	7
Sanitary Wastewater	95
South Carolina Department of Health and Environmental Control (SCDHEC) 401	0
SCDHEC Infectious Waste Registration	1
SCDHEC Bureau of Drug Control Controlled Substances Registration	2
Nondispensing Drug Outlet License	4
SCDHEC Navigable Waters	0
Underground Injection Control	10
Scientific Collecting Permits	7[c]
Groundwater Withdrawal	13
Surface Water Withdrawal	1
Total	**613**

[a] This count includes the Ameresco Clean Air Act permit (TV-00800-144) and the noncolocated Savannah River Plutonium Processing Facility construction air permit (CP-50000085 v.1.0, Air Agency Number 0080-0194).
[b] This count includes the Ameresco National Pollutant Discharge Elimination System permit (SC0049107).
[c] This count includes scientific collecting permits from the U.S. Fish and Wildlife Service, the U.S. Geological Survey, the South Carolina Department of Natural Resources, and the Georgia Department of Natural Resources. Savannah River Nuclear Solutions and the Savannah River Ecology Laboratory maintain three and four permits, respectively. This count does not include freshwater fishing licenses assigned to individuals.

The EPA's Enforcement and Compliance History Online (ECHO) database contains additional information on SRS permitting and compliance. ECHO identifies the following SRS facilities:

Enforcement and Compliance History Online (ECHO) Facility Identification	Facility Registry Service (FRS) Identification	Program Area
DOE AMERESCO Savannah River Site Biomass Cogen	110046328693	Air/Water
DOE/Westinghouse Savannah River Company (WSRC) Savannah River Site	110001120000	Resource Conservation and Recovery Act (RCRA)
Savannah River Site	110013700904	Air/Water
U.S. DOE Savannah River Site	110006909248	Air/Water

3.4 MAJOR DOE ORDERS FOR ENVIRONMENTAL COMPLIANCE

SRS complies with the following major DOE Orders in addition to state and federal regulations for environmental compliance:

- DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*—This order requires DOE to provide oversight related to protecting the public, workers, environment, and national security assets effectively through continuous improvement.
- DOE Order 231.1B, *Environment, Safety and Health Reporting*—This order requires the Site to prepare this *SRS Environmental Report*.
- DOE Order 232.2, *Administrative Change 1, Occurrence Reporting and Processing of Operations Information*—This order requires DOE to use the designated system called Occurrence Reporting and Processing System (ORPS). ORPS ensures that the DOE complex and the NNSA are informed of events that could adversely affect the health and safety of the public and workers, the environment, DOE missions, or DOE's credibility.
- DOE Order 414.1D, *Quality Assurance*—See Chapter 8, *Quality Assurance,* of this report.
- DOE Order 435.1, *Change 2, Radioactive Waste Management*—See Section 3.3.1 in this chapter of this report.
- DOE Order 436.1A*, Departmental Sustainability*—See Chapter 2, *Environmental Management Systems,* of this report.
- DOE Order 458.1, *Administrative Change 4, Radiation Protection of the Public and the Environment*—See Chapter 5, *Radiological Environmental Monitoring Program*, and Chapter 6, *Radiological Dose Assessment,* of this report.

3.5 REGULATORY SELF-DISCLOSURES

SRS did not make any regulatory disclosures in 2023.

3.6 ENVIRONMENTAL AUDITS

The Federal Energy Regulatory Commission (FERC), SCDHEC, and the EPA inspected and audited the SRS environmental program for regulatory compliance. Table 3-4 summarizes the results of the 2023 audits and inspections. During 2023, SRS conducted multiple internal audits for various facility programs throughout the Site. These reviews help identify opportunities for continuous improvement.

Table 3-4 Summary of 2023 External Agency Audits and Inspections of the SRS Environmental Program and Results

Audit/Inspection	Action	Results
632-G Construction and Demolition (C&D) Landfill and 288-F Ash Landfill Inspections	South Carolina Department of Health and Environmental Control (SCDHEC) conducted four quarterly inspections of the 632-G and 288-F landfills.	No compliance issues or violations resulted from the quarterly inspections.
Federal Energy Regulatory Commission (FERC) Inspection	FERC performed the annual inspection of PAR Pond Dam and Steel Creek Dam, and Ponds 2, 4, and 5 in May.	FERC visually inspected the dams and found no conditions indicating a concern for the immediate safety and permanence of the structures. FERC noted SRS adequately operates and maintains the facility, and the dams were in satisfactory condition based on visual inspection.
Resource Conservation and Recovery Act (RCRA) Comprehensive Groundwater Monitoring Evaluation	SCDHEC inspected groundwater facilities associated with the F- and H-Area Seepage Basins, M-Area Settling Basin, Metallurgical Laboratory Basin, Mixed Waste Management Facility, and Sanitary Landfill on May 9. SCDHEC also completed a records review of groundwater-related files.	The inspection noted no problems or concerns.
SCDHEC Sanitary Survey of SRS Drinking Water Systems	SCDHEC inspects the wells, tanks, and treatment systems supporting the primary SRS A-Area Drinking Water system biannually. SCDHEC also inspects four of the smaller SRS Drinking Water systems (Advanced Tactical Training Academy [ATTA]) Range, Central Sanitary Wastewater Treatment Plant, PAR Pond Lab, and L-Area Fire Station) on either a three- or a five-year rotation, depending on the classification of the system. SCDHEC conducted Sanitary Surveys of the SRS A-Area and ATTA Drinking Water systems in 2023.	Both SRS Drinking Water systems inspected in 2023 received SCDHEC’s highest rating of “Satisfactory.”
Interim Sanitary Landfill and the F-Area Railroad Crosstie Pile Landfill Postclosure Inspection	SCDHEC conducted an annual review of the closed landfills in September.	SCDHEC identified no compliance issues.

Table 3-4 Summary of 2023 External Agency Audits/Inspections of the SRS Environmental Program and Results (continued)

Audit/Inspection	Action	Results
RCRA Compliance Evaluation Inspection (CEI)	SCDHEC conducted the unannounced RCRA CEI for fiscal year (FY) 2023 from March 15-16, 2023. The Environmental Protection Agency (EPA) and SCDHEC conducted the unannounced RCRA CEI for FY 2024 on October 30 to November 1, 2023.	The inspectors identified container management deficiencies at two facilities during the FY 2023 inspection, which were corrected before receiving SCDHEC's CEI Report. The inspectors identified container management deficiencies during the FY 2024 inspection. Subsequently, Savannah River Mission Completion submitted a letter responding to the deficiencies and is awaiting a response from SCDHEC.
Underground Storage Tank (UST) CEI	SCDHEC inspected 17 USTs on May 8, 2023.	SCDHEC identified no issues.
Saltstone Disposal Facility (SDF), identified in the permit as Z-Area Saltstone Solid Waste Landfill, Inspections	SCDHEC performed monthly inspections of the SDF. This included reviewing facility procedures and performing walkdowns of the SDF.	SCDHEC identified no issues.
National Pollutant Discharge Elimination System (NPDES) 3560 CEI	SCDHEC completed an inspection of four wastewater treatment plants.	SCDHEC identified no compliance issues.
Industrial Wastewater Construction Permit Inspection	SCDHEC performed a final inspection of the consolidated control room for Effluent Treatment Facility and Saltstone Production Facility on November 6, 2023.	SCDHEC issued the approval to place the consolidated control room in operation.

3.7 KEY FEDERAL LAWS COMPLIANCE SUMMARY

The Code of Federal Regulations implements federal laws and state regulations that a federal agency has delegated to the state. Additional information is on the EPA website. Table 3-5 summarizes SRS's 2023 compliance status with applicable key federal environmental laws.

Table 3-5 Status of Key Federal Environmental Laws Applicable to SRS

Regulatory Program Description	2023 Status
The Atomic Energy Act/DOE Order 435.1 grants DOE the authority to develop applicable standards (documented in DOE Orders) to protect the public, workers, and environment from radioactive materials.	The fiscal year (FY) 2022 Performance Assessment (PA) and Composite Analysis (CA) annual reviews for SRS showed that radioactive low-level waste (LLW) operations were within the required performance envelope and the facilities continued to comply with performance objectives.
The Clean Air Act (CAA) establishes air quality standards for criteria pollutants, such as sulfur dioxide and particulate matter, and for hazardous air emissions, such as radionuclides and benzene.	SRS received a renewal to its CAA Air Quality Operating Permit (TV-0080-0041), which became effective April 1, 2021. The Site previously operated under an application shield the South Carolina Department of Health and Environmental Control (SCDHEC) granted in September 2007, as its previous Title V operating permit expired March 31, 2008; the Ameresco permit (TV-0080-0144); and other applicable CAA regulatory requirements.
The Clean Water Act (CWA) regulates liquid discharges at outfalls (for example, drains or pipes) that carry effluent to streams (National Pollutant Discharge Elimination System [NPDES], Section 402). It also regulates dredge and fill operations in Waters of the United States (Section 404) and water quality for those activities (Water Quality Criteria, Section 401).	SRS received a Notice of Violation (NOV) for failing to comply with a reporting requirement of its NPDES Permit. SRS completed corrective actions. See Section 3.3.7.1.1 and 3.8.
The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) establishes criteria for liability and compensation, cleanup, and emergency response requirements for hazardous substances released to the environment.	SRS continues to comply with CERCLA and the requirements of the Federal Facility Agreement (FFA).
The Emergency Planning and Community Right-to-Know Act (EPCRA), also referred to as Superfund Amendments and Reauthorization Act (SARA), Title III, requires SRS to report hazardous substances and their releases to the Environmental Protection Agency (EPA), state emergency response commissions, and local planning units.	SRS continues to comply with all reporting and emergency planning requirements.
The Endangered Species Act (ESA) prevents the extinction of federally listed endangered or threatened species and conserves critical habitats.	SRS continues to protect these species and their habitats as outlined in the Natural Resource Management Plan for SRS.

Table 3-5 Status of Key Federal Environmental Laws Applicable to SRS (continued)

Regulatory Program Description	2023 Status
The FFA for SRS between the EPA, DOE, and SCDHEC integrates CERCLA and Resource Conservation and Recovery Act (RCRA) requirements to achieve a comprehensive remediation strategy, set annual work priorities, and establish milestones to clean up and close the high-level radioactive waste tanks at SRS.	SRS continues to meet all the milestones contained within the FFA (51 milestones met on or ahead of schedule in FY 2023).
The Federal Facility Compliance Act (FFCA) requires federal agencies to comply with federal, state, and local solid and hazardous waste laws.	SRS continues to comply with the FFCA.
The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates restricted-use pesticides through a state-administered certification program.	SRS continues to comply with FIFRA requirements.
The Migratory Bird Treaty Act (MBTA) protects migratory birds, including their eggs and nests.	SRS continues to comply with the MBTA.
The National Defense Authorization Act (NDAA) allows the Secretary of Energy, in consultation with the Nuclear Regulatory Commission (NRC), to determine that certain waste from reprocessing is not high-level radioactive waste requiring deep geologic disposal if it meets the criteria set forth in Section 3116. Section 3116(b) addresses monitoring by the NRC and SCDHEC.	SRS provided routine documents as requested by the NRC to support monitoring SRS facilities in accordance with NDAA 3116(b). The NRC did not conduct any onsite monitoring observation visits to F-Tank Farm, H-Tank Farm, but did visit the Saltstone Disposal Facility. Additionally, several virtual meetings were held between the NRC, DOE, and DOE contractor staff.
The National Environmental Policy Act (NEPA) requires federal agencies to identify potential environmental consequences of proposed federal actions and alternatives to ensure informed, environmentally sound decision-making regarding design and implementing programs and projects.	SRS continues to comply with NEPA.
The National Historic Preservation Act (NHPA) protects historical and archaeological sites.	The Savannah River Archaeological Research Program (SRARP) provides cultural resource management guidance to DOE to ensure continued compliance with the NHPA.
RCRA governs hazardous and nonhazardous solid waste management and underground storage tanks (USTs) containing petroleum products, hazardous materials, and wastes. RCRA also regulates universal waste and recyclable used oil.	SRS continues to manage hazardous waste, nonhazardous solid waste, and underground storage tanks in compliance with RCRA. SRS is performing groundwater monitoring and corrective actions at the F- and H-Area Hazardous Waste Management Facilities (HWMFs), the M-Area and Metallurgical Laboratory HWMFs, the Sanitary Landfill, and the Mixed Waste Management Facility and performs surveillance and maintenance at closed HWMFs in accordance with the SRS RCRA Permit Renewal.

Table 3-5 Status of Key Federal Environmental Laws Applicable to SRS (continued)

Regulatory Program Description	2023 Status
The Safe Drinking Water Act (SDWA) protects drinking water and public drinking water resources.	All drinking water samples of the primary SRS drinking water system (A-Area Loop) taken in 2023 met drinking water quality standards. The Advanced Tactical Training Academy (ATTA) drinking water system also met drinking water standards.
The Toxic Substances Control Act (TSCA) regulates polychlorinated biphenyls (PCBs), radon, asbestos, and lead, and requires users to evaluate and notify the EPA when they use new chemicals and when significant new uses of existing chemicals occur.	SRS manages all regulated materials in compliance with TSCA requirements.

3.8 ENVIRONMENTAL COMPLIANCE SUMMARY

The Savannah River Site is committed to safe, efficient, and environmentally compliant operations. SRS was not involved in any environmental lawsuits during 2023. In April 2023, SRS received a Notice of Violation (NOV) for not conducting Whole Effluent Toxicity sampling by February 2023. SRS conducted the sampling and reported the results in its October Discharge Monitoring Report. SRS also completed corrective actions to prevent reoccurrence. Table 3-6 summarizes the NOVs and Notices of Alleged Violation (NOAVs) SRS received from 2019–2023.

Table 3-6 NOV/NOAV Summaries, 2019–2023

	Notice of Violation (NOV)/Notice of Alleged Violation (NOAV)				
Program Area	**2019**	**2020**	**2021**	**2022**	**2023**
Clean Air Act (CAA)	0	0	0	0	0
Clean Water Act (CWA)	1	1	0	0	1
Resource Conservation and Recovery Act (RCRA)	0	0	0	0	0
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	0	0	0	0	0
Others	0	0	0	0	0
Total	**1**	**1**	**0**	**0**	**1**

Chapter 4: **Nonradiological Environmental Monitoring Program**

The purpose of the Savannah River Site (SRS) Nonradiological Environmental Monitoring Program is twofold: it confirms the Site is complying with state and federal regulations and permits, and it monitors any effects SRS has on the environment, both onsite and offsite. SRS monitors permitted point-source discharges from onsite facilities for nonradiological parameters to ensure it is complying with regulations and permit requirements. SRS collects and analyzes environmental media such as air, water, sediment, and fish for nonradiological parameters to evaluate the effect of Site operations on the environment.

2023 Highlights

Effluent Releases

- Nonradiological effluent releases for all categories except industrial wastewater met permit limits and applicable standards.
- SRS reported only two exceptions out of 2,328 analyses at SRS National Pollutant Discharge Elimination System (NPDES) industrial wastewater outfalls, a greater than 99% compliance rate.
- All SRS industrial stormwater outfalls under the South Carolina general industrial stormwater permit were compliant.

Onsite Drinking Water

All SRS drinking water systems complied with South Carolina Department of Health and Environmental Control and U.S. Environmental Protection Agency water quality standards.

Surveillance Program

- Due to SRS's high rate of compliance, industrial wastewater and industrial stormwater discharges are not significantly affecting the water quality of onsite streams and the Savannah River.
- Sediment results from SRS streams, stormwater basins, and the Savannah River were consistent with the background control locations and were comparable with historical levels.
- Samples of fish flesh were collected from the Savannah River and results were consistent with historical levels.

4.1 INTRODUCTION

Environmental monitoring programs at the Savannah River Site (SRS) examine both radiological and nonradiological constituents that Site activities could release into the environment. This chapter summarizes nonradiological monitoring at SRS. Chapter 5, *Radiological Environmental Monitoring Program,* discusses the radiological monitoring.

The SRS Nonradiological Environmental Monitoring Program collects and analyzes samples from numerous locations throughout SRS and the surrounding area. The program has two focus areas: 1) effluent monitoring, and 2) environmental surveillance. The objective of the effluent monitoring program is to demonstrate the Site is complying with permits, and the focus of the environmental surveillance program is to assess the environmental impacts of Site operations on the surrounding area. SRS determines sampling frequency and analyses based on permit-mandated monitoring requirements and federal regulations.

Chapter 4—Key Terms

Effluent *is a release to the environment of treated or untreated water or air from a pipe or a stack. Liquid effluent flows into a body of water, such as a stream or lake. Airborne effluent (also called emission) discharges into the air.*

Environmental surveillance *is the collection of samples beyond the effluent discharge points and from the surrounding environment.*

Outfall *is a place where treated or untreated water flows out of a pipe or ditch.*

SRS conducts nonradiological environmental monitoring on the following categories:

- Atmospheric (airborne emissions and precipitation with a special focus on mercury deposition)
- Water (wastewater, stormwater, sludge, onsite drinking water, and river and stream water quality)
- Sediment for rivers, streams, and stormwater basins
- Fish

Figure 4-1 shows the types and typical locations of the nonradiological sampling SRS performs. Influenced sampling media is media that Site operations could impact. Uninfluenced sampling media is media that Site operations would not likely impact, for example, sediment upriver of Site facilities.

Section 8.4, *Environmental Monitoring Program QA Activities,* and Section 8.5, *Environmental Monitoring Program QC Activities,* summarize the quality assurance (QA) and quality control (QC) practices that support the sampling and analysis reported in this chapter. Appendix Table B-1 of this document summarizes the nonradiological surveillance sampling media and frequencies.

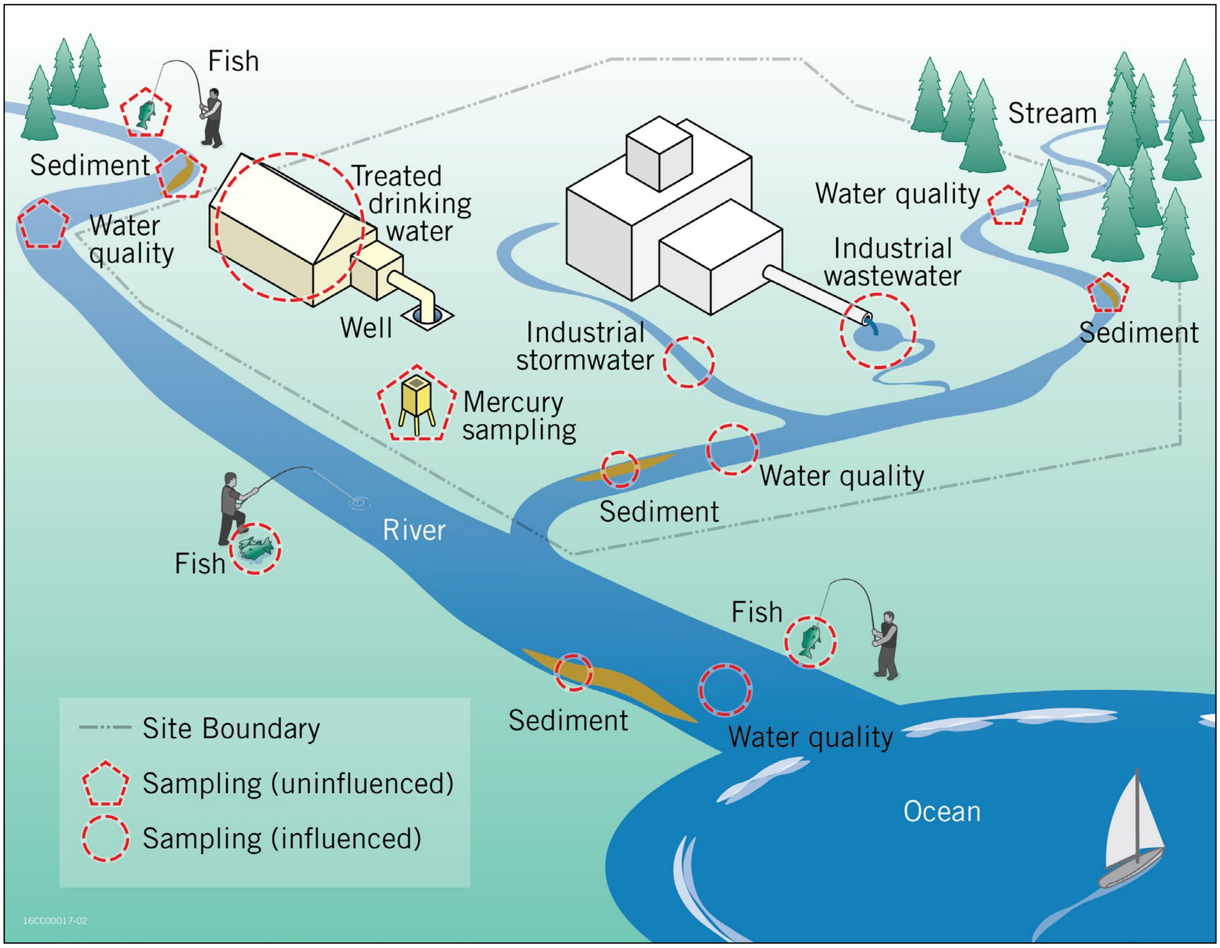


Figure 4-1 Types and Typical Locations of Nonradiological Sampling

4.2 CALCULATED AIR EMISSIONS

Airborne contaminants can present a risk to public health and the environment. Thus, identifying and quantifying these contaminants is essential to a nonradiological monitoring program. The South Carolina Department of Health and Environmental Control (SCDHEC) regulates nonradioactive air pollutant emissions from SRS sources. The regulations list pollutants, compliance limits, and the analytical methods or test procedures approved to demonstrate compliance.

SRS uses nonradioactive volatile chemicals (gasoline and toluene), fuels, and combustion products that can adversely affect the environment if released into the air in sufficient quantities. However, the Site uses most of these materials in very small quantities, and the environmental impact from their potential release is negligible. Due to the nature and quantity of potential air emissions, regulators do not require SRS to sample or monitor the ambient air for chemical pollutants. Following SCDHEC requirements, SRS uses process data to calculate emissions.

Many of the applicable regulatory standards are source-dependent, meaning they are applicable to certain types of industries, processes, or equipment. The SCDHEC-issued Title V operating permit provides the source-specific limits for operating facilities, source sampling, testing, monitoring, and reporting frequency. SRS demonstrates it is complying with these regulations by performing air dispersion modeling and submitting to SCDHEC an emissions inventory of air pollutant emissions. SRS uses SCDHEC- and U.S. Environmental Protection Agency (EPA)-approved calculations that include source-operating parameters—such as operating hours, process throughput, and EPA-approved emission factors—to determine facility source emissions. SRS then compares the total actual annual emissions for each source to the emission limits contained in applicable permits. Chapter 3, *Compliance Summary*, Section 3.3.6.4, *Air Emissions Inventory,* discusses emissions reporting.

4.3 WATER MONITORING

SRS nonradiological water monitoring includes collecting water (wastewater, stormwater, sludge, drinking water, and surface water [river and stream]) and sediment samples as well as performing field measurements on various water sources onsite and from the Savannah River. The sample results enable SRS personnel to evaluate whether there is long-term buildup of pollutants downstream of discharge points and determine whether SRS is complying with permit requirements. SRS also collects and analyzes fish from the Savannah River to evaluate metal uptake in the flesh. This section does not discuss the results of SRS groundwater monitoring, as Chapter 7, *Groundwater Management Program,* covers this information.

4.3.1 Wastewater, Stormwater, and Sludge Monitoring

SRS monitors nonradiological liquid discharges to surface waters through the National Pollutant Discharge Elimination System (NPDES) program, as mandated by the Clean Water Act. Nonradiological surface water monitoring primarily consists of sampling discharges (industrial wastewater and industrial stormwater) associated with SRS NPDES-permitted outfalls. The NPDES permit program controls water pollution by regulating point sources that discharge pollutants into Waters of the United States.

SCDHEC administers the NPDES permit program and is responsible for permitting, compliance tracking, monitoring, and enforcing the program. The permits SCDHEC issues to SRS provide specific requirements for sampling locations, collection methods, analytes required at an individual outfall, monitoring frequency, permit limits for each analyte, and analytical and reporting methods.

SRS collects NPDES samples in the field according to 40 Code of Federal Regulations (CFR) 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants*. This document lists specific methods for sample collection and preservation and acceptable analytical methods for the type of pollutant.

A Refrigerated Sampler Allows for Remote Temperature Verification.

4.3.1.1 Wastewater

SRS monitored 21 industrial wastewater outfalls in 2023 for physical and chemical properties, including flow, dissolved oxygen, acidity (pH), temperature, ammonia, biochemical oxygen demand, fecal coliform, metals, oil and grease, volatile organic compounds, and total suspended solids (TSS). Figure 4-2 shows these locations. The permit specifies how often SRS is to monitor the outfalls; the type of process water and its treatment determine the frequency (daily, weekly, monthly, or quarterly). SRS collected either grab samples (individual samples collected all at one time) or composite samples (samples collected over a specific period, typically 24 hours). The permit states how SRS is to operate when collecting samples to guarantee the integrity of the sample, and results of the samples are expected to not exceed minimum and maximum values. If an analytes result is lower than the permitted minimum value, or higher than the permitted maximum value, a permit limit exceedance occurs. An exceedance could potentially result in a Notice of Violation (NOV), which is a formal response from the state requiring certain steps to correct the violations. Also, the permit specifies how samples are to be collected, and if SRS deviates from those methods i.e. equipment failure, water treatment failure, etc. a permit violation can occur. To improve sample collection methods and mitigate potential permit infractions, SRS has continued to utilize new technology to more efficiently collect samples and improve QA and QC methods. For example, a refrigerated sampler coupled with a modem has allowed personnel to verify the sample temperature and communicate with the equipment by remote control. In addition, SRS collected QC samples as an internal check to ensure representative data. Section 8.5, *Environmental Monitoring Program QC Activities,* summarizes the QC sample results.

SCDHEC assesses the SRS NPDES Industrial Wastewater program during Comprehensive Evaluation Inspections or Comprehensive Sample Inspections. The evaluation includes discharge sampling; records and procedures review; personnel interviews; and outfall, treatment facility, and land application site inspections. SCDHEC did not conduct any inspections in 2023.

4.3.1.1.1 Wastewater Results Summary

SRS reports NPDES industrial wastewater analytical results to SCDHEC through monthly Discharge Monitoring Reports (DMR). The Site reported only two permit exceptions for the 2,328 analyses performed during 2023, a 99.9% compliance rate. One exception was due to a maximum flow exceedance at outfall K-12 from heavy rains, and the other was for not conducting Whole Effluent Toxicity sampling, for which SRS received an NOV. SRS conducted the sampling and reported the results in its October DMR. SRS also completed corrective actions to prevent reoccurrence.

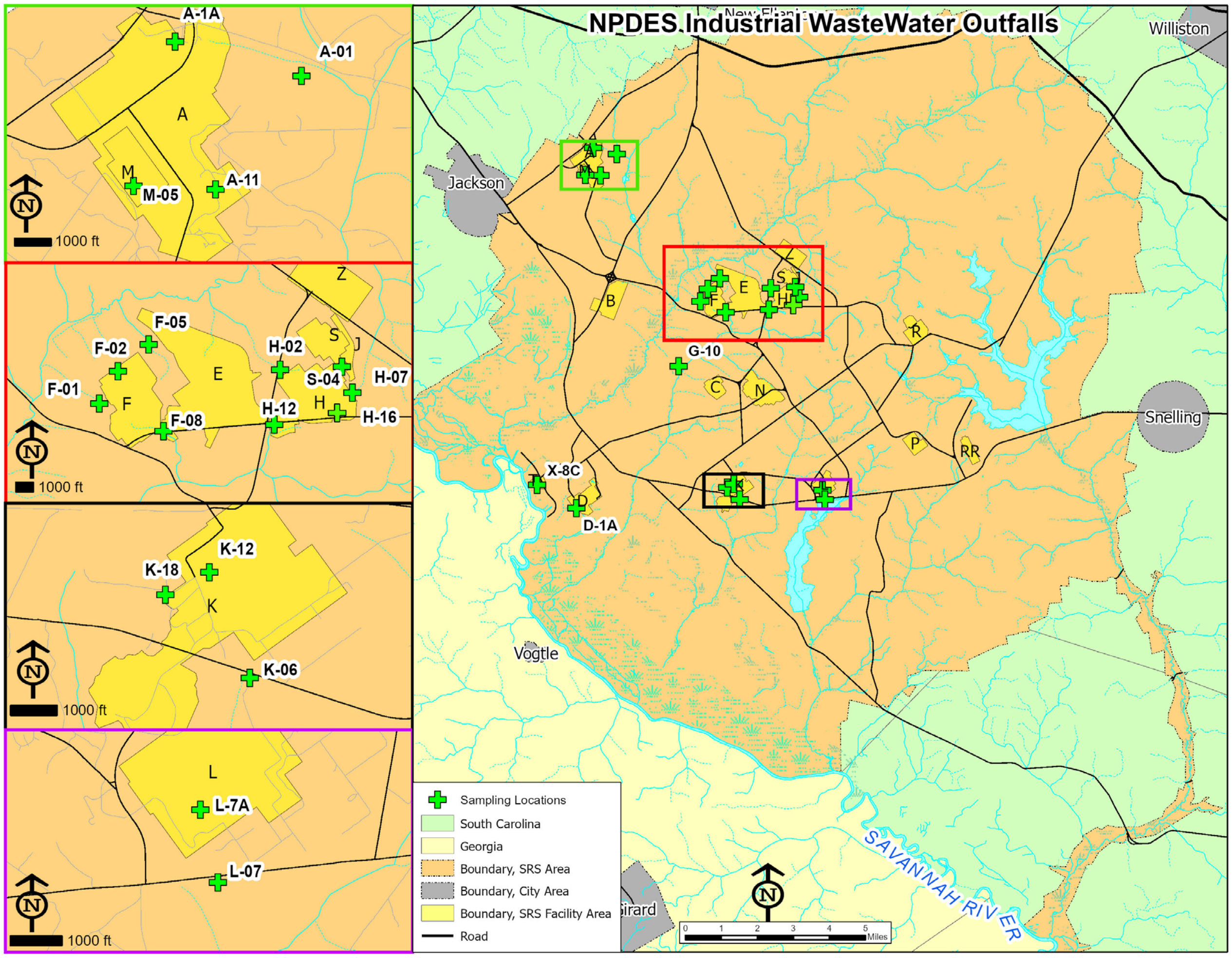


Figure 4-2 NPDES Industrial Wastewater Outfall Sampling Locations

4.3.1.2 Stormwater

SCDHEC issued a new five-year Industrial Stormwater General Permit, effective July 2022. SRS has 33 outfalls under this permit, as illustrated in Figure 4-3. Industrial stormwater monitoring consists of four components: effluent limitations guidelines monitoring, impaired waters monitoring, benchmark monitoring, and visual assessment.

SRS typically collects stormwater samples during qualifying rain (flow) events, characterized by two conditions: 1) at least 72 hours have elapsed since the previous flow event, and 2) the sample collection should occur during the first 30 minutes of the flow event. For benchmark samples, SRS continues to use wireless technology to send immediate text notifications of rain events and to start automated samplers. For visual assessments, SRS uses sample bottles installed in some outfalls that fill when the flow reaches the bottle inlet. These practices allow SRS to comply with the SCDHEC permit requirement of sampling within 30 minutes of stormwater flow. SRS collects grab samples in a few locations where automated installations are not possible due to the construction of the outfall.

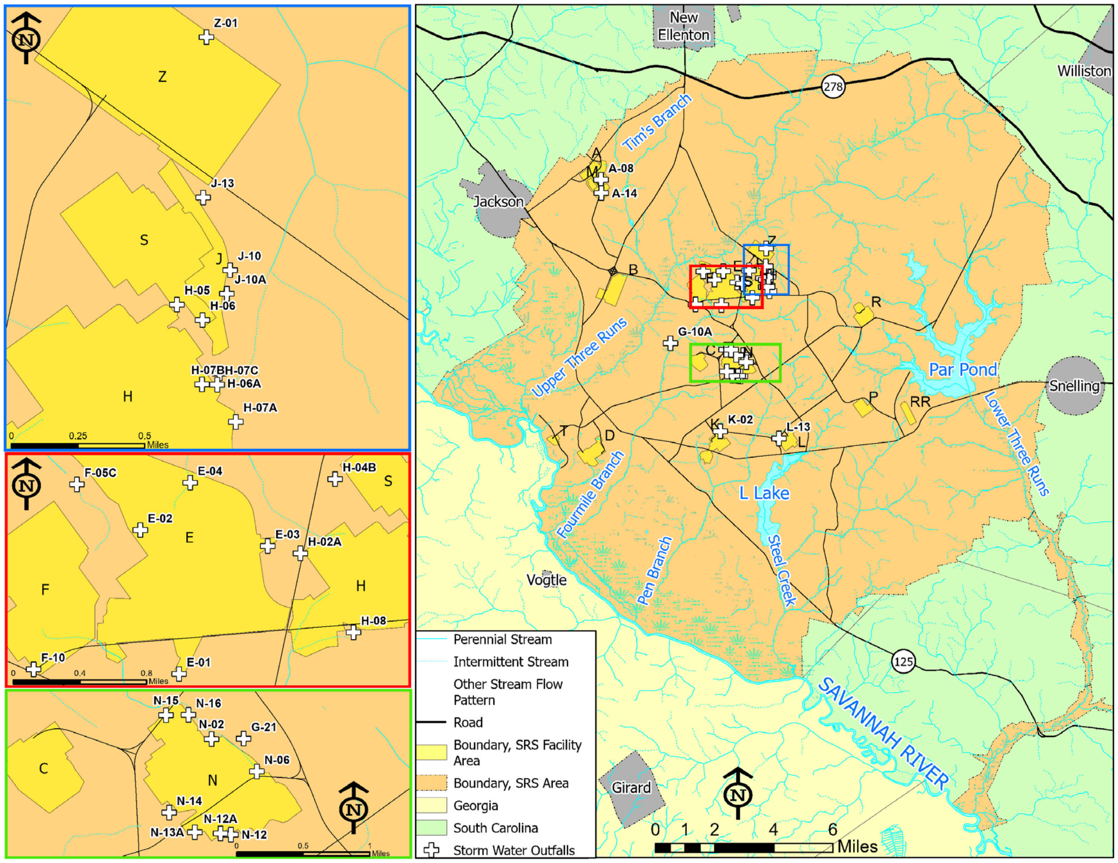


Figure 4-3 NPDES Industrial Stormwater Outfall Sampling Locations

Effluent Limitations Guidelines Monitoring—The EPA develops effluent limitations guidelines on an industry-by-industry basis. In the SCDHEC Industrial Stormwater General Permit, certain outfall sectors have these specific limitations imposed. SRS has one outfall, H-07B, that falls in a regulated sector. The outfall's watershed includes a coal storage pile area at a decommissioned steam electric-generating facility. The stormwater runoff collects into a basin that was designed for at least a 10-year/24-hour rainfall event. Although the outfall has not discharged since 1991, if it does discharge, SRS will sample for pH. SRS submits an annual report to SCDHEC that indicates the outfall has not discharged in the previous 12 months.

Impaired Waters Monitoring—A waterbody is impaired if it has been identified as not meeting applicable state water quality standards. There are two segments of streams impaired due to *Escherichia coli* (*E. coli*) that occur within SRS. However, since SRS industrial activities do not contribute to the impairment, no sampling is required.

Benchmark Monitoring—Benchmark outfalls are divided into groups with substantially identical effluents. Substantially identical outfalls are two or more outfalls that have discharges of effluents based upon similarities that include the following:

- General industrial activities and control measures
- Exposed materials that may significantly contribute pollutants to stormwater
- Runoff coefficients of the drainage areas

Each year, one outfall is selected from each group to be the designated representative outfall for the required quarterly sampling. The representative outfall in each group rotates annually so that each outfall is the representative outfall at least once during the five-year permit time period.

SRS must monitor for any benchmark parameter (for example, ammonia, arsenic, cadmium, chemical oxygen demand, copper, cyanide, *E. coli*, lead, mercury, nitrate-nitrite as N, selenium, silver, total suspended solids [TSS], and zinc) specified for the outfall's assigned industrial sector(s). Not all outfalls require benchmark monitoring. For those outfalls that do, benchmark sampling for an analyte must be performed until the average of four consecutive quarters meets the analyte's benchmark limit. The requirement is then met until the fourth year of the five-year permit, when it must be repeated. During 2023, all but two outfalls that were sampled satisfied this requirement.

A Teledyne ISCO Sampler Jug is Removed Before Being Taken to the Lab for Analysis.

Visual Assessment—Visual assessment outfalls are also divided into groups with substantially identical effluents; one outfall is selected from each group each year to be the designated representative outfall for the required quarterly sampling. Trained Site employees collect samples and inspect them for color, odor, clarity, solids (floating, settled, suspended), foam, oil sheen, and other indicators of stormwater pollution. The inspector completes visual assessment forms to document the assessment results.

4.3.1.2.1 Stormwater Results Summary

SRS monitored all industrial stormwater outfalls according to permit requirements.

Effluent Limitations Guidelines Monitoring—SRS did not perform sampling at the one outfall (H-07B) that required effluent sampling because there was no discharge in 2023. SRS reported results to SCDHEC in a required annual Discharge Monitoring Report.

Benchmark Monitoring—SRS met benchmark sampling requirements at all but two outfalls sampled in 2023. Although they fulfilled benchmark sampling requirements for other analytes, N-06 and N-12A did not meet the benchmark limits for zinc and copper, respectively. However, corrective measures (oyster shells and bone char installation) implemented in 2017, 2018, 2022, and 2023 are expected to be effective for several years. Oyster shells and bone char adsorb metals to reduce concentrations in the stormwater. Benchmark sampling at Outfalls G-10A and Z-01 was not performed because these outfalls did not discharge in 2023.

Visual Assessment—For visual assessment sampling, SRS grouped substantially identical outfalls—27 of the 33 outfalls in 8 groupings—and designated one outfall to represent their group for 2023. SRS sampled the remaining six outfalls individually and not in groups. In 2023, Site personnel visually assessed the water of these outfalls for indicators of stormwater pollution. Visual assessments identified no industrial impacts.

4.3.1.3 Sludge

SRS disposes of sludge from the Central Sanitary Wastewater Treatment Facility according to the requirements in the SCDHEC-issued NPDES land application permit. In doing so, the Site must sample the sludge to confirm it has met the permit's standards before applying the sludge to the designated pine forest land. SRS did not perform sludge land application from the Central Sanitary Wastewater Treatment Facility in 2023.

4.3.2 Onsite Drinking Water Monitoring

SRS uses groundwater sources to supply drinking water to onsite facilities. The A-Area treatment plant supplies most of SRS's drinking water. The Site also has four smaller drinking water facilities regulated by SCDHEC, each serving fewer than 25 people.

SCDHEC requires SRS to collect 10 bacteriological samples each month from the A-Area Domestic Water Distribution System to ensure that domestic water meets SCDHEC and EPA bacteriological drinking water quality standards. SRS surpasses this requirement by collecting at least 15 samples each month from various locations throughout the system.

4.3.2.1 Onsite Drinking Water Results Summary

All drinking water bacteriological samples that SRS collected in 2023 met the state and federal drinking water quality standards.

4.3.3 Surface (River and Stream) Water Quality Surveillance

South Carolina Regulation 61-69, *Classified Waters,* classifies SRS streams and the Savannah River as "freshwaters." Freshwaters, as defined in Regulation 61-68, *Water Classifications and Standards,* (SCDHEC 2014), support the following:

- Primary and secondary contact recreation and as a drinking water source after conventional treatment in accordance with SCDHEC requirements
- Fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora
- Industrial and agricultural uses

SRS surveys river and stream water quality to identify: 1) any degradation that could be attributable to the water discharges NPDES permits regulate, and 2) materials coming from inadvertent releases from sources other than routine release points.

SRS sampled 10 onsite streams and 5 Savannah River locations for various physical and chemical properties, including temperature, hardness, dissolved oxygen, pH, metals, nitrate, nitrite, phosphorus, total organic carbon, and TSS. The river and stream sampling locations (shown in Figure 4-4) are upstream from, adjacent to, and downstream from the Site. SRS compares results to background levels of chemicals from natural sources and from contaminants produced by municipal sewage plants, medical facilities, and other upstream industrial facilities to assess the environmental impacts of Site operations on the

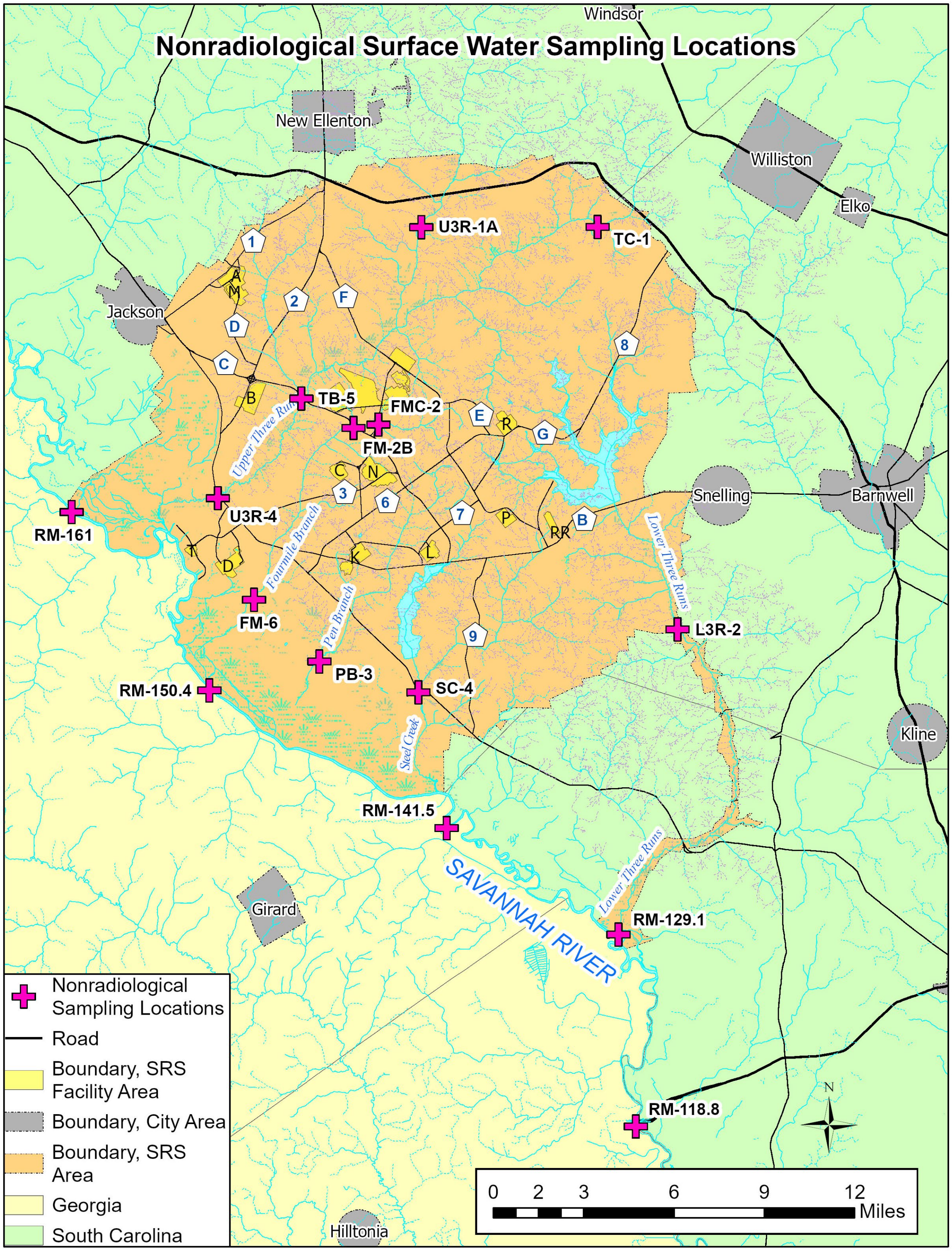


Figure 4-4 Nonradiological Surface Water Sampling Locations

surrounding area. SRS samples the water quality locations monthly by the conventional grab collection technique. SCDHEC also collects samples at several onsite stream locations as a QC check of the SRS program. SRS collects quality control samples throughout the year, as documented in Section 8.5, *Environmental Monitoring Program QC Activities,* of this document.

4.3.3.1 Surface (River and Stream) Water Quality Results Summary

SRS analyzed 3,717 individual analytes (177 samples) collected from the 15 stream and river water quality locations during 2023. Samples were not collected in October, November, or December at RM-141.5 due to unsafe low river water levels; the other four river location samples were collected at substitute locations. In 2023, 2,724 of 3,009 (90.5%) met South Carolina Freshwater Quality Standards, as available. (Not all analytes sampled have a standard.) All samples met standards for beryllium, cadmium, chromium, nickel, nitrite, temperature, and thallium. Averages for each river and stream location met standards for copper, mercury, nitrate, zinc, and dissolved oxygen. Additionally, all locations met pH maximum standards. These results (summarized in Table C-1) continue to indicate that SRS discharges are not markedly affecting the water quality of onsite streams or the Savannah River.

SRS Surveys River and Stream Water Quality.

4.3.4 Stream and River Sediment Sampling

SRS's nonradiological sediment surveillance program measures the concentrations of various inorganic contaminants that the Site releases and are deposited in stormwater basins, stream systems, and the Savannah River. Once deposited, the contaminants can either accumulate or disperse.

SRS's Sediment Sampling Program Examines Metals Concentrations in Rivers, Streams, and Basins.

The nonradiological sediment program collects sediment samples annually at various Site stream, stormwater basin, and Savannah River locations (Figure 4-5). The locations vary from year to year, depending on the rotation schedule agreed upon with SCDHEC. SRS collects duplicate samples to assess QC, as Section 8.5, *Environmental Monitoring Program QC Activities,* documents. Samples are evaluated using ecological risk-based sediment and soil screening values. These values are used to refine the list of potential contaminants of concern at a site and to guide decisions regarding the need for any further site-specific investigations of ecological risk. These values, refinement screening values (RSVs), are screening values from other sources or are modifications to screening values to reflect site-specific conditions.

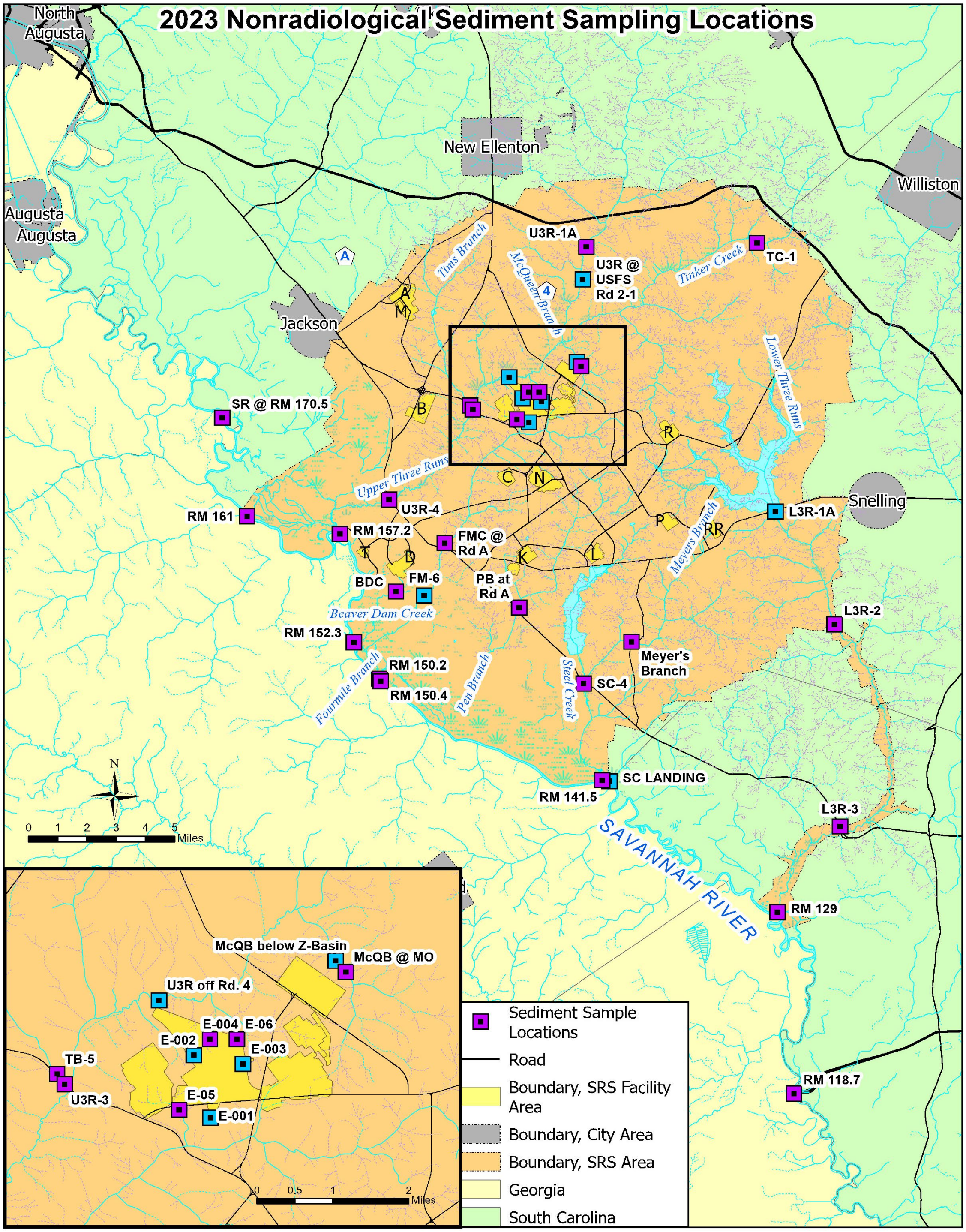


Figure 4-5 Nonradiological Sediment Sampling Locations
(Locations in purple were sampled in 2023, while locations in blue were not.)

4.3.4.1 <u>Stream and River Sediment Results Summary</u>

In 2023, SRS collected and analyzed 400 individual sediment analytes from 25 locations (11 from streams, 3 from stormwater basins, and 2 from the shared stream and basin background locations; and 8 from the Savannah River and 1 from the Savannah River background location). SRS measured aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, uranium, and zinc. Many of these are trace metals that occur naturally in soils and sediments. Of the 2023 results, 95.5% (382 of 400 analyses) met the EPA Region 4 Sediment RSVs. Barium accounted for 11 of the 18 samples that exceeded its RSV (60 mg/kg), while manganese and iron accounted for the remaining seven exceedances, with RSVs of 1,100 mg/kg and 40,000 mg/kg, respectively. SRS considers the barium exceedances as background, as evidenced by the Agency for Toxic Substances and Disease Registry 2007 Toxicological Profile for Barium, which states that, depending on the soil type, mean values for barium in the earth's crust range between 265 and 835 mg/kg. Additionally, the barium concentrations at both stream control locations have remained similar (~100 mg/kg difference or less) since 2007. Appendix Table C-2 summarizes the analytical results for all sediment analyses. All results are consistent with those of the previous five years and demonstrate SRS activities are not significantly affecting the metals concentrations of onsite basins, onsite streams, or the Savannah River.

4.3.5 Fish Monitoring

SRS samples aquatic species to identify and evaluate any effect of Site operations on contaminant levels in fish. The Site collects freshwater fish (bass, catfish, flathead catfish, and panfish) at six locations on the Savannah River from above SRS at Augusta, Georgia, to the coast at Savannah, Georgia. Freshwater fish are collected at the mouth of the streams that flow through the Site, and saltwater fish (mullet) are gathered at the Savannah River mouth near Savannah. SRS analyzes samples of the edible flesh for the uptake of metals, including antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc.

4.3.5.1 Fish Results Summary

In 2023, SRS performed 1,750 individual analyses on 175 fish flesh samples. Five hundred sixty-seven, or 32%, of the 1,750 individual analyses were detected. Fifty-three percent of the detected results were estimated values, meaning SRS detected the analyte, but the concentration was close to the method detection limit. The analytes that had detected values were arsenic, cadmium, copper, manganese, mercury, nickel, and zinc. The remaining 1,183, or 68%, of the 1,750 individual analyses were not detected.

The 2023 data is consistent with results from the previous five years. Mercury is of particular interest in fish, and as Figure 4-6 shows, the average mercury concentration results, sorted by fish type for 2018 through 2023, has remained consistent. Appendix Tables C-3 and C-4 summarize all analytical results; however, similar trending is seen.

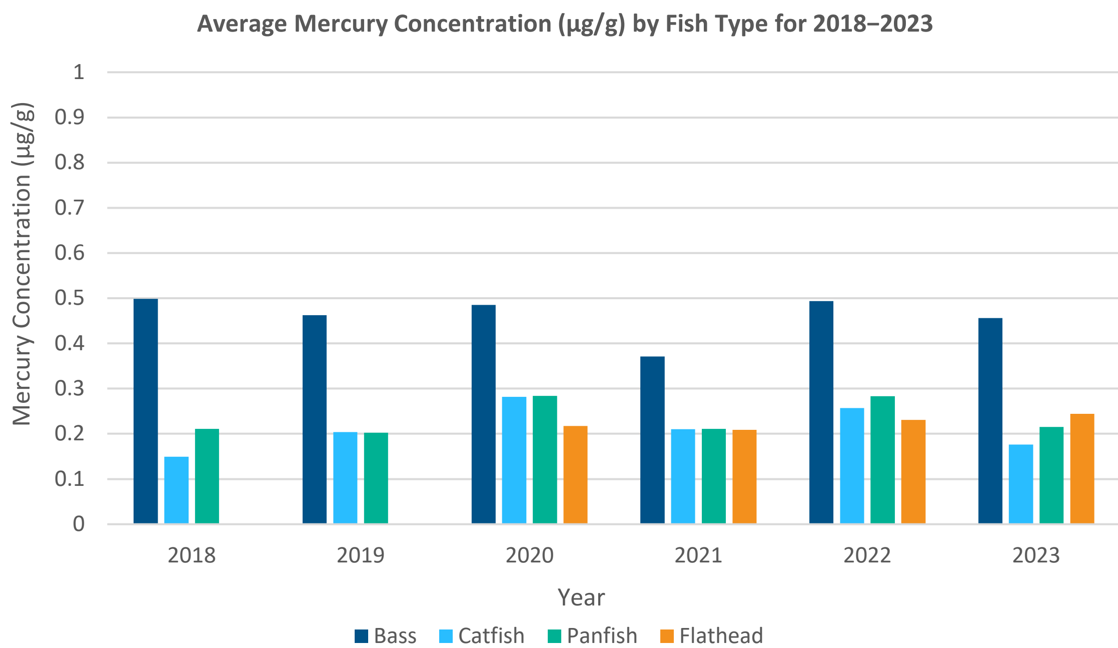


Figure 4-6 Average Mercury Concentration of Fish Species in the Savannah River, Adjacent to the Savannah River Site

Chapter 5: **Radiological Environmental Monitoring Program**

The purpose of the Savannah River Site (SRS) Radiological Environmental Monitoring Program is twofold: it monitors effects SRS has on the environment, and it demonstrates the Site is complying with applicable U.S. Environmental Protection Agency, South Carolina Department of Health and Environmental Control, and U.S. Department of Energy (DOE) regulations and standards. Monitoring substantiates that SRS operations pose no risk to the surrounding population. As part of this program, the Site collects thousands of samples throughout the year and analyzes them for radionuclides that could be present from releases due to SRS operations. The Site collects samples both onsite and in the communities surrounding SRS. State and federal regulations drive some of the monitoring that SRS conducts. DOE Orders 231.1B, "Environment, Safety and Health Reporting," and 458.1, "Radiation Protection of the Public and the Environment," also address environmental monitoring requirements.

2023 Highlights

Air Pathway—All air contaminants SRS released were below applicable permit and regulatory limits. Radiological results for surveillance media associated with the airborne pathway were within historical levels.

Water Pathway—Water contaminants SRS released were all below applicable standards. Radiological results for surveillance media associated with the liquid pathway were within historical levels.

Wildlife Surveillance—All harvested animals SRS monitored during the annual onsite hunts were below the applicable standard. SRS monitored the deer, feral hogs, turkeys, and coyotes harvested during the hunts and released all 355 animals.

5.1 INTRODUCTION

Environmental monitoring at the Savannah River Site (SRS) examines both radiological and nonradiological constituents that the Site could release to the environment. This chapter discusses radiological monitoring at SRS; Chapter 4, *Nonradiological Environmental Monitoring Program*, presents the nonradiological monitoring.

The SRS Radiological Environmental Monitoring Program (EMP) monitors radiological contaminants from both air and liquid sources, as well as the environment. Samples are collected and analyzed from numerous locations throughout the Site and the surrounding area. SRS measures tritium in most sample media as it is a significant contributor to the potential dose to the public. The EMP has two focus areas: 1) effluent monitoring and 2) environmental surveillance. SRS determines sampling frequency and analyses based on permit-mandated monitoring requirements, federal regulations, and U.S. Department of Energy (DOE) Orders.

In accordance with DOE Order 458.1, SRS evaluates the effluent monitoring program by comparing the annual average concentrations to the DOE-derived concentration standards (DCSs). DOE's *Derived Concentration Technical Standard* (DOE 2022) establishes numerical values for DCSs. DCSs are radiological quantities for certain radionuclides specific to a surface or concentration used in surveying or characterizing radiation. SRS demonstrates DCS compliance when the sum of the ratios of each radionuclide's observed concentration to its corresponding DCS does not exceed 1.00. This sum is called the "sum of fractions." The DCSs are applicable at the point of discharge, and SRS uses them to screen existing effluent treatment systems to determine whether they are appropriate and effective. SRS uses the same DCSs as reference concentrations to conduct environmental protection programs. All DOE sites use these DCSs.

The EMP surveillance program samples the types of media in the effluent monitoring program that the Site's releases may impact. Figure 5-1 shows the liquid and airborne pathways, as well as the types of media sampled through those pathways.

SRS conducts environmental monitoring of the following:

- Air (stack emissions and ambient air)
- Rainwater
- Vegetation
- Soil

Chapter 5—Key Terms

Actinides *are a group of radioactive metallic elements with an atomic number between 89 and 103. Within this chapter, laboratory analysis of actinides generally refers to the elements uranium, plutonium, americium, and curium.*

Derived Concentration Standard (DCS) *is the concentration of a radionuclide, measured at the discharge point, in air or water effluents that—under conditions of continuous exposure for one year (annual ingestion of water, submersion in air, or inhalation)—would result in a dose of 100 millirem (mrem). This assumption of direct exposure to discharge point effluents is extremely unlikely and ensures that the DCSs are highly conservative.*

Dose *is a general term for the quantity of radiation (energy) absorbed.*

Effluent monitoring *collects samples or data from the point (such as a stack or pipe) that a facility discharges liquids or releases gases.*

Environmental monitoring *encompasses both effluent monitoring and environmental surveillance.*

Environmental surveillance *collects samples beyond the effluent discharge points and from the surrounding environment.*

Exposure pathway *is the way that releases of radionuclides into the water and air could impact a person.*

- Surface water (facility effluents, stream and river water, and stormwater basins)
- Drinking water
- Stream, basin, and river sediment
- Aquatic food products
- Wildlife
- Food products (milk, meat, fruit, nuts, grains, and vegetables)

Sampling results provide the data needed to assess the exposure pathways for the people living near SRS, as documented in Chapter 6, *Radiological Dose Assessment*.

Appendix Table B-2 of this document summarizes the radiological surveillance sampling media and frequencies.

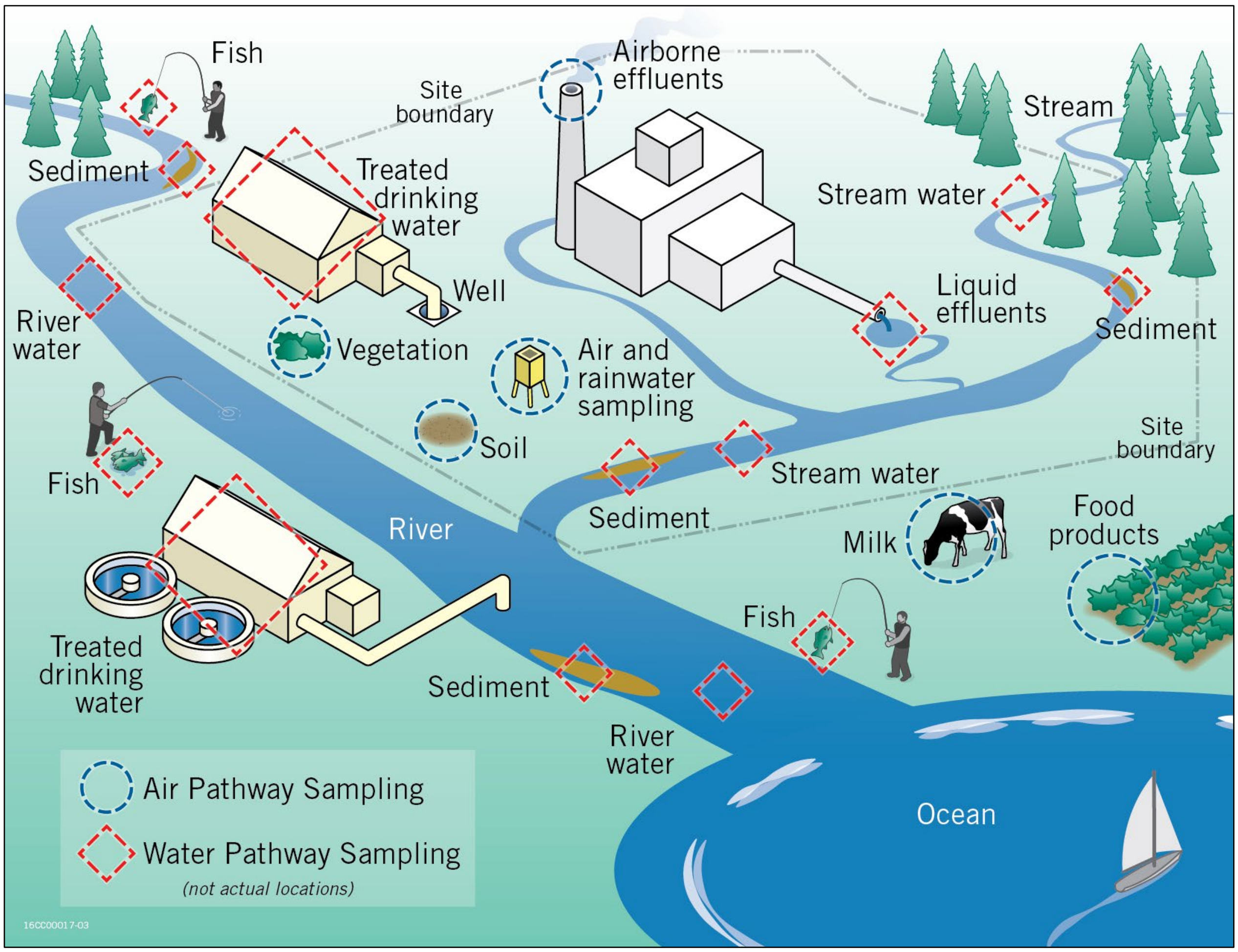


Figure 5-1 Types and Typical Locations of Radiological Sampling

5.2 SRS OFFSITE MONITORING

Offsite monitoring involves collecting and analyzing samples of air, river water, drinking water, soil, sediment, vegetation, milk, food products, fish, and other media from many locations. SRS analyzes these samples for radioactive contaminants to monitor effects the Site may have on the environment and to assess potential long-term trends of the contaminants in the environment. SRS collects samples at various distances beyond the Site perimeter in both Georgia and in South Carolina. Additionally, SRS collects samples at several population centers in Georgia and South Carolina.

SRS monitors the Savannah River at five locations adjacent to and downriver of SRS. A control location is about seven miles northeast of Shell Bluff, Georgia, and northwest of the Site perimeter, adjacent to the Savannah River at River Mile (RM) 161.0. Media-specific chapter figures and Environmental Maps show offsite environmental sampling locations.

5.3 AIR PATHWAY

The media sampled and discussed in this section support the air pathway dose assessment discussed in Chapter 6, *Radiological Dose Assessment*.

5.3.1 Air Monitoring

SRS monitors the air to determine whether airborne radionuclides from SRS emissions have reached the environment in measurable quantities and to ensure that radiation exposure to the public remains below regulatory limits. SRS performs effluent monitoring of airborne radionuclides at the point of discharge from operating SRS facilities. This monitoring complies with Environmental Protection Agency (EPA) and DOE requirements and regulations that are in place to protect the public. SRS conducts additional air sampling at surveillance stations onsite, along the SRS perimeter, and within communities surrounding SRS. Radionuclides in and around the SRS environment are both from SRS operations and from sources not related to the Site. The sources not associated with SRS include 1) naturally occurring radioactive material, 2) past atmospheric testing of nuclear weapons, 3) offsite nuclear power plant operations, and 4) offsite medical and industrial activities. Krypton-85 and tritium in the elemental (hydrogen gas) and oxide (water vapor) forms make up most of the radionuclide emissions from SRS to the air. The amount of krypton-85 and tritium released from SRS varies yearly, based on mission activities and on the annual production schedules of the processing facilities.

5.3.2 Airborne Emissions

The EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) program establishes the limits for radionuclide emissions, detailing the methods for estimating and reporting radioactive emissions from DOE-owned or -operated sources. The South Carolina Department of Health and Environmental Control issues Clean Air Act Part 70 Air Quality Permits to regulate radioactive airborne pollutant emissions for each major source of airborne emissions on SRS. Each permit has specific limitations and monitoring requirements.

SRS quantifies the total amount of radioactive material released to the environment by the following methods:

- Data obtained from monitored air effluent release points (stacks or vents)

- Calculated releases of unmonitored radioisotopes from spent fuel dissolution
- Estimates for unmonitored sources based on approved EPA calculation methods

SRS monitors the emissions from process-area stacks at facilities that release, or have the potential to release, airborne radioactive materials. SRS typically uses laboratory analyses of samples to determine concentrations of radionuclides in airborne emissions. The Site collects airborne effluent samples on filter papers for particulates, on charcoal sampling media for gaseous iodine, and in a bubbler solution for airborne tritium. Depending on the processes involved, SRS may also use real-time instruments to monitor instantaneous and cumulative releases (of tritium, for example) to the air.

The dissolution of spent nuclear fuel in the H-Canyon facility releases krypton-85, carbon-14, and tritium. SRS calculates these emissions and includes them with the monitored releases.

Each year, SRS calculates radionuclide release estimates in curies (Ci) from unmonitored diffuse and point sources. Point sources include stacks or other exhaust points, such as vents. In contrast, emissions from diffuse sources are not actively ventilated or exhausted. Diffuse emissions may originate from a larger area and not from a single location. SRS diffuse sources include research laboratories, disposal sites and storage tanks, and deactivation and decommissioning activities. The emissions calculated from unmonitored releases use the methods found in Appendix D, *Radiological Environmental Monitoring Program Supplemental Information,* of the EPA's NESHAP regulations (EPA 2002). Because these methods employ conservative assumptions, they generally overestimate actual emissions. Although SRS does not monitor these releases at their source, it uses onsite and offsite environmental surveillance to assess the impact, if any, of unmonitored releases.

5.3.2.1 Airborne Emissions Results Summary

During the past 10 years, the total annual tritium release from SRS operations has ranged from about 7,000 to 40,000 Ci per year, with an annual average tritium release of 16,601 Ci (Figure 5-2). SRS tritium releases fluctuate from year to year due to deactivation of legacy process buildings, the amount of tritium released during routine operations, and natural decay of tritium (about 5% per year). The 2023 SRS tritium releases totaled 8,523 Ci, which is lower than the annual average tritium release. Table 5-1 summarizes radiologic atmospheric releases for the calendar year (CY). Appendix Table D-1 also presents SRS radioactive release totals from monitored and unmonitored (calculated) sources.

Tritium and krypton-85 accounted for most of the total radiation SRS operations released to the air in 2023. Tritium-processing facilities are responsible for most of the SRS tritium releases, and highly enriched uranium reprocessing at H-Area separations facilities is responsible for all krypton-85 releases. Tritium releases from the separations areas are a combination of releases from the tritium-processing facilities and the dissolution in H Canyon. Figure 5-2 shows a 10-year history of tritium releases from separations areas, legacy reactor facilities, and unmonitored sources, with tritium from separations facilities historically comprising most of the releases. Tritium from separations facilities made up 98.79% of the total tritium releases in 2023, as Figure 5-3 illustrates. Appendix Table D-1 includes additional information on tritium releases.

Table 5-1 SRS Radiological Atmospheric Releases for CY 2023

Release Type	Total (curies)
Tritium	8.52E+03
Krypton-85 (^{85}Kr)	2.27E+04
Short-Lived Fission and Activation Products (T1/2 < 3 hr)[a,b]	4.31E-09
Fission and Activation Products (T1/2 > 3 hr)[a,b]	7.00E-02
Total Radio-iodine	7.70E-03
Total Radio-strontium[c]	5.48E-03
Total Uranium	9.18E-05
Plutonium[d]	1.77E-04
Other Actinides	5.18E-06
Other	2.30E-06

[a] International Commission on Radiological Protection (ICRP) 107 half-life data, *Nuclear Decay Data for Dosimetric Calculations (2008)*
[b] International Atomic Energy Agency (IAEA) Common Fission and Activation Products
[c] Includes unidentified beta releases
[d] Includes unidentified alpha releases

Appendix Table D-2 summarizes the 2023 air effluent-derived concentration standard (DCS) sum of fractions for continuous sources. The table contains calculated concentrations for tritium from the legacy reactor areas and the tritium-processing facilities and for krypton-85, carbon-14, and tritium released from the H-Canyon facility during the dissolving process. SRS calculates these concentrations based on the annual releases in curies and the annual stack release volume.

Because of the nature of operations at several SRS facilities, tritium oxide releases exceeded DOE’s tritium air DCS. DOE recognizes that tritium oxide, which is essentially water vapor, cannot be filtered or removed from the effluent and, therefore, DOE Order 458.1 specifically exempts tritium from Best Available Technology considerations but not from environmental As Low As Reasonably Achievable (ALARA) requirements that Site procedures implement. Thus, to comply with DOE Order 458.1, the Site maintains tritium releases via implementations of procedures that enforce ALARA principles. The ALARA process manages radiological activities onsite so that dose to members of the public (both individual and collective) and releases to the environment are kept ALARA.

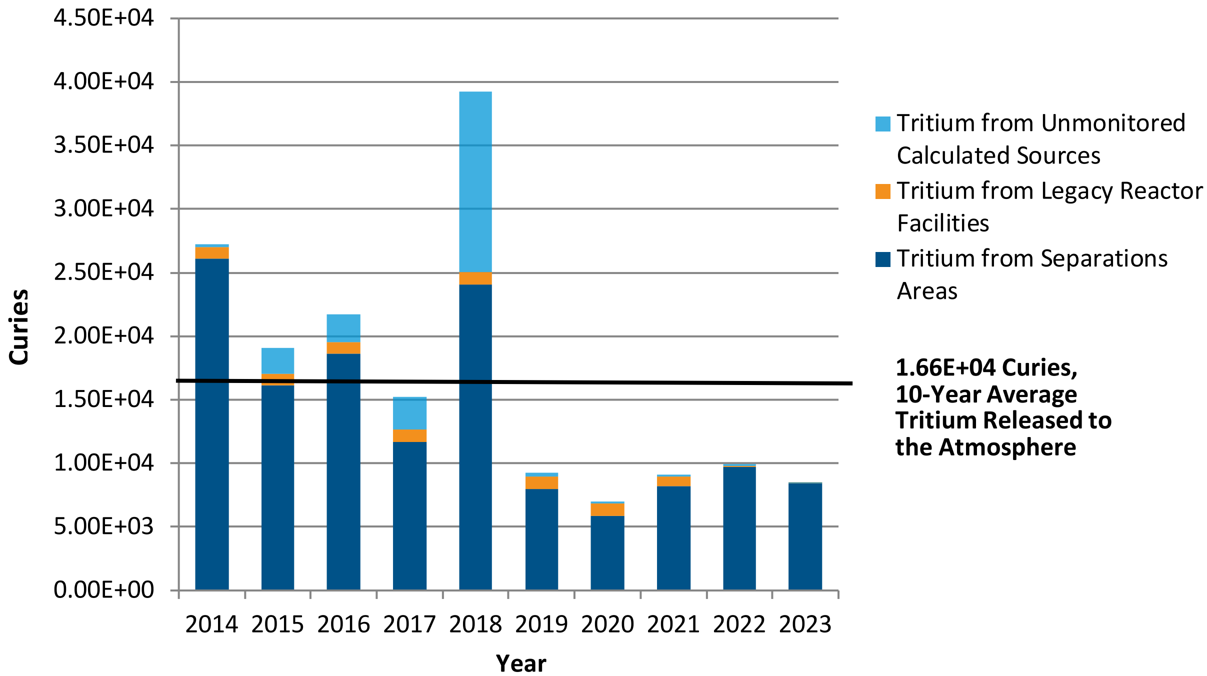


Figure 5-2 10-Year History of SRS Annual Tritium Releases to the Air

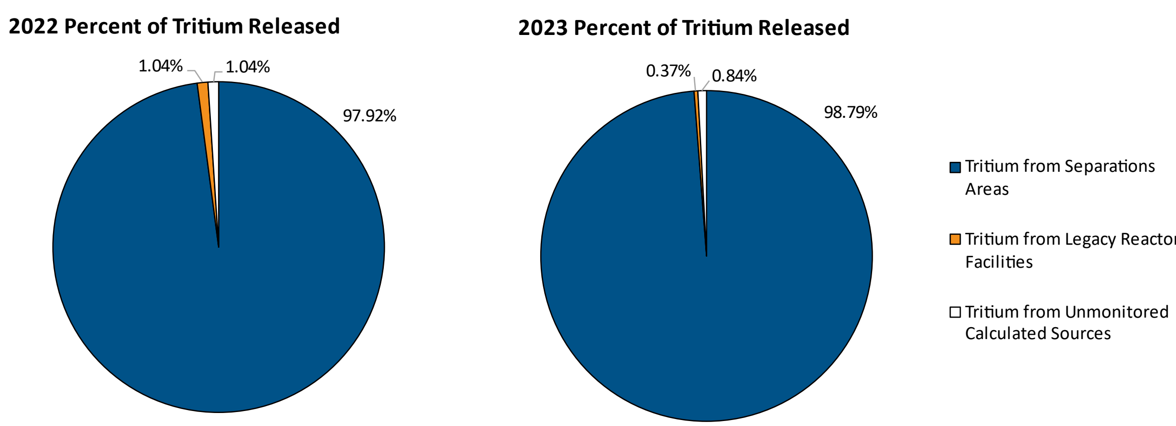


Figure 5-3 Percent of Tritium Released to the Air for 2022 and 2023

5.3.3 Air Surveillance

Beyond the operational facilities, SRS maintains a network of 16 air sampling stations (Figure 5-4 and Environmental Maps, *Radiological Air Surveillance Sampling Locations*) in and around SRS to monitor concentrations of radionuclides in the air and rainwater. The air contains radionuclides in various forms (gaseous, particulate matter, water vapor). Rainwater can redeposit radionuclides from the air onto the ground and vegetation, or soil can eventually absorb the radionuclides.

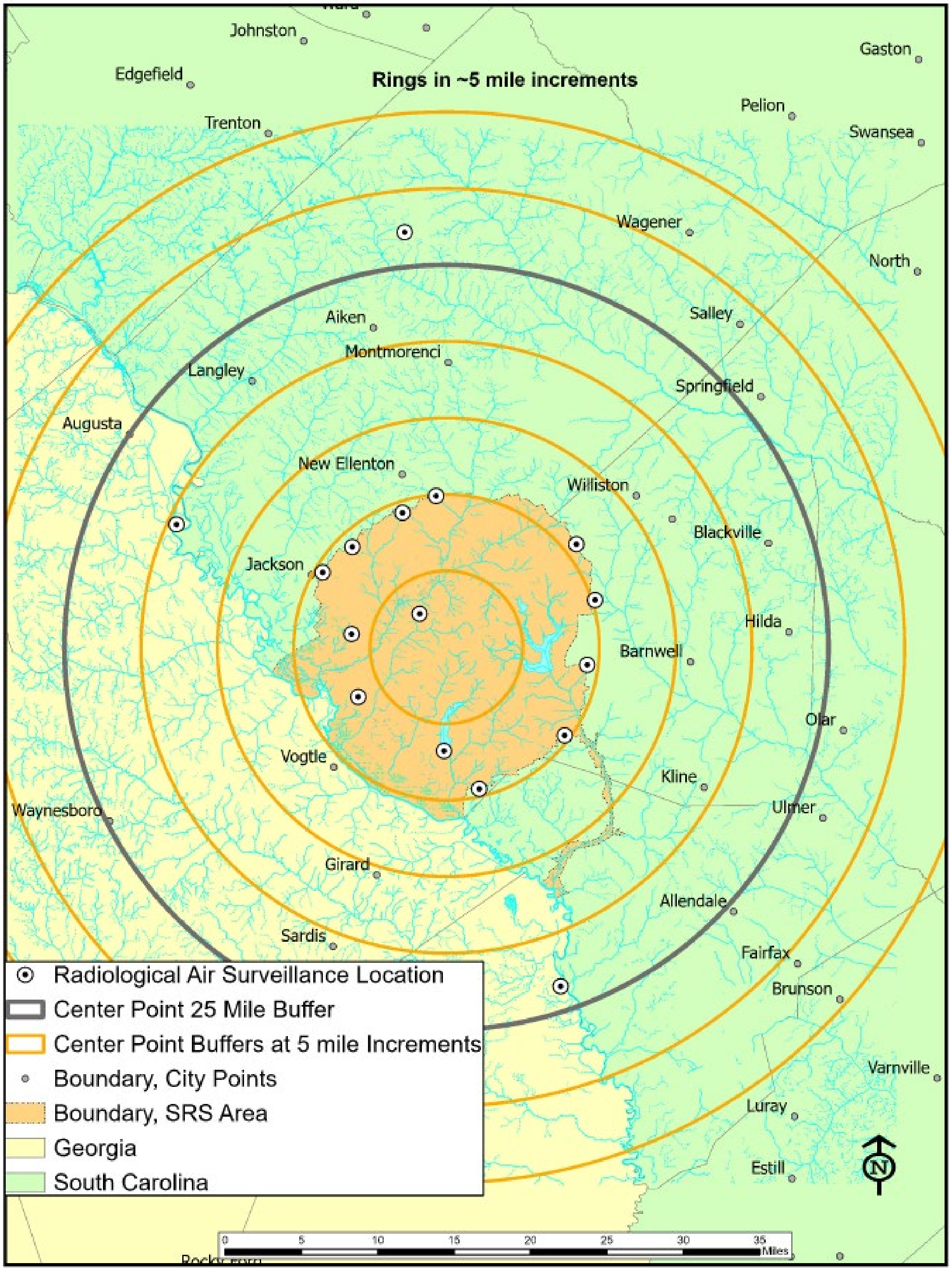


Figure 5-4 Air Sampling Locations Surrounding SRS Up to 25 Miles

The sampling stations are at locations on and off the Site. Onsite stations are at the center of the Site and around the perimeter. Offsite sampling stations are 25 miles from the Site in population centers and at a control location, the U.S. Highway 301 Bridge at the Georgia Welcome Center in Screven County. SRS operations are not likely to affect the control location. SRS has placed air sampling stations near the Site boundary and beyond to be representative of the atmospheric distribution of airborne releases to the environment.

Various air sampling media are utilized at the sampling locations based on known SRS airborne emission sources. Table 5-2 presents the media tables and the radionuclides that media allow for detection of. Background levels in the air consist of naturally occurring radionuclides (for example, uranium, thorium, and radon) and radionuclides from global fallout due to historical nuclear weapons testing related to the Cold War (for example, strontium-90, and cesium-137 [a manmade gamma-emitting radionuclide]).

Table 5-2 Air Sampling Media

Media	Purpose	Radionuclides
Glass-Fiber Filter	Airborne particulate matter	Gamma-emitting radionuclides, gross alpha/beta-emitting radionuclides, actinides, strontium-90
Silica Gel	Tritiated water vapor	Tritium
Rainwater	Tritium in rainwater	Tritium

5.3.3.1 Results Summary

The 2023 results for tritium in air showed detectable levels in 49 of the 417 samples, or 12%, which is the same detection level observed in 2022. Appendix Tables D-3 and D-4 summarize results for tritium in air (water vapor) and tritium in rainwater and compare them to the background control location at the U.S. Highway 301 Bridge.

The 2023 results for tritium in rainwater showed detectable levels in 14 of the 208 rainwater samples, or 7%, as compared to 2022 results, with detectable levels in 8% of the samples. Twelve of 14 results were detected for Burial Ground North, which is at the center of the Separations Area at SRS. Barricade 8 and D Area each had 1 of 14 results detected.

SRS discontinued quarterly charcoal canister analysis for radioiodine in 2023 due to the low quantity of detectable results and cost associated with analysis and deployment of the cannisters. This determination for the discontinuing radioiodine sampling was based on a review of historical radioiodine results from September 2014 through April 2022 at all 16 air surveillance sites, with Barricade 8 being added in October 2020 and A-14 being added in October 2021. During this time, 360 samples were collected: 9 of the 360 samples were close to the detection limit but estimated (2.5%), and 351 of the 360 samples were non-detect (97.5%). Should the necessity arise, SRS will maintain a stockpile of charcoal cannisters for future deployment.

SRS also selected glass fiber filter samples from offsite and the Site perimeter to analyze for actinides and strontium-90. Sample selection frequency increased from annually to quarterly for 2023. Samples chosen were dependent on dates of elevated concentrations at F-Canyon stacks and the wind direction during the corresponding time period. Actinide and strontium-90 analysis was also performed on glass fiber filter samples collected biweekly at Burial Ground North onsite. However, due to the increased sampling frequency from annually to quarterly at the other air stations and the low volume of non-detected results, SRS decided to discontinue biweekly sampling on February 22, 2023. Burial Ground North was moved to quarterly analysis as well. Appendix Table D-5 summarizes all glass fiber filter results, which are all comparable to historical trends.

5.3.4 Ambient Gamma Surveillance

Since 1965, SRS has been monitoring ambient (surrounding) environmental gamma exposure rates. SRS currently measures ambient gamma exposure using optically stimulated luminescent dosimeters (OSLDs), which are passive devices that measure exposure from ionizing radiation. The Site uses data from OSLDs to determine the impact of Site operations on the gamma exposure to the public and the environment and to evaluate trends in exposure levels. Other uses include supporting routine and emergency response dose calculations.

An SRS Employee Retrieves an OSLD to Transport to the Lab for Analysis.

An extensive OSLD network in and around SRS monitors external ambient gamma exposure rates (Environmental Maps, *SRS Optically Stimulated Luminescent Dosimeter [OSLD] Sampling Locations*). The SRS ambient gamma radiation-monitoring program has four subprograms: 1) Site perimeter stations, 2) population centers, 3) air surveillance stations, and 4) onsite perimeter stations colocated with Georgia Power's Vogtle Electric Generating Plant's stations. SRS conducts most gamma exposure monitoring onsite and at the SRS perimeter.

SRS monitors population centers near the Site boundary, with limited monitoring beyond at the three 25-mile air surveillance stations.

5.3.4.1 Ambient Gamma Results Summary

Ambient gamma exposure rates at all OSLD monitoring locations show some variation based on location and natural levels of background radiation in the environment. In 2023, ambient gamma exposure rates onsite varied between 100 mR/yr at the Allendale Gate location and 157 mR/yr at A-14. Rates at population centers ranged from 119 mR/yr at the McBean, Georgia, location to 157 mR/yr at the Beech Island, South Carolina, location. Appendix Table D-6 summarizes the gamma results.

Consistent with the previous five-year trends, ambient gamma results indicate that no significant difference in average annual dose rates exists between monitoring networks. Ambient dose rates in population centers are slightly elevated compared to the other monitoring networks, as expected, because materials present in buildings and roadways contribute to the natural background radiation.

5.3.5 Soil Surveillance

SRS conducts soil surveillance to provide the following:

- Data for long-term trending of radioactivity deposited from atmospheric fallout (both wet and dry deposition)
- Information on the concentrations of radioactive materials in the environment

In 2023, SRS collected soil samples from 5 onsite locations, 12 locations at the Site perimeter, and 7 offsite locations (Environmental Maps, *Radiological Soil Sampling Locations*). Radionuclide concentrations in soil vary greatly among locations because of differences in the patterns, retention, and transport of rainfall. Therefore, a direct comparison of year-to-year data could be misleading. However, SRS evaluates the data for long-term trends.

Sampling technicians use hand augers, shovels, or other similar tools at each sampling location to collect soil samples to a depth of 6 inches. The technicians mix the soil samples from each sampling location to ensure they are homogeneous when the laboratory analyzes them for gross alpha, gross beta, gamma-emitting radionuclides, strontium-90, and actinides.

5.3.5.1 Soil Results Summary

In 2023, SRS detected radionuclides in soil samples from all 24 sampling locations. Analyses detect uranium isotopes (uranium-233/234, uranium-235, and uranium-238) in the soil samples each year. Uranium is naturally occurring in soil and is expected to be present in the environment. The concentration range for naturally occurring uranium in soil is typically about 1–5 picocuries/gram (pCi/g), with an average concentration of 2 pCi/g in soils in the United States. Many factors affect the uranium concentration in soil over time, including the pH of the soil, the type of soil, and deposits from the air transferred through rainfall. Organic matter and clay minerals provide exchange sites in soil, which can increase the uranium sorption. Uranium results both onsite and at the Site perimeter are consistent with naturally occurring uranium levels.

SRS Collects Soil Samples to Test for Radionuclides.

The concentrations of radionuclides at these locations are consistent with historical results. Cesium-137 typically produces the highest concentrations due to 1) global fallout from atmospheric weapons testing and 2) discharges, leaks, and spills from legacy fission processes at SRS. For 2023, SRS had a maximum cesium-137 concentration of 37.2 pCi/g at the Creek Plantation Trail 1 1805' location and 0.084 pCi/g at the control location (Highway 301). Appendix Table D-7 summarizes the results.

5.3.6 Grassy Vegetation Surveillance

SRS collects and analyzes grassy vegetation samples annually at locations onsite and offsite (Environmental Maps, *Radiological Vegetation Sampling Locations*). This information complements the soil sample results that the Site uses to evaluate radionuclide accumulation in the environment and to validate SRS dose models. Vegetation can receive radioactive contamination either externally, when radioactive particles from the air settle on a plant, or internally, when a plant absorbs contaminants in soil and water through its roots. The Site prefers Bermuda grass for surveillance because of its importance as a pasture grass for dairy herds. SRS collects vegetation samples from the following:

- All air sampling locations
- When applicable, locations where SRS expects soil radionuclide concentrations to be higher than normal background levels

- When applicable, locations receiving potentially contaminated water

Vegetation sample analyses consist of tritium, gross alpha, gross beta, gamma-emitting radionuclides, strontium-90, technetium-99, and actinides.

5.3.6.1 Grassy Vegetation Results Summary

SRS collected 16 annual samples for 2023. SRS detected various radionuclides in the grassy vegetation samples at all air sampling locations (1 onsite, 12 at the perimeter, and 3 offsite). All radionuclides are within the trends of the previous 10 years for all locations. Appendix Table D-8 summarizes the results.

5.3.7 Terrestrial Food Surveillance

SRS personnel collect terrestrial food products grown and consumed in the communities surrounding the Site, as well as fish and shellfish caught from the Savannah River. Samples are analyzed for radionuclides, and the results reveal whether radionuclides are present in the environment. Tritium releases from SRS sources are the primary contributors to tritium in food products.

SRS's Environmental Bioassay Laboratory Analyzes Terrestrial Food, Such as Pecans, Grown and Consumed Near to the Site.

Agricultural products, livestock, and game animals that humans eat may contain radionuclides. Livestock and game animals may be exposed if the radionuclides are in the air. Radionuclides in the air can settle on grass, which animals can eat. If humans consume the meat of these exposed animals, they become exposed to radiation. Dairy cows are also livestock of concern to SRS because they produce milk that humans consume, leading to potential radiation exposure. SRS samples milk, meat, fruit, nuts, grains, and vegetables based on their potential to transport radionuclides to humans through the food chain.

Local gardens, farms, and dairies are the source of terrestrial food products for analysis. SRS collects beef, watermelon, and greens annually. Site personnel also collect two specific crops a year, rotating through a variety of vegetables, grains, and nuts. Samples of vegetables, grains, nuts, fruit, and rotational crops come from each of the four quadrants surrounding SRS, which extend up to 10 miles from the Site boundary. Additionally, SRS collects a control sample to the southeast at a distance between 10 miles and 25 miles from the Site boundary. Once a quarter, the Site collects milk samples. Dairy samples are collected from dairies in the vicinity of the Site perimeter in Georgia and South Carolina. Due to the increasing difficulty in finding small dairies within the 30-mile radius, some may actually extend outside of that mile limit.

Laboratory analysis of the food samples include those for gamma-emitting radionuclides, tritium, strontium-90, technetium-99, gross alpha, gross beta, and actinides (including neptunium-237). Laboratory analysis of the dairy samples include those for gamma-emitting radionuclides, tritium, and strontium-90.

5.3.7.1 Terrestrial Food Results Summary

In 2023, SRS sampled milk and the following terrestrial foodstuffs: greens, watermelons, beef, peanuts, and soybeans. The analytical results of the routine terrestrial foodstuffs and milk are consistent with 10-year trends. Results for most foodstuffs (73% for terrestrial foodstuffs and nearly 96% for dairy) did not detect radionuclides. Thirty-two percent of the detected terrestrial foodstuff results were associated with natural uranium. Appendix Tables D-9 and D-10 summarize the foodstuffs and dairy results.

5.4 LIQUID PATHWAY

Surface water is a primary medium through which individuals in surrounding areas can be exposed to contaminants the Savannah River Site generates. These contaminants may reach offsite individuals through various liquid pathways, such as fish and shellfish consumption, irrigation, water recreation, and ingestion. Thus, monitoring liquid effluents is an initial step in evaluating SRS's impact on the environment and is a key component in designing the environmental surveillance program.

The media presented in this section support the water pathway dose assessment discussed in Chapter 6, *Radiological Dose Assessment.* Environmental Maps, *Stream Systems,* identifies SRS stream systems included in the pathway.

5.4.1 Liquid Effluents Monitoring Program

The liquid effluent monitoring program directly monitors liquid releases and collects and analyzes samples from all Site process outfalls that have the potential to release contaminants to Site surface waters.

SRS routinely samples, analyzes for radionuclides, and monitors flow at each liquid effluent discharge point that release, or has potential to release, radioactive materials. Figure 5-5 shows the effluent sampling points near SRS facilities.

5.4.1.1 Liquid Effluent Results Summary

Table 5-3 summarizes the liquid effluent releases of radioactive materials and shows tritium as the largest contributor. During the past 10 years, the total annual tritium release has ranged from 348 to 736 Ci per year, with an annual average tritium release of 528 Ci. The direct releases (including migration) of tritium increased by 9% (from 348 Ci in 2022 to 378 Ci in 2023). Appendix Table D-11 provides SRS liquid radionuclide releases for 2023. These releases include direct releases plus the shallow groundwater migration (discussed in Section 5.4.3) of radioactivity from SRS seepage basins and the Solid Waste Disposal Facility (SWDF). E-003 Outfall was added to the radiological liquid effluent program in September 2023, and sampling at E-003 Basin was discontinued.

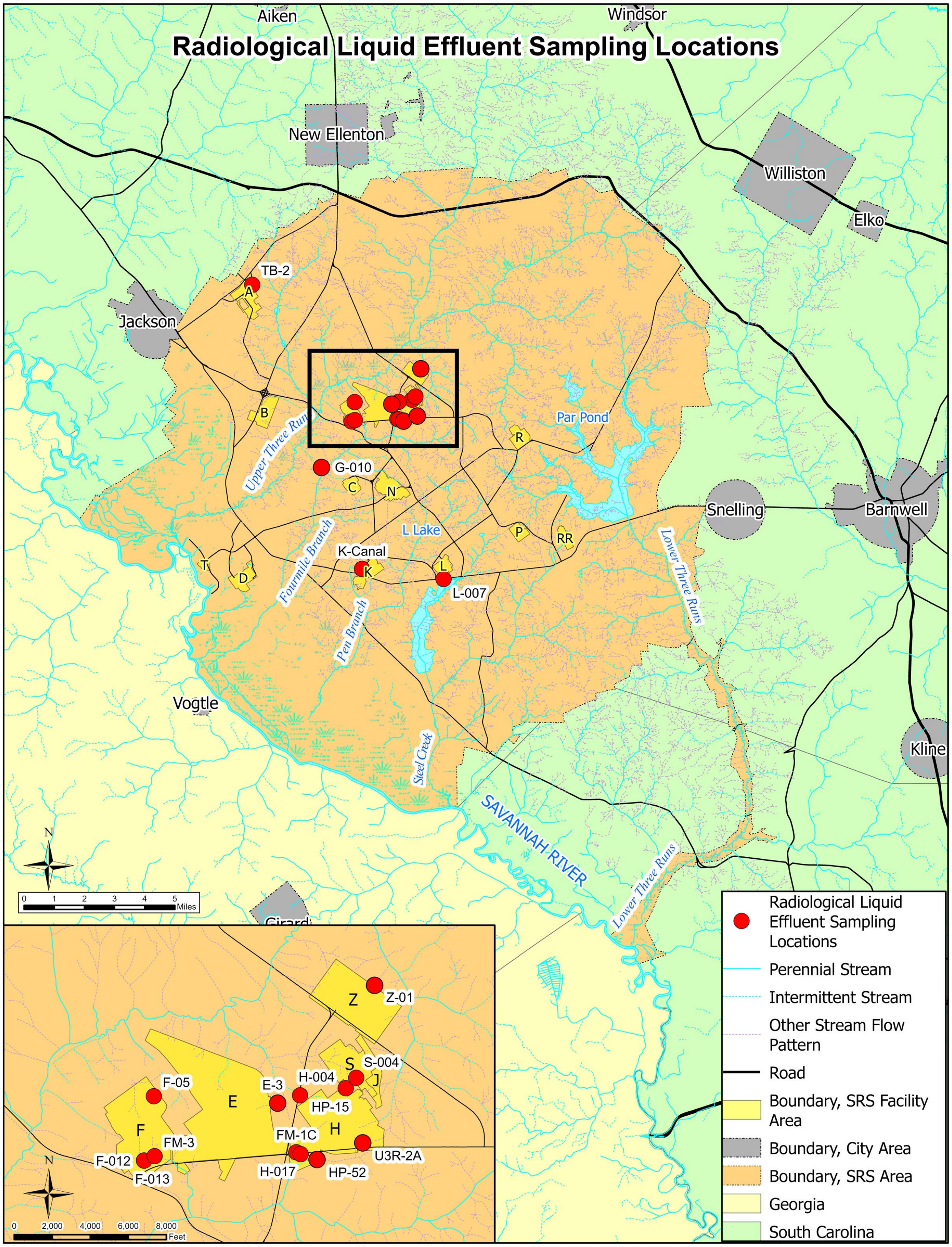


Figure 5-5 Radiological Liquid Effluent Sampling Locations

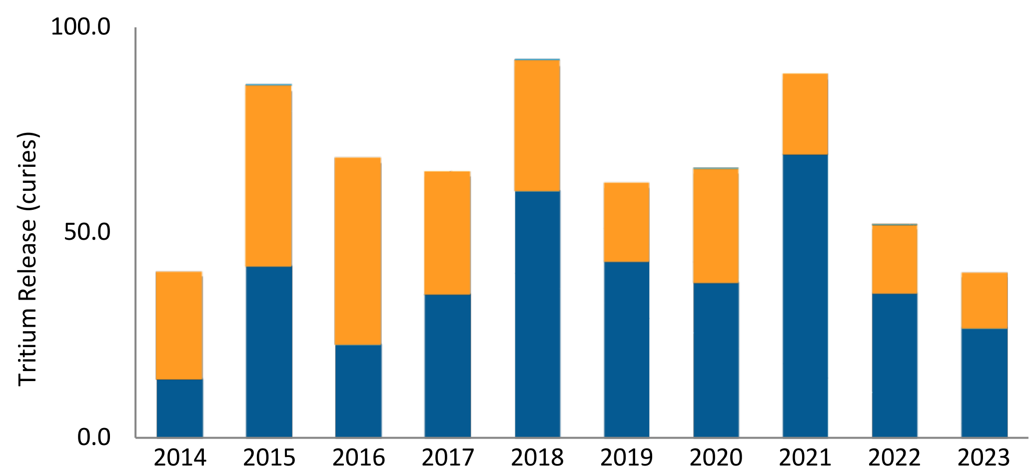
Table 5-3 SRS Radiological Liquid Effluent Releases[a] of Radioactive Material for CY 2023

Release Type	Totals (curies)
Tritium	3.78E+02
Fission and Activation Products (half-life > 3 hr)[b,c]	2.54E-02
Total Radio-iodine	1.45E-02
Total Radio-strontium[d]	7.63E-02
Total Uranium	1.32E-01
Plutonium[e]	1.58E-02
Other Actinides	4.18E-04
Other	0

[a] Includes direct releases and shallow groundwater migration from SRS seepage basins and Solid Waste Disposal Facility
[b] International Commission on Radiological Protection (ICRP) 107 half-life data, *Nuclear Decay Data for Dosimetric Calculations (2008)*
[c] International Atomic Energy Agency (IAEA) Common Fission and Activation Products
[d] Includes unidentified beta releases
[e] Includes unidentified alpha releases

The total amount of tritium released directly from process areas to SRS streams (not including shallow groundwater migration) during 2023 was 40.4 Ci, compared to 52.1 Ci released in 2022. Figure 5-6 presents the tritium released by source area and shows that while oftentimes variable, the total direct releases of tritium in 2023 is consistent with the 10-year historical measurements.

As the introduction to this chapter mentions, compliance with the derived concentration standard (DCS) is when the sum of the ratios of each radionuclide's observed concentration to its corresponding DCS does not exceed 1.00. The DCS sum of fractions for all liquid effluent locations was less than 1.00. Appendix Table D-12 summarizes the 2023 liquid effluent sum of fractions and radionuclides detected at each outfall or facility.



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
SRNL	0	0.01	0	0	0.05	0	0.02	0	0.01	0
Legacy Reactor Areas	26.1	43.8	45.2	29.9	31.7	19.3	27.8	19.5	16.8	13.5
Separations Areas	14.5	41.8	22.9	35.0	60.1	42.8	37.7	68.9	35.3	26.9

Figure 5-6 10-Year History of Direct Releases of Tritium to SRS Streams

5.4.2 Stormwater Basin Surveillance

The Site stream and stormwater basin surveillance network consists of 29 locations. These include onsite control locations and stations on each onsite watershed downstream of process effluents. SRS monitors the accumulated stormwater in the Site's stormwater basins for gross alpha, gross beta, tritium, strontium-90, technetium-99, gamma-emitting radionuclides, and carbon-14. Additional analytes may include actinides (including neptunium-237). With no active processes discharging to SRS's stormwater basins, the accumulations in these basins are mainly stormwater runoff. SRS selects the specific radionuclides for monitoring based on the operational history of each basin. The E-Area basins receive stormwater from SWDF, the E-Area Vault, and stormwater from the controlled clean-soil pit on the east side of E Area. F-Area Pond 400 receives stormwater from F Area and the Savannah River Plutonium Processing Facility. The Z-Area Stormwater Basin receives stormwater from Z Area (Saltstone processing and disposal facilities). Stormwater basins may release to monitored outfalls during heavy rainfall. Figure 5-7 identifies all the Site's stormwater basin locations, along with the Site's stream surveillance locations that are part of the surface water surveillance program. This is discussed later in this chapter in Section 5.4.3, *SRS Stream Sampling and Monitoring.*

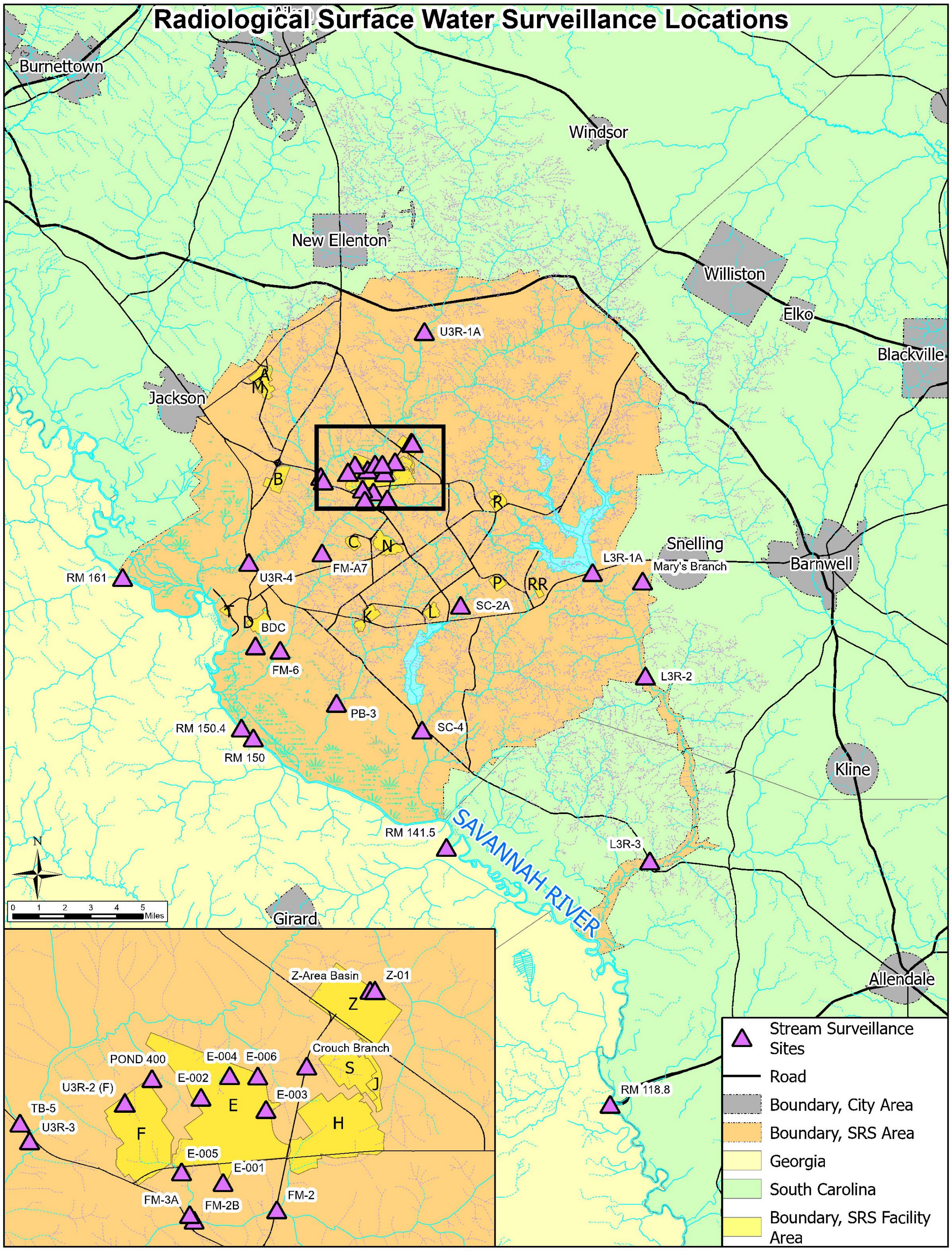


Figure 5-7 Radiological Surface Water Sampling Locations

5.4.2.1 Stormwater Basin Results Summary

In 2023, SRS sampled at six E-Area Basins (E-001, E-002, E-003, E-004, E-005, and E-006), as well as at the Z-Area Stormwater Basin and F-Area Pond 400. Table 5-4 summarizes gross alpha, gross beta, and tritium results for stormwater basins. Beginning in September 2023, E-003 Outfall was added to the radiological liquid effluent program, and grab sampling at E-003 Basin was discontinued. The classification of E-003 Basin changed from a Category III liquid effluent discharge point to a Category II due to increases in radionuclide concentrations that require flow monitoring. However, E-003 Basin had the highest tritium concentration (27,000 picocuries/liter [pCi/L]), which is consistent with the results reported for E-003 in 2022 (15,300 pCi/L). Tritium results for all basin locations are consistent with the 10-year historical measurements.

Table 5-4 Radionuclide Concentrations Summary for Stormwater Basins for CY 2023

Basin Location	Average Gross Alpha (pCi/L)	Average Gross Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
E-001	0.40	2.30	2,430	3,820
E-002	All < DL	2.93	12,587	26,000
E-003	All < DL	25.28	10,006	27,000
E-004	All < DL	1.95	11,664	18,100
E-005	0.59	2.62	4,494	7,290
E-006	All < DL	2.26	ALL < DL	ALL < DL
Pond 400	All < DL	5.92	347	840
Z Basin	All < DL	244.33	914	3,620

Note:
DL = detection limit

5.4.3 SRS Stream Sampling and Monitoring

SRS routinely samples streams downgradient of several process areas to detect and quantify levels of radioactivity that liquid effluents and shallow groundwater may transport to the Savannah River (Figure 5-7). The five primary streams that deposit into the Savannah River are Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs. SRS monitors and quantifies radioactivity migration from SRS seepage basins and Solid Waste Disposal Facility (SWDF) as part of its stream surveillance program. Seepage basins include the General Separations Area (F and H Area) Seepage Basins and the K-Area Seepage Basin. SRS closed the F-Area and H-Area Seepage Basins in 1991 and the K-Area Seepage Basin in 2002. Radioactivity previously deposited in the seepage basins and SWDF continues to migrate through the groundwater and enter SRS streams. Additionally, Table 5-5 provides the stream sampling locations used to determine radioactivity migration in streams and the direct release sample locations associated with the contributing migration source. The sampling frequency and types of analyses depend on the upstream discharges and groundwater migration history of radionuclides.

In addition to the monthly samples collected for tritium, gross alpha, gross beta, and gamma analyses, SRS collects samples annually for alpha-specific actinide analyses to provide a more comprehensive suite of radionuclides for annual shallow groundwater migration reporting.

Table 5-5 Radionuclide Concentrations in the Primary SRS Streams by Location for CY 2023

	Average Alpha (pCi/L)	Average Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
Onsite Stream Locations				
Lower Three Runs (L3R-3)	0.44	1.15	287	601
Steel Creek (SC-4)	2.69	2.77	828	1,380
Pen Branch (PB-3)	0.97	1.31	5,163	7,280
Fourmile Branch (FM-6)	1.10	4.33	13,777	17,100
Upper Three Runs (U3R-4)	16.4	8.76	373	666
Onsite Control Locations (for comparison)				
Upper Three Runs (U3R-1A)	7.25	4.07	52.8	453

5.4.3.1 SRS Stream Results Summary

SRS found detectable concentrations of tritium at all major stream locations. Table 5-5 presents the average 2023 concentrations of gross alpha, gross beta, and tritium, along with the maximum concentrations of tritium in SRS streams. These stream locations represent the last monitoring location for the respective tributary before discharging into the Savannah River.

The 10-year trend for the average tritium levels in the streams shows a decrease, which is due to decreases in Site effluent releases, SRS remediation actions, and the natural decay of tritium. Although onsite streams are not a direct source of drinking water, the surveillance program uses the Environmental Protection Agency (EPA) standard as a benchmark for comparing stream surface water results. Average tritium concentration in Fourmile Branch (Figure 5-8) is decreasing and is below the EPA drinking water standard of 20,000 pCi/L. Pen Branch continues to remain below the EPA drinking water standard. Tritium concentration is higher in Fourmile Branch compared to the other streams due to shallow groundwater migration from the historical seepage basins and SWDF. SRS has taken active measures to reduce this migration. Section 7.3.3, *Remediating SRS Groundwater,* presents additional information on the groundwater remediation to reduce tritium to Fourmile Branch.

As Figure 5-9 shows, migration releases of tritium generally have declined over the past 10 years, with year-to-year variability caused mainly by the amount of annual rainfall. During 2023, the total quantity of tritium migrating from SRS seepage basins and SWDF into SRS streams was 338 Ci, compared to 295 Ci in 2022, which represents a 14.5% increase.

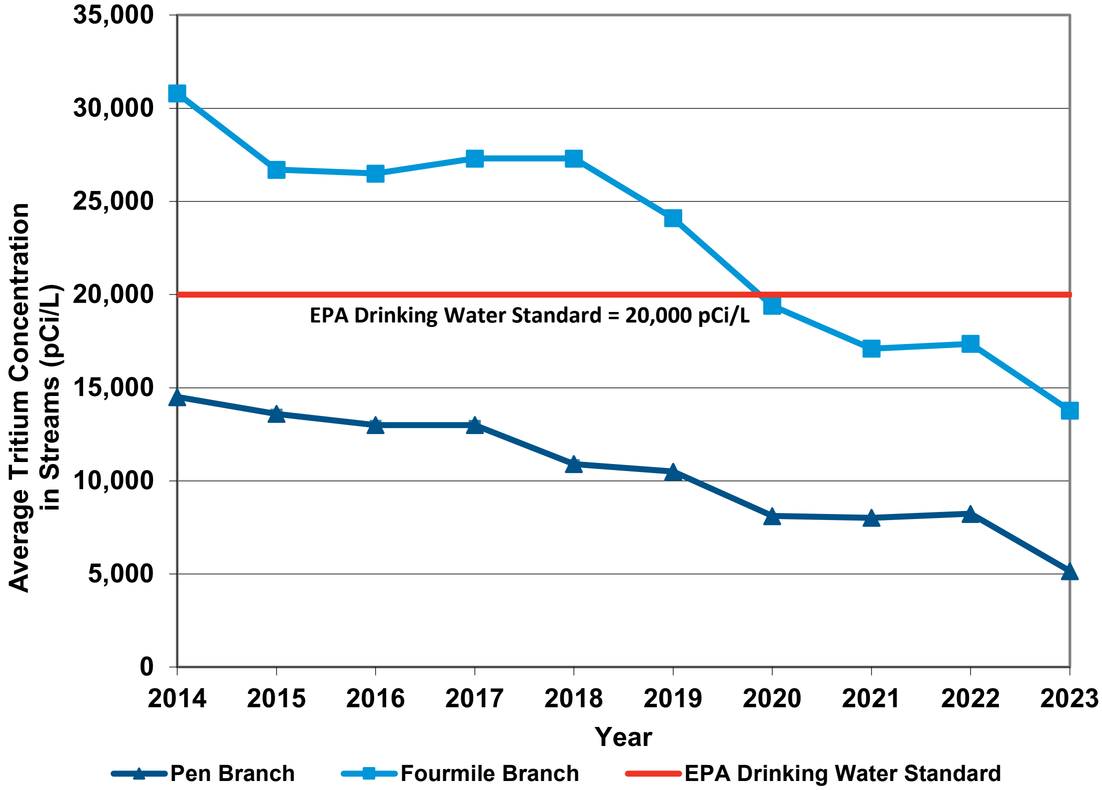


Figure 5-8 10-Year Trend of Tritium in Pen Branch and Fourmile Branch

SRS calculated 242 Ci (71.6%) of the 338 Ci of tritium migrated into SRS streams in Fourmile Branch. Sampling in Pen Branch measures the tritium migration from the K-Area Seepage Basin and the percolation field below the K-Area Retention Basin. An estimated 96 Ci migrated in 2023, compared to 89 Ci in 2022. Stream transport includes tritium migration releases from C-Area, L-Area, and P-Area Seepage Basins. (See Section 5.4.5, *Tritium Transport in Streams and Savannah River Surveillance,* in this chapter.) Migration releases of other radionuclides vary from year to year but have remained below 1 Ci the past 10 years.

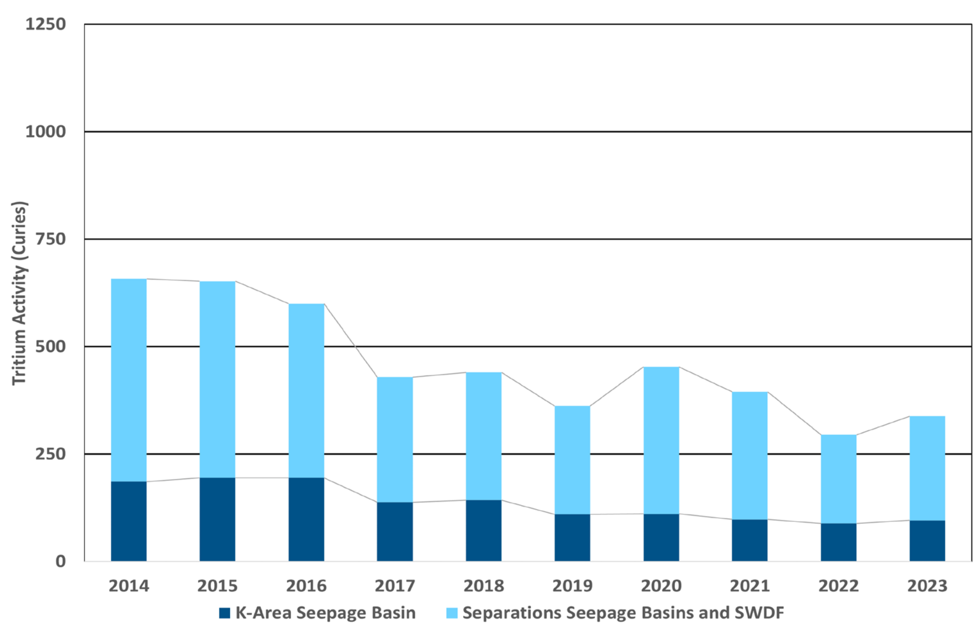


Figure 5-9 10-Year History of Tritium Migration from SRS Seepage Basins and SWDF to SRS Streams

5.4.4 Savannah River Sampling and Monitoring

The Savannah River surveillance program consists of a system of five sampling stations located on the Savannah River near SRS (Figure 5-7) that are sampled routinely. Upriver of SRS, River Mile (RM)-161.0 exists to survey background conditions of the Savannah River in the vicinity of SRS. RM-150.4 monitors liquid additions from Vogtle Electric Generating Plant (VEGP). Three other locations exist to monitor river conditions in the vicinity of stream discharge from tributaries onsite. (See Section 5.4.2.) This system serves to quantify the contribution of SRS effluents to the radiological levels in the river.

SRS collects samples weekly at these river locations for tritium, gross alpha, gross beta, radium-226, and gamma analyses. SRS also collects samples annually for strontium-90, technetium-99, and actinides to provide a more comprehensive suite of radionuclides.

5.4.4.1 Savannah River Results Summary

Table 5-6 lists the average 2023 concentrations of gross alpha, gross beta, and tritium and the maximum 2023 concentrations of tritium at river locations. The tritium concentration levels are well below the EPA drinking water standard of 20 pCi/mL (20,000 pCi/L).

Tritium is frequently detected above background levels in the Savannah River in the downriver vicinity of SRS. The combined SRS, VEGP, and Barnwell Low-Level Disposal Facility (BLLDF) tritium estimates based on concentration results at Savannah River RM-141.5 and average flow rates at RM-141.5 were 2,779 Ci in 2023, compared to 1,556 Ci in 2022. This increase was due to increased releases from SRS, increased migration from the seepage basins, increased releases from BLLDF, and, finally, increased tritium release from VEGP. (See section 5.4.5.1.) As a comparison, the estimated total of SRS's tritium releases to the river was 378 Ci in 2023, while the release total was 348 Ci in 2022. The total of the estimated releases from BLLDF was 16 Ci in 2023 and 13 Ci in 2022.

Average radionuclide concentrations for gross alpha, gross beta, tritium, strontium-90, technetium-99, actinides, and gamma-emitting radionuclides are consistent with the results from the previous 10 years.

Table 5-6 Radionuclide Concentrations in the Savannah River for CY 2023

Location	Average Gross Alpha (pCi/L)	Average Gross Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
RM-161.0 (CONTROL)	0.157	2.00	124	347
RM-150.4 (VEGP)	0.178	2.14	926	3,590
RM-150.0	0.254	2.04	198	382
RM-141.5	0.244	2.15	392	3,190
RM-118.8	0.246	2.16	371	1,060

5.4.5 Tritium Transport in Streams and Savannah River Surveillance

Due to the mobility of tritium in water and the amount released over the course of more than 70 years of SRS operations, the Site monitors and compares the amount of tritium measured at various onsite stream sampling locations to that found at the Savannah River sampling locations. The comparison uses the following methods of calculation:

- Direct releases measured at the source—Total direct tritium releases, including releases from facility effluent discharges (discussed in Section 5.4.1) and inferred shallow groundwater migration (discussed in Section 5.4.3) of tritium from SRS seepage basins and SWDF
- Stream transport, which measures the amount of tritium leaving the Site—Tritium transport in SRS streams, measured at the last sampling point before entry into the Savannah River. This includes shallow groundwater migration contributions from C-Area, L-Area, and P-Area Seepage Basins.
- River transport—Tritium transport in the Savannah River, measured downriver of SRS (near RM-141.5) after subtracting any measured contribution above SRS (RM-161.0)

SRS bases its methods for estimating releases on the environmental data reporting guidance in *Environmental Radiological Effluent Monitoring and Environmental Surveillance* (DOE 2015). General agreement between the three calculation methods of annual tritium transport—measurements at the source plus any measured migration, stream transport, and river transport—validates both that SRS is sampling at the appropriate locations and the accuracy of analytical results.

Within the past 10 years, SRS has detected a measurable amount of tritium migrating from a non-SRS source, BLLDF, which Energy*Solutions*, LLC operates. The tritium continues to enter the SRS stream system at Marys Branch, which discharges into Lower Three Runs. The facility is privately owned and adjacent to SRS. The tritium currently in groundwater will continue to decay and dilute as it moves from the source toward Lower Three Runs. In 2014, SRS started monitoring at Marys Branch, which is near BLLDF, to account for the tritium BLLDF contributes. SRS estimated the amount of tritium from BLLDF during 2023 to be 16 Ci, which SRS direct release or stream transport totals did not include.

For compliance dose calculations, the Site uses whichever value is higher: SRS direct releases or the stream transport measurements. (See Chapter 6, *Radiological Dose Assessment.*)

5.4.5.1 Tritium Transport in Streams and Savannah River Results Summary

In 2023, tritium levels in stream transport and river transport showed an increase, specifically as described below:

- The total liquid effluent releases (including migration) of tritium increased by 8.5% (from 348 Ci in 2022 to 378 Ci).
- The stream transport of tritium increased by 27.7% (from 246 Ci in 2022 to 314 Ci).
- The river transport of tritium increased by 78.6% (from 1,556 Ci in 2022 to 2,779 Ci). VEGP, BLLDF, and SRS contributed to these values.

Tritium transport in the Savannah River includes the 16 Ci migration value attributed to BLLDF and the 2,450 Ci release value attributed to VEGP.

SRS tritium transport data from 1960 to 2023 (Figure 5-10), shows the history of direct releases plus migration, stream transport, and river transport, while Table 5-7 shows an increase from 2022 to 2023 for most quantified contributors of these three tritium transport categories. The general downward trend over the past 60 years is attributed to the following:

- Variations in tritium production and processing at SRS
- Implementing effluent controls beginning in the early 1960s
- SRS tritium inventory continuing to deplete and decay

Chapter 6, *Radiological Dose Assessment*, discusses that the direct plus migration releases value was higher than the tritium stream transport value. Therefore, the compliance dose calculations for 2023 use the direct releases and migration value of 378 Ci.

Table 5-7 Liquid Tritium Releases and Transport

Releases/Transport (curies)	CY 2022	CY 2023
Liquid Effluent Releases		
Direct Releases	52	40
Shallow Groundwater Migration from Separations Areas Basins, K-Area Seepage Basins, and Percolation Field below K-Area Retention Basin	296	337
Total Liquid Effluent Releases (direct releases and migration)	**348**	**378**
Total Stream Transport		
Stream Transport and Shallow Groundwater Migration from C-Area, L-Area, and P-Area Seepage Basins	246	314
River Transport		
SRS Contribution	348	378
VEGP Contribution	1,430	2,450
BLLDF Contribution	13	16
Total River Transport (SRS, VEGP, and BLLDF)	**1,556**	**2,779**

Note:
For compliance dose calculations, the Site uses whichever value is higher: SRS direct releases and migration or the stream transport measurements. Therefore, in 2023, SRS used direct releases and migration to calculate the dose. See Chapter 6, *Radiological Dose Assessment.*
VEGP = Vogtle Electric Generating Plant
BLLDF = Barnwell Low-Level Disposal Facility

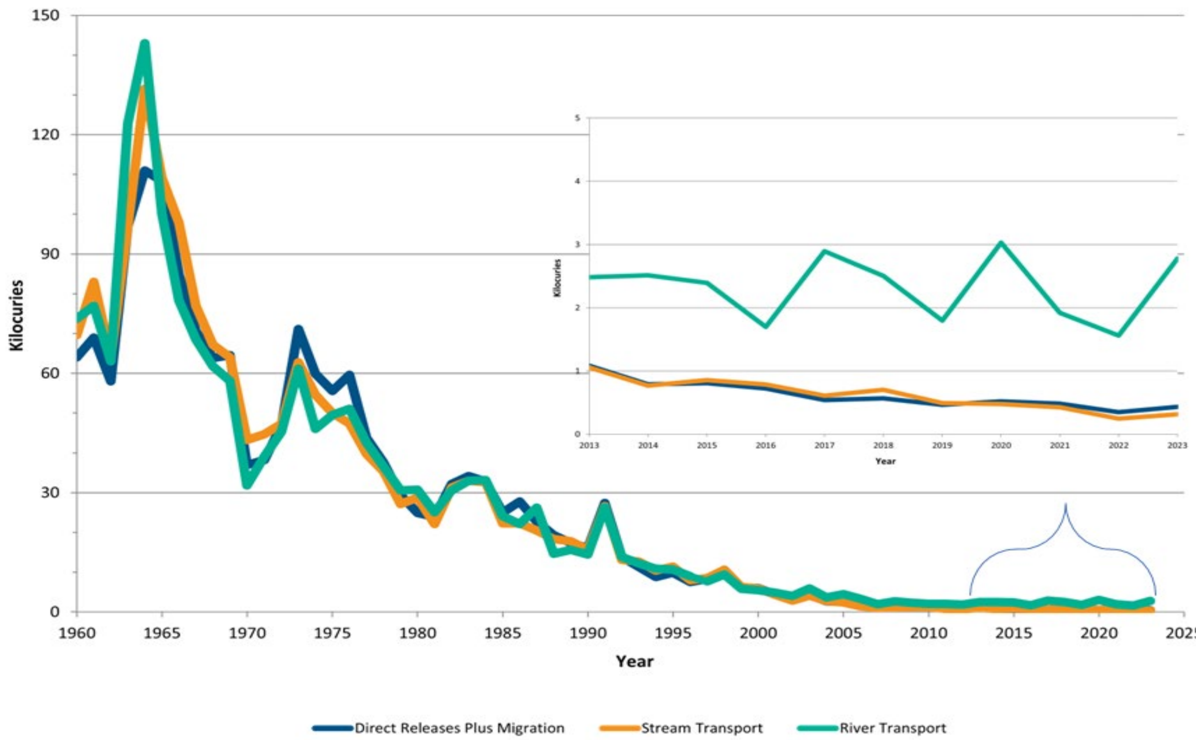


Figure 5-10 History of SRS Tritium Transport (1960–2023)

5.4.6 Settleable Solids Surveillance

SRS evaluates settleable solids in water, in conjunction with routine sediment monitoring, to determine whether a long-term buildup of radioactive materials occurs in stream systems. Settleable solids are solids in water that are dense enough to sink to the bottom of the collection container.

DOE limits for the radioactivity levels in settleable solids are 5 pCi/g above background for alpha-emitting radionuclides and 50 pCi/g above background for beta/gamma-emitting radionuclides. Accurately measuring radioactivity levels in settleable solids is impractical in water samples with low total suspended solids (TSS). In 1995, DOE interpreted the radioactivity levels in settleable solids requirement. The interpretation indicated that TSS levels below 40 parts per million comply with the DOE limits.

To determine compliance with these limits, SRS uses TSS results gathered from radiological liquid effluent locations and National Pollutant Discharge Elimination System outfalls that are colocated at or near radiological liquid effluent locations. If TSS results are regularly greater than 40 parts per million, SRS will investigate the cause and take additional water or sediment samples, or both, if necessary, to ensure compliance.

5.4.6.1 Settleable Solids Results Summary

In 2023, all TSS averages were below the 40 parts per million limit. The TSS results indicate that SRS remains in compliance with DOE's requirement related to radioactivity levels in settleable solids.

5.4.7 Sediment Sampling

Sediment sample analysis measures the movement, deposition, and accumulation of long-lived radionuclides in streambeds and in the bed of the Savannah River. Year-to-year differences may be evident because sediment continuously moves and deposits at different locations in the stream and riverbeds (or because of slight variations in sampling locations). The Site can use data obtained to observe long-term environmental trends.

Sediment Sampling Locations Vary Year to Year.

In 2023, SRS collected annual sediment samples at 11 Savannah River locations, 8 basin or pond locations, and 21 onsite streams or swamp discharge locations (Environmental Maps, *Radiological Sediment Sampling Locations*). The locations vary from year to year, depending on the rotation schedule agreed upon with the South Carolina Department of Health and Environmental Control, which duplicates sampling at several locations as a quality control check of the SRS program. SRS also collects duplicate samples to assess quality control, as Section 8.5, *Environmental Monitoring Program QC Activities,* documents.

5.4.7.1 Sediment Results Summary

Soil contamination areas at SRS are locations where the contamination levels exceed 150 pCi/g for beta and gamma radionuclides. Table 5-8 shows the maximum cesium-137 concentrations found in river, stream, and basin sediment, by sampling location. The Z-Area Stormwater Basin, a posted soil contamination area, had the maximum cesium-137 concentration of 1,160 pCi/g. Appendix Table D-13 shows the maximum of each radionuclide compared to the applicable SRS control location.

Radionuclide concentrations in SRS stream, river, and basin sediment are within historical levels. Results indicate radioactive materials from effluent release points are not accumulating in the sediment at the sampling locations.

Table 5-8 Maximum Cesium-137 Concentration in Sediments Collected in 2023

Location	Maximum Concentration (pCi/g)	Location
Savannah River Sediment	4.20E-01	RM-129.0
SRS Stream Sediment	5.18E+01	Downstream of R-1
SRS Basin Sediment	1.16E+03	Z Basin

5.4.8 Drinking Water Monitoring

SRS collects drinking water samples from 10 locations at SRS and at 2 water treatment facilities that use water from the Savannah River as a source of drinking water (Environmental Maps, *Domestic Water Systems*).

Onsite drinking water sampling consists of samples from the large treatment plant in A Area, from five small systems, and from groundwater samples from four wells. However, the pump at 905-112G Domestic Water Faucet, one of the small systems, was inoperable in 2023. Onsite sample analyses consist of tritium, gross alpha, gross beta, gamma-emitting radionuclides, strontium-90, and actinides.

SRS monitors potable water at offsite treatment facilities to ensure that SRS operations do not adversely affect the water supply and that drinking water does not exceed Environmental Protection Agency (EPA) drinking water standards for radionuclides. SRS collects samples offsite from the following two South Carolina locations (Figure 5-11):

- Beaufort-Jasper Water and Sewer Authority's Purrysburg Water Treatment Plant
- North Augusta Water Treatment Plant

SRS collects treated water from these two treatment plants, which supply water to the public. Offsite sample analyses consist of tritium, gross alpha, and gross beta.

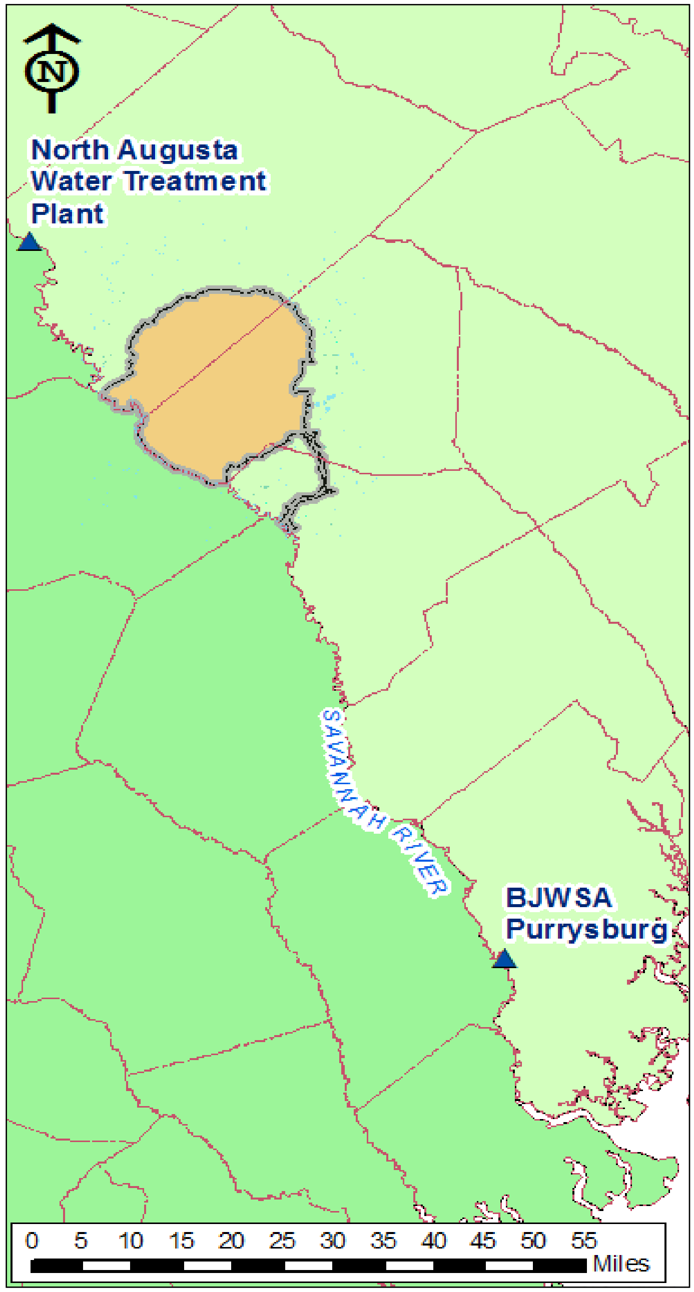


Figure 5-11 Offsite Drinking Water Sampling Locations

The North Augusta Water Treatment Plant samples determine concentrations in drinking water upstream of SRS. The Beaufort-Jasper Water and Sewer Authority's Purrysburg Water Treatment Plant is the furthest downriver sampling location. SRS compares these locations to evaluate potential impacts from upstream sources that include SRS.

5.4.8.1 Drinking Water Results Summary

In 2023, SRS performed gross alpha and gross beta analyses on all onsite and offsite drinking water samples. All results were well below the EPA's 15 pCi/L alpha concentration limit and 50 pCi/L beta concentration limit. In addition, no onsite or offsite drinking water samples exceeded the 20,000 pCi/L EPA standard for tritium, and no onsite drinking water samples exceeded the 8 pCi/L strontium-90 maximum contaminant level (MCL).

Figure 5-12 presents the average drinking water tritium concentrations for the local water treatment plants upstream and downstream from SRS compared to the average of weekly river water samples collected at River Mile (RM)-141.5. The average tritium concentration at RM-141.5 is approximately 2% of the EPA standard for tritium and decreases slightly at the downstream sampling location.

Sample results did not detect tritium, cobalt-60, cesium-137, strontium-90, plutonium-238, plutonium-239/240, americium-241, and curium-243/244 in onsite drinking water test locations. Appendix Table D-14 summarizes on and offsite results. All analytical results are well below the EPA standard.

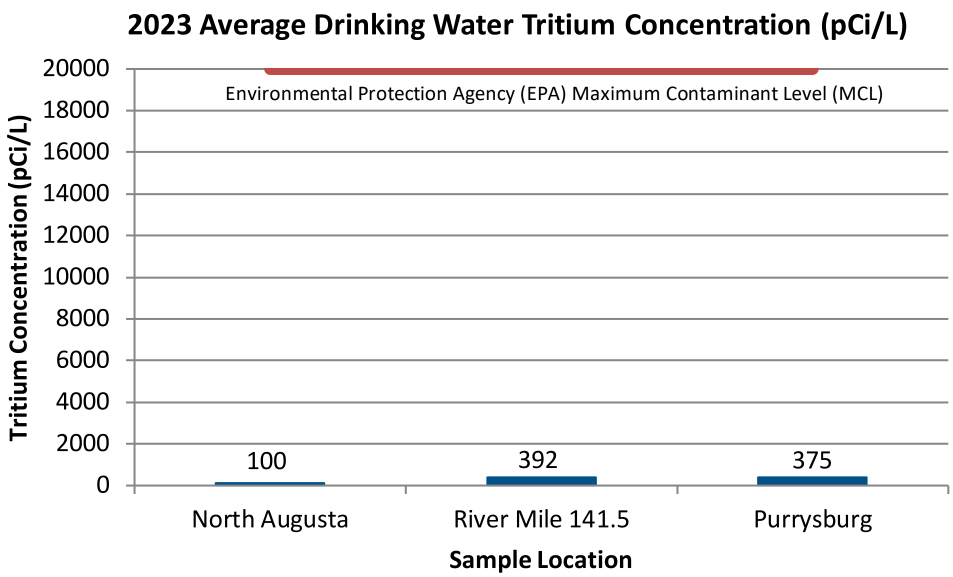


Figure 5-12 Tritium in Offsite Drinking Water and River Mile 141.5

5.5 AQUATIC FOOD PRODUCTS

5.5.1 Fish Collection in the Savannah River

SRS collects aquatic food from the Savannah River, including freshwater fish, saltwater fish, and shellfish. Freshwater fish come from six locations on the Savannah River from above SRS at Augusta, Georgia, to the Highway 301 bridge (Environmental Maps*, Fish Sampling Locations*). Onsite, SRS collects freshwater fish at the mouth of the streams that traverse the Site. Saltwater fish come from the Savannah River mouth near Savannah, Georgia. Additionally, shellfish come from the Savannah River mouth near Savannah or SRS purchases them from Savannah-area vendors that harvest from local saltwater that waters of the Savannah River potentially influence. Table 5-9 identifies the aquatic products collected in 2023. SRS analyzes both edible (meat and skin only) and nonedible (bone) samples of freshwater and saltwater fish. SRS analyzes only the edible portion of shellfish. Analyses of edible samples of all aquatic species collected include gross alpha, gross beta, gamma-emitting radionuclides (specifically, cesium-137 and cobalt-60), strontium-90, technetium-99, and iodine-129. Strontium-90 is the only analysis SRS conducts on the nonedible samples.

Table 5-9 Aquatic Products Collected by SRS in 2023 for the Radiological Environmental Monitoring Program

Freshwater Fish		Saltwater Fish	Shellfish
Bass	Catfish	Mullet	Crab
Flathead	Panfish		Shrimp

5.5.1.1 Fish in Savannah River Results Summary

In 2023, SRS collected freshwater fish from the six locations along the Savannah River in the vicinity of SRS, saltwater fish from the Savannah River mouth, and obtained crabs and shrimp from a Savannah-area supplier that harvests from saltwater potentially influenced by Savannah River water. SRS analyzed 72 freshwater fish composites, 3 saltwater fish composites, and 2 shellfish composites. The freshwater and saltwater composites consisted of three to eight fish each. The shellfish composites comprised separate composites: one from a bushel of crab and another from one bushel of shrimp. The analytical results of the freshwater and saltwater fish as well as shellfish collected are consistent with results for the previous 10 years. Most of the results for the specific radionuclides associated with SRS operations (including cesium-137, cobalt-60, iodine-129, strontium-90, and technetium-99) were nondetectable (75% for freshwater fish, 94% for saltwater fish, and 90% for shellfish). Table 5-10 lists the maximum concentration for those radionuclides detected in the flesh of all fish types sampled. The table also identifies the fish type and the collection location associated with the maximum concentration for each detected radionuclide. SRS did not detect cobalt-60, iodine-129, and technetium-99 in any fish flesh samples. Appendix Tables D-15, D-16, and D-17 for freshwater fish, saltwater fish, and shellfish, respectively, summarize results for all fish and shellfish.

Gross alpha results were below the minimum detectable concentration for saltwater fish and shellfish, but were above the minimum detectable concentration in one sample from one freshwater fish location. However, the gross alpha result was below the threshold to analyze for actinides (0.961 pCi/g). Gross beta activity was detectable in all freshwater and saltwater fish, as well as shellfish. The concentrations are consistent with results from the previous 10 years and are likely due to the naturally occurring radionuclide potassium-40.

Determining the potential dose and risk to the public, as reported in Chapter 6, *Radiological Dose Assessment*, includes data from fish monitoring.

Table 5-10 Location and Fish Type for the Maximum Detected Concentration of Specific Radionuclides Measured in Flesh Samples Collected in 2023

Radionuclide	Maximum Detected Concentration (pCi/g)	Location	Fish Type
Cesium-137	0.349	Lower Three Runs Creek River Mouth	Bass
Strontium-90	0.00385	Upper Three Runs Creek River Mouth	Panfish

5.6 WILDLIFE SURVEILLANCE

5.6.1 Wildlife Monitoring of Game

The wildlife surveillance program monitors wildlife harvested from SRS and subsequently released to the public. Monitoring assesses any impact of Site operations on the wildlife populations and ensures that no individual exceeds the SRS Annual Administrative Game Animal Release Limit of 22 millirem (mrem)/year (yr). Annual game animal hunts for deer, coyote, and feral hogs are open to the public. During 2023, SRS held 2 turkey hunts for Wounded Warriors and residents with mobility impairments in the spring and 10 game animal hunts in the fall. The Site holds the annual hunts to reduce vehicle collisions with animals and control the Site's turkey, deer, coyote, and feral hog populations.

SRS monitors all animals harvested during the annual hunts to ensure the total dose to any hunter is below the SRS 22 mrem/yr limit. SRS uses portable sodium iodide detectors to perform field analyses for cesium-137.

SRS uses the cesium-137 concentration detected in the edible flesh of the animal to calculate dose. The Site assigns a dose to each hunter for every animal harvested if the cesium-137 concentration is above the background concentration of 1.97 pCi/g for hogs (Morrison et al., 2019) and 2.59 pCi/g for deer and coyote (Aucott et al., 2017). The background cesium-137 activities from Aucott et al., 2017 are decay-corrected from January 1, 2013, to the current hunt date. In addition to field monitoring, SRS collects samples of muscle for laboratory analysis of cesium-137 concentrations in both deer and hogs based on the following: 1) A set frequency (every five animals are scanned up until the 20th, and then every 10 animals are scanned [5th, 10th, 15th, 20th, 30th, 40th, and every 10th animal thereafter]), 2) the field-measured cesium-137 activity concentration (for example, an unusual result), or 3) exposure limit considerations (for example, the administrative dose limits for hunters and other considerations). These laboratory-analyzed data provides a quality-control check on the field monitoring results.

Cesium-137 is chemically similar to and behaves like potassium in the environment. Cesium-137 has a half-life of about 30 years and tends to persist in soil, where it can readily enter the food chain through plants. It is widely distributed throughout the world from nuclear weapons detonations from 1945 to 1980 and is present at low levels in all environmental media. Flesh sample laboratory analyses also include cobalt-60, strontium-90, gross alpha, and gross beta. SRS collects bone samples at the same frequency as the flesh samples and analyzes them in the laboratory for strontium-90.

5.6.1.1 Wildlife Results Summary

During the hunts in 2023, SRS monitored a total of 278 deer, 49 feral hogs, 9 coyotes, and 19 turkeys. SRS did not assign a dose to any hunter during the two turkey hunts. This indicates that the cesium-137 activity in the turkeys was below the field equipment's detection limits (~0.6 pCi/g). All animals harvested during the 2023 hunts were released to the hunters based on administrative dose limits (22 mrem/yr, 100 mrem/hunter lifetime).

Appendix Table D-18 summarizes the muscle and bone laboratory sample results of monitored deer and hogs collected in 2023. As seen in previous years, laboratory analysis detected cesium-137 in muscle tissue. Laboratory analysis detected strontium-90, a beta-emitting radionuclide, in bone and in some muscle tissue.

Because its chemistry is similar to calcium, strontium is found more frequently in bone than in muscle tissue. In 2023, all 41 deer bone and all 6 hog bone samples had detectable levels of strontium-90. Strontium-90 was detected in deer bone with an average of 2.12 pCi/g and a maximum of 5.18 pCi/g. Strontium-90 was detected in hog bone with an average of 4.83 pCi/g and a maximum of 11.7 pCi/g.

Generally, the field detector results are similar to that of laboratory methods. Table 5-11 summarizes all field and laboratory measurements. Average cesium-137 concentrations in deer have indicated an overall decreasing trend for the past 50 years, with relatively little change in the last 10 years. (See Figure 5-13.) Chapter 6, *Radiological Dose Assessment,* presents the calculation of dose from consuming wildlife harvested on SRS.

Table 5-11 Cesium-137 Results for Laboratory and Field Measurements in Wildlife for CY 2023

	Number of Animals Field Monitored	Field Gross Average Cs-137 Conc. (pCi/g)	Field Maximum Cs-137 Conc. (pCi/g)	Number of Samples Collected for Laboratory Analysis	Number of Detected Results	Lab Average Cs-137 Conc. (pCi/g)	Lab Maximum Cs-137 Conc. (pCi/g)
Deer	278	1.80	5.98	41	41	1.82	5.26
Hog	49	1.59	4.19	6	6	1.46	3.54
Coyote	9	1.53	4.17	-----	-----	-----	-----
Turkey	19	0.58	0.63	-----	-----	-----	-----

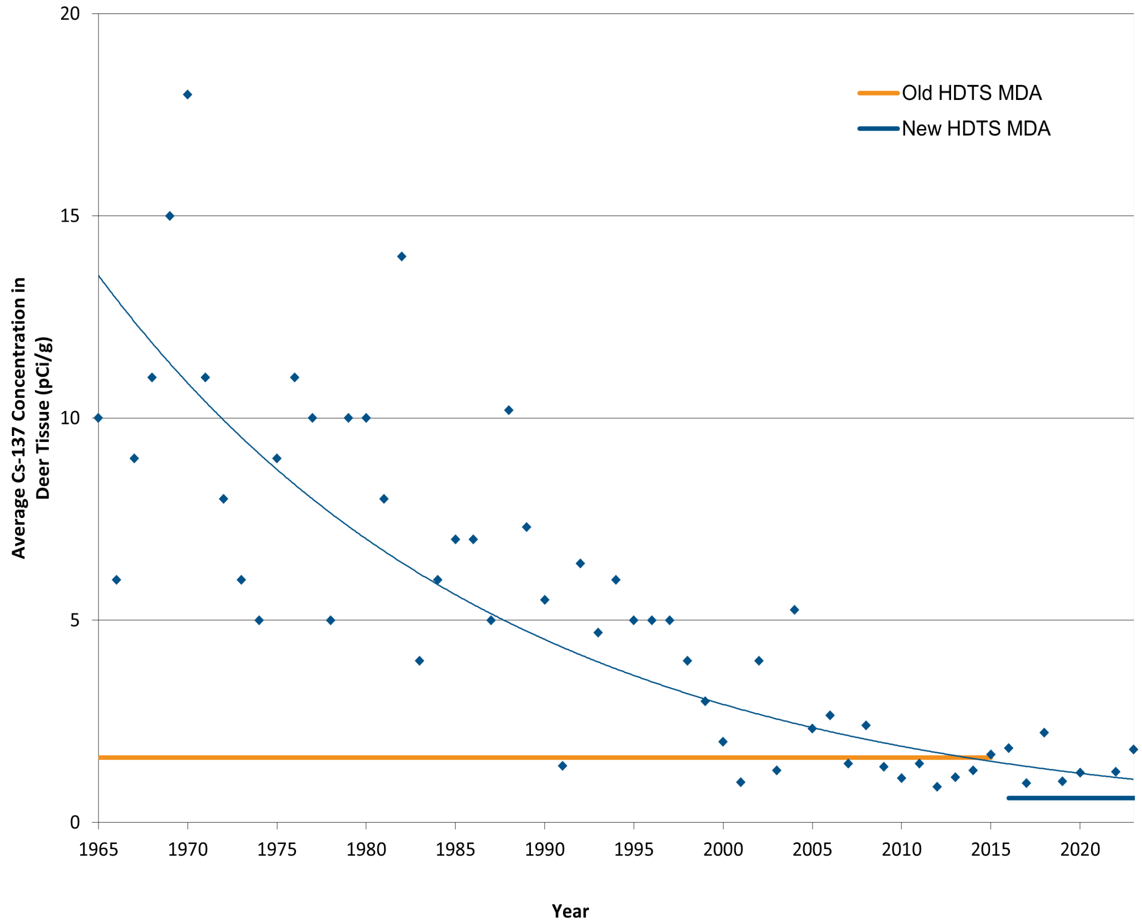


Figure 5-13 Yearly Average Cesium-137 Concentration in Wildlife, 1965–2023

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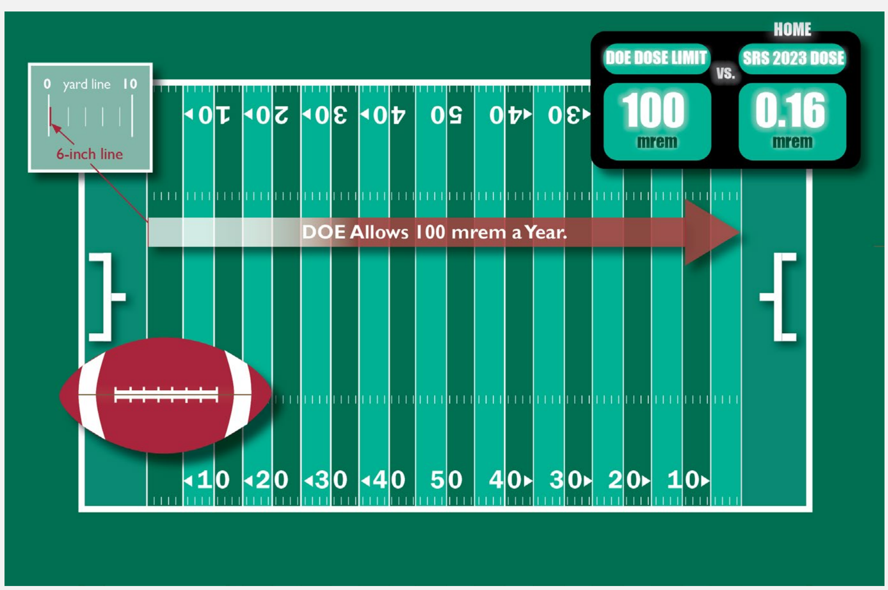
Chapter 6: **Radiological Dose Assessment**

Department of Energy (DOE) Order 458.1, "Radiation Protection of the Public and the Environment," establishes dose limits for the public and biota (plants and animals) that are onsite. DOE establishes these dose limits to protect the public and environment from the potential effects of radiation released during radiological operations. To document that radiation exposure does not exceed the DOE public dose limit of 100 millirem/year (mrem/yr), the Savannah River Site (SRS) calculates the potential dose to the public from radioactive releases in air and water through all reasonable exposure pathways. SRS also considers and quantifies exposure pathways that are nontypical and not included in the standard dose calculations to the representative person. These apply to conservative and unlikely scenarios, such as a member of the public eating fish caught only from the mouths of SRS streams, or to special scenarios, such as hunters who participate in onsite hunts. In addition, DOE Order 458.1 establishes authorized surface contamination limits, which allow SRS to release personal and real property unconditionally. SRS performs radiological surveys on all equipment considered for release and follows applicable procedures.

2023 Highlights

Dose to the Offsite Representative Person—To comply with the DOE all-pathway dose limit of 100 mrem/yr, SRS conservatively adds the doses to the offsite representative person from both Site liquid and air pathways. In 2023, the dose to the offsite representative person was 0.14 mrem from liquid releases and 0.016 mrem from air releases. The total representative person dose was 0.16 mrem, which is 0.16% of the 100 mrem/yr DOE dose limit.



Comparison of DOE's 100 mrem/yr Dose Limit to SRS's 2023 All-Pathway Dose of 0.16 mrem

2023 Highlights (continued)

Sportsman Doses

- **Onsite Hunter**—SRS conducts annual hunts to control onsite deer and wild hog populations. SRS determines the estimated potential dose from eating harvested deer or hog meat for every onsite hunter. During 2023, the maximum potential dose an onsite hunter received was 9.42 mrem, or 9.42% of DOE's 100 mrem/yr all-pathway dose standard.
- **Creek Mouth Fisherman**—SRS estimated the maximum potential dose from fish consumption from bass collected at the mouth of Lower Three Runs at 0.17 mrem. This dose is 0.17% of the 100 mrem/yr DOE dose limit. SRS bases this hypothetical dose on the low probability that during 2023, a fisherman consumed 53 pounds (lbs) of bass caught exclusively from the mouth of Lower Three Runs.

Release of Material Containing Residual Radioactivity—SRS did not release any real property (land or buildings) in 2023. SRS unconditionally released 13,324 items of personal property (such as tools) from radiological areas. Most of these items did not leave SRS but were reused elsewhere on the Site. Therefore, these items required no additional radiological controls postsurvey, as they met DOE Order 458.1 release criteria.

Radiation Dose to Aquatic and Terrestrial Biota—SRS evaluates plant and animal doses for water and land systems using the RESidual RADioactivity (RESRAD) Biota model (version 1.8) (SRS EDAM 2017). This model is a graded approach to evaluating radiation doses to aquatic and terrestrial biota to comply with DOE Order 458.1. For 2023, all SRS water, sediment, and soil locations passed the Level 1 (using maximum measured concentrations) screenings and did not require further assessments.

6.1 INTRODUCTION

Routine Savannah River Site (SRS) operations release controlled amounts of radioactive materials to the environment through air and water. These releases could expose offsite individuals to radiation. To confirm that this potential exposure is below public dose limits, SRS calculates annual dose estimates using environmental monitoring and surveillance data, combined with relevant Site-specific data (such as weather conditions, population characteristics, and river flow). SRS also confirms that the potential doses to plants and animals (biota) living onsite remain below the U.S. Department of Energy (DOE) biota dose limits. This chapter explains radiation doses, describes how SRS calculates doses, and presents the estimated doses from SRS activities for 2023.

SRS used the data from the monitoring programs described in Chapter 5, *Radiological Environmental Monitoring Program,* to calculate the potential doses to the public. *Radiological Impact of 2023 Operations at the Savannah River Site* (Stagich, Dixon, and Peyton 2024) details SRS dose calculation methods and results.

6.2 WHAT IS RADIATION DOSE?

Radioactivity represents the rate at which energy in the form of radiation is emitted through radioactive decay and is measured in U.S. units of curies (Ci). Radiation dose to a person is the amount of energy the human body absorbs from a radiation source located either inside or outside of the body and is expressed as absorbed or effective dose. Absorbed dose is the amount of energy deposited per unit mass, and effective dose further accounts for the source's radiation type and the specific tissue or organ, or both, exposed. The effective dose is a calculated value that can be used to set regulatory limits that protect individuals against potential long-term health effects. SRS typically reports dose in millirem, which is one-thousandth of a rem. A rem is a standard unit used to measure the amount of radiation deposited in human tissue.

Humans, plants, and animals potentially receive radiation doses from natural and manmade sources. The average annual background dose for all people living in the United States is 625 mrem (NCRP 2009). This includes an average background dose of 311 mrem from naturally occurring radionuclides found in our bodies, in the earth, and from cosmic radiation, such as from the sun. Manmade sources and their doses include medical procedures (300 mrem), consumer products (13 mrem), and industrial and occupational exposures from facilities such as SRS (less than 1 mrem).

Chapter 6—Key Terms

Exposure pathway *is the way that releases of radionuclides into the water and air could impact a person.*

Maximally exposed individual *is a hypothetical member of the public (typically an adult male) who lives near the SRS boundary and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible radiation dose.*

Reference person *is a hypothetical person with average physical and physiological characteristics—including factors such as age and gender—used internationally to standardize radiation dose calculations.*

Representative person *is a hypothetical individual receiving a dose that is representative of highly exposed individuals in the population. The calculations incorporate age, gender, food and water consumption, and breathing rate. At SRS, the representative person equates to the 95th percentile of applicable national human-use radiation exposure data.*

Current System (U.S.)	International System (SI)	Conversion
curie (Ci)	becquerel (Bq)	1 Ci = 3.7×10^{10} Bq
rad (radiation absorbed dose)	gray (Gy)	1 rad = 0.01 Gy = 0.01 J/kg
rem (roentgen equivalent man)	sievert (Sv)	1 rem = 0.01 Sv = 0.01 J/kg

Note:

Further definitions and unit conversions are provided in Appendix F: *Glossary* and Appendix H: *Units of Measure*

DOE has established dose limits to the public so that DOE operations will not contribute significantly to this average annual exposure. DOE Order 458.1 (DOE 2013) establishes 100 mrem/yr (1 millisievert [mSv]/yr) as the annual dose limit to a member of the public. This is also referred to as the total effective dose (TED). Doses will be presented in both the U.S. units (millirem) and the equivalent International System of Units (millisievert) where appropriate. Exposure to radiation primarily occurs through the following pathways, which Figure 6-1 illustrates:

- Inhaling air
- Ingesting water and food
- Absorbing through skin
- Direct (external) exposure to radionuclides in soil, air, and water

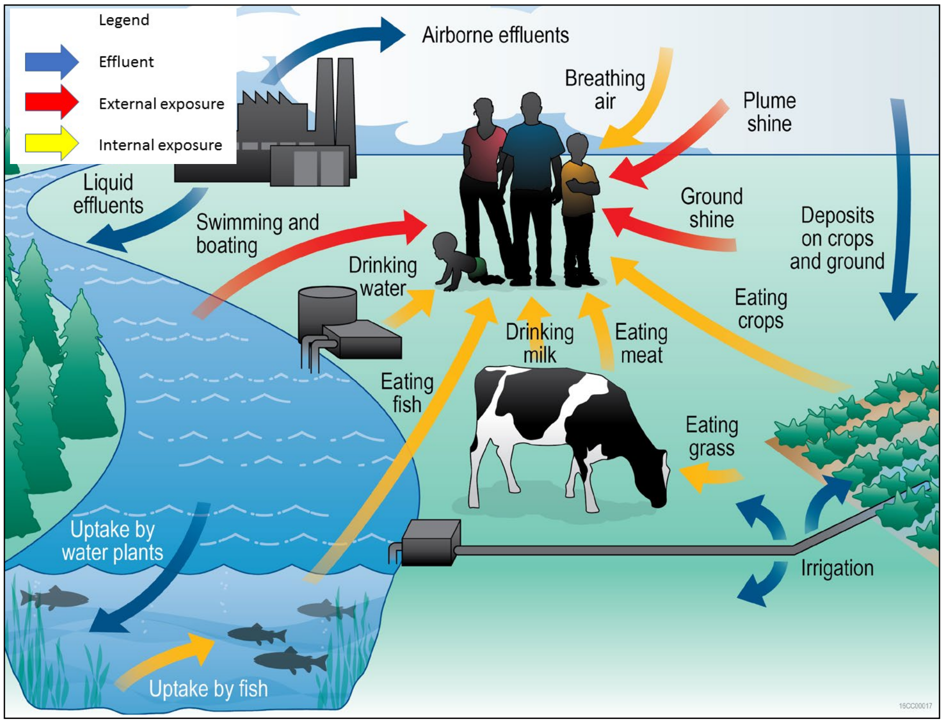


Figure 6-1 Exposure Pathways to Humans from Air and Liquid Effluents

6.3 CALCULATING DOSE

To comply with DOE Order 458.1, SRS has developed a set of environmental transport and dosimetry models that employ technically valid methodologies comparable to those accepted by DOE and other agencies. These models estimate potential radiation doses to a representative person or a maximally exposed individual (MEI). The MEI is a hypothetical member of the public (typically an adult male) who lives near the SRS boundary and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible radiation dose. In comparison, the representative person is a hypothetical individual receiving a dose that is representative of highly exposed individuals in the population. The calculations incorporate age, gender, food and water consumption, and breathing rate. The MEI is usually assumed to be an adult male, and the representative person embodies all ages and genders of the highly exposed individuals in the population. The representative person or MEI is a hypothetical offsite individual constructed to receive the most dose. This dose is not likely to underestimate or substantially overestimate the potential dose. The estimated collective doses are as realistic as practicable and include all members of the actual exposed population.

Since 2012, SRS has used the representative person concept to determine whether the Site is complying with the DOE public dose limit. DOE Order 458.1 defines the representative person as an individual receiving a dose that is representative of the more highly exposed individuals in the population. The representative person dose is based on reference person usage parameters developed specifically for SRS and related to human behavior and characteristics that help determine an individual's exposure to an agent such as an environmental contaminant. The reference person is weighted based on gender and age. The International Commission on Radiation Protection Publication 89 (ICRP 2002) groups these ages as: Infant (0 years), 1 year, 5 years, 10 years, 15 years, and Adult (17 years and older). The reference person accounts for the fact that younger people are generally more sensitive to radioactivity than older people.

The SRS representative person falls at the 95th percentile (or the upper tail) of national and regional data for a particular exposure factor from the U.S. Environmental Protection Agency's (EPA's) *Exposure Factors Handbook*, 2011 Edition (EPA 2011) and recently updated chapters (EPA 2018a, 2018b, 2018c, 2019a, 2019b). SRS also developed human usage parameters at the 50th percentile for calculating dose to a "typical" person when determining population doses. The SRS report *Site-Specific Reference Person Parameters and Derived Concentration Standards for SRS* (Stone and Jannik 2013) documents SRS-specific reference and typical person usage parameters. The SRS report *Land and Water Use Characteristics and Human Health Input Parameters for Use in Environmental Dosimetry and Risk Assessments at the Savannah River Site* (Stagich 2021) documents all other applicable land- and water-use parameters in the dose calculations. These parameters include local characteristics of food production, river recreational activities, and other human usage parameters required in SRS models to calculate radiation dose exposure.

To determine whether the Site is complying with DOE public dose requirements, SRS calculates the potential doses to members of the public from Site effluent releases of radioactive materials (air and liquid) for the following scenarios:

- Representative person living near the SRS boundary
- Adult person working at the Three Rivers Landfill located on SRS (near B Area)
- Population living within a 50-mile (80-kilometer [km]) radius of SRS's H Area, the location of most radiological releases

For all routine environmental dose calculations, SRS uses environmental transport and dose models based on codes the Nuclear Regulatory Commission (NRC) developed (NRC 1977). The NRC-based transport models use DOE-accepted methods, consider all significant exposure pathways, and permit detailed analysis of the effects of routine operations. To demonstrate compliance with DOE Order 458.1, SRS uses the MAXDOSE-SR and POPDOSE-SR codes for air releases (representative person and population, respectively) and LAPTAP XL© for liquid releases. The SRS *Environmental Dose Assessment Manual* (SRNL 2023) describes these models.

At SRS, the dose to a representative person is based on the following:

- SRS-specific reference person usage parameters at the 95th percentile of appropriate national or regional data (Stone and Jannik 2013)
- Reference person (gender- and age-averaged) ingestion and inhalation dose coefficients from the *DOE Derived Concentration Technical Standard*, DOE-STD-1196-2022 (DOE 2022)
- External dose coefficients derived from the EPA's Federal Guidance Report (FGR) #15 (EPA 2019b). FGR #15 is a revision to FGR #12 (EPA 1993), which incorporated age-specific external dose coefficients. SRS used these age-specific values to develop reference-person external dose coefficients in a method similar to what DOE 2011 documents. SRS started using these newly developed reference person external dose coefficients in 2019. The SRS report *Updated External Exposure Dose Coefficients*, SRNL-L3200-2020-00014 (Laird and Jannik 2020) documents the external dose coefficients used.

6.3.1 Weather Database

Complete and accurate weather (meteorological) data are important to determine offsite contamination levels. To show compliance with DOE environmental orders, potential offsite doses from releases of radioactivity to the atmosphere are calculated with the quality-assured meteorological data for A Area, K Area (for combined releases from C Area, K Area, and L Area), and H Area (for combined releases from all other areas and for the Center of Site). The meteorological databases for the years 2014–2018, are the most recent 5-year compilation period (Bell 2020).

To show compliance with EPA regulations, only the H-Area database was used in the calculations because the EPA-required dosimetry code is limited to a single release location. Figure 6-2 presents the H-Area wind rose plot for 2014−2018 and shows the direction and frequency the wind blows. SRS bases its wind rose plot in H Area because it is where most of SRS's radiological air releases occur. As shown, the wind blows the most towards the East-Northeast sector (about 10% of the time), but there is no strongly prevalent wind direction.

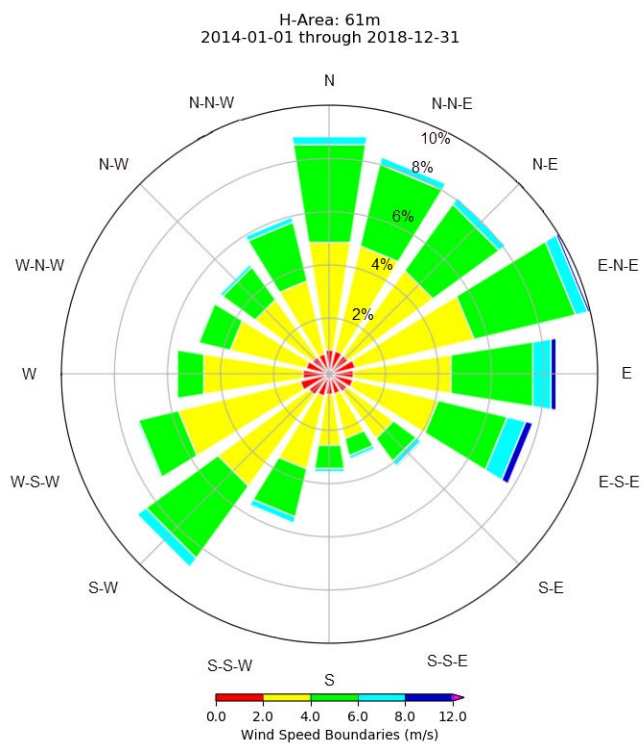


Figure 6-2 2014–2018 Wind Rose Plot for H Area (Showing Direction and Frequency Toward Which the Wind Blows)

6.3.2 Population Database and Distribution

SRS calculates the collective (population) doses from air releases for the population within a 50-mile radius of the H Area. Based on the U.S. Census Bureau's 2020 data, the population within a 50-mile radius of H Area is 838,833 people. This translates to about 111 people per square mile outside the SRS boundary, with the largest concentration in the Augusta metropolitan area.

SRS calculates the collective (population) doses from routine SRS liquid releases as the sum of the following five contributing categories:

- Consumers of water from Beaufort-Jasper Water and Sewer Authority (BJWSA)
- Consumers of water from City of Savannah Industrial and Domestic (I&D) Domestic Water Supply Plant
- Consumers of fish and invertebrates of Savannah River origin
- Participants of recreational activities on the Savannah River
- Gardeners and farmers irrigating foodstuffs with river water near River Mile (RM) 141.5

Table 6-1 presents the number of people currently served by the three drinking water supply plants that are downriver of SRS.

Table 6-1 Regional Water Supply Service

Water Supply Plant	Nearest City	Population Served
City of Savannah Industrial and Domestic (I&D) Domestic Water Supply	Port Wentworth, Georgia	70,000 people
Beaufort-Jasper Water and Sewer Authority (BJWSA) Chelsea Water Treatment Plant	Beaufort, South Carolina	108,000 people
BJWSA Purrysburg Water Treatment Plant	Beaufort, South Carolina	86,700 people

6.3.3 River Flow Rate Data

The annual rate of flow in the Savannah River, which varies greatly from year to year, is an important criterion for determining down-river concentrations of the contaminants SRS releases. The U.S. Geological Survey (USGS) measures Savannah River flow rates downriver of SRS at its RM-118.8 gauging station near the U.S. Hwy 301 Bridge.

Figure 6-3 provides the river flow rates the USGS measured at this location from 1983 to 2023. It also shows that the average river flow rate for these years is about 10,011 cubic feet per second (cfs). Since 2020, the measured average flow rates have been trending downward but slightly increased in 2023 with a rate of 9,932 cfs.

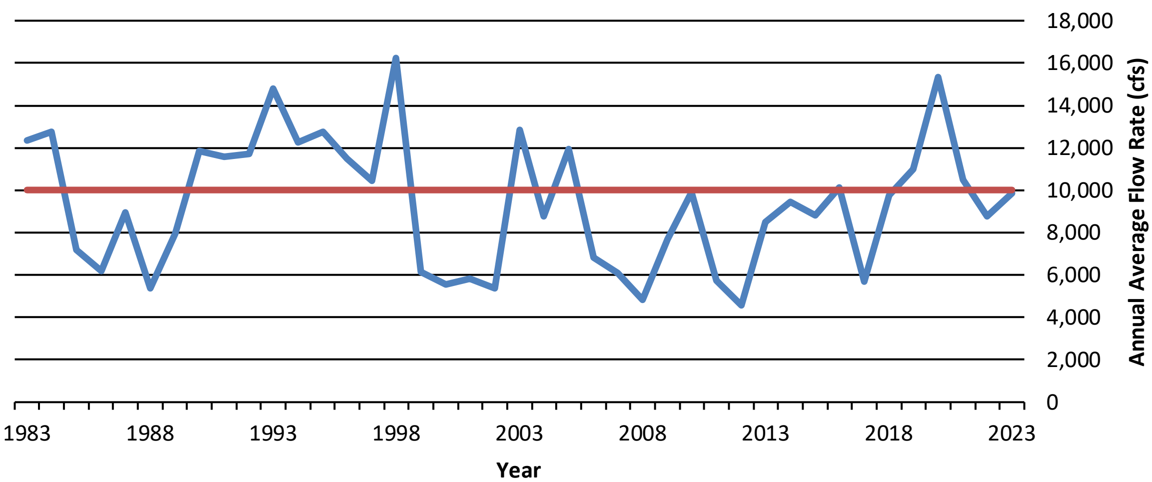


Figure 6-3 Savannah River Annual Average Flow Rates Measured by USGS at River Mile 118.8

For 2023, SRS used a calculated “effective” Savannah River flow rate of 7,939 cfs in the dose calculations. The 2023 effective flow rate is about 10% more than the 2022 effective flow rate of 7,230 cfs. This effective flow rate (based on actual measured tritium concentrations in the river) is more conservative than the 2023 USGS measured flow rate of 9,895 cfs (based on daily flow rates). By using a more conservative method, the calculated effective flow rate assumes radioactive material is less diluted and, therefore, increases the estimated potential dose.

6.4 OFFSITE REPRESENTATIVE PERSON DOSE CALCULATION RESULTS

To determine whether the Site is complying with DOE public dose requirements, SRS calculates the potential offsite doses from Site effluent releases of radioactive materials in air and liquid pathways for a representative person living near the SRS boundary. SRS calculates the pathways individually and then adds the two results to obtain the total representative person dose.

6.4.1 Liquid Pathway

For routine liquid releases, DOE and the EPA require demonstration of compliance with annual dose limits and maximum contaminant levels (MCLs), respectively. For the EPA, SRS compares the potential liquid source term concentrations in the drinking water with the MCLs. For DOE’s annual dose limits, SRS calculates the offsite individual and population doses resulting from exposure to drinking water, ingestion of aquatic foods, recreational activities in the Savannah River, and ingestion of foodstuffs irrigated with river water.

6.4.1.1 Liquid Release Source Terms

Tritium accounts for more than 99% of the total amount of radioactivity released from the Site to the Savannah River. In 2023, SRS released 378 curies (Ci) of tritium to the river, a 9% increase from the 2022 amount of 348 Ci. For compliance dose calculations, SRS used the measured direct release total (378 Ci), which was higher than the stream transport measurement (314 Ci).

During 2023, in addition to the 378 Ci SRS released, the Georgia Power Company's Vogtle Electric Generating Plant (VEGP) released 2,183 Ci of tritium to the Savannah River, and about 16.4 Ci migrated from the Barnwell Low-Level Disposal Facility (BLLDF).

Table 6-2 shows, by radionuclide, the amount of radioactivity in liquid form that SRS released in 2023. SRS uses these release amounts in the dose calculations. This table uses the "river transport" total of 2,779 Ci of tritium, which includes SRS, VEGP, and BLLDF contributions. Chapter 5, *Radiological Environmental Monitoring Program,* discusses these sources of data.

Radionuclide Concentrations in Savannah River Water, Drinking Water, and Fish—SRS measures concentrations of tritium in the river water and cesium-137 in fish at several locations along the Savannah River. SRS uses these direct measurements to make dose determinations. The amounts of all other radionuclides SRS released are so small that conventional analytical techniques usually cannot detect their

Table 6-2 2023 Liquid Release Source Term and 12-Month Average Downriver Radionuclide Concentrations Compared to the EPA's Drinking Water Maximum Contaminant Levels (MCLs)

Radionuclide	Curies Released	12-Month Average Concentration (pCi/L) Below SRS[a]	BJWSA Purrysburg Plant[b]	EPA MCL[c]
H-3[d]	2.78E+03	3.92E+02	3.75E+02	2.00E+04
C-14	4.11E-03	5.79E-04	5.54E-04	2.00E+03
Sr-90	1.90E-02	2.67E-03	2.56E-03	8.00E+00
Tc-99	1.24E-02	1.75E-03	1.68E-03	9.00E+02
I-129	1.45E-02	2.04E-03	1.95E-03	1.00E+00
Cs-137[e]	1.67E-01	2.36E-02	2.26E-02	2.00E+02
U-234	5.80E-02	8.18E-03	7.82E-03	1.03E+01
U-235	4.04E-03	5.70E-04	5.45E-04	4.67E-01
U-238	6.97E-02	9.83E-03	9.40E-03	1.00E+01
Np-237	3.60E-05	5.07E-06	4.85E-06	1.50E+01
Pu-238	2.52E-04	3.55E-05	3.40E-05	1.50E+01
Pu-239	8.96E-05	1.26E-05	1.21E-05	1.50E+01
Am-241	2.35E-04	3.31E-05	3.17E-05	1.50E+01
Cm-244	1.47E-04	2.08E-05	1.99E-05	1.50E+01
Gross Alpha	1.54E-02	2.18E-03	2.08E-03	1.50E+01
Nonvolatile Beta	5.73E-02	8.08E-03	7.73E-03	8.00E+00

[a] Near Savannah River Mile 141.5, downriver of SRS near the Steel Creek mouth

[b] Beaufort-Jasper Water and Sewer Authority, drinking water at the Purrysburg Water Treatment Plant

[c] Maximum contaminant levels (MCLs) for uranium based on radioisotope-specific activity X 30 µg/L X isotopic abundance

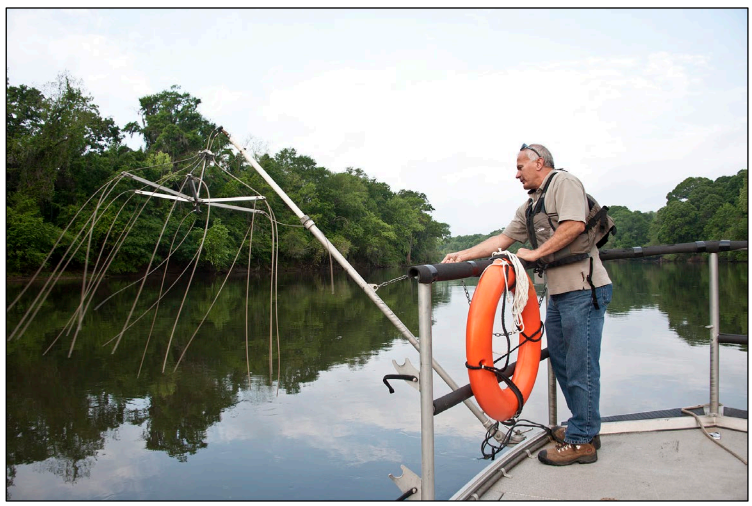
[d] Actual measurements of the Savannah River water at the various locations are the basis for the tritium concentrations and source term. They include contributions from Vogtle Electric Generating Plant (VEGP) and the Barnwell Low-Level Disposal Facility (BLLDF). In 2023, SRS used the effective river flow rate of 7,939 cfs (see Section 6.3.3) to calculate all other radionuclide concentrations.

[e] Depending on which value is higher, the Cs-137 release total is based on concentrations measured in Steel Creek fish or on the actual measured effluent + migration release total from the Site. (See section "Radionuclide Concentrations in Fish" below.)

concentration in the Savannah River. The Site calculates the concentrations in the river based on the annual release amounts and river flow rates and then compares them to the Safe Drinking Water Act, 40 CFR 141 (EPA 2000) MCL for each radionuclide.

Radionuclide Concentrations in River Water and Treated Drinking Water—In 2023, the 12-month average tritium concentration measured in Savannah River water near RM-141.5 was 392 picocuries per liter (pCi/L). This concentration is well below the EPA's MCL for tritium of 20,000 pCi/L. Table 6-2 shows the measured concentrations of tritium in the Savannah River near RM-141.5 and at the BJWSA Purrysburg Water Treatment Facility, which is representative of the BJWSA Chelsea and the City of Savannah I&D water treatment plants. These downriver tritium concentrations include tritium releases from SRS, VEGP, and BLLDF. The calculated concentrations are provided for the other released radionuclides and a comparison of these concentrations to the EPA's MCLs. As shown, all radionuclide concentrations are well below the MCLs. Because SRS releases more than one radionuclide, the sum of the fractions of the reported concentration of each radionuclide divided by its corresponding MCL must not exceed 1.0. The sum of the fractions for the locations near RM-141.5 and at the BJWSA Purrysburg Water Treatment Facility were below 1.0 at 0.026 and 0.025, respectively.

Radionuclide Concentrations in Fish—Consuming fish is an important dose pathway for the representative person. Fish exhibit a high degree of bioaccumulation, or gradual buildup of a contaminant in a living organism, for certain elements. For cesium (including radioactive isotopes of cesium, such as cesium-137), the bioaccumulation factor for Savannah River fish is estimated to be 3,000, meaning the cesium concentration in fish flesh is about 3,000 times the concentration of cesium found in the water in which the fish live (Carlton et al. 1994).



SRS Samples Fish from the Savannah River Using Electrofishing Methods.

Because of this high bioaccumulation factor, SRS can detect cesium-137 more easily in fish flesh than in river water. Therefore, when conservative to do so, SRS bases the fish pathway dose from cesium-137 directly on analyzing the fish collected from the location of the hypothetical representative person, which is near the mouth of Steel Creek, at RM-141.5. In 2023, SRS used the Steel Creek fish concentrations to determine the Site's overall cesium-137 release value of 0.167 Ci, which is conservatively higher than the measured cesium-137 effluent release value of 0.00883 Ci.

6.4.1.2 Dose to the Representative Person

SRS estimates the 2023 potential dose to the representative person from all liquid pathways (including irrigation) to be 0.14 mrem (0.0014 mSv), which is 18% less than the comparable dose of 0.17 mrem in 2022.

Table 6-3 shows that the total liquid pathway dose is 0.14% of the DOE public dose limit of 100 mrem/yr (1 mSv/yr).

The fish consumption pathway accounted for 60%, and the drinking water pathway accounted for 7%. About 32% of the 2023 total dose to the representative person is from consuming vegetables grown and meat and milk from animals raised using Savannah River water from near RM 141.5. As Figure 6-4 shows, cesium-137 (65%), nonvolatile beta (8%), tritium (5%), uranium-234 (5%) and uranium-238 (5%) contributed the most to the liquid pathway dose.

Table 6-3 Potential Dose to the Representative Person from SRS Liquid Releases in 2023

	Dose (mrem)	Applicable Limit (mrem)	Percent of Limit (%)
Near Site Boundary (All Liquid Pathways)			
All Liquid Pathways Except Irrigation	0.10		
Irrigation Pathways	0.047		
Total Liquid Pathways	0.14	100[a]	0.14%

Note:

Calculations involving results shown above use all available digits, while the results shown in this table are rounded for ease of reporting.

[a] DOE dose limit: 100 mrem/yr (DOE Order 458.1)

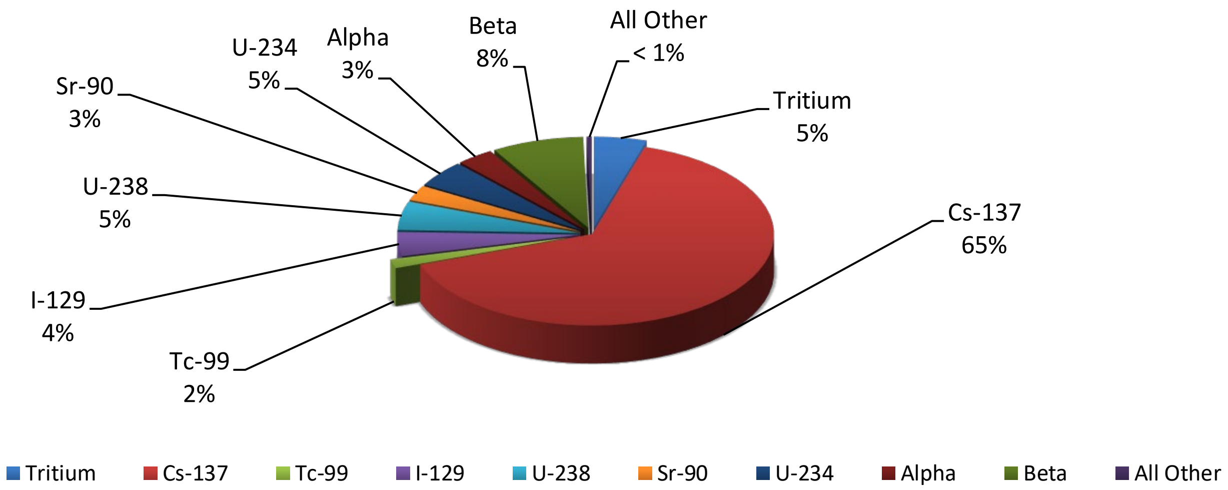


Figure 6-4 Radionuclide Contributions to the 2023 SRS Total Liquid Pathway Dose of 0.14 mrem (0.0014 mSv)

6.4.1.3 Drinking Water Pathway Dose

People living downriver of SRS may receive some dose by drinking water that contains radioactive releases from the Site as well as releases from VEGP and BLLDF. In 2023, SRS estimated the maximum potential drinking water dose from all sources to be 0.035 mrem (0.00035 mSv). Tritium in downriver drinking water represented the highest percentage of the dose (about 81%) received by customers of the three downriver water treatment plants.

SRS-only releases were responsible for a maximum potential drinking water dose of 0.010 mrem (0.00010 mSv). DOE and the EPA do not have a specific regulatory drinking water dose limit, but the EPA bases its MCLs, as defined in 40 CFR 141 (EPA 2000), on a potential dose of about 4 mrem/yr for beta and gamma emitters. The 2023 maximum drinking water dose of 0.010 mrem is well below this value.

6.4.1.4 Collective (Population) Dose

The collective (population) dose is the sum of the individual effective doses received in a given time period by a specified population from exposure to a specified population from exposure to a specified source of radiation. The collective dose is often used to establish the total health effects of a release involving radiation to an exposed population.

SRS calculates the collective drinking water consumption dose for the separate population groups that are customers of the Beaufort-Jasper Water and Sewer Authority (BJWSA) and City of Savannah Industrial and Domestic (City of Savannah I&D) water treatment plants. Calculations of collective doses from agricultural irrigation assume that major food types (vegetables, milk, and meat) either grow or originate from animals kept on 1,000-acre parcels of land in the SRS area, with the population within 50 miles of SRS consuming all the food produced on these 1,000-acre parcels.

SRS calculates the collective dose in person-rem as the average dose per typical person, multiplied by the number of people exposed. DOE Order 458.1 requires that SRS calculate and report a collective dose, but there is not a separate collective dose limit for comparison. In 2023, the collective dose from all liquid pathways was 2.3 person-rem (0.023 person-Sv).

6.4.2 Air Pathway

6.4.2.1 Air Release Source Terms

Chapter 5, *Radiological Environmental Monitoring Program*, documents the 2023 radioactive air release quantities used as the source term in SRS dose calculations. Tritium accounts for most of the dose from SRS air releases.

6.4.2.2 Air Concentrations

SRS uses calculated radionuclide concentrations instead of measured concentrations for dose determinations because conventional analytical methods do not detect most of the radionuclides that SRS released in the air samples collected at the Site perimeter and offsite locations. However, SRS can routinely measure tritium concentrations at locations along the Site perimeter and compare these results with the calculated concentrations to confirm the dose models. In 2023, this comparison showed that the dose models used at SRS were about two times more conservative than the actual measured tritium concentrations.

6.4.2.3 Dose to the Representative Person

The 2023 estimated dose from air releases to the representative person is 0.016 mrem (0.00016 mSv), 0.16% of the EPA air pathway limit of 10 mrem per year. DOE Order 458.1 requires that all DOE sites comply with the EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations. Table 6-4 compares the representative person dose with the EPA dose limit of 10 mrem/yr. The 2023 dose was the same as the 2022 dose of 0.016 mrem (0.00016 mSv). Refer to Chapter 5, *Radiological*

Environmental Monitoring Program, Section 5.3.2 for details concerning these measurements. The air pathway representative person is located at the SRS boundary in the north compass point direction, near New Ellenton, South Carolina.

Table 6-4 Potential Doses to the Representative Person and to the MEI from SRS Air Releases in 2023 and Comparison to the Applicable Dose Limit

	DOE Representative Person (MAXDOSE-SR)	EPA NESHAP MEI (CAP88-PC)
Calculated dose (mrem)	0.016	0.028
Applicable Limit (mrem)	10[a]	10[b]
Percent of Limit (%)	0.16	0.28

Note:
EPA = Environmental Protection Agency, MEI = maximally exposed individual NESHAP = National Emission Standards for Hazardous Air Pollutants
[a] DOE: DOE Order 458.1
[b] EPA: (NESHAP) 40 CFR 61, Subpart H

As Figure 6-5 shows, tritium releases were 72% of the air pathway dose to the representative person. Iodine-129 accounted for 16% of the dose. Krypton-85 (8%), cesium-137 (2%), and strontium-90 (1%) were the only other individual radionuclides that contributed 1% or more to the representative person dose.

The predominant ways a representative person received radiation dose from air releases were consuming vegetables (35%), inhalation (32%), and consuming cow milk (21%).

In 2017, the Site began to calculate the potential dose for an adult worker at the Three Rivers Landfill near SRS's B Area. The public has direct access to the landfill from South Carolina Highway 125, which is outside of the Site's security perimeter. The workers at Three Rivers Landfill are not Site employees and are now considered members of the public to comply with DOE Order 458.1.

For this assessment, SRS assumed that an adult person worked at Three Rivers Landfill for 2,000 hours during the year (8 hours a day, 5 days a week, 50 weeks a year). SRS also assumed that this worker was exposed only from the inhalation and external-exposure pathways. The Site did not consider any locally grown food consumption at this industrial location.

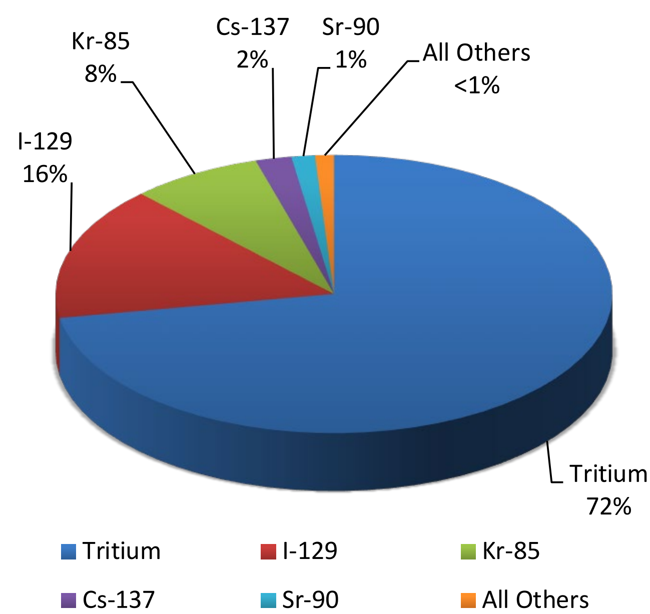


Figure 6-5 Radionuclide Contributions to the 2023 SRS Air Pathway Dose of 0.016 mrem (0.00016 mSv)

For 2023, SRS calculated a potential dose of 0.011 mrem (0.00011 mSv) to a Three Rivers Landfill worker. This dose is less than the representative person dose of 0.016 mrem that SRS reported to comply with DOE Order 458.1.

6.4.2.4 Collective (Population) Dose

SRS calculates the air pathway collective dose for all 838,833 members of the population living within 50 miles of the Site's H Area. In 2023, SRS estimated the airborne pathway collective dose to be 0.73 person-rem (0.0073 person-Sv). DOE Order 458.1 requires that SRS calculate and report a collective dose, but there is not a separate collective dose limit for comparison.

6.4.2.5 National Emission Standards for Hazardous Air Pollutants (NESHAP) Compliance

DOE Order 458.1 requires the Site to comply with the EPA's NESHAP regulations (EPA 2002). To demonstrate this compliance, SRS calculated the maximally exposed individual (MEI) and collective doses using the following:

- The CAP88 PC version 4.1.0.2 computer code (released January 2020), which the EPA requires
- The 2023 airborne-release source term
- Site-specific input parameters

The EPA requires using the MEI concept and not the representative person concept, and it specifies most of the input parameters in the CAP88 PC program. The EPA requires specific approval for any changes to these parameters.

For 2023, SRS calculated doses to two potential MEIs to demonstrate the Site complied with the EPA's 10 mrem/yr (0.1 mSv/yr) public dose limit for air emissions from DOE sites. One potential MEI was at the usual offsite location, near the Site's northern boundary. The second potential MEI was a worker at the Three Rivers Landfill. The EPA requires that the Site consider all exposure pathways (including food consumption) for the potential MEI, even for an industrial worker.

NESHAP dose calculations use H Area as the location for all Site releases because a large majority of SRS's radiological air releases are from the area's Tritium and Separations facilities (Minter et al. 2018).

SRS estimated the MEI dose at the Site boundary to be 0.0263 mrem (0.000263 mSv). SRS estimated the MEI dose for the Three Rivers Landfill worker to be 0.0277 mrem (0.000277 mSv). For 2023, SRS reported the slightly higher Three Rivers Landfill worker dose of 0.0277 mrem for NESHAP compliance. This dose is 0.28% of the 10 mrem/yr EPA limit.

The radionuclides that accounted for most of the MEI dose, were tritium oxide (48%), iodine-129 (33%), elemental tritium (14%), krypton-85 (2.0%), cesium-137 (1.2%), and strontium-90 (1.0%). No other radionuclide contributed 1% or more to the total MEI dose. The 2023 NESHAP compliance dose (Three Rivers Landfill dose) is 10% less than the 2022 dose of 0.0307 mrem (0.000307 mSv). Refer to Chapter 5, *Radiological Environmental Monitoring Program*, Section 5.3.2 for details concerning these measurements.

6.4.3 All-Pathway Doses

6.4.3.1 All-Pathway Representative Person Dose

As stated in DOE Order 458.1, the all-pathway dose limit to a member of the public is 100 mrem/yr. SRS ensures a conservative estimate by combining the representative person airborne all-pathway and liquid all-pathway dose estimates, even though the two estimated doses are for hypothetical individuals living in different geographic locations.

For 2023, the potential representative person all-pathway dose is 0.16 mrem (0.0016 mSv), calculated as 0.14 mrem from liquid pathways plus 0.016 mrem from air pathways. As Table 6-5 shows, the all-pathway representative person dose is 0.16% of the 100 mrem/yr (1 mSv/yr) DOE dose limit. The all-pathway total dose is less than the 2022 total dose of 0.18 mrem (0.0018 mSv). As discussed previously, SRS attributes this decrease in 2023 to the decrease in radioactive liquid releases.

Figure 6-6 shows a 10-year history of SRS's all-pathway (airborne pathways plus liquid pathways) doses to the representative person.

Table 6-5 Potential Dose to the Representative Person from All Standard Pathways in 2023

Pathways	Committed Dose (mrem)	Applicable Limit (mrem)	Percent of Limit
Near Site Boundary (All Pathways)			
Total Liquid Pathways	0.14	100[a]	0.14%
Total Air Pathways	0.016	10[a,b]	0.16%
Total All Pathways	0.16	100[a]	0.16%

[a] DOE: DOE Order 458.1
[b] EPA: (NESHAP) 40 CFR 61, Subpart H

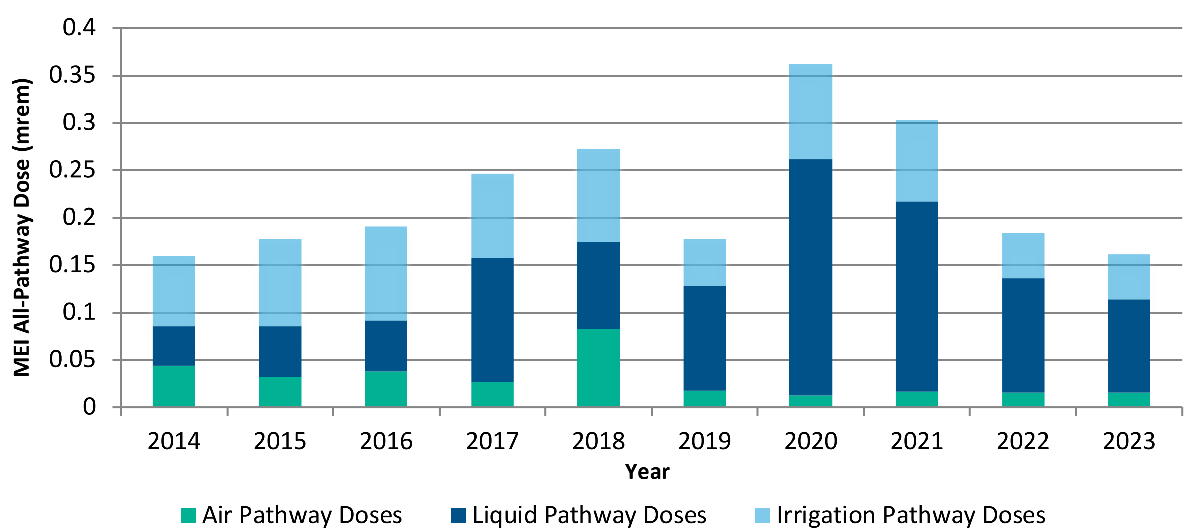


Figure 6-6 10-Year History of SRS Maximum Potential All-Pathway Doses

Table 6-6 Potential Collective Dose to the 50-Mile Population Surrounding SRS, Including the People Served by the Downriver Drinking Water Plants (Based on Dose to a Typical Person from all Standard Pathways in 2023)

Pathways	Collective Dose (person-rem)	Natural Background Dose (person-rem)	Percent of Natural Background
50-mile Population Dose (All Pathways)			
Total Liquid Pathways	2.3	Not Applicable	Not Applicable
Total Air Pathways	0.73	Not Applicable	Not Applicable
Total All Pathways	**3.0**	**261,000** [a]	**< 0.01%**

[a] Calculated as 838,833 people (surrounding SRS population) times 311 mrem (0.311 rem) per person per year, which is the average annual natural background dose for people living in the United States (NCRP 2009).

6.4.3.2 All-Pathway Collective (Population) Dose

DOE Order 458.1 requires that SRS calculate and report a collective dose, but there is not a separate collective dose limit for comparison. For 2023, the total potential collective all-pathway dose is 3.0 person-rem (0.030 person-Sv), calculated as 2.3 person-rem from liquid pathways plus 0.73 person-rem from air pathways. To compare, the annual collective dose from natural sources of radiation that the population within the 50-mile radius surrounding SRS's H Area is about 261,000 person-rem. As Table 6-6 shows, the SRS all-pathway collective dose of 3.0 person-rem is less than 0.01% of the annual collective background dose from natural resources.

6.5 SPORTSMAN DOSE CALCULATION RESULTS

DOE Order 458.1 specifies radiation dose limits for individual members of the public. The dose limit of 100 mrem/yr includes the dose a person receives from routine DOE operations through all exposure pathways. Additionally, SRS considers and quantifies nontypical exposure pathways the standard calculations of the doses to the representative person do not include. This is because they apply to unlikely scenarios such as eating fish caught only from the mouths of SRS streams ("creek-mouth fish") or to special scenarios such as hunters who volunteer to participate in an onsite hunt.

SRS also considered the following exposure pathways for a hypothetical offsite hunter and offsite fisherman on Creek Plantation, a neighboring, privately owned portion of the Savannah River Swamp:

- Ingesting deer meat or fish harvested on Creek Plantation
- Receiving external exposure to contaminated soil
- Incidentally ingesting contaminated soil
- Incidentally inhaling resuspended contaminated soil

6.5.1 Onsite Hunter Dose

Deer and Hog Consumption Pathway—SRS holds annual hunts for the public to control the Site's deer and wild hog populations and to reduce animal-vehicle accidents. The estimated dose from consuming harvested deer or hog meat is determined for every onsite hunter. During 2023, the maximum potential dose an onsite hunter received was 9.42 mrem (0.0942 mSv), or 9.42% of DOE's 100 mrem/yr dose standard (Table 6-7). This dose is for an actual hunter who harvested one animal (one deer) during the 2023 hunts. For the hunter-dose calculation, SRS conservatively assumes that the hunter individually consumed the entire edible portion of this animal, about 29 kilograms (kg) (64 lbs).

Turkey Consumption Pathway—SRS typically hosts a special turkey hunt in April for hunters with mobility impairments. Hunters harvested 19 turkeys in 2023. SRS measured all turkeys for radiation. Because none of them measured above the background level, SRS did not assign a dose to these hunters.

6.5.2 Hypothetical Offsite Hunter Dose

Deer and Hog Consumption Pathway—The deer and hog consumption pathways considered were for hypothetical offsite individuals whose entire intake of meat (81 kg [179 lbs]) during the year was either deer or hog meat. SRS assumes that these individuals harvest deer or hogs that had lived on SRS during the year but then moved offsite before hunting season.

Based on these unlikely assumptions and on the measured average concentration of cesium-137 in all deer (1.80 pCi/g) and hogs (1.59 pCi/g) harvested from SRS during 2023, the potential maximum doses from this pathway were estimated to be 5.30 mrem (0.0530 mSv) for the offsite deer hunter and 4.44 mrem (0.0444 mSv) for the offsite hog hunter.

Savannah River Swamp Hunter Soil Exposure Pathway—SRS estimated the potential dose to a recreational hunter exposed to SRS legacy contamination on the privately owned Creek Plantation. SRS used the soil concentration data obtained during the 2017 comprehensive survey of Creek Plantation for this assessment (SRNS 2018). The potential dose assumed that this person hunted for 120 hours during the year (8 hours a day for 15 days) at the location of maximum radionuclide contamination. SRS estimated this offsite-hunter soil exposure dose to be 1.86 mrem.

As Table 6-7 shows, the offsite deer consumption pathway dose (5.30 mrem) and the Savannah River Swamp hunter soil exposure pathway dose (1.86 mrem) were conservatively added together to obtain a total maximum offsite hunter dose of about 7.16 mrem (0.0716 mSv). This potential dose is 7.16% of the DOE 100 mrem/yr dose limit.

Table 6-7 2023 Sportsman Doses Compared to the DOE Dose Limit

	Committed Dose (mrem)	Applicable Standard (mrem)[a]	Percent of Standard (%)
Sportsman Dose			
Onsite Hunter	9.42	100	9.42
Creek-Mouth Fisherman[b]	0.17	100	0.17
Savannah River Swamp Hunter			
Offsite Hog Consumption	4.44		
Offsite Deer Consumption	5.30		
Soil Exposure[c]	1.86		
Maximum Offsite Hunter Dose[d] (Deer + Soil Exposure)	7.16	100	7.16
Savannah River Swamp Fisherman			
Steel Creek Fish Consumption	0.11		
Soil Exposure[e]	2.08		
Total Offsite Fisherman Dose (Fish + Soil Exposure)	2.19	100	2.19

[a] DOE dose limit; 100 mrem/yr (DOE Order 458.1)
[b] The 2023 maximum dose to a hypothetical fisherman resulted from consuming bass from the mouth of Lower Three Runs
[c] Includes the dose from combining external exposure and incidentally ingesting and inhaling the worst-case Savannah River swamp soil
[d] Assumes only a deer or hog (maximum concentration) is harvested by the offsite hunter
[e] Includes the dose from combining external exposure and incidentally ingesting and inhaling Savannah River swamp soil near the mouth of Steel Creek

6.5.3 Hypothetical Offsite Fisherman Dose

Creek-Mouth Fish Consumption Pathway—For 2023, SRS analyzed four species of fish (panfish, catfish, flathead catfish, and bass), taken from the mouths of four SRS streams, for radionuclides. Using these concentrations, SRS estimated the maximum potential dose from fish consumption to be 0.17 mrem (0.0017 mSv) from bass collected at the mouth of Lower Three Runs. SRS bases this hypothetical dose on the low probability scenario that during 2023, a fisherman consumed 24 kg (53 lbs) of bass caught exclusively from the mouth of Lower Three Runs. All this potential dose was from cesium-137. As Table 6-7 shows, this dose is 0.17% of the DOE 100 mrem/yr (1 mSv/yr) dose limit.

Savannah River Swamp Fisherman Soil Exposure Pathway—SRS calculated the potential dose to a recreational fisherman exposed to SRS legacy contamination in Savannah River Swamp soil on the privately owned Creek Plantation using the RESRAD code (Yu et al., 2001). SRS assumes that this recreational sportsman fished on the South Carolina bank of the Savannah River near the mouth of Steel Creek for 250 hours during the year.

Using the radionuclide concentrations measured at this location, SRS estimated the potential dose to a fisherman from a combination of 1) external exposure to the contaminated soil, 2) incidental ingestion of the soil, and 3) incidental inhalation of renewed suspension soil to be 2.08 mrem (0.0208 mSv).

As Table 6-7 shows, SRS added the maximum Steel Creek fish consumption dose (0.11 mrem) and the Savannah River Swamp fisherman soil exposure dose (2.08 mrem) to conservatively obtain a total offsite fisherman dose of 2.19 mrem (0.0219 mSv). This potential dose is 2.19% of the DOE 100 mrem/yr dose limit.

6.5.4 Potential Risk from Consumption of SRS Creek-Mouth Fish

During 1991 and 1992, in response to a U.S. House of Representatives Appropriations Committee request for a plan to evaluate risk to the public from fish collected from the Savannah River, SRS developed a fish monitoring plan in conjunction with the EPA, Georgia Department of Natural Resources, and South Carolina Department of Health and Environmental Control. This plan includes assessing radiological risk from consuming Savannah River fish and requires that SRS summarize the results in the annual *SRS Environmental Report*. SRS estimated the potential risks using the cancer morbidity risk coefficients from Federal Guidance Report No. 13 (EPA 1999). For 2023, SRS estimated the maximum potential lifetime risk of developing fatal and nonfatal cancer from consuming SRS creek-mouth fish to be 1.3E-07. That is, if 10 million people each received a dose of 0.17 mrem, there is a potential for 1.3 extra cancer incidents.

6.6 RELEASE OF MATERIAL CONTAINING RESIDUAL RADIOACTIVITY

DOE Order 458.1 establishes authorized surface contamination limits for unconditional release of personal and real property. This order defines personal property as “property of any kind, except for real property” and defines real property as “land and anything permanently affixed to the land such as buildings, fences and those things attached to the buildings, such as light fixtures, plumbing and heating fixtures, or other such items, that would be personal property if not attached.” SRS handles the unconditional release of real property on an individual basis that requires DOE approval. SRS did not release any real property in 2023; therefore, the following discussion is associated with release of personal property from SRS. DOE Order 458.1 specifies that the Site must prepare and submit an annual summary of cleared property to the DOE-Savannah River Manager.

6.6.1 Property Release Methodology

SRS uses procedures to govern unconditionally releasing equipment. SRS can release the item after it has a radiological survey if it meets specific documented limits. For items meeting unconditional release criteria, SRS generates a form and attaches it electronically to the applicable radiological survey via the Site’s Visual Survey Data System (VSDS). In some areas, SRS documents equipment and material release directly on the radiological survey form. SRS subsequently compiled these VSDS and survey forms and coordinated a sitewide review to determine the amount of material and equipment SRS released from its facilities in 2023. These measures ensure that radiological material releases from SRS are consistent with DOE Order 458.1 requirements.

SRS unconditionally released 13,324 items of personal property from radiological areas in 2023. Most of these items did not leave the SRS and were reused elsewhere on the Site. Therefore, all items required no additional radiological controls postsurvey as they met DOE Order 458.1 release criteria. (DOE Order 458.1 allows using DOE Order 5400.5-derived supplemental limits for unconditionally releasing equipment and materials.)

In 2003, DOE approved an SRS request to use supplemental limits to release material from the Site with no further DOE controls. These supplemental release limits, provided in Table 31 of *Radiological Impact of 2023 Operations at the Savannah River Site* (Stagich, Dixon, and Peyton 2024), are dose-based and are such that if any member of the public received any exposure, it would be less than 1 mrem/yr. The supplemental limits include both surface and volume concentration criteria. The volume criteria allow SRS the option to dispose of potentially volume-contaminated material in Three Rivers Landfill, an onsite sanitary waste facility. In 2023, SRS did not release any material from the Site using the supplemental release limits volume concentration criteria.

6.7 RADIATION DOSE TO AQUATIC AND TERRESTRIAL BIOTA

DOE Order 458.1 requires that SRS operate in a manner that protects the local biota from adverse effects of radiation and radioactive material releases. To demonstrate it is complying with this requirement, SRS follows the approved DOE Standard, DOE-STD-1153-2019, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2019).

The biota dose rate limits specified in this standard are the following:

- Aquatic animals: 1.0 rad/day
- Riparian animals: 0.1 rad/day
- Terrestrial plants: 1.0 rad/day
- Terrestrial animals: 0.1 rad/day

6.7.1 DOE Biota Concentration Guides

SRS evaluates plant and animal doses for water and land systems using the RESRAD Biota model (version 1.8) (SRS EDAM 2017), which directly implements the DOE (2019) guidance. The RESRAD Biota model uses a graded approach consisting of three increasingly more detailed steps of analysis:

- Level 1 Screening—uses maximum measured concentrations and conservative default model input parameters
- Level 2 Screening—uses average concentrations or site-specific input parameters, as appropriate
- Level 3 Analysis—uses site-specific biota parameters or measured concentrations in the actual biota living at the assessed location

For water systems (animals and plants that live in the water or along riverbanks), the RESRAD Biota model performs a combined water-plus-sediment evaluation. SRS performed initial (Level 1) screenings in 2023 using radionuclide concentration data from SRS's 14 onsite, colocated stream and sediment sampling locations. A sum of the fractions less than 1.0 indicates the sampling site has passed its initial pathway screening, which means that the sampling site did not exceed its biota dose rate limits, and SRS does not have to assess the location further. All SRS aquatic system locations passed the Level 1 screenings and did not require further assessment.

To evaluate land-based systems, SRS performed Level 1 screenings using concentration data from the five onsite radiological soil sampling locations. Typically, SRS collects and analyzes only one soil sample per year from each location. For 2023, all land-based locations passed their initial Level 1 pathway screenings.

Chapter 7: Groundwater Management Program

The purpose of the Savannah River Site (SRS) groundwater management program is to protect, monitor, remediate, and use groundwater. With this focus, the program accomplishes the following:

- Ensures future groundwater contamination does not occur
- Monitors groundwater to identify areas of contamination
- Remediates groundwater contamination as needed
- Conserves groundwater

2023 Highlights

Drinking Water Standards—In 2023 there were no exceedances of drinking water standards (measured by maximum contaminant levels [MCLs] or regional screening levels [RSLs]) in SRS boundary wells near A/M Area. These wells are the closest to the Site boundary and would indicate whether contamination was getting offsite.

Groundwater Contaminant Removal—SRS removed 9,238 pounds (lbs) of volatile organic compounds (VOCs) from groundwater and the vadose zone. The Site also prevented 24.7 curies (Ci) of tritium from reaching SRS streams.

Offsite Groundwater Monitoring (Georgia)—Since 2001, tritium has been detected at low concentrations (less 1 picocurie/milliliter [pCi/mL]) in only a few offsite wells, which is well below the MCL for tritium (20 pCi/mL). Most of the groundwater sampling has resulted in no detections of tritium. This data supports the conclusions of a U.S. Geological Survey (USGS) that indicate there is no mechanism by which groundwater could flow under the Savannah River and contaminate Georgia wells (Cherry 2006).

7.1 INTRODUCTION

Previous missions and operations at the Savannah River Site (SRS) have released chemicals and radionuclides into the soil and thus contaminated the groundwater around hazardous waste management facilities and waste disposal sites. Because of these past releases, SRS operates extensive groundwater monitoring and groundwater remediation programs.

The SRS groundwater monitoring program requires regular well sampling to monitor for groundwater contaminants. Well monitoring meets the sampling requirements in agreements established through the Federal Facility Agreement (FFA) for the Savannah River Site (FFA 1993) and in the Resource Conservation and Recovery Act (RCRA) permit for SRS. Well monitoring ensures the Site is providing quality data to compare to South Carolina Department of Health and Environmental Control (SCDHEC) and U.S. Environmental Protection Agency (EPA) drinking water quality standards. SRS uses SCDHEC-certified laboratories audited by the U.S. Department of Energy to analyze groundwater samples using EPA methods or equivalents.

The monitoring data show that most of the contaminated groundwater plumes are in the central area of SRS, and none extends beyond the SRS boundary. Groundwater contamination at SRS is limited primarily to the Upper Three Runs/Steed Pond Aquifers and the Gordon/Lost Lake Aquifers (Figure 7-1). SRS submits summaries of groundwater data to regulatory agencies and, if necessary, remediates or removes the contamination. *Appendix E: Groundwater Management Program Supplemental Information* lists the documents reporting groundwater monitoring data that SRS submits to the regulatory agencies.

SRS uses several technologies to remediate groundwater that exceeds the maximum contaminant levels (MCLs) or regional screening levels (RSLs). Remediation includes closing and remediating waste units to reduce the potential for contaminants to reach groundwater, actively treating contaminated water, and employing passive and natural remedies.

Groundwater remediation at SRS focuses on volatile organic compounds (VOCs), low groundwater pH, metals, and tritium. VOCs in groundwater, mainly trichloroethylene (TCE) and tetrachloroethylene (PCE), originate from their use as degreasing agents in industrial work at SRS. Tritium in groundwater is a byproduct of nuclear materials production at SRS. Corrective measures at SRS range from active treatment, such as using oxidants to destroy the VOCs in place, to passive or enhanced measures, such as monitored natural attenuation and phytoremediation (using trees and plants to remove or break down contaminants). These practices are removing VOCs from the groundwater and effectively reducing tritium releases from groundwater into SRS streams and the Savannah River.

Chapter 7—Key Terms

Aquifer *is an underground water supply found in porous rock, sand, gravel, and other materials.*

Attenuation *is a reduction of groundwater contaminants over time due to naturally occurring physical, chemical, and biological processes.*

Confining unit *is the opposite of an aquifer. It is a layer of rock or clay that limits groundwater movement in and out of an aquifer.*

Contaminants of concern *are contaminants identified in the risk assessment that are found at a waste unit and pose an unacceptable risk to human health and the environment.*

Groundwater *is water found underground in cracks and pore spaces in soil, sand, and rocks.*

Maximum contaminant level (MCL) *is the highest level of a contaminant allowed in drinking water.*

Plume *is a volume of contaminated water originating at a waste source (for example, a hazardous waste disposal site). It extends downward and outward from the waste source.*

Recharge *occurs when water from the surface travels down into the subsurface, replenishing the groundwater.*

Regional screening level (RSL) *is the risk-based concentration derived from standardized equations, combining exposure assumptions with toxicity data.*

Remediation *cleans up sites contaminated with waste from historical activities.*

Surface water *is water found above ground (for example, streams, lakes, wetlands, reservoirs, and oceans).*

Vadose zone *is the subsurface layer below the land surface and above the water table. The vadose zone has a low water content compared to saturated zones; therefore, it is also referred to as being unsaturated.*

Waste unit *is an area that is, or may be, posing a threat to human health or the environment. It ranges in size from a few square feet to tens of acres and includes basins, pits, piles, burial grounds, landfills, tank farms, disposal facilities, process facilities, and contaminated groundwater.*

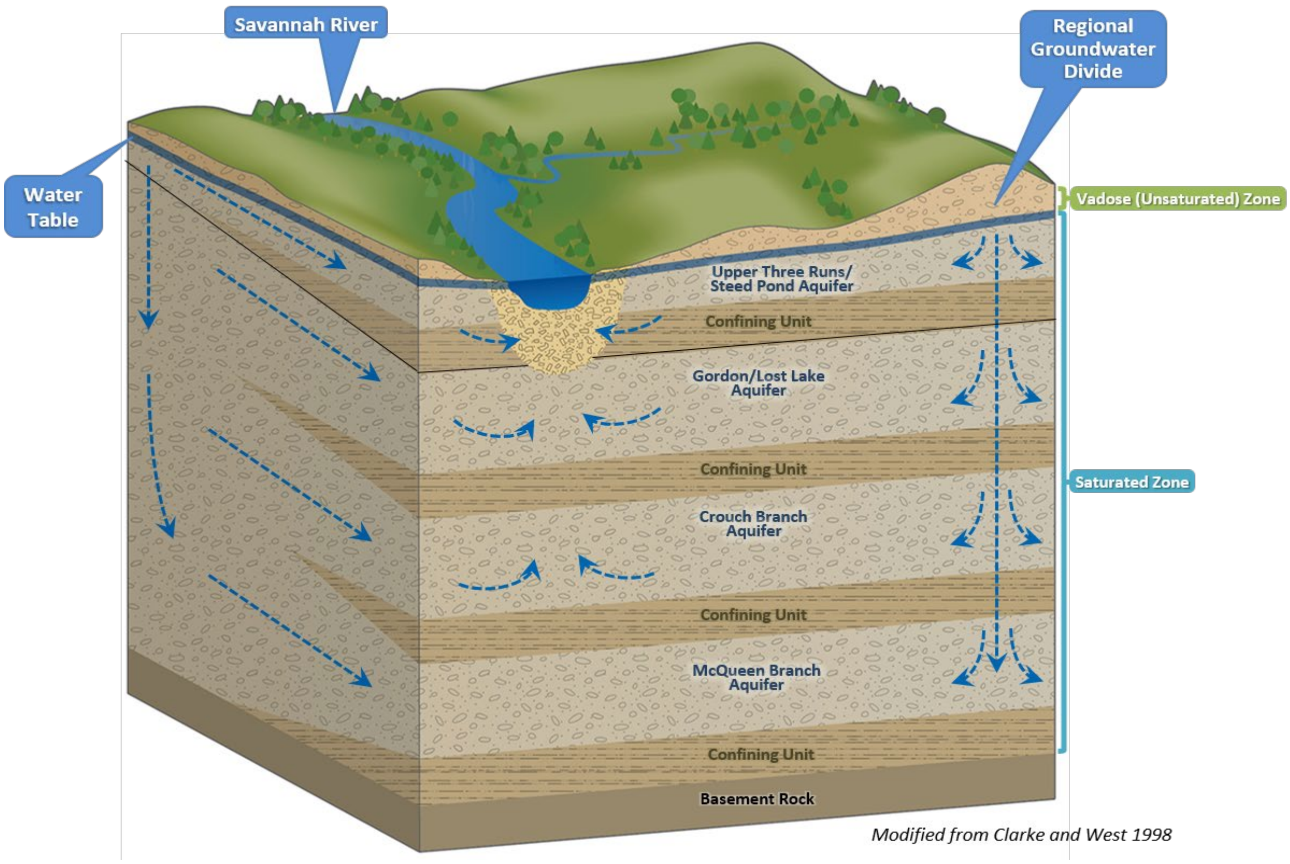


Figure 7-1 Groundwater at SRS

7.2 GROUNDWATER AT SRS

The groundwater flow system at SRS consists of four major aquifers separated by confining units:

- Upper Three Runs/Steed Pond
- Gordon/Lost Lake
- Crouch Branch
- McQueen Branch

Groundwater flow in recharge areas generally migrates downward and laterally. It eventually flows into the Savannah River and its tributaries or migrates into the deeper regional flow system. Figure 7-1 presents a three-dimensional block diagram of these units at SRS and the generalized groundwater flow patterns within those units. Water moving from the ground's surface into the aquifers can carry contamination along with it, resulting in underground plumes of contaminated water (Figure 7-2).

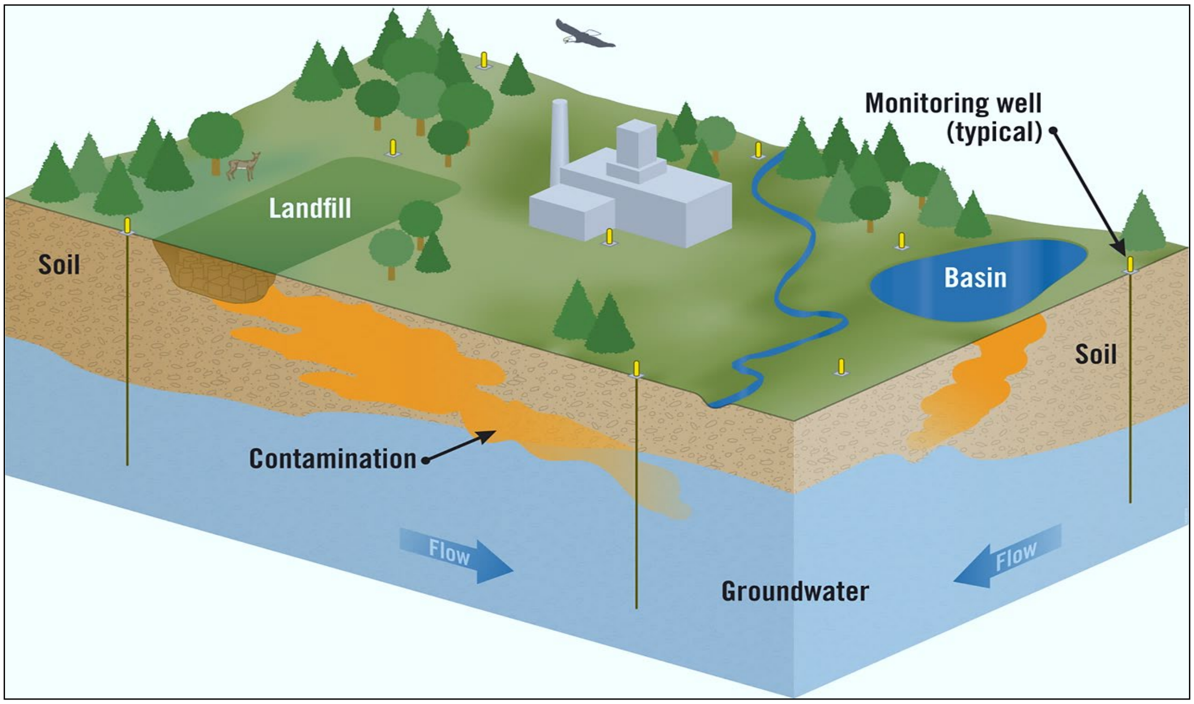


Figure 7-2 How Contamination Gets to Soil and Groundwater

7.3 GROUNDWATER MANAGEMENT PROGRAM AT SRS

SRS has designed and implemented a groundwater management program to prevent new releases to groundwater and to remediate contaminated groundwater to meet federal and state laws and regulations, DOE Orders, and SRS policies and procedures. It accomplishes the following:

- Protects groundwater
- Monitors groundwater
- Remediates contaminated groundwater
- Conserves groundwater

7.3.1 Protecting SRS Groundwater

SRS groundwater management focuses on preventing and monitoring groundwater contamination, protecting the public and environment from contamination, and preserving groundwater quality for future use. SRS protects groundwater by

- Preventing or controlling groundwater contamination sources from construction sites, hazardous waste management facilities, and waste units
- Monitoring groundwater and surface water to detect contaminants
- Reducing contaminants through a groundwater cleanup program

7.3.2 Monitoring SRS Groundwater

The purpose of monitoring groundwater is to observe and evaluate changes in the groundwater quality over time and to establish, as accurately as possible, the baseline quality of the groundwater occurring naturally in the aquifers. The SRS groundwater monitoring program includes two primary components: groundwater contaminant source monitoring and groundwater surveillance monitoring. SRS evaluates groundwater monitoring data frequently to identify whether new groundwater contamination exists or whether it should modify the current monitoring program.

Monitoring the groundwater around SRS facilities, waste disposal sites, and associated streams is the best way to detect and track contaminant migration. Figure 7-3 shows the groundwater plumes associated with SRS. Through careful monitoring and analysis, SRS implements appropriate remedial or corrective actions.

SRS uses groundwater monitoring data to determine the effects of Site operations on groundwater quality. The program supports the following critical activities:

- Complying with environmental regulations and DOE directives
- Evaluating the status of groundwater plumes
- Evaluating potential impacts from activities planned near or within the footprint of the groundwater plume
- Enhancing groundwater remediation through basic and applied research projects

Increasing national attention to “emerging contaminants” or contaminants of emerging concern (CEC) can prompt a call for action from federal, state, and local governments. Increased monitoring and detections of unregulated substances can lead the EPA to identify solutions to address these substances that may present a risk to human health or the environment. As a result of discussions with the EPA and SCDHEC, SRS adds emerging contaminants to analyte lists when historical or process knowledge indicates that a contaminant could be of concern. 1,4-Dioxane is one of the previously emerging contaminants that SRS monitors regularly in conjunction with VOC plumes.

Other CECs include per- and polyfluoroalkyl substances (PFAS). PFAS are a family of man-made chemicals that have been manufactured and used worldwide since the 1940s. They are present in various items such as cookware, stain repellants, food packaging, and firefighting foam. Chapter 9, *Per- and Polyfluoroalkyl (PFAS) Substances*, provides more information on PFAS. In 2019, SRS began assessing the past and present use of PFAS at the Site. Groundwater sampling of PFAS was initiated in D Area due to known use of firefighting foam at a former firefighting

The Emulsified Zero Valent Iron Field Scale Pilot Study Will Determine if the Innovative Technology Will be Successful in Removing Solvents from a Plume in A/M Area.

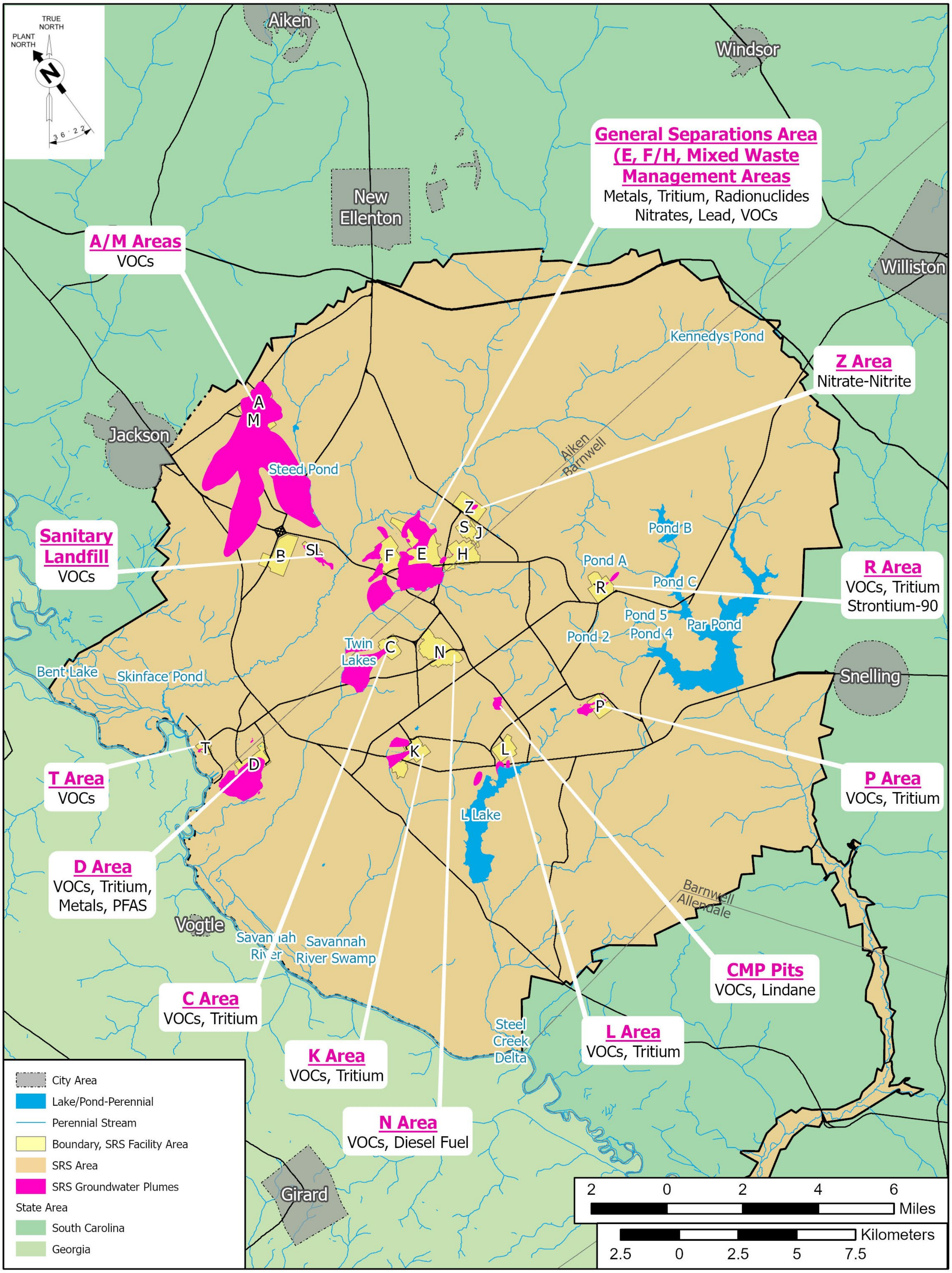


Figure 7-3 Groundwater Plumes at SRS

training area. Sampling has continued into 2023. Results from 2023 groundwater sampling range from <1 nanogram/liter (ng/L) up to 2,100 ng/L, which are similar to previous results. These results from D Area indicate that current PFAS concentrations are related to historical use of firefighting foams. SRS is committed to understanding the full nature and extent of PFAS contamination at SRS. The SRS groundwater monitoring program ensures that there is no cross contamination in samples due to the presence of PFAS in many consumer products. The EPA, SCDHEC, and the Interstate Technology Regulatory Council webpages have information on the current state of knowledge and regulatory status of PFAS.

7.3.2.1 Groundwater Surveillance Monitoring

Surveillance monitoring at SRS focuses on collecting and analyzing data to characterize the groundwater flow and determine the presence or absence of contaminants. Characterization at SRS includes the following activities:

- Collecting soil and groundwater samples to determine the extent of contamination
- Obtaining geologic soil cores or seismic profiles to better determine aquifer and confining unit physical and geochemical properties
- Installing wells to periodically collect water-level measurements and groundwater samples
- Developing maps to interpret groundwater flow, and visualize the extent of horizontal and vertical contamination
- Performing calculations based on water elevation data to estimate groundwater velocities
- Using groundwater modeling to understand future SRS groundwater movement—and specifically contaminant movement—near facilities, individual waste units, and at the Site boundary
- Characterizing regional surface water flow to assess contaminant risk to perennial streams, which receive groundwater flow

7.3.2.2 2023 Groundwater Surveillance Results Summary

SRS uses more than 150 wells to monitor a significant plume beneath A/M Area. Some of these monitoring wells lie within a half-mile of the northwestern boundary of SRS. The direction of groundwater flow in the area is parallel to the Site boundary; however, the flow direction of groundwater can fluctuate. Because of this, SRS concentrates on the groundwater results from the wells along the Site boundary, as well as those between A/M Area and the nearest population center, Jackson, South Carolina (SRNS 2024a). The data show no exceedances of drinking water standards (MCLs or RSLs) in SRS boundary wells near A/M Area. Additionally, no detectable contamination exists in most of these SRS boundary wells.

Although most SRS-contaminated groundwater plumes do not approach the Site boundary, contaminated groundwater discharge potentially affects Site streams that migrate offsite. SRS monitors and evaluates groundwater contamination that discharges into Site streams and remediates it as appropriate. In conjunction with stream monitoring, as discussed in Chapter 5, *Radiological Environmental Monitoring Program*, Section 5.4.3, *SRS Stream Sampling and Monitoring*, SRS conducts extensive monitoring near SRS waste units and operating facilities, regardless of their proximity to the boundary. *Savannah River Site Groundwater Management Strategy and Implementation Plan* (SRNS 2020) details groundwater monitoring and conditions at individual sites.

Table 7-1 identifies the typical contaminants of concern (COCs) found in SRS groundwater and their significance. These COCs are a result of historical SRS operations that released chemicals and radionuclides into the soil and groundwater near hazardous waste management facilities and waste disposal sites. Table 7-2 presents a general summary of the most common contaminants found in groundwater at SRS facility areas, based on 2023 monitoring data, and compares the maximum concentrations to the appropriate drinking water standards. This table also shows the major COCs in the groundwater beneath SRS, including common degreasers (TCE and PCE) and radionuclides (tritium, gross alpha, and nonvolatile beta emitters).

Table 7-1 Typical Contaminants of Concern at SRS

Contaminants	Sources	Limits, Exposure Pathways, and Health Effects
Gross Alpha	Alpha radiation emits positively charged particles from radioactive decay of certain elements including uranium, thorium, and radium. Alpha radiation in drinking water can be in the form of dissolved minerals or a gas (radon).	The maximum contaminant level (MCL) is 15 pCi/L. An alpha particle cannot penetrate a piece of paper or human skin. It causes increased risk of cancer through ingestion or inhalation.
Nonvolatile Beta	Beta decay commonly occurs among neutron-rich fission byproducts produced in nuclear reactors.	MCL is 4 mrem/yr. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
Tritium	Radioactive isotope of hydrogen with a half-life of 12.3 years. It emits a very weak beta particle and behaves like water.	MCL is 20 pCi/mL. It primarily enters the body when people swallow tritiated water. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
Trichloroethylene (TCE) and Tetrachloroethylene (PCE)	Volatile organic compounds (VOCs) used primarily to remove grease from fabricated metal parts.	MCL is 5 µg/L. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
Vinyl Chloride	VOC formed as a degradation product of TCE/PCE.	MCL is 2 µg/L. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
1,4-Dioxane[a]	Synthetic industrial chemical used as a stabilizer for VOCs to reduce degradation.	The regional screening level (RSL) for tap water is 0.46 µg/L. The EPA has classified it as a probable human carcinogen. It has potential acute and chronic health effects.
Per- and Polyfluoroalkyl Substances (PFAS)[a]	Constituent in firefighting foams and in consumer products such as cookware, packaging, and stain repellants.	U.S. Environmental Protection Agency (EPA) Drinking Water Lifetime Health Advisory Limit (nonenforceable) is 70 ng/L. Current scientific research suggests that exposure to certain PFAS may lead to adverse health outcomes.

[a] Substance identified by the EPA as a contaminant of emerging concern

Table 7-2 Summary of the Maximum Contaminant Concentrations for Major Areas within SRS

Location	Major Contaminant	Units	2023 Max Concentration	Well	MCL/RSL	Likely Stream Endpoints
A/M Area	1,4-Dioxane	µg/L	280	MCB037C	6.1[a]	Upper Three Runs
	Beryllium	µg/L	2.97	MSB 40C	4	
	Chloroethene (Vinyl Chloride)	µg/L	2.42	MSB 107CC	2	
	Gross Alpha	pCi/L	14.7	MSB 04BR	15	
	Nonvolatile Beta	pCi/L	31.3	MSB 64C	50[b]	
	Tetrachloroethylene (PCE)	µg/L	69,800	MSB 04BR	5	
	Trichloroethylene (TCE)	µg/L	51,500	MSB 36B	5	
C Area	Chloroethene (Vinyl Chloride)	µg/L	149	CRP 50B	2	Fourmile Branch
	Tetrachloroethylene (PCE)	µg/L	6.39	CRP 5C	5	
	Trichloroethylene (TCE)	µg/L	2,510	CRP 20CU	5	
	Tritium	pCi/mL	997	CRW024C	20	
CMP Pits (G Area)	1,4-Dioxane	µg/L	250	CMP 35D	0.46[a]	Pen Branch
	Chloroethene (Vinyl Chloride)	µg/L	1.1	CMP 11B	2	
	Lindane	µg/L	7.7	CMP 35D	0.2	
	Tetrachloroethylene (PCE)	µg/L	2,600	CMP 35D	5	
	Trichloroethylene (TCE)	µg/L	1,400	CMP 35D	5	
D Area	1,4-Dioxane	µg/L	3.2	DOB 16	6.1[a]	Savannah River
	Aluminum	µg/L	151,000	DCB 22A	20,000	
	Arsenic	µg/L	58	DWP 008	10	
	Beryllium	µg/L	125	DCB 21B	4	
	Chloroethene (Vinyl Chloride)	µg/L	10	DOB 15	2	
	Iron	µg/L	241,000	DCB 87A	14,000	
	Manganese	µg/L	18,400	DCB 87A	430	
	Mercury	µg/L	7	DCB 85A	2	
	Nickel	µg/L	531	DCB 22A	390	
	Perflurornonanoic acid (PFNA)	ng/L	2,100	DCB 62	59	
	Perfluorooctane sulfonic acid (PFOS)	ng/L	350	DRW 1	40	
	Perflouroroctanoic acid (PFOA)	ng/L	140	DCB 78	60	
	Tetrachloroethylene (PCE)	µg/L	6.41	DCB 45C	5	
	Trichloroethylene (TCE)	µg/L	92.1	DCB 62	5	
	Tritium	pCi/mL	125	DCB 26AR	20	
E Area (MWMF)	1,4-Dioxane	µg/L	520	BSW 6C3	6.1[a]	Upper Three Runs/Fourmile Branch
	Gross Alpha	pCi/mL	26.6	BGO 43CR	15	
	Nonvolatile Beta	pCi/mL	20	BGO 30D	50[b]	
	Trichloroethylene (TCE)	µg/L	337	HSB120C	5	
	Tritium	pCi/mL	5,740	SWP 01C	20	
F Area	Gross Alpha	pCi/L	1,530	FGW005C	15	Fourmile Branch
	Nonvolatile Beta	pCi/L	665,000	FGW005C	50[b]	
	Strontium-90	pCi/L	522,000	FGW005C	8	
	Technetium-99	pCi/L	1,090	FTF-28	50[c]	
	Trichlorethylene	µg/L	17.9	FBP 43DL	5	
	Tritium	pCi/mL	127	FGW005C	20	
F-Area HWMF	Gross Alpha	pCi/L	259	FSB 94DR	15	Fourmile Branch
	Nonvolatile Beta	pCi/L	447	FSB 94C	50[b]	
	Strontium-90	pCi/L	181	FSB 78C	8	
	Trichlorethylene (TCE)	µg/L	12.7	FSB 78C	5	
	Tritium	pCi/mL	796	FSB 78C	20	

Table 7-2 Summary of the Maximum Contaminant Concentrations for Major Areas within SRS (continued)

Location	Major Contaminant	Units	2023 Max Concentration	Well	MCL/RSL	Likely Stream Endpoints
F-Area Tank Farm	Gross Alpha	pCi/L	15	FTF 31	15	Fourmile Branch/Upper Three Runs
	Nonvolatile Beta	pCi/L	603	FTF 28	50[b]	
	Strontium-90	pCi/L	14.1	FTF 28	8	
	Technetium-99	pCi/L	1,284	FTF 28	50[c]	
H Area	Nonvolatile Beta	pCi/L	73.73	HAA 14D	50[b]	Upper Three Runs/Fourmile Branch
	Tritium	pCi/mL	34.8	HAA 12C	20	
H-Area HWMF	Gross Alpha	pCi/L	54.7	HSB 102D	15	Fourmile Branch
	Nonvolatile Beta	pCi/L	667	HSB 102D	50[b]	
	Strontium-90	pCi/L	318	HSB 102D	8	
	Trichloroethylene (TCE)	µg/L	328	HSB 120C	5	
	Tritium	pCi/mL	2,330	HSB120C	20	
H-Area Tank Farm	Nonvolatile Beta	pCi/L	34.6	HAA 14D	50[b]	Fourmile Branch/ Upper Runs
	Tritium	pCi/mL	34.8	HAA 12C	20	
K Area	Tetrachloroethylene (PCE)	µg/L	7.14	KDB 9	5	Indian Grave Branch
	Trichloroethylene (TCE)	µg/L	2.95	KRP 9	5	
	Tritium	pCi/mL	616	KRB 19D	20	
L Area	Tetrachloroethylene (PCE)	µg/L	61.6	LSW 25DL	5	Steel Creek
	Trichloroethylene (TCE)	µg/L	2.95	LSW025DL	5	
	Tritium	pCi/mL	377	LSW 25DL	20	
P Area	cis-1,2-Dichloroethylene	µg/L	720	P003L	5	Steel Creek/ Lower Three Runs
	Tetrachloroethylene (PCE)	µg/L	131	PAO003DU	5	
	Trichloroethylene (TCE)	µg/L	6,420	PGW 26C	5	
	Tritium	pCi/mL	8,910	PSB 02B	20	
R Area	Strontium-90[d]	pCi/L	167	RSE 10	8	Lower Three Runs
	Trichloroethylene (TCE)	µg/L	24.8	RAG008B	5	
	Tritium	pCi/mL	866	RDB 03D	20	
Sanitary Landfill	1,4-Dioxane	µg/L	130	LFW 62C	6.1[a]	Upper Three Runs
	Chloroethene (Vinyl Chloride)	µg/L	23	LFW 21	2	
	Trichloroethylene	µg/L	3.9	LFW 32	5	
TNX	Trichloroethylene	µg/L	14.5	TRW 2	5	Savannah River
Z Area	Nitrate-Nitrate as Nitrogen	mg/L	10.9	ZBG002D	10	Upper Three Runs
	Nonvolatile Beta	pCi/L	101	ZBG002D	50[b]	
	Technetium-99	pCi/L	148	ZBG002D	50[c]	

Notes:
MWMF is the Mixed Waste Management Facility; HWMF is the Hazardous Waste Management Facility; TNX is the 678-T facilities; CMP is the Chemicals, Metals, and Pesticides Pits; PFAS is Per- and Polyfluoroalkyl Substances; MCL is maximum contaminant level; RSL is regional screening level.
µg = micrograms

[a] The 1,4-Dioxane standard is a Resource Conservation Recovery Act-permitted Groundwater Protection Standard.
[b] The MCL for nonvolatile beta activity (pCi/L or pCi/mL) equivalent to 4 mrem/yr varies according to which specific beta emitters are present in the sample. At SRS, this value equates to 50 pCi/L.
[c] The MCL for technetium-99 is the sum of beta dose <4 mrem/yr and technetium-99 < 900 pCi/L.
[d] At R Area, strontium-90 is sampled every two years. It was last sampled in 2022.

Since the early 1990s, SRS has directed considerable effort to assessing the likelihood of flow beneath the Savannah River from South Carolina to Georgia. A groundwater model developed by the U.S. Geological Survey (USGS) indicates there is no mechanism by which groundwater could flow under the Savannah River and contaminate Georgia wells (Cherry 2006). SRS continues to monitor for tritium in groundwater wells in Georgia (Figure 7-4) by collecting samples annually during the second half of the year. Since 1999, detections

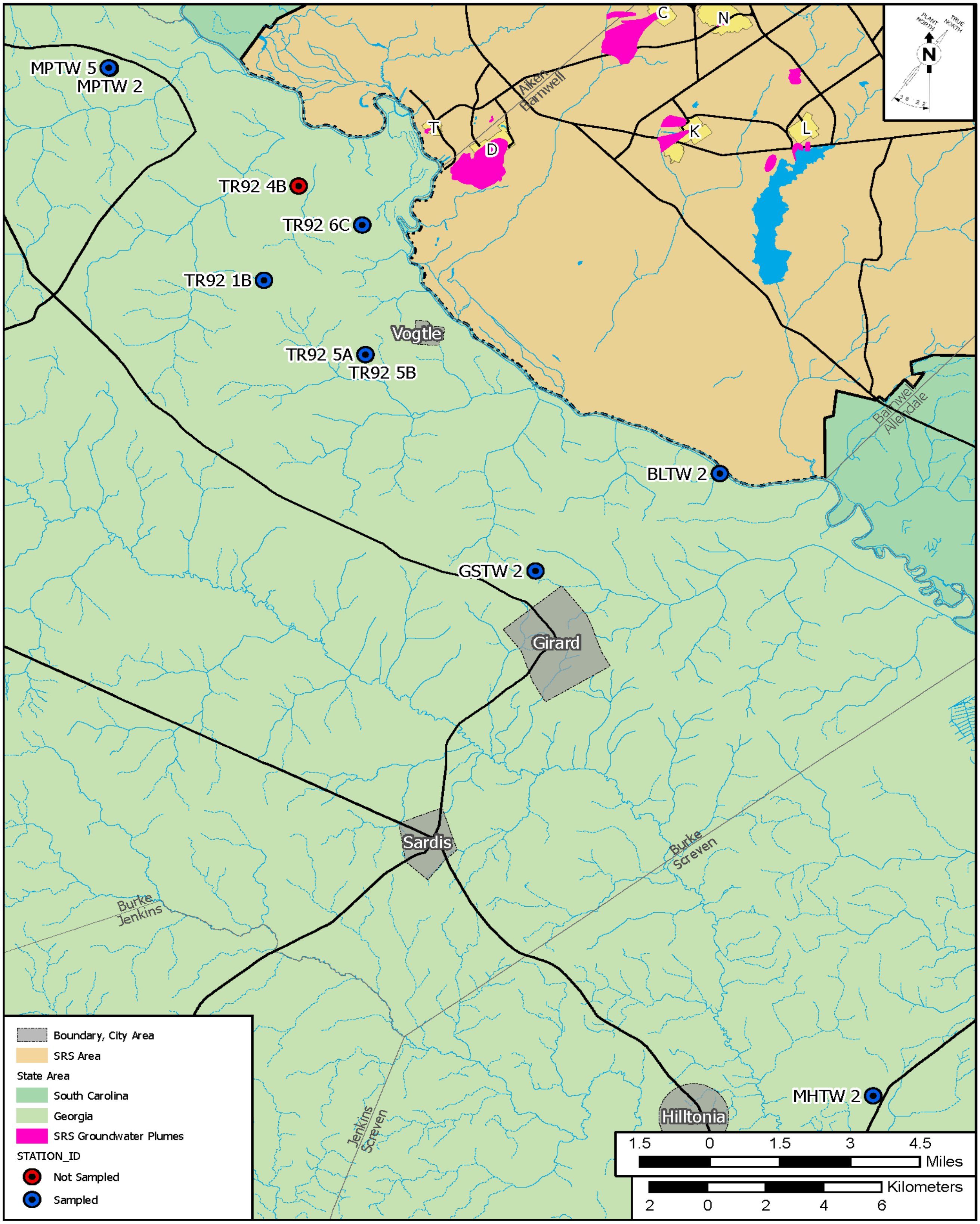


Figure 7-4 Locations of Tritium Monitoring Wells in Burke and Screven Counties, Georgia

of tritium in these Georgia offsite wells have been below 1.5 pCi/mL (1,500 pCi/L), which substantiates the results of the USGS groundwater model. As a comparison, the MCL, or drinking water standard, for tritium is 20 pCi/mL (20,000 pCi/L). For 2023, tritium was not detected in any of the groundwater collected at the nine locations sampled. One location was not sampled due to inaccessibility.

7.3.3 Remediating SRS Groundwater

SRS's environmental remediation program has been in place for more than 20 years. The Federal Facility Agreement (FFA) for the Savannah River Site (FFA 1993) specifies that RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act regulate the processes of remediating and monitoring contaminated groundwater. Remediation focuses on removing mass, reducing contaminant levels, and reducing the exposure of humans and the environment to contaminants that exceed either the MCLs or RSLs. Table 7-2 identifies the MCLs and RSLs for the primary contaminants of concern in SRS groundwater.

For each remediation project, SRS determines the degree of contamination in the groundwater. After this evaluation, SRS and the regulatory agencies decide upon a strategy for remediating the groundwater.

SRS often applies remedial actions to the groundwater contamination source. For instance, SRS widely uses soil vapor extraction, a technology that extracts contaminated soil vapor from the vadose (unsaturated) zone to remove VOCs. This technology minimizes the VOCs that will reach the water table. Recently, SRS has emphasized converting soil vapor extraction systems requiring permanent electrical power to passive systems using solar power or barometric pumping.

SRS Field Work Includes Preparing Soil Cores and Collecting Soil Samples for Characterization.

SRS implements several groundwater remedial technologies. These technologies manage the rate the contaminants move and reduce the risk of contaminant exposure to human health and ecological receptors. Forty-one remediation systems are currently operating. In 2023, SRS removed 9,238 pounds (lbs) of VOCs from the groundwater and the vadose zone (SRNS 2024b). The amount of VOCs removed from the groundwater in 2023 is approximately 29% less than in 2022 due to an average reduction of 100 hours of operational time per month because of maintenance and equipment repairs and declining concentrations in the water being treated. Although mass removal rates will vary annually and generally decline over time as less mass is available for removal, SRS is dedicated to continuing to remediate contaminated groundwater.

SRS has worked for more than 20 years to reduce the tritium flux to Fourmile Branch. Since 2000, SRS has reduced the tritium flux to Fourmile Branch by almost 70% using groundwater remedial technologies (subsurface barriers and water capture with phytoirrigation). The Mixed Waste Management Facility (MWMF) Phytoremediation Project has the largest reductions of the technologies currently in use on the Site. In 2023, the MWMF Phytoremediation Project prevented 24.7 Ci of tritium from reaching SRS streams.

A/M Area is SRS's largest groundwater plume (Figure 7-3). The earliest identified contamination in the A/M-Area plume is associated with the M-Area and Metallurgical Laboratory Hazardous Waste Management Facility (HWMF), located in the general proximity of the "M" shown in Figure 7-3. Remediation at these two facilities began in 1983, when SRS pumped groundwater from wells to an above-ground treatment system, followed by soil vapor extraction, and then by thermal treatment. Figure 7-5 shows that as of 2023, these technologies have removed 1.62 million lbs of solvent, consisting of TCE and PCE (SRNS 2024a).

Overall, the size, shape, and volume of most SRS groundwater plumes are not significantly increasing because most of the contaminant sources have remediation systems in place. The *Savannah River Site Groundwater Management Strategy and Implementation Plan* (SRNS 2020) contains details concerning groundwater monitoring and conditions at individual sites.

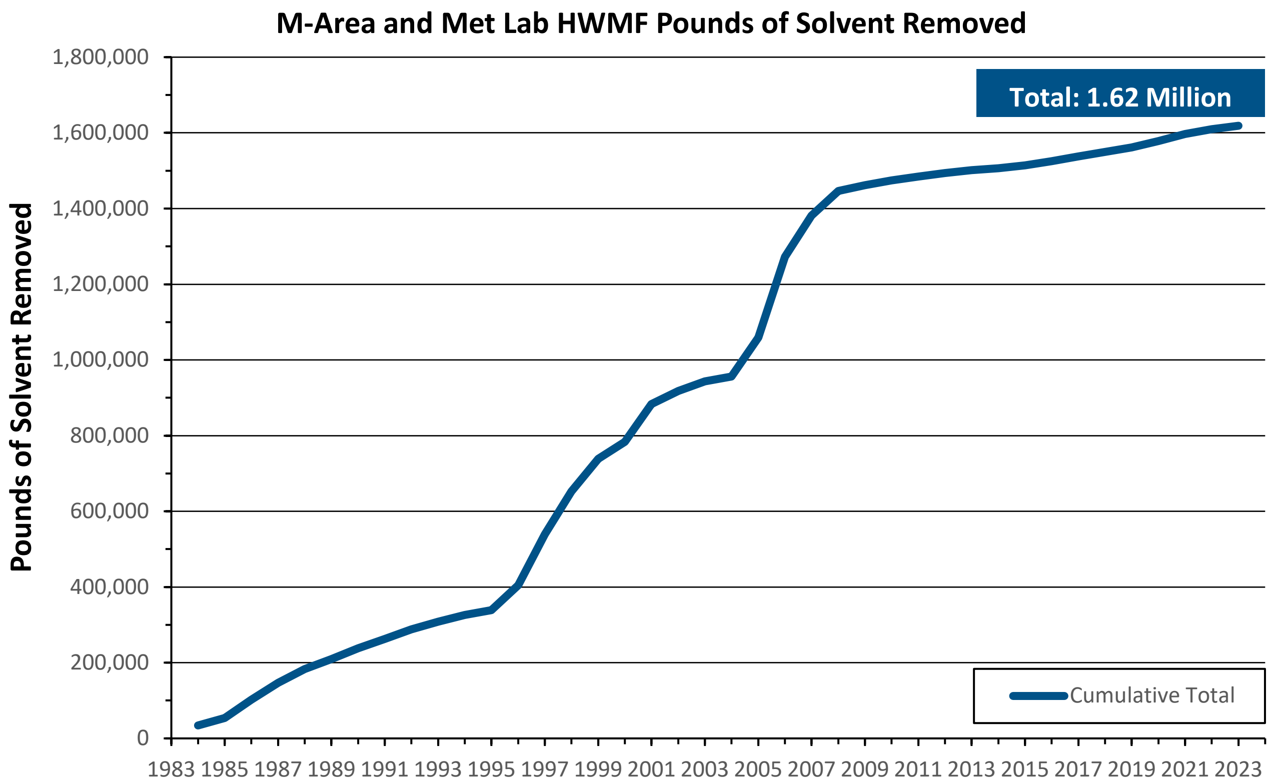


Figure 7-5 Solvent Removed from A/M-Area Groundwater Plume

7.3.4 Conserving SRS Groundwater

As in the past, SRS continues to report its drinking and process water use to SCDHEC. In 2023, SRS used 2.60 million gallons of water per day. Information on SRS water conservation is in Chapter 2, *Environmental Management System*.

SRS manages its own drinking and process water supply from groundwater beneath the Site. Approximately 40 production wells in widely scattered locations across the Site supply SRS domestic and process water systems. Eight of these wells are domestic water systems that supply drinking water. The other 32 wells provide water for all SRS facility operations. The 2023 *SRS Environmental Report* webpage contains a map of SRS domestic water systems under the *Environmental Maps* heading.

The A-Area domestic water system now supplies treated water to most Site areas. The system consists of a treatment plant, distribution piping, elevated storage tanks, and a well network. The wells range in capacity from 200 to 1,500 gallons per minute. Remote facilities, such as field laboratories, barricades, and pump houses, use small drinking water systems and bottled water. SRS domestic water systems meet state and federal drinking water quality standards. SCDHEC samples the systems quarterly for chemical analyses. Monitoring the A-Area water system for bacteria occurs monthly. SCDHEC performs sanitary surveys every two years on the A-Area system and inspects the smaller systems every three years. All 2023 water samples complied with SCDHEC and EPA water quality standards. Information on compliance activities associated with the SRS drinking water system is in Chapter 3, *Compliance Summary*, Section 3.3.7.2, *Safe Drinking Water Act (SDWA);* Chapter 4, *Nonradiological Environmental Monitoring Program,* Section 4.3.2, *Onsite Drinking Water Monitoring;* and Chapter 5, *Radiological Environmental Monitoring Program*, Section 5.4.8, *Drinking Water Monitoring.*

A, F, H, and S Areas have process water systems to meet SRS demands for boiler feedwater, equipment cooling water, facility washdown water, and makeup water. SRS uses the makeup water for cooling towers, fire storage tanks, chilled-water-piping loops, and Site test facilities. Process water wells ranging in capacity from 100 to 1,500 gallons per minute supply water to these systems. In K Area, L Area, and Z Area, the domestic water system supplies the process water system. At some locations, the process water wells pump to ground-level storage tanks, where SRS implements corrosion control measures. At other locations, the wells directly pressurize the process water distribution piping system without supplemental treatment.

Chapter 8: **Quality Assurance**

The Savannah River Site (SRS) quality assurance (QA) and quality control (QC) program objectives verify that SRS products and services meet or exceed customers' requirements and expectations. The Environmental Monitoring Program (EMP) has multiple QA requirements for collecting samples, analyzing and reporting data, and managing records. It is important to confirm the accuracy of sample results so SRS can confidently assess the impacts Site activities may have on human health and the environment.

2023 Highlights

Analytical Laboratory Quality Assurance

SRS continued to use South Carolina Department of Health and Environmental Control (SCDHEC)-certified laboratories to analyze the environmental monitoring samples it reports to SCDHEC and the U.S. Environmental Protection Agency.

The U.S. Department of Energy Consolidated Audit Program (DOECAP) requires the analytical laboratories providing service to DOE have accreditation through the program. In 2023, three SRS subcontract laboratories that analyzed the environmental samples reported in this document continued to maintain their accreditation, as required to provide analytical services to SRS.

DOECAP audits facilities that provide service to DOE. In 2023, SRS participated in one DOECAP audit of a treatment, storage, and disposal facility (TSDF) and reviewed DOECAP audit reports of other TSDFs. The audits indicated that there were no significant findings that would cause SRS waste generators to discontinue using the commercial TSDFs.

Quality Control Activities

QC samples identified no defects affecting the analytical results of the surveillance and monitoring programs. Onsite and subcontracted laboratories reported acceptable proficiency and maintained SCDHEC certification for all analyses.

8.1 INTRODUCTION

The Savannah River Site (SRS) implements and conducts its quality assurance (QA) program to comply with the following regulations: 1) U.S. Department of Energy (DOE) Order 414.1D, *Quality Assurance*, 2) American Society of Mechanical Engineers Nuclear Quality Assurance (NQA) standards NQA-1-2008 with the NQA-1a-2009 Addenda, *QA Requirements for Nuclear Facility Applications*, and 3) the Code of Federal Regulations (CFR) in 10 CFR 830, *Nuclear Safety Management*. In addition, specific programs may have other QA requirements from outside organizations. For example, under the Tank Closure Program and Area Completion Projects, the U.S. Environmental Protection Agency (EPA) and South Carolina Department of Health and Environmental Control (SCDHEC) require DOE to develop and follow a project-specific sampling and analysis plan and a QA program plan. DOE has QA programs to verify the integrity of analyses from both onsite and subcontracted offsite laboratories and to ensure it is complying with the quality control (QC) program requirements.

> ### *Chapter 8—Key Terms*
>
> ***Quality assurance*** *is an integrated system of management activities involving planning, implementing, documenting, assessing, reporting, and improving quality to ensure quality in the processes through which products are developed. The goal of QA is to improve processes so that defects do not arise when the product is produced. It is proactive.*
>
> ***Quality control*** *is a set of activities that ensure quality in products by identifying defects in the actual products. The goal of QC is to identify and correct defects in the finished product before it is made available to the customer. QC is a reactive process.*
>
> *In summary, quality assurance makes sure an entity is doing the right things, the right way; quality control makes sure these results are what the entity expected.*

The SRS radiological Environmental Monitoring Program (EMP) uses and disseminates high-quality data to promote environmental stewardship and support other Site missions. The environmental monitoring QA and QC program improves the methods and techniques used to both collect and analyze the environmental data and to prevent errors in generating the data. The QA and QC program includes continuous assessments, precision checks, and accuracy checks, as Figure 8-1 shows. Through an ongoing process, the results of activities in one area provide input into assessments or checks conducted in the other two areas. The result is high-quality data. By combining continuous assessment of field, laboratory, and data management performance with checks for accuracy and precision, SRS ensures that all monitoring and surveillance data accurately represent conditions at SRS. Appendix F, *Glossary*, contains definitions for each term Figure 8-1 presents.

Some elements of the QA and QC program are inherent within environmental monitoring standard procedures and practices. SRS evaluates these elements as part of the continuous assessment process. The Department of Energy Consolidated Audit Program (DOECAP) focuses on assessing specific QA and QC program elements.

8.2 BACKGROUND

DOE Order 414.1D, *Quality Assurance*, requires an integrated management system, ensuring that the results of the EMP meet the requirements of federal and state regulations and DOE Order 458.1, *Radiation Protection of the Public and the Environment*. SRS uses field and laboratory procedures to guide activities such as collecting samples, analyzing samples, evaluating data, and reporting results. SRS uses an integrated testing system to ensure the integrity of analyses SRS and offsite laboratories perform. This testing includes internal laboratory QA and QC tests and testing associated with state and national testing programs, such as the Mixed Analyte Performance Evaluation Program (MAPEP). In addition, SRS uses QA and QC procedures to verify and control environmental monitoring. Together, these quality measures ensure that the resulting data representatively reflects SRS operational impacts on the health and safety of the public, workers, and the environment.

8.3 QUALITY ASSURANCE PROGRAM SUMMARY

The SRS Environmental Monitoring QA and QC Program focuses on minimizing errors through ongoing assessment and control of the program components. The QA and QC activities are interdependent.

For example, QC identifies an ongoing problem with the quality of the product and alerts QA personnel that there is a problem in the process. QA determines the root cause and extent of the problem and changes the process to eliminate the problem, prevent reoccurrences, and improve product quality.

QA focuses on the processes implemented to produce the data presented in this report. SRS continuously evaluates the EMP to identify and implement improvements. The EMP QA efforts that lead to recurring or one-time program improvements include the following:

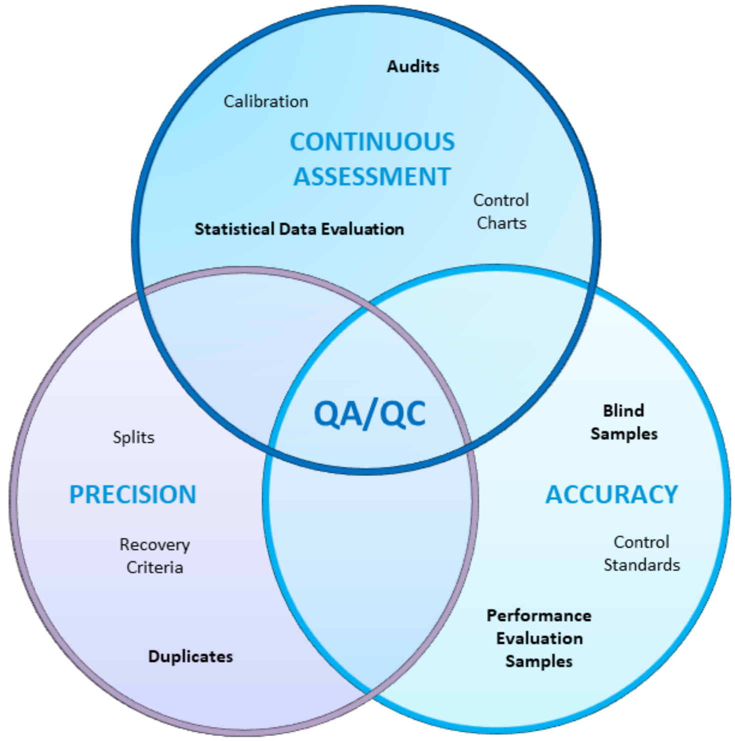


Figure 8-1 Interrelationship between QA and QC Activities

- Implementing EMP enhancements
- Improving data quality in the laboratory and field
- Recertifying one of the SRS onsite laboratories
- Performing DOECAP audits of commercial treatment, storage, and disposal facility (TSDFs) that SRS waste generators use
- Ensuring commercial analytical laboratories maintain DOECAP accreditation

QC activities are the tests and checks that ensure SRS is complying with defined standards. Ongoing QC associated with the EMP includes the following:

- Participating in MAPEP by laboratories that perform analytical measurements on SRS samples
- Participating in proficiency testing by laboratories performing National Pollutant Discharge Elimination System (NPDES) and drinking water analyses
- Collecting and analyzing QC samples (duplicates and blind samples) associated with field sampling
- Analyzing QC samples (blanks, laboratory control samples, duplicates, spikes, and others) associated with laboratory analyses

These specific checks identify instances when defects can occur in SRS processes and ensure that when addressed through planning and improving, quality data is produced.

8.4 ENVIRONMENTAL MONITORING PROGRAM QA ACTIVITIES

SRS repeatedly assesses the EMP to identify and implement continuous improvements and minimize the potential for errors. During 2023, SRS implemented the following quality improvements:

- Radiological Liquid Effluent Program—SRS added a new outfall location and removed a basin location.
- Radiological Liquid Surveillance Program—SRS added niobium-94 (Nb-94) and radium-226 (Ra-226) to the radionuclide analytical list.
- Air Effluent Program—SRS added two new airborne effluent monitoring locations in H-Tank Farm.
- Comprehensive Environmental Data Management System (CEDMS)—SRS transitioned to a new comprehensive environmental database system, which replaced a suite of existing applications, systems, and databases. The application programming interface enables SRS to load and extract data from a consolidated data storage system.
- Industrial Stormwater Program—SRS installed oyster shells at check dams in a stormwater ditch to adsorb metals.
- Surface water sampling equipment—SRS installed modems and cameras at basin locations for remote programming and to confirm discharge, a new refrigerated sampler at an NPDES outfall, and a new staff gauge at a liquid surveillance sampling location.

A Refrigerated Sampler Ensures the Preservation of Samples.

SRS uses SCDHEC-certified laboratories for those EMP parameters that are reportable to SCDHEC. SCDHEC certifies the SRS onsite laboratories and offsite subcontract laboratories for a large variety of environmental analyses. In 2023, SCDHEC performed a recertification evaluation of the Central Sanitary Wastewater Treatment Facility Laboratory. These evaluations include a review of QA and QC practices and procedures. SCDHEC renewed the certification for this onsite laboratory for another three years.

8.4.1 Department of Energy Consolidated Audit Program (DOECAP)

DOECAP is a comprehensive program that audits contract and subcontracted laboratories, providing analytical services to DOE Operations and Field Offices. DOECAP performs consolidated audits to reduce the number of audits DOE field sites conduct independently and to standardize audit methodologies, processes, and procedures. DOECAP audits commercial environmental analytical laboratories and commercial TSDFs that DOE facilities use.

8.4.1.1 DOECAP Laboratory Audits

The DOECAP Laboratory Audit Program is a formal accreditation program that DOE requires of commercial laboratories that perform analyses for the DOE Complex. A DOECAP-approved third-party accreditation body must assess a laboratory for it to receive and maintain DOECAP accreditation. The DOECAP-approved accreditation bodies evaluate laboratories based on technical capability and competence, along with their proficiency in complying with DOE QA requirements. The accreditation bodies assess how well the laboratories document incoming samples, calibrate instruments, adhere to analytical procedures, verify data, issue data reports, manage records, perform nonconformance and corrective actions, perform preventative maintenance, and dispose of samples. Within these topics, auditors evaluate how the laboratories use control charts, control standards, chemical recoveries, performance evaluation samples, and laboratory procedures.

In 2023, the three subcontracted laboratories that analyze the environmental samples documented in the *SRS Environmental Report* maintained their accreditation and continued to provide service to DOE and SRS.

8.4.1.2 DOECAP TSDF Audits

DOECAP performs annual audits of the commercial treatment, storage, and disposal facility (TSDFs) SRS uses to treat and dispose of mixed and hazardous waste. These reviews ensure that TSDFs are meeting contract requirements and are complying with applicable local, state, and federal regulations. DOECAP uses functional area checklists to conduct the following audits: QA, analytical data quality, environmental compliance, radiological controls, waste operations, safety and industrial hygiene, and transportation.

In 2023, SRS provided one auditor who participated in one of these audits (virtual and onsite) of a commercial TSDF. Additionally, SRS reviewed all final DOECAP audit reports of each TSDF that SRS has contracts with. The reviews indicated that there were no significant findings that would cause SRS waste generators to discontinue using the commercial TSDFs.

8.5 ENVIRONMENTAL MONITORING PROGRAM QC ACTIVITIES

As an important part of SRS Environmental Monitoring Program QC activities is to ensure Site personnel collect and analyze samples to the highest standard and without analysis errors. All laboratories analyzing samples for the SRS EMP must participate in QC programs that either SCDHEC or DOE directs.

8.5.1 QC Sampling

SRS personnel collect and transport several types of QC samples—including blinds, field duplicates, trip blanks, and field blanks—throughout the year to determine the source of any measurement error.

To assess the quality and reliability of field data measurements, SRS routinely analyzes blind samples to measure hydrogen ion activity (pH). A blind sample contains a composition known to the submitter but not known to the analyst. Analysis of blind samples also tests the analyst’s proficiency in performing the specified analysis. Samples are tested and expected to be within the acceptable limit of less than 0.4 standard unit difference between the original and blind samples.

During intralaboratory checks performed for the NPDES industrial wastewater program, SRS personnel collect blind and duplicate field samples for at least 10% of each outfall's required frequency. For example, if an outfall has a monthly sampling requirement, then SRS collects two blinds and two duplicate samples during the year. SRS onsite and subcontracted laboratories also analyze duplicate samples for the water quality (nonradiological) program. Each month, SRS collects duplicate samples at one river and one stream location to verify analytical results. SRS also collects duplicate samples for both the radiological and nonradiological sediment samples.

The relative percent difference (RPD) between each sample result and the result of the corresponding blind or duplicate sample (when both values are at least five times above the detection limit) should be less than or equal to 20%. Table 8-1 summarizes 1) the blind and duplicate sample analyses associated with the NPDES industrial wastewater program, 2) the duplicate sample analyses associated with the river and stream water quality program, 3) both the nonradiological and radiological duplicate sample analyses for river, stream, and basin sediment programs, and 4) the number of impacted analytes per program and sample type. Results in this table address both SRS and offsite subcontracted laboratory analyses. Processing duplicate samples evaluates the accuracy of the analytical and measurement methods the laboratories use. One hundred percent of the NPDES pH blind samples, 98% percent of the NPDES blind samples, 99% of the NPDES duplicate samples, 97% of the water-quality duplicate samples, 69% of the nonradiological sediment duplicate samples, and 93% of the radiological sediment duplicate samples met the acceptable difference limit. Reasons for results differing between the programs include sampling uncertainties and analytical uncertainties associated with the measurements, such as the precision of the analytical instruments and detection limits of the analytical instruments.

Table 8-1 Summary of Laboratory Blind and Duplicate Sample Analyses

Program and Sample Type	Number of Comparisons	Number of (%) Comparisons within Acceptable Limits (RPD between Results ≤ 20%)		Number of (%) Comparisons Outside Acceptable Limits (RPD between Results > 20%)		Number of Impacted Analytes
NPDES pH Blind	24	24	(100%)	0	(0%)	0
NPDES Blind	90	88	(98%)	2	(2%)	2
NPDES Duplicate	96	95	(99%)	1	(1%)	1
River/Stream Water Quality Duplicate	414	403	(97%)	11	(3%)	5
Nonradiological River/Stream/Basin Sediment Duplicate	48	33	(69%)	15	(31%)	8
Radiological River/Stream/Basin Sediment Duplicate	30	28	(93%)	2	(7%)	2

Note:
RPD = relative percent difference
NPDES = National Pollutant Discharge Elimination System

Although results indicate there were some differences between the QC samples and their corresponding compliance samples, they did not impact conclusions made with the data. The results indicate that in 2023 there were no consistent problems with either sample collection or laboratory analysis techniques.

Table 8-2 summarizes the results of field and trip blank analyses associated with the NPDES industrial wastewater program. A field blank determines whether the field sampling and sample processing environments have contaminated the sample. A trip blank documents contamination associated with shipping and field-handling procedures. All 2023 field blank and trip blank results were nondetect, indicating neither sampling nor shipping techniques contributed to contaminants in the actual samples as discussed in Chapter 4, *Nonradiological Environmental Monitoring Program.*

Table 8-2 Summary of Trip and Field Blank Sample Analyses

Program and Sample Type	Number of Samples Analyzed	Number of Samples with Results Below Detection Limits
NPDES Trip Blank	30	30
NPDES Field Blank	10	10

Note:
NPDES = National Pollutant Discharge Elimination System

8.5.2 Laboratory Proficiency Testing

8.5.2.1 Nonradiological Methods Proficiency Testing

SCDHEC Regulation 61-81, *State Environmental Laboratory Certification Program,* requires laboratory proficiency testing to ensure the validity and quality of the data being generated. Proficiency testing validates a particular measurement process. It is used to evaluate a laboratory's performance against pre-established criteria by testing the same samples at other laboratories and comparing the results. SRS laboratories performing NPDES and drinking water analyses maintained state certification for all analyses after achieving acceptable results in SCDHEC-required proficiency testing.

During 2023, onsite and subcontracted laboratories participated in water pollution and water supply performance evaluation studies. Onsite laboratories reported proficiency of 100%, and subcontracted laboratories reported proficiency greater than 97% for the parameters tested for NPDES and drinking water laboratories. Both onsite and subcontracted laboratories maintained SCDHEC certification for all analyses at SRS.

Laboratories develop corrective actions for failed analyses. The corrective actions are submitted to SCDHEC, along with subsequent passing proficiency testing results for those analyses. The objective of the corrective actions is to prevent a reoccurrence of failed analyses. Corrective actions may include modifying sample preparation or analysis procedures. The unacceptable measurements did not affect the analyses provided to SRS in support of the NPDES and drinking water monitoring programs.

8.5.2.2 Radiological Methods Proficiency Testing

All laboratories performing environmental analytical measurements in support of DOE's Environmental Management (DOE-EM) activities must participate in Mixed Analyte Performance Evaluation Program (MAPEP). This intercomparison program is an integral component of the DOE-EM Laboratory Management Division's QA program, ensuring laboratories provide DOE-EM with defensible, accurate data. The Radiological and Environmental Sciences Library twice a year prepares, characterizes, and distributes MAPEP proficiency samples, which contain environmentally important and compliance-required constituents in representative matrices. The samples include air filter, soil, vegetation, and water matrices with stable inorganic, organic, and radioactive elements representative of those found at DOE sites. The MAPEP rounds conducted during 2023 were MAPEP 48 and 49. The SRS Environmental Laboratory participated in the two MAPEP studies, receiving acceptable results for 100% of results on MAPEP Series 48 and 97% acceptable results for water, air, vegetation, and soil analytes in MAPEP Series 49.

One SRS subcontracted laboratory participated in MAPEP Series 48 and had acceptable results in 97% of the water and soil matrices. SRS sent all applicable environmental samples to the subcontracted laboratory, which continued to successfully participate in the MAPEP program.

In the case of less than 100% reported proficiency, laboratories develop corrective actions for failed analyses. These corrective actions may include modifying procedures for preparing and analyzing samples.

8.6 RECORDS MANAGEMENT

EMP documentation is an important part of the SRS Environmental Program. The *SRS Environmental Report* is the public record of EMP's annual performance. SRS compiles the report every year following guidelines in DOE Order 231.1B, *Environment, Safety, and Health Reporting*.

The *SRS Environmental Report* communicates EMP's results and those of the Groundwater Management Program and Environmental Compliance programs to government agencies and the public. In addition to this report, SRS generates various records and reports to document SRS nonradiological and radiological environmental programs, groundwater management, and Site compliance with applicable regulations. SRS maintains these documents and the records generated as part of the EMP, in accordance with SRS records management procedures.

Chapter 9: **Per- and Polyfluoroalkyl Substances (PFAS)**

Emerging contaminants of concern bring unique challenges to the Savannah River Site (SRS) as changing regulatory requirements compel the reevaluation of historical and current practices to maintain regulatory compliance and continue to protect human health and the environment. SRS responds to this by

- Ensuring transparency with regulators and the public
- Being proactive and responsive in anticipating regulatory changes
- Collecting data and information to assess and determine further appropriate actions

2023 Highlights

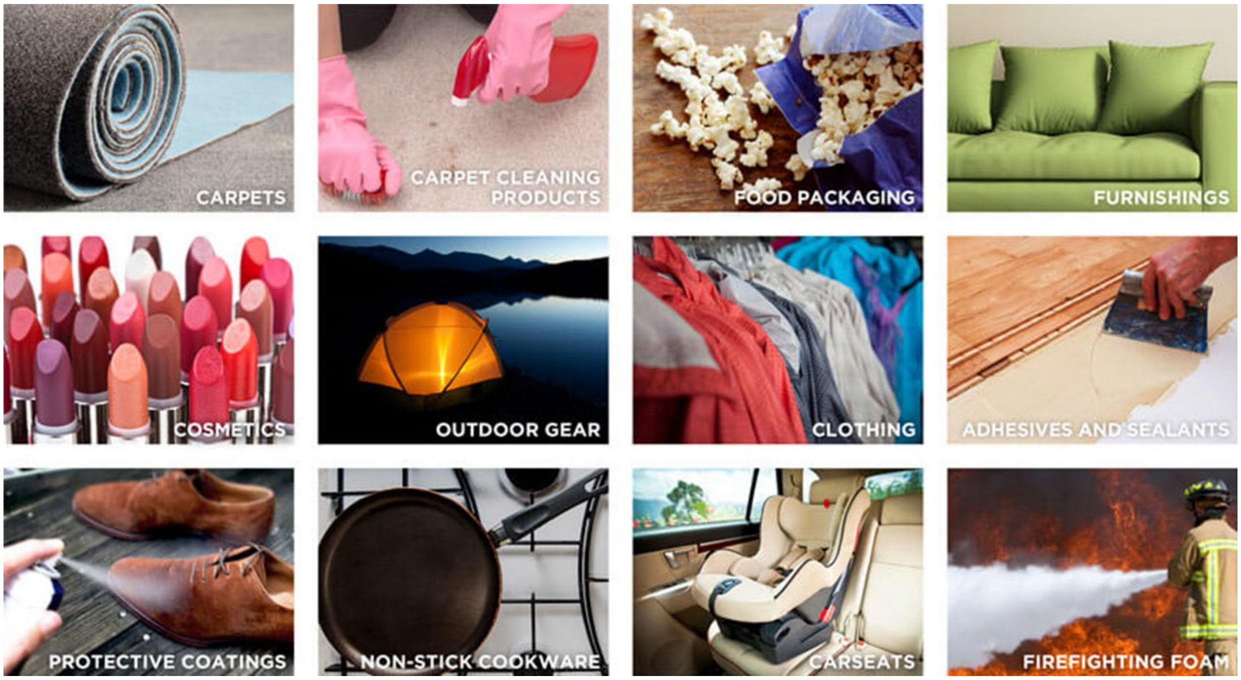
- The U.S. Department of Energy (DOE), led by the Office of Environment, Health, Safety, and Security, continues to actively assess and understand per- and polyfluoroalkyl substances (PFAS) presence at DOE sites and to take actions to manage risk.
- The SRS PFAS Working Group (PWG) continued working with DOE-Headquarters (HQ) by reviewing draft guidance documents and commenting on proposed U.S. Environmental Protection Agency (EPA) rulemaking and initiatives.
- In October, DOE-Savannah River (DOE-SR) began reviewing the *SRS PFAS Implementation Plan*, Revision 1. SRS had submitted the draft document in December 2022 as a DOE PFAS Strategic Roadmap commitment.
- In October and November, SRS sampled 65 wells and 10 surface water stations in D Area for PFAS constituents as part of an ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigation.
- In November, SRS briefed the SRS Citizens Advisory Board on SRS PFAS activities during its Full Board Meeting.

9.1 INTRODUCTION

Increasing national attention on the topic of per- and polyfluoroalkyl substances (PFAS) has prompted calls for action from federal, state, and local government. It is important to understand the nature and use of PFAS to comprehend the scope of these responses.

PFAS are carbon atoms linked to each other and bonded to fluorine atoms. The fluorination imparts properties to the molecule. The carbons may be partially fluorinated (polyfluorinated) or fully fluorinated (perfluorinated). PFAS are a group of more than 9,000 man-made synthetic chemicals that have been used worldwide in industry and consumer products for more than 70 years. PFAS compounds have numerous different properties and applications depending on the compound chemical structure.

Because of their wide range of properties, PFAS use is ubiquitous and pervasive from both a consumer product and industrial application, as shown in the examples below.



PFAS Use is Common In a Variety of Consumer and Industrial Products.

PFAS have followed a pattern of emergence and awareness similar to many other regulated environmental contaminants, such as 1,4-dioxane. Figure 9-1 provides a general timeline of PFAS manufacturing, use, and awareness.

PFAS are a broad group of man-made chemicals with numerous properties and applications. They include 3,000 to 5,000 individual chemicals. The most-studied PFAS are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS). PFOA and PFOS are chemically very inert, resistant to high temperatures, reduce surface tension, and are water- and dirt-repellent and grease-proof. The very properties that have made these materials into an industrial success also have led to persistency, bioaccumulation, and, in some cases, their toxicity in the environment. These compounds do not readily degrade by most natural processes. They are thermally, chemically, and biologically stable and are resistant to biodegradation, atmospheric photooxidation, direct photolysis, and hydrolysis. The structure of perfluorochemicals increases their resistance to degradation; the carbon-fluorine bonds require a lot of energy to break down, and the fluorine atoms shield the carbon backbone. Although PFOA and PFOS are no longer manufactured in the United States, they may exist in legacy products and imports.

Due to their widespread production and use, as well as their ability to move and persist in the environment, surveys conducted by the Centers for Disease and Prevention show that most people in the United States have been exposed to PFAS. Figure 9-2 shows the following exposure pathways:

- Occupational exposures—PFAS manufacturing resulting in inhalation and dermal contact
- Nonoccupational exposure
  - Drinking water contaminated with PFAS
  - Eating foods, such as fish caught in PFAS-contaminated water, or crops grown in PFAS-contaminated soil
  - Breathing air containing PFAS
  - Inhaling and ingesting house dust containing PFAS
  - Having direct contact with consumer products treated or packaged with PFAS

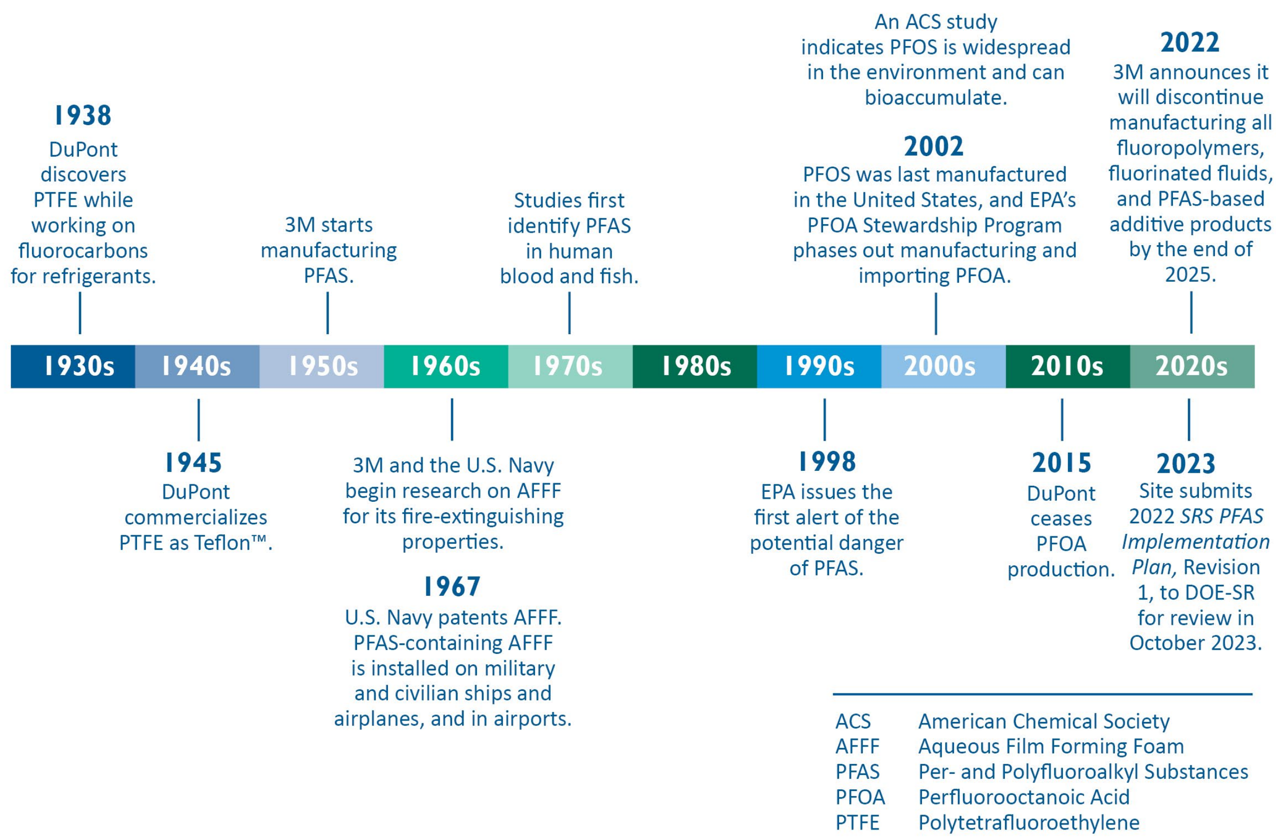


Figure 9-1 Key Dates in the Development and Regulation of PFAS in the United States

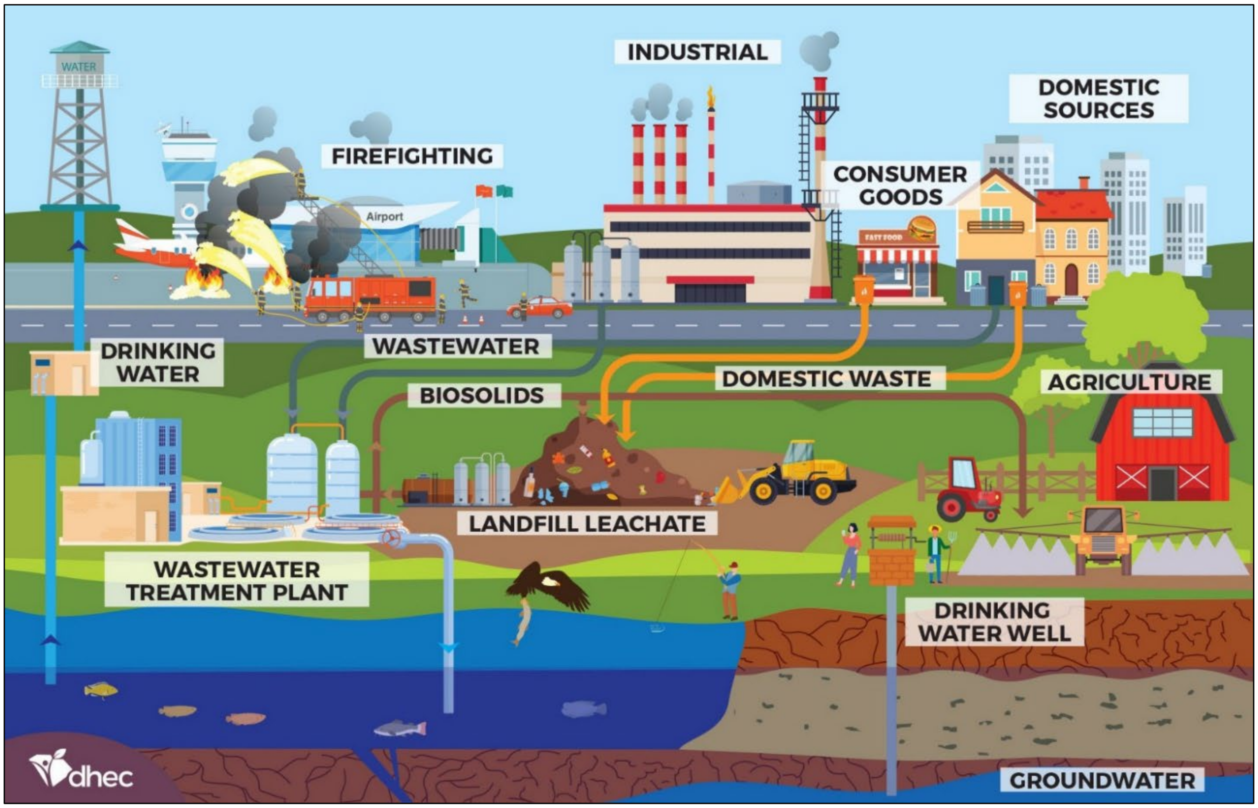


Figure 9-2 PFAS Exposure Pathways

Terminology is one of the confusing points when discussing PFAS both within the scientific community and with the public. Because there are thousands of chemicals within this group, they do not all have the same properties and associated concerns. For example, stating that PFAS can cause cancer is misleading, because only a small portion of the thousands of PFAS have been studied. Health effects from peer-reviewed scientific studies have shown that exposure to certain PFAS chemicals may lead to

- Reproductive effects, such as decreased fertility or increased high blood pressure in pregnant women
- Developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes
- Increased risk of some cancers, including prostate, kidney, and testicular cancers
- Reduced ability of the body's immune system to fight infections, including reduced vaccine response
- Interference with the body's natural hormones
- Increased cholesterol levels and the risk of obesity

9.2 STATUS OF PFAS REGULATIONS AND GUIDANCE

9.2.1 U.S. Environmental Protection Agency (EPA)

The EPA's *PFAS Strategic Roadmap* is the driver for all the regulatory actions pertaining to PFAS. The agency developed this plan to attack the problem on multiple fronts while leveraging the full range of statutory authorities to confront the human health and ecological risks of PFAS. The EPA made specific commitments to action for 2021 through 2024. The planned actions represent important and meaningful steps to safeguard communities from PFAS contamination. Cumulatively, these responses will build on one another and lead to more enduring and protective solutions.

The EPA's integrated approach to PFAS focuses on three central directives:

- Research—Invest in research, development, and innovation to increase understanding of PFAS exposures and toxicities, human health and ecological effects, and effective interventions that incorporate the best available science
- Restrict—Pursue a comprehensive approach to proactively prevent PFAS from entering air, land, and water at levels that can adversely impact human health and the environment
- Remediate—Broaden and accelerate the cleanup of PFAS contamination to protect human health and ecological systems

2023 highlights of the EPA's regulatory initiatives include the following:

- Adding nine PFAS chemicals to the Toxic Release Inventory list starting in reporting year 2023 (due July 1, 2024)
- Publishing Proposed National Primary Drinking Water Regulation for six PFAS chemicals (PFOA, PFOS, perfluorononanoic acid [PFNA], hexafluoropropylene oxide dimer acid [HFPO-DA, commonly known as GenX Chemicals], perfluorohexane sulfonic acid [PFHxS], and perfluorobutane sulfonic acid [PFBS]) (*Federal Register*, March 29, 2023)
- Requiring all manufacturers and importers of PFAS and PFAS-containing articles to report information on uses, production volumes, disposal, exposures, and hazards in any year since 2011. For most manufacturers and importers, the report must be submitted to the EPA in 2025.
- Announcing a framework for evaluating PFAS to ensure that new PFAS, or new uses of existing PFAS, do not pose risks to human health or the environment before they are approved for use.

9.2.2 U.S. Department of Energy

In response to the EPA's roadmap, the U.S. Department of Energy (DOE) issued its own PFAS Strategic Roadmap, DOE Commitments to Action 2022–2025, in August 2022. The DOE PFAS Strategic Roadmap (Figure 9-3) outlines DOE's overall approach, goals, objectives, and planned actions to assess and manage PFAS risk at DOE sites in an effort to protect human health and the environment.

DOE-Headquarters (DOE-HQ) established a PFAS Working Group (PWG) in March 2021. The DOE-HQ PWG is responsible for

- Exchanging and gathering information from DOE sites, including sampling strategies, remediation techniques, and success stories
- Working collaboratively with DOE sites to identify potential PFAS contamination issues
- Interfacing with HQ interagency working groups
- Educating DOE sites on PFAS
- Understanding PFAS operations and use at DOE sites
- Sharing lessons learned regarding PFAS

In October 2022, DOE established a PFAS Panel to provide input on critical DOE guidance and policy documents.

Figure 9-3 DOE's Approach to PFAS Rests on Four Pillars and Their Associated Goals

9.2.3 Savannah River Site

In response to the DOE directives, the Savannah River Site (SRS) established its own PWG in March 2022. The SRS PWG serves as a Site-level conduit to the DOE PFAS Coordinating Committee, which led the development of and will guide future updates to the DOE PFAS Roadmap. The SRS PWG researches the interpretation of aspects of PFAS issues. As appropriate, it may develop advisory or tactical recommendations to DOE-Savannah River (DOE-SR) management on specific PFAS issues or objectives. The SRS PWG recognizes that decision-making and communications with regulators and stakeholders rest with DOE-SR management and coordination with DOE-HQ.

As part of the DOE PFAS Strategic Roadmap commitments, SRS submitted the *SRS PFAS Implementation Plan* in December 2022. This plan documents the actions that will implement the goals, objectives, and actions described in the DOE PFAS Strategic Roadmap. The 2022 *SRS PFAS Implementation Plan* was reviewed during the summer of 2023, and SRS submitted Revision 1 to DOE-SR for review in October 2023. The revision included updates to sampling and monitoring conducted by SRS, Site activities to develop and update procurement guidance to restrict purchases of PFAS-containing products, and updated information on research projects associated with the effects of PFAS on Site surface water, groundwater, and biota.

9.3 ONGOING SRS PFAS ACTIVITIES

SRS is working with federal and state regulators to comply with rapidly changing regulations and directives associated with PFAS contaminants. SRS is actively engaged in responding to the emerging requirements for PFAS as discussed in the following sections.

9.3.1 PFAS-Containing Aqueous Film Forming Foam (AFFF) Discontinuance and Disposal

In September 2020, SRS evaluated whether existing AFFF used by the SRS Fire Department contained PFAS. The following was identified:

- SRS had a total of 500 gallons of fluorinated AFFF: 250 gallons on its fire trucks for immediate use and 250 gallons for future use.
- E Area had approximately 200 gallons of fluorinated AFFF in inventory.

Waste determination confirmed that the AFFF products were nonhazardous, but it was likely that they contained PFAS constituents. At that time, all fluorinated AFFF at SRS was replaced with Firebull F3 Fluorine Free Foam (manufactured by EnforcerOne, LLC).

Two Lined 25-Cubic-Yard Roll-off Containers Hold a Mixture of Liquid AFFF and Portland Cement, Which Hardens Into Solid Concrete Blocks.

After evaluating the available options, SRS decided that solidifying and stabilizing the AFFF was the most environmentally protective option to prevent the release of PFAS into the environment. The goal in solidifying and stabilizing the AFFF was to form a uniform, solid block of treated waste with high structural integrity limiting the mobility of the PFAS constituents. To ensure that the liquid AFFF was sufficiently mixed and formed a uniform matrix, SRS employed a method that the hazardous waste industry routinely uses for stabilization. SRS added a layer of Portland Cement and absorbent to the lined 25-cubic-yard roll-off container and poured a portion of the liquid AFFF into the container. The liquid and solid material was thoroughly mixed using a backhoe until it was of a uniform consistency. Additional liquid and cement was added and mixed until the roll-off container was approximately three-quarters full. Another layer of cement was added to the top of the mixture, and the entire batch was allowed to set. SRS used the same process to treat the remaining liquid AFFF in the second roll-off container. Approximately 12,000 pounds of concrete was used. The contents of the roll-offs were inspected the next day and were found to be solid concrete blocks. Subsequently, SRS installed covers on the roll-offs and performs routine inspections. In 2023, SRS requested approval from DOE-HQ to dispose of the roll-off containers. It is currently awaiting authorization before final disposition of the containers.

9.3.2 D-Area Groundwater

As information about the environmental presence of PFAS began to arise, SRS reviewed its historical uses of PFAS, especially PFOS and PFOA. Research showed that AFFF was used at D Area in the fire-training areas and in response to a fire-suppression event at a D-Area gas station.

SRS shared this information with the regulators as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Federal Facility Agreement (FFA) Core Team (DOE, the EPA, and South Carolina Department of Health and Environmental Control [SCDHEC]) scoping process, and the sampling data has been included in recent D-Area Groundwater Monitoring Reports supplied to the regulators and the public. SRS began sampling for PFAS in D-Area groundwater in 2020; sampling results identified PFAS-contaminated groundwater. Chapter 7, *Groundwater Management Program,* includes this data.

Current work focuses on obtaining additional data to adequately assess the nature and extent of the plume to support future decision-making. The current schedule for D-Area groundwater includes a record of decision by March 2028. SRS is committed to understanding the nature and extent of PFAS contamination at the Site.

When new information regarding historical use of PFAS is documented or sampling identifies PFAS contaminants, SRS will assess Site-specific uses and locations. CERCLA investigations, including sampling, will be developed with input by the FFA Core Team. Public notice of all actions will follow the existing CERCLA process, and SRS will share data within the *SRS Environmental Report*.

9.3.3 Savannah River National Laboratory (SRNL) Technology Development Grant

The DOE-Environmental Management Technology Development Office funded a project for Savannah River National Laboratory's (SRNL's) Environmental and Legacy Management Directorate to support the DOE PFAS Strategic Roadmap, which was released in August 2022. This project will provide data that will contribute to understanding the fate and transport of PFAS compounds in soil and groundwater. It will also demonstrate both the biotic and abiotic (or combined) approaches for treating PFAS. The initiative will provide data on toxicity during exposure to PFAS by performing studies on human and other mammalian cell lines. Planning for this multiphase project began in 2023 and will continue through 2024.

9.3.4 University of Georgia's Savannah River Ecology Laboratory (SREL) Ongoing Research

SREL initiated a characterization study of PFAS at SRS. The overarching goal of the study is to characterize the spatial distribution of PFAS, as well as learn more about the extent to which these compounds are biologically available.

Surface water, sediment, and mosquitofish samples were collected from aquatic systems on SRS, including the identified PFAS-contaminated streams in the D-Area fire training area; historical stream sites monitored by the SRS Integrator Operable Unit program; non-stream sites, such as Par Pond and L Lake; and the H-02 constructed wetland as a reference site. Samples were processed at SREL and measured for PFAS concentrations at the University of Florida in 2023. Data analyses were completed for water and sediment samples. Mosquitofish analyses need to be repeated due to issues with analytical instrumentation.

Generally, PFAS concentrations in surface water samples collected from SRS were relatively low compared to the surface water concentrations throughout South Carolina that SCDHEC collected. There appears to be a positive correlation between PFAS concentrations in surface water and potential PFAS sources on the Site.

Findings from this study will provide an initial snapshot of PFAS on the Site regarding their distribution, levels, bioaccumulation potential, and toxicity. Ultimately, the work may provide baseline levels of PFAS on the SRS landscape, identify potential remediation efforts for PFAS on the Site, and reduce uncertainties in risk assessment regarding these long-lasting contaminants at SRS.

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Appendix A: **Environmental Management System**

FY 2023 Environmental Management System (EMS) Goals and Objectives

Requirement	**Leadership in sound environmental stewardship at SRS through innovative programs and projects**
Strategy	**Continuous improvement in reducing the environmental impacts of SRS operations**

DOE EMS Sustainability Goals

Goal	Significant Environmental Aspect	Objectives	Implementation
#1 Energy Management	• Air pollutants • Energy Efficiency and Greenhouse Gases • Renewable energy	• Continue operating the four biomass plants • Implement and identify Energy Conservation Measures (ECMs)	• DOE Sustainability Dashboard • Site Sustainability Plan
#2 Renewable Energy	• Air pollutants • Renewable energy • Interaction with wildlife and Habitat	• Continue operating the four biomass plants • Plan for the 10-megawatt solar field	• DOE Sustainability Dashboard • Site Sustainability Plan
#3 Water Management	• Drinking water quality • Surface water or stormwater contamination	• Reduce water use by installing low-flow devices and replacing degraded pipes • Continue to reduce non-potable (industrial, landscaping, and agricultural) water consumption	• DOE Sustainability Dashboard • Site Sustainability Plan
#4 Performance Contracting	• All aspects	• Continue to look for new opportunities for Energy Saving Performance Contracts in addition to the existing one	• Site Sustainability Plan
#5 Sustainable Buildings	• All aspects	• Preventive maintenance and energy-efficient repairs • Evaluate buildings that are meeting a significant portion of the Guiding Principles for Sustainable Buildings	• DOE Sustainability Dashboard • Site Sustainability Plan
#6 Waste Management	• Industrial waste generation and management • Pollution prevention • Solid waste • Use, reuse, and recycling resources	• Continue to divert at least 50% of sanitary waste to recycle • Continue to recycle excess- and construction-related waste	• DOE Sustainability Dashboard
#7 Energy Management, Building Evaluations, Benchmarking	• All aspects	• Conduct 15 Energy Independence and Security Act (EISA) audits (25% of applicable buildings per year) • Perform building upgrades for light-emitting diodes; heating, ventilation, and air conditioning; building automation; metering; right-sizing equipment; and other applicable ECMs outlined in the EISA 432 guidance, when feasible	• DOE Sustainability Dashboard • Site Sustainability Plan
#8 Fleet Management	• Air pollutants • Energy efficiency and greenhouse gases	• Continue to replace vehicles with alternative fuel vehicles (E-85) and obtain low greenhouse gas emission vehicles • Install 16 charging stations for 62 battery electric vehicles	• DOE Sustainability Dashboard • Site Sustainability Plan
#9 Acquisition and Procurement	• All aspects	• Include statutory requirements for sustainable acquisition in applicable contract actions • Evaluate actions to ensure sustainable acquisitions	• DOE Sustainability Dashboard • Site Sustainability Plan
#10 Electronic Stewardship	• Energy efficiency and greenhouse gases • Use, reuse, and recycling resources	• Acquire electronics that are sustainable (for example, ENERGY STAR®, Electronic Product Environmental Assessment Tool) • Continue to recycle electronics by donating to schools, nonprofit organizations, or by using authorized recycling companies	• DOE Sustainability Dashboard

FY 2023 Environmental Management System (EMS) Goals and Objectives (continued)

Goal	Significant Environmental Aspect	Strategy	Implementation
DOE EMS Sustainability Goals			
#11 Data Center Management	• Energy efficiency and greenhouse gases	• Continue collecting data to support energy-efficient management of data centers • Review feasibility of a data center management tool • Install meter on Backup Computing Facility to provide energy use data	• DOE Sustainability Dashboard
#12 Greenhouse Gases Management and Reporting	• Air pollution • Energy efficiency and greenhouse gases	• Operate four biomass plants • Continue E-85 usage and alternate fuel vehicle leases • Continue to monitor fugitive emissions with Chemical Safety Environmental Management System software • Utilize online communication services for teleconferences to reduce travel requirements • Review teleworking options to reduce commuting mileage and record this data	• DOE Sustainability Dashboard • Site Sustainability Plan
#13 Resilience	• All aspects	• Implement projects identified by the Vulnerability Assessment and Resilience Plan for SRS	• Site Sustainability Plan

FY 2023 Environmental Management System (EMS) Goals and Objectives (continued)

Goal	Significant Environmental Aspect	Strategy	Implementation
SRS EMS Environmental Goals			
#14 Environmental Awareness	• All aspects	• Provide external workshops and seminars for community awareness in surrounding areas • Provide internal training and seminars • Participate in Department of Energy-Headquarters and internal working groups	• 3Q Procedures
#15 Environmental Compliance	• All aspects	• Zero notices of violation in fiscal year 2023 • Meet 100% of regulatory commitments • Evaluate new Site actions and missions for compliance with National Environmental Policy Act and environmental permits and regulations	• 3Q Procedures
	• Air pollution	• Update the Title V Operating Permit	• TV-0080-0041 and • TV-0080-0041-C5 • SCDHEC Permitting Forms
	• Discharge of wastewater systems or groundwater • Surface water or stormwater contamination	• Renewal of National Pollutant Discharge Elimination System Industrial Wastewater application	• Permit #SC0000175 • 3Q Procedures
		• Plan to consolidate multiple water discharges to a common outfall	• 3Q Procedures
	• Proposed/Emerging Regulations	• Integration of emerging chemicals and contaminants regulations	• 3Q Procedures
#16 Environmental Performance Evaluation	• All aspects	• Conduct self-assessments, management field observations, and preinspections • Conduct and participate in internal audits • Encourage and participate in external audits and inspections	• 3Q Procedures
#17 Environmental Continual Improvement	• All aspects	• Record program enhancements • Participate in issue evaluations (for example, issue investigations, causal analyses) • Develop and create supplementary resources • Update environmental databases	• 3Q Procedures

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Appendix B: **Environmental Surveillance Media and Sampling Frequencies**

Appendix Table B-1 SRS Routine Nonadiological Surveillance Sampling Media and Frequencies

Media	Environmental Surveillance	Sampling Frequency	
		Monthly	Annually
Surface Water	Water quality downstream of National Pollutant Discharge and Elimination System (NPDES) outfalls (stream and river)	✓	
Sediment	Surveillance for the existence and possible buildup of inorganic contaminants		✓
Fish	Bioaccumulation of nonradiological contaminants in fish		✓

Appendix Table B-2 SRS Routine Radiological Surveillance Sampling Media and Frequencies

Media	Environmental Surveillance	Sampling Frequency				
		Weekly	Bi-Weekly	Monthly	Quarterly	Annually
Air	Airborne particulate matter		✓			
	Tritiated water vapor		✓			
	Tritium in rainwater			✓		
Soil	Radionuclide deposition into soils					✓
Food Products	Radionuclide uptake in the food chain					✓
Vegetation	Radionuclide uptake in plants					✓
Optically Stimulated Luminescence	Ambient gamma radiation monitoring				✓	
Water	Onsite drinking water					✓
	Offsite drinking water			✓		
	Onsite surface water (streams and basins)			✓		✓
	Savannah River	✓				✓
Sediment	Radionuclides in streambeds, the Savannah Riverbed, and Savannah River Site (SRS) basin beds					✓
Fish and Shellfish	Radionuclides in freshwater fish, saltwater fish, and shellfish					✓
Wildlife	Radionuclides in onsite deer, feral hogs, turkey, and coyotes during SRS-sponsored hunts					✓

Appendix C: Nonradiological Environmental Monitoring Program Supplemental Information

Appendix Table C-1 River and Stream Water Quality Results Summary

The Savannah River Site (SRS) collected monthly water quality samples at 5 Savannah River locations and 10 stream locations in 2023, totaling 177 samples per analyte or 3,717 records. Locations sampled are as follows: Savannah River locations (RM-118.8, RM-129.1, RM-141.5, and RM-150.4 [Vogtle discharge]) and SRS Stream locations (FM-2B, FM-6, FMC-2, L3R-2, PB-3, SC-4, TB-5, and U3R-4). The control location for the river samples is RM-161.0. The control locations for the stream samples are TC-1 and U3R-1A.

The table compares all results to South Carolina Freshwater Quality Standards (unless otherwise noted) and shows the average and maximum values of each analyte for the river and stream samples. Locations in which analytes are outside standard limits are shown in **red** text. Field duplicates were not included in the generation of these tables.

Notes:

1. The dissolved oxygen (DO) value in the maximum column is a minimum value because the South Carolina Freshwater Quality Standard is based on a minimum value.
2. The pH value in the average column is a minimum value because the South Carolina Freshwater Quality Standard includes minimum and maximum limits.

DL = Detection Limit
DO = Dissolved Oxygen
TOC = Total Organic Carbon
TSS = Total Suspended Solids

Appendix Table C-2 River and Stream Water Quality Results Summary

Four River Locations Plus One Control

Analyte	South Carolina Freshwater Quality Standard	Unit	Number of Results Outside Standard	Number of Results > DL	Control RM-161.0		Highest River Location				Comments
					Avg.[a]	Max.[b]	Avg.[a]		Max.[b]		
DO[c]	min. 4.0	mg/L	0 of 57		8.6	7.1	RM-129.1	8	RM-129.1	6.2	All samples met standard
pH[d]	6.0-8.5	SU	5 of 57		**5.8**	7.1	RM-141.5	**5.9**	RM-118.8	7.2	All maximums met standard
Temperature	< 5°F (2.8°C) above nat. cond. and not > 90°F (32.2°C)	°C	0 of 57		17	24.2	RM-141.5	18.8	RM-141.5	30.2	All samples met standard
Aluminum	87[e]	µg/L	47 of 57	55 of 57	**356**	**2,260**	RM-141.5	**501**	RM-150.4	**2,830**	
Beryllium	4[f]	µg/L	0 of 57	3 of 57	< DL	< DL	RM-141.5	0.1	RM-141.5	0.12	All samples met standard
Cadmium	0.26	µg/L	0 of 57	1 of 57	< DL	< DL	RM-150.4	0.1	RM-150.4	0.1	All samples met standard
Chromium	11	µg/L	0 of 57	37 of 57	1.5	3.5	RM-118.8	2.4	RM-118.8	4.4	All samples met standard
Copper	2.9	µg/L	0 of 57	43 of 57	1.3	2.2	RM-141.5	1.4	RM-150.4	2.8	All samples met standard
Hardness (total)	none	mg/L	no standard	57 of 57	19	30	RM-150.4	26	RM-150.4	76	
Iron	1,000[g]	µg/L	4 of 57	57 of 57	491	**1,580**	RM-141.5	676	RM-150.4	**1,500**	All averages met standard
Lead	0.54	µg/L	6 of 57	11 of 57	0.53	**1.07**	RM-150.4	**0.56**	RM-150.4	**1.28**	
Manganese	none	µg/L	no standard	57 of 57	94.7	160	RM-141.5	96.9	RM-141.5	211	
Mercury	0.05	µg/L	0 of 57	0 of 57	< DL	< DL	< DL	< DL	< DL	< DL	All samples met standard
Nickel	16	µg/L	0 of 57	27 of 57	0.58	1.2	RM-141.5	0.64	RM-150.4	1.5	All samples met standard
Nitrate-Nitrogen	1[h]	mg/L	0 of 57	57 of 57	0.23	0.36	RM-118.8	0.28	RM-118.8	0.4	All samples met standard
Nitrite-Nitrogen	1[h]	mg/L	0 of 57	52 of 57	0.006	0.01	RM-150.4	0.006	RM-150.4	0.01	All samples met standard
Thallium	0.24[f]	µg/L	0 of 57	0 of 57	< DL	< DL	< DL	< DL	< DL	< DL	All samples met standard
TOC	none	mg/L	no standard	57 of 57	3.2	5.3	RM-129.1	3.7	RM-129.1	7.2	
Phosphorus	0.06	mg/L	50 of 57	53 of 57	**0.1**	**0.17**	RM-118.8	**0.13**	RM-118.8	**0.33**	
TSS	none	mg/L	no standard	56 of 57	8.7	42	RM-118.8 & RM-141.5	11	RM-150.4	40	
Zinc	37	µg/L	1 of 57	47 of 57	6.3	28	RM-150.4	9	RM-150.4	**48**	All averages met standard

Appendix Table C-3 River and Stream Water Quality Results Summary (continued)

Eight Stream Locations Plus Two Controls

Analyte	South Carolina Freshwater Quality Standard	Unit	Number of Results Outside Standard	Number of Results > DL	Control TC-1		Control U3R-1A		Highest Stream Location				Comments
					Avg.[a]	Max.[b]	Avg.[a]	Max.[b]	Avg.[a]		Max.[b]		
DO[c]	min. 4.0	mg/L	6 of 120		8.6	5.4	8.3	6.8	FMC-2	5.4	FMC-2	**1.5**	All averages met standard
pH[d]	6.0-8.5	SU	35 of 120		**5.4**	7	**5.3**	7.2	FMC-2	**4.7**	L3R-2	7.4	All maximums met standard
Temperature	< 5°F (2.8°C) above nat. cond. and not > 90°F (32.2°C)	°C	0 of 120		16.4	23.3	16.7	22.1	SC-4	19	U3R-4	27.3	All samples met standard
Aluminum	87[e]	µg/L	57 of 120	105 of 120	52	**118**	**110**	**668**	PB-3	**267**	PB-3	**538**	
Beryllium	4[f]	µg/L	0 of 120	8 of 120	< DL	< DL	0.11	0.19	U3R-4	0.11	FMC-2	0.16	All samples met standard
Cadmium	0.26	µg/L	0 of 120	0 of 120	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	All samples met standard
Chromium	11	µg/L	0 of 120	24 of 120	1.1	3.1	0.98	1.7	FM-2B	1.4	FMC-2	3.4	All samples met standard
Copper	2.9	µg/L	3 of 120	27 of 120	0.95	1	1	1.4	U3R-4	1.7	U3R-4	**10**	All averages met standard
Hardness (total)	none	mg/L	no standard	111 of 120	14	18	7	16	L3R-2	32	L3R-2	44	
Iron	1,000[g]	µg/L	32 of 120	120 of 120	470	**1,160**	351	781	FMC-2	**2,169**	FMC-2	**5,940**	
Lead	0.54	µg/L	3 of 120	23 of 120	0.43	0.5	0.51	**1.22**	FM-2B	0.48	FM-2B	**1.07**	All averages met standard
Manganese	none	µg/L	no standard	120 of 120	17.6	31.5	9.6	23.9	FMC-2	126	FMC-2	497	
Mercury	0.05	µg/L	1 of 120	2 of 120	< DL	< DL	< DL	< DL	FMC-2	0.02	FMC-2	**0.07**	All averages met standard
Nickel	16	µg/L	0 of 120	82 of 120	0.54	0.8	0.73	1.4	TB-5	4.2	TB-5	7	All samples met standard
Nitrate-Nitrogen	1[h]	mg/L	1 of 120	119 of 120	0.08	0.17	0.37	0.42	FM-6	0.63	FM-6	**1.2**	All averages met standard
Nitrite-Nitrogen	1[h]	mg/L	0 of 120	37 of 120	0.003	0.003	0.003	0.01	FM-6	0.006	FM-6	0.03	All samples met standard
Thallium	0.24[f]	µg/L	0 of 120	3 of 120	< DL	< DL	< DL	< DL	FMC-2	0.068	FMC-2	0.24	All samples met standard
TOC	none	mg/L	no standard	119 of 120	4	7.7	2.7	14	FMC-2	6.9	FMC-2	11	
Phosphorus	0.06	mg/L	32 of 120	69 of 120	0.056	**0.16**	0.04	**0.096**	FM-6	**0.1**	FM-6	**0.13**	
TSS	none	mg/L	no standard	112 of 120	4.3	8	2.9	6	FM-2B	9.4	FM-2B	65	
Zinc	37	µg/L	2 of 120	104 of 120	4.2	23	4	7	FMC-2	11	FMC-2	**49**	All averages met standard

[a] If analyte is non-detect, detection limit is used in averaging calculation.
[b] Maximum detected value
[c] Minimum was reported in the maximum (Max.) value reported columns for DO.
[d] Minimum was reported in the average (Avg.) value columns for pH.
[e] Environmental Protection Agency (EPA) Region 4 Ecological Risk Assessment Supplemental Guidance, March 2018 Update
[f] Standard from Human Health vs. Freshwater Aquatic Life, which has no standard
[g] EPA National Recommended Water Quality Criteria—Aquatic Life
[h] Per South Carolina Department of Health and Environmental Control Environmental Surveillance and Oversight Program 2022 Data Report (CR-004111 12/23)

Appendix Table C-2 Summary of Nonradiological Results for Sediments Collected from the Savannah River, SRS Streams, and Stormwater Basins

SRS collected annual sediment samples at 25 locations in 2023: 9 Savannah River locations, 13 stream locations, and 3 stormwater basin locations, totaling 400 analytes. The control location for the river samples is RM-161.0. The control locations for the stream and stormwater basin sediment samples are TC-1 and U3R-1A, respectively.

The table compares all results to Environmental Protection Agency Region 4 Refinement Screening Values (RSVs) for sediment and shows the maximum detected value of each analyte for the river, stream, and stormwater basin samples. Locations in which detected analytes exceed RSVs are shown in **red** text and are counted in the number of results greater than the RSV. Analytes not detected are not counted in the number of results greater than the RSV.

River Sediment Results

Eight River Locations Plus One Control

Analyte	No. of Detected Results	Control RM-161.0 (mg/kg)	Location of Maximum Result	Maximum Conc. (mg/kg)	EPA Region 4 RSV for Sediment (mg/kg)	No. of Results > RSV	Comments
Aluminum	9 of 9	17,000	RM-157.2	40,000	58,000	0	All samples met standard
Antimony	0 of 9	< DL	All < DL	< DL	25	0	All samples met standard
Arsenic	2 of 9	< DL	RM-129.0	1.24	33	0	All samples met standard
Barium	9 of 9	**130**	RM-157.2	**200**	60	6	Control exceeded RSV
Cadmium	0 of 9	< DL	All < DL	< DL	5	0	All samples met standard
Chromium	9 of 9	25	RM-157.2	51	111	0	All samples met standard
Copper	9 of 9	12	RM-157.2	26	149	0	All samples met standard
Iron	9 of 9	20,000	RM-157.2	**41,000**	40,000	1	
Lead	9 of 9	11	RM-157.2	28	128	0	All samples met standard
Manganese	9 of 9	**2,400**	RM-157.2	**2,400**	1,100	5	Control exceeded RSV
Mercury	0 of 9	< DL	All < DL	< DL	1.1	0	All samples met standard
Nickel	9 of 9	9.1	RM-157.2	20	48.6	0	All samples met standard
Selenium	1 of 9	1.9	RM-157.2	< DL	2.9	0	One DL is greater than RSV
Silver	0 of 9	< DL	All < DL	< DL	2.2	0	Three DLs are greater than RSV
Uranium	0 of 9	< DL	All < DL	< DL	1,000	0	All samples met standard
Zinc	9 of 9	42	RM-157.2	88	459	0	All samples met standard

Note:
DL = Detection Limit
EPA = U.S. Environmental Protection Agency
RM = River Mile
RSV = Refinement Screening Values

Appendix Table C-2 Summary of Nonradiological Results for Sediments Collected from the Savannah River, SRS Streams, and Stormwater Basins (continued)

Stream Sediment Results

Eleven Stream Locations Plus Two Controls

Analyte	No. of Detected Results	Control TC-1 (mg/kg)	Control U3R-1A (mg/kg)	Location of Maximum Result	Maximum Conc. (mg/kg)	EPA Region 4 RSV for Sediment (mg/kg)	No. of Results > RSV	Comments
Aluminum	13 of 13	6,600	38,000	U3R-3	13,000	58,000	0	All samples met standard
Antimony	0 of 13	< DL	< DL	All < DL	< DL	25	0	All samples met standard
Arsenic	9 of 13	< DL	< DL	SC-4	3	33	0	All samples met standard
Barium	13 of 13	**110**	**230**	U3R-3	**160**	60	5	Controls exceeded RSV
Cadmium	0 of 13	< DL	< DL	All < DL	< DL	5	0	All samples met standard
Chromium	13 of 13	12	45	U3R-3	19	111	0	All samples met standard
Copper	13 of 13	5.3	24	BDC	11	149	0	All samples met standard
Iron	13 of 13	5,100	13,000	U3R-3	12,000	40,000	0	All samples met standard
Lead	13 of 13	13	45	U3R-3	14	128	0	All samples met standard
Manganese	13 of 13	180	78	SC-4	740	1,100	0	All samples met standard
Mercury	5 of 13	< DL	< DL	SC-4	0.1	1.1	0	All samples met standard
Nickel	10 of 13	< DL	< DL	U3R-3	18	48.6	0	All samples met standard
Selenium	2 of 13	< DL	< DL	L3R-2	1.1	2.9	0	One DL is greater than RSV
Silver	0 of 13	< DL	< DL	All < DL	< DL	2.2	0	All samples met standard
Uranium	1 of 13	< DL	< DL	L3R-3	2.7	1,000	0	All samples met standard
Zinc	13 of 13	26	86	U3R-3	49	459	0	All samples met standard

Note:
DL = Detection Limit
EPA = U.S. Environmental Protection Agency
RSV = Refinement Screening Values

Appendix Table C-2 Summary of Nonradiological Results for Sediments Collected from the Savannah River, SRS Streams, and Stormwater Basins (continued)

Stormwater Basin Sediment Results

Three Basin Locations Plus Two Stream Controls

Analyte	No. of Detected Results	Control TC-1 (mg/kg)	Control U3R-1A (mg/kg)	Location of Maximum Result	Maximum Conc. (mg/kg)	EPA Region 4 RSV for Sediment (mg/kg)	No. of Results > RSV	Comments
Aluminum	5 of 5	6,600	38,000	E-005	34,000	58,000	0	All samples met standard
Antimony	0 of 5	< DL	< DL	All < DL	< DL	25	0	All samples met standard
Arsenic	1 of 5	< DL	< DL	E-004	9.7	33	0	All samples met standard
Barium	5 of 5	**110**	**230**	E-004	40	60	2	Controls exceeded RSV
Cadmium	0 of 5	< DL	< DL	All < DL	< DL	5	0	All samples met standard
Chromium	5 of 5	12	45	E-004	45	111	0	All samples met standard
Copper	5 of 5	5.3	24	E-004	17	149	0	All samples met standard
Iron	5 of 5	5,100	13,000	E-004	**43,000**	40,000	1	
Lead	5 of 5	13	45	E-006	23	128	0	All samples met standard
Manganese	5 of 5	180	78	E-004	120	1,100	0	All samples met standard
Mercury	0 of 5	< DL	< DL	All < DL	< DL	1.1	0	All samples met standard
Nickel	3 of 5	< DL	< DL	E-005	8.6	48.6	0	All samples met standard
Selenium	0 of 5	< DL	< DL	All < DL	< DL	2.9	0	Two DLs are greater than RSV
Silver	0 of 5	< DL	< DL	All < DL	< DL	2.2	0	All samples met standard
Uranium	0 of 5	< DL	< DL	All < DL	< DL	1,000	0	All samples met standard
Zinc	5 of 5	26	86	E-004	60	459	0	All samples met standard

Note:

The two stream and stormwater basin control locations, TC-1 and U3R-1A, are included in the number of results greater than the detection limit and the number of results greater than the RSV for both the stream and stormwater basin sediment results tables.

DL = Detection Limit

EPA = U.S. Environmental Protection Agency

RSV = Refinement Screening Values

Appendix Table C-3 Summary of Detected Metal Results for Freshwater Fish Tissue Collected from the Savannah River

All antimony, chromium, lead, and nickel results were not detected; therefore, they were not reported in this table.

Analyte	Number of Detected Values (above the MDC)	Number of Estimated Values (above the MDC, below the SQL)	Maximum Detected Concentration (µg/g)	SQL (µg/g)	MDC (µg/g)	Fish Type with Maximum Concentration	Location of Maximum Concentration
Arsenic	22	22	2.51	10.1	1.01	Catfish	Upper Three Runs Creek River Mouth
Cadmium	4	4	0.142	0.484	0.0484	Catfish	Highway 301 Bridge Area
Copper	87	87	0.543	2.03	0.203	Catfish	Augusta Lock and Dam 614
Manganese	99	98	2.06	0.998	0.0998	Panfish	Lower Three Runs Creek River Mouth
Mercury	168	69	1.05	0.2	0.02	Bass	Upper Three Runs Creek River Mouth
Zinc	168	6	16.9	4.07	0.407	Flathead Catfish	Highway 301 Bridge Area

Note:

175 freshwater tissue samples were collected and analyzed for metals and mercury.

MDC = Maximum Detected Concentration

SQL = Standard Quantification Limit

Appendix Table C-4 Summary of Detected Metal Results for Saltwater Fish Tissue Collected from the Savannah River between River Miles 0–8, Near Savannah, Georgia

Antimony, lead, and mercury results were not detected; therefore, they were not reported in this table. All results are for mullet.

Analyte	Number of Detected Values (above the MDC)	Number of Estimated Values (above the MDC, below the SQL)	Maximum Detected Concentration (µg/g)	SQL (µg/g)	MDC (µg/g)
Arsenic	3	3	1.7	10	1
Cadmium	3	3	0.27	0.532	0.0532
Chromium	1	1	0.233	2.13	0.213
Copper	3	3	0.261	2	0.2
Manganese	1	1	0.115	1.06	0.106
Nickel	1	1	0.444	3.19	0.319
Zinc	7	5	4.16	4	0.4

Note:

Seven freshwater tissue samples were collected and analyzed for metals and mercury.

MDC = Maximum Detected Concentration

SQL = Standard Quantification Limit

Appendix D: Radiological Environmental Monitoring Program Supplemental Information

Negative values are reported in tables in this appendix. Background counts are subtracted from the sample counts. Negative values occur when the background count is greater than the sample count. Background counts reflect naturally occurring radionuclides and cosmic radiation that is detected by laboratory instrumentation.

Appendix Table D-1 Summary of Radioactive Atmospheric Releases by Source

In the Calculated column, blanks indicate the radionuclide is not present. A 0.00E+00 in the Calculated column indicates the radionuclide had the potential to be present, but the estimated release was zero. In the facility (Reactors, Separations, Savannah River National Laboratory [SRNL]) columns, a blank indicates the radionuclide was not analyzed. A 0.00E+00 in the facility columns indicates the result was not detected.

Radioactive Atmospheric Releases by Source (curies)[a]

Radionuclide	Half-Life[b]		Calculated[c] (Ci)	Reactors (Ci)	Separations[d] (Ci)	SRNL (Ci)	Total (Ci)
Gases and Vapors							
H-3 (oxide)	12.3	y	7.18E+01	3.13E+01	6.53E+03		6.63E+03
H-3 (elemental)	12.3	y			1.89E+03		1.89E+03
H-3 Total	12.3	y	7.18E+01	3.13E+01	8.42E+03		8.52E+03
C-14	5,700	y	3.52E-07		6.60E-02		6.60E-02
Hg-203	46.6	d	4.77E-10				4.77E-10
Kr-85	10.8	y			2.27E+04		2.27E+04
I-129	1.57E+07	y	6.04E-05		7.64E-03	0.00E+00	7.70E-03
I-131	8.02	d	5.52E-10				5.52E-10
Particles							
Ag-110m	250	d	0.00E+00				0.00E+00
Am-241	432	y	4.20E-07	0.00E+00	3.15E-06	1.30E-09	3.58E-06
Am-243	7,370	y	4.33E-09				4.33E-09
Au-198	2.6952	d	2.78E-08				2.78E-08
Ba-133	10.5	y	3.92E-09				3.92E-09
Be-7	53	d	0.00E+00				0.00E+00
Cd-109	461	d	1.65E-08				1.65E-08
Ce-137	9	h	1.87E-05				1.87E-05
Ce-139	138	d	4.71E-10				4.71E-10
Ce-141	32.5	d	0.00E+00				0.00E+00
Ce-144	285	d	0.00E+00				0.00E+00
Cm-243	29.1	y	0.00E+00				0.00E+00
Cm-244	18.1	y	7.46E-08	0.00E+00	3.50E-08	2.99E-08	1.39E-07
Co-56	77.23	d	0.00E+00				0.00E+00
Co-57	272	d	4.51E-10				4.51E-10
Co-60	5.27	y	1.80E-07	0.00E+00	0.00E+00	0.00E+00	1.80E-07
Cs-134	2.06	y	1.47E-09				1.47E-09
Cs-137	30.2	y	3.33E-03	0.00E+00	5.76E-04	0.00E+00	3.90E-03
Eu-152	13.5	y	8.61E-09				8.61E-09
Eu-154	8.59	y	9.53E-10				9.53E-10

Appendix Table D-1 Summary of Radioactive Atmospheric Releases by Source (continued)

Radioactive Atmospheric Releases by Source (curies)[a] (continued)

Radionuclide	Half-Life[b]		Calculated[c] (Ci)	Reactors (Ci)	Separations[d] (Ci)	SRNL (Ci)	Total (Ci)
Eu-155	4.76	y	0.00E+00				0.00E+00
F-18	1.83	h	0.00E+00				0.00E+00
Fe-55	2.74	y	6.76E-09				6.76E-09
K-40	1.25E+09	y	7.08E-09				7.08E-09
La-140	1.6781	d	0.00E+00				0.00E+00
Mn-54	312	d	4.51E-10				4.51E-10
Na-22	2.6019	y	0.00E+00				0.00E+00
Nb-94	2.03E+04	y	0.00E+00				0.00E+00
Nb-95	35	d	0.00E+00				0.00E+00
Ni-59	1.01E+05	y	0.00E+00				0.00E+00
Ni-63	100	y	3.20E-09				3.20E-09
Np-237	2.14E+06	y	1.40E-08	1.75E-10	3.08E-07	2.15E-10	3.22E-07
Pa-233	27	d	0.00E+00				0.00E+00
Pa-234	6.7	h	2.65E-07				2.65E-07
Pb-212	10.6	h	8.43E-07				8.43E-07
Pm-147	2.62	y	0.00E+00				0.00E+00
Pm-148m	41.3	d	0.00E+00				0.00E+00
Pr-144	17.3	m	0.00E+00				0.00E+00
Pu-236	2.86	y	1.21E-09				1.21E-09
Pu-238	87.7	y	1.16E-07	0.00E+00	2.90E-06	2.45E-08	3.04E-06
Pu-239	2.41E+04	y	4.16E-05	0.00E+00	4.53E-05	9.53E-09	8.69E-05
Pu-240	6,560	y	5.08E-07				5.08E-07
Pu-241	14.4	y	8.96E-06				8.96E-06
Pu-242	3.75E+05	y	3.29E-09				3.29E-09
Ra-226	1,600	y	1.16E-08				1.16E-08
Ra-228	5.75	y	1.82E-09				1.82E-09
Rh-106[e]	29.8	s	4.31E-09				4.31E-09
Ru-103	39.3	d	0.00E+00				0.00E+00
Ru-106	374	d	4.31E-09				4.31E-09
Sb-125	2.76	y	2.11E-09				2.11E-09
Sb-126[e]	12.4	d	0.00E+00				0.00E+00
Sc-46	83.79	d	0.00E+00				0.00E+00
Se-79	2.95E+05	y	0.00E+00				0.00E+00
Sm-151	90	y	0.00E+00				0.00E+00

Appendix Table D-1 Summary of Radioactive Atmospheric Releases by Source (continued)

Radioactive Atmospheric Releases by Source (curies)[a] (continued)

Radionuclide	Half-Life[b]		Calculated[c] (Ci)	Reactors (Ci)	Separations[d] (Ci)	SRNL (Ci)	Total (Ci)
Sn-113	115	d	6.27E-10				6.27E-10
Sn-123	129	d	0.00E+00				0.00E+00
Sn-126	2.30E+05	y	0.00E+00				0.00E+00
Sr-85	64.8	d	6.02E-10				6.02E-10
Sr-89	50.5	d	1.12E-10				1.12E-10
Sr-90	28.8	y	2.52E-03	0.00E+00	5.55E-05		2.58E-03
Tc-99	2.11E+05	y	3.75E-07				3.75E-07
Te-127	9.35	h	0.00E+00				0.00E+00
Te-129	69.6	m	0.00E+00				0.00E+00
Th-228	1.91	y	1.22E-11	1.82E-09			1.83E-09
Th-229	7,340	y	1.39E-09				1.39E-09
Th-230	7.54E+04	y	8.40E-07	2.03E-09			8.42E-07
Th-231	25.5	h	0.00E+00				0.00E+00
Th-232	1.41E+10	y	2.20E-08	1.07E-09			2.31E-08
Tl-208	3.05	m	1.41E-06				1.41E-06
U-232	68.9	y	2.80E-09				2.80E-09
U-233	1.59E+05	y	2.36E-07				2.36E-07
U-234	2.46E+05	y	1.95E-05	5.05E-08	1.73E-05	2.70E-09	3.69E-05
U-235	7.04E+08	y	4.76E-07	0.00E+00	1.42E-06	1.31E-09	1.90E-06
U-236	2.34E+07	y	1.54E-07				1.54E-07
U-237	6.75	d	2.21E-10				2.21E-10
U-238	4.47E+09	y	2.83E-05	6.45E-08	2.42E-05	0.00E+00	5.26E-05
Y-88	107	d	4.51E-10				4.51E-10
Y-90[e]	64.1	h	2.52E-03	0.00E+00	5.55E-05		2.58E-03
Y-91	58.5	d	0.00E+00				0.00E+00
Zn-65	244	d	9.93E-10				9.93E-10
Zr-95	64	d	0.00E+00				0.00E+00
Unidentified Alpha[f]	N/A		6.62E-05	6.06E-06	5.42E-06	8.35E-08	7.78E-05
Unidentified Beta[g]	N/A		1.75E-04	7.24E-05	7.99E-05	3.03E-06	3.30E-04
TOTAL	N/A		7.18E+01	3.13E+01	3.11E+04	3.19E-06	3.12E+04

Note:

SRNL = Savannah River National Laboratory

[a] One curie equals 3.7E+10 Becquerels

[b] ICRP 107, *Nuclear Decay Data for Dosimetric Calculations (2008);* Half-life time intervals are given in seconds (s), hours (h), days (d), minutes (m), and years (y).

[c] Estimated releases from unmonitored sources. Beginning in 2016, individual isotope annual releases below 1E-12 Ci (1 pCi) are no longer reported in this table; therefore, they were not used in the dose calculations.

[d] Includes separations, waste management, and tritium facilities

[e] Daughter products (Sb-126, Rh-106 and Y-90) in secular equilibrium with source terms (Sn-126, Ru-106 and Sr-90, respectively). In MAXDOSE/POPDOSE, they are included in the source term, and their ingrowth is included in their parents' source term.

[f,g] For dose calculations, unidentified alpha and beta/gamma releases are assumed to be Pu-239 and Sr-90, respectively.

Appendix Table D-2 Summary of Air Effluent DOE DCS Sum of Fractions

As discussed in Chapter 5, *Radiological Environmental Monitoring Program*, SRS evaluates the effluent monitoring program by comparing the annual average concentrations to the U.S. Department of Energy (DOE)-derived concentration standards (DCSs). DOE's *Derived Concentration Technical Standard*, DOE-STD-1196-2022 (DOE 2022), establishes numerical standards for DCSs to support implementing DOE Order 458.1. This table presents the air effluent DCS sum of fractions for continuously monitored sources where at least one analyte had at least one detected value. Continuously monitored sources are sampled on a weekly, biweekly, or monthly basis.

Facility (Sampling Location)	Radionuclides Included in the DCS Sum of Fractions	DCS Sum of Fractions	DCS Sum of Fractions Excluding Tritium
C Area (C-Area Main Stack)	H-3 (oxide)	1.76E-01	0.00E+00
F Area (235-F Sandfilter Discharge)	Pu-238, Pu-239/240, U-233/234, U-238	3.38E-04	3.38E-04
F Area (292-F Main Stack)	Am-241, Cm-243/244, I-129, Np-237, Pu-238, Pu-239/240, Sr-90, U-233/234, U-235, U-238	5.93E-01	5.93E-01
F Area (772-4F Stack)	Cm-243/244, Pu-238, Pu-239/240, U-233/234, U-238	3.22E-04	3.22E-04
H Area (292-H Main Stack)	Am-241, Cs-137, Cm-243/244, I-129, Np-237, Pu-238, Pu-239/240, Sr-90, U-233/234, U-235, U-238, H-3 (oxide), Kr-85, C-14	5.11E+00	4.69E+00
K Area (K-Area Main Stack)	H-3 (oxide)	1.05E-01	0.00E+00
L Area (L-Area Disassembly)	H-3 (oxide)	1.02E-01	0.00E+00
L area (L-Area Main Stack)	H-3 (oxide)	7.44E-02	0.00E+00
Tritium (232-H Stack)	H-3 (elemental), H-3 (oxide)	2.77E+01	0.00E+00
Tritium (233-H Stack)	H-3 (elemental), H-3 (oxide)	3.63E+00	0.00E+00
Tritium (234-H Stack)	H-3 (oxide)	5.34E+00	0.00E+00
Tritium (238-H Stack)	H-3 (oxide)	1.68E-01	0.00E+00
Tritium (264-H Stack)	H-3 (elemental), H-3 (oxide)	3.74E+01	0.00E+00

Appendix Table D-3 Summary of Tritium in Environmental Air

Samples were collected approximately every two weeks at each of the 16 air surveillance locations. Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. One sample was invalidated for Patterson Mill Road, deployed March 8 to March 22, and one sample was invalidated for Barricade 8, deployed November 1 to November 15, both due to pump failure. Special samples were pulled as a precautionary measure at Burial Ground North and Allendale Gate locations due to open glove box maintenance at H Area, which is why these locations have more samples. The results at the following locations were all not detected; therefore, they are not reported in this table: Site Perimeter (A-14, Barnwell Gate, and Patterson Mill Road) and 25-Mile Radius (Aiken Airport and Highway 301 @ State Line). The Highway 301 @ State Line location is the control location.

Location	Number of Detected Results	Mean Concentration (pCi/m^3)	Minimum Concentration (pCi/m^3)	Maximum Concentration (pCi/m^3)
Onsite				
Burial Ground North	27 of 27	3.53E+02	**9.84E+01**	**7.42E+02**
Site Perimeter				
Allendale Gate	2 of 27	3.20E+00	-6.34E+00	**1.73E+01**
Barricade 8	3 of 25	5.21E+00	-9.90E+00	**1.57E+01**
D Area	3 of 26	7.43E+00	-7.80E+00	2.76E+01
Darkhorse @ Williston Gate	3 of 26	5.22E+00	-4.89E+00	**1.74E+01**
East Talatha	3 of 26	5.07E+00	-3.91E+00	1.42E+01
Green Pond	1 of 26	4.25E+00	-4.09E+00	**2.25E+01**
Highway 21/167	1 of 26	5.19E+00	-5.54E-01	1.17E+01
Jackson	3 of 26	4.51E+00	-1.04E+01	**1.83E+01**
Talatha Gate	2 of 26	5.28E+00	-3.18E+00	**2.76E+01**
25-Mile Radius				
Augusta Lock and Dam 614	1 of 26	2.90E+00	-4.03E+00	1.36E+01

Appendix Table D-4 Summary of Tritium in Rainwater

Samples were collected approximately every four weeks at each of the 16 air surveillance locations. Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. The results at the following locations were all not detected; therefore, they are not reported in this table: Site Perimeter (A-14, Allendale Gate, Barnwell Gate, Darkhorse @ Williston Gate, East Talatha, Green Pond, Hwy 21/167, Jackson, Patterson Mill Road, and Talatha Gate) and 25-Mile Radius (Augusta Lock & Dam 614, Aiken Airport, and Highway 301 @ State Line). The Highway 301 @ State Line location is the control location.

Location	Number of Detected Results	Mean Concentration (pCi/L)	Minimum Concentration (pCi/L)	Maximum Concentration (pCi/L)
Onsite				
Burial Ground North	12 of 13	1.62E+03	3.68E+02	**3.34E+03**
Site Perimeter				
Barricade 8	1 of 13	9.93E+01	-1.57E+02	**7.51E+02**
D Area	1 of 13	1.77E+02	-3.09E+01	**6.83E+02**

Appendix Table D-5 Summary of Radionuclides in Environmental Air

Glass fiber filter samples were collected approximately every two weeks at each of the 16 air surveillance locations shown in Figure 5-4. Samples from all locations were analyzed biweekly for gamma-emitting radionuclides, gross alpha, and gross beta.

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

All media collected March 8 to March 22 at Patterson Mill Road and all media collected November 1 to November 15 at Barricade 8 were invalidated due to pump failure. Cobalt-60 and cesium-137 results were not detected for any samples collected biweekly; therefore, they were not reported in the table *Biweekly Samples: All Locations*.

Biweekly Samples: All Locations

Radionuclide	Number of Detected Results	Location of Minimum Concentration	Minimum Concentration (pCi/m^3)	Location of Maximum Concentration	Maximum Concentration (pCi/m^3)
Gross Alpha	408 of 414	Darkhorse @ Williston Gate	1.38E-04	Darkhorse @ Williston Gate	**6.54E-03**
Gross Beta	414 of 414	Darkhorse @ Williston Gate	**5.76E-03**	East Talatha	**3.31E-02**

One sample from every air surveillance location was chosen quarterly in 2023 for actinide and strontium-90 analysis based on elevated releases at F-Area stacks during 2023. This is true except for Burial Ground North, which began the year with biweekly analyses, resulting in a higher number of samples. Highway 301 @ State Line is the control location. Of note, the samples collected May 3 to May 17 at D Area and Barricade 8 were not analyzed for uranium-233/234, uranium-235, and uranium-238.

Strontium-90 results were not detected for the quarterly analyses; therefore, they were not reported in the table *Actinide and Strontium-90*.

Actinide and Strontium-90

Radionuclide	Number of Detected Results	Location of Minimum Concentration	Minimum Concentration (pCi/m^3)	Location of Maximum Concentration	Maximum Concentration (pCi/m^3)
Am-241	2 of 67	D Area	-1.99E-05	East Talatha	5.03E-05
Cm-243/244	7 of 67	Allendale Gate	-2.61E-06	Augusta Lock and Dam 614	**3.80E-05**
Pu-238	2 of 67	A-14	-1.15E-05	Allendale Gate	3.81E-05
Pu-239/240	1 of 67	Talatha Gate	-1.44E-05	D Area	2.96E-05
U-233/234	5 of 65	D Area	-4.60E-06	Allendale Gate	9.39E-05
U-235	1 of 65	Darkhorse @ Williston Gate	-1.41E-05	Burial Ground North	1.24E-05
U-238	9 of 65	Barnwell Gate	-1.10E-05	Green Pond	**1.33E-04**

Appendix Table D-6 Summary of Gamma Surveillance

Samples were collected approximately every quarter (13 weeks) at each of the 52 optically stimulated luminescent dosimeter locations. Please reference Environmental Maps, SRS Optically Stimulated Luminescent Dosimeter [OSLD] Sampling Locations.

Station Location Type	Number of Stations	Quarter 1 Average (mR/day)	Quarter 2 Average (mR/day)	Quarter 3 Average (mR/day)	Quarter 4 Average (mR/day)	Annual Total Average (mR/year)	Annual Minimum (mR/year)	Annual Maximum (mR/year)
Population Centers	9	0.37	0.38	0.35	0.42	138.79	119	157
Site Perimeter	9	0.30	0.33	0.29	0.35	115.92	100	132
Air Surveillance Stations	16	0.32	0.33	0.32	0.37	121.99	100	157
Plant Vogtle Vicinity	18	0.29	0.31	0.30	0.36	114.57	95	138

Appendix D-7 Summary of Radionuclides in Soil

Bolded concentration results were reported as detected. Concentrations not bolded indicate the result was less than the analytical method detection limit or that the uncertainty is large. Soil samples were collected from 24 locations in 2023, as described below. Creek Plantation locations are only sampled for gamma-emitting radionuclides and strontium-90.

Locations sampled are as follows:

- Onsite locations: F Area (2,000' West), H Area (2,000' East), Z Area (#3), and Burial Ground locations (643-26E-2 and Burial Ground North)
- Plant Perimeter locations: A-14, Allendale Gate, Barnwell Gate, Barricade 8, D Area, Darkhorse @ Williston Gate, East Talatha, Green Pond, Highway 21/167, Jackson, Patterson Mill Road, and Talatha Gate
- 25-Mile Radius locations: Aiken Airport, Augusta Lock and Dam 614, and Highway 301 @ State Line
- Creek Plantation locations: Trail 1 (1175', 1600', 1805') and Trail 6 (2300'). The Highway 301 @ State Line is the control location.

All cobalt-60 and neptunium-237 results were not detected; therefore, they were not reported in this table.

Radionuclide	Number of Detected Results	Control Hwy 301 Concentration (pCi/g)	Location of Minimum Concentration	Minimum Concentration (pCi/g)	Location of Maximum Concentration	Maximum Concentration (pCi/g)
Am-241	19 of 20	**3.21E-03**	Augusta Lock and Dam 614	**1.25E-03**	Burial Ground North	**1.55E-02**
Cm-243/244	6 of 20	3.66E-04	Patterson Mill Road	-1.28E-04	Burial Ground North	**6.77E-03**
Cs-137	21 of 24	**8.40E-02**	Green Pond	2.22E-02	Trail 1 1805'	**3.72E+01**
Gross Alpha	20 of 20	**1.74E+01**	East Talatha	**2.33E+00**	643-26E-2	**2.34E+01**
Gross Beta	12 of 20	**1.15E+01**	Highway 21/167	-4.89E-01	Z Area (#3)	**2.02E+01**
Pu-238	3 of 20	2.11E-04	Jackson	1.77E-04	F Area (2000' West)	**3.88E-02**
Pu-239/240	18 of 20	**6.45E-03**	Barricade 8	1.36E-03	F Area (2000' West)	**1.39E-01**
Sr-90	2 of 24	**1.22E-01**	D Area	-2.61E-02	Trail 1 1600'	**1.22E-01**
U-233/234	20 of 20	**1.62E+00**	F Area (2000' West)	**3.61E-01**	643-26E-2	**3.24E+00**
U-235	19 of 20	**9.42E-02**	Patterson Mill Road	7.98E-03	643-26E-2	**1.80E-01**
U-238	20 of 20	**1.51E+00**	F Area (2000' West)	**3.66E-01**	643-26E-2	**3.33E+00**

Appendix Table D-8 Summary of Radionuclides in Grassy Vegetation

Vegetation samples were collected from 16 locations in 2023. Bolded values are detected results. Values not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

Locations sampled are as follows:

- Onsite location: Burial Ground North
- Site Perimeter locations: A-14, Allendale Gate, Barnwell Gate, Barricade 8, D Area, Darkhorse @ Williston Gate, East Talatha, Green Pond, Highway 21/167, Jackson, Patterson Mill Road, and Talatha Gate
- 25-Mile Radius locations: Aiken Airport, Augusta Lock and Dam 614, and Highway 301 @ State Line. Highway 301 @ State Line is the control location.

All results for cobalt-60 and gross alpha were not detected; therefore, they were not reported in this table.

Radionuclide	Number of Detected Results	Control (Highway 301) Concentration (pCi/g)	Location of Minimum Concentration	Minimum Concentration (pCi/g)	Location of Maximum Concentration	Maximum Concentration (pCi/g)
Am-241	10 of 16	**5.17E-04**	Talatha Gate	-8.81E-05	Highway 21/167	**2.64E-03**
Cm-243/244	1 of 16	6.45E-05	Aiken Airport	-3.42E-05	Highway 21/167	**3.31E-03**
Cs-137	5 of 16	1.12E-01	Augusta Lock & Dam 614	-1.53E-02	Allendale Gate	**5.37E-01**
Gross Beta	16 of 16	**1.43E+01**	Allendale Gate	**8.68E+00**	Talatha Gate	**1.57E+01**
H-3	1 of 16	3.08E-02	A-14	-7.19E-03	Darkhorse @ Williston Gate	**5.51E-02**
Np-237	1 of 16	5.02E-05	Augusta Lock & Dam 614	-1.07E-04	A-14	4.66E-04
Pu-238	12 of 16	**3.68E-04**	Darkhorse @ Williston Gate	-9.90E-05	Allendale Gate	**4.69E-03**
Pu-239/240	5 of 16	1.22E-04	D Area	4.35E-07	Allendale Gate	**3.54E-03**
Sr-90	14 of 16	**8.94E-02**	Talatha Gate	1.30E-02	Highway 21/167	**1.56E-01**
Tc-99	11 of 16	**2.10E-01**	D Area	9.08E-02	Highway 21/167	**4.00E-01**
U-233/234	16 of 16	**7.96E-03**	Barnwell Gate	**1.06E-03**	Green Pond	**1.31E-02**
U-235	10 of 16	**5.61E-04**	Augusta Lock & Dam 614	-4.99E-05	Patterson Mill Road	**7.49E-04**
U-238	14 of 16	**6.32E-03**	Barnwell Gate	7.53E-04	Allendale Gate	**2.04E-02**

Appendix Table D-9 Summary of Radionuclides in Foodstuffs

Samples of five foodstuffs are collected annually from five regions surrounding SRS. Beef, greens, and fruit are collected each year. In 2023, the greens collected were collards, and the fruit collected was watermelon. Two specific crops a year are also collected, rotating through a variety of vegetables, grains, and nuts. Soybeans and peanuts were the rotational crop samples for 2023. Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

Food Type	Radionuclide	Number of Samples	Number of Results > Detection Limit	Mean Sample Conc. (pCi/g)	Minimum Sample Conc. (pCi/g)	Maximum Sample Conc. (pCi/g)
Beef	Gross Beta	5	5	2.59E+00	**2.20E-01**	**3.53E+00**
	Plutonium-239/240	5	1	7.23E-06	-5.72E-06	**3.05E-05**
	Strontium-90	5	1	8.58E-04	1.91E-04	**3.03E-03**
	Uranium-233/234	5	2	5.77E-05	1.05E-05	**1.50E-04**
	Uranium-238	5	1	4.46E-05	-1.44E-05	**1.16E-04**
Americium-241, Cesium-137, Cobalt-60, Curium-243/244, Gross Alpha, Neptunium-237, Plutonium-238, Technetium-99, Tritium, and Uranium-235 were not detected in beef.						
Peanuts	Americium-241	5	2	4.98E-04	1.55E-04	**8.67E-04**
	Curium-243/244	5	4	1.14E-03	1.43E-04	**1.69E-03**
	Gross Beta	5	5	6.44E+00	**5.67E+00**	**7.05E+00**
	Neptunium-237	5	1	9.41E-05	-8.06E-05	**5.17E-04**
	Plutonium-238	5	2	4.24E-04	-1.86E-04	**9.42E-04**
	Uranium-233/234	5	1	6.33E-04	-9.53E-05	**1.16E-03**
Cesium-137, Cobalt-60, Gross Alpha, Plutonium-239/240, Strontium-90, Technetium-99, Tritium, Uranium-235, and Uranium-238 were not detected in peanuts.						
Watermelon	Americium-241	5	1	2.13E-05	-1.06E-05	**5.28E-05**
	Gross Beta	5	5	7.23E-01	**2.81E-01**	**1.31E+00**
	Plutonium-238	5	3	8.86E-05	5.30E-05	**1.70E-04**
	Strontium-90	5	1	2.18E-03	-1.71E-03	**6.31E-03**
	Uranium-233/234	5	5	1.85E-04	**1.30E-04**	**2.70E-04**
	Uranium-238	5	3	1.56E-04	9.46E-05	**2.28E-04**
Cesium-137, Cobalt-60, Curium-243/244, Gross Alpha, Neptunium-237, Plutonium 239/240, Technetium-99, Tritium, and Uranium-235 were not detected in watermelon.						

Appendix Table D-9 Summary of Radionuclides in Foodstuffs (continued)

Food Type	Radionuclide	Number of Samples	Number of Results > Detection Limit	Mean Sample Conc. (pCi/g)	Minimum Sample Conc. (pCi/g)	Maximum Sample Conc. (pCi/g)
Collards	Americium-241	5	2	2.76E-03	4.00E-06	**1.22E-02**
	Cesium-137	5	1	1.39E-02	-8.09E-04	**2.34E-02**
	Curium-243/244	5	1	1.02E-03	-1.59E-05	**4.83E-03**
	Gross Beta	5	5	2.31E+01	**1.02E+01**	**3.00E+01**
	Neptunium-237	5	2	5.44E-04	-6.51E-05	**1.97E-03**
	Plutonium-238	5	4	4.53E-04	2.09E-04	**7.03E-04**
	Plutonium-239/240	5	2	3.24E-04	1.46E-04	**5.17E-04**
	Strontium-90	5	4	5.41E-02	2.53E-02	**8.43E-02**
	Uranium-233/234	5	5	7.98E-03	**5.10E-03**	**9.18E-03**
	Uranium-235	5	2	5.49E-04	2.49E-04	**9.81E-04**
	Uranium-238	5	5	9.10E-03	**6.66E-03**	**1.35E-02**
Cobalt-60, Gross Alpha, Technetium-99, and Tritium were not detected in collards.						
Soybeans	Americium-241	5	4	9.25E-04	2.24E-04	**1.74E-03**
	Curium-243/244	5	1	1.40E-04	-3.03E-05	**5.92E-04**
	Gross Beta	5	5	1.55E+01	**1.36E+01**	**1.79E+01**
	Neptunium-237	5	1	1.48E-04	-8.74E-05	3.91E-04
	Plutonium-238	5	3	9.05E-04	4.91E-04	**1.39E-03**
	Plutonium-239/240	5	1	3.86E-04	7.60E-05	**1.06E-03**
	Uranium-233/234	5	4	2.51E-03	6.09E-04	**6.69E-03**
	Uranium-238	5	4	3.14E-03	8.81E-04	**7.95E-03**
Cesium-137, Cobalt-60, Gross Alpha, Strontium-90, Technetium-99, Tritium, and Uranium-235 were not detected in soybeans.						

Appendix Table D-10 Summary of Radionuclides in Dairy

SRS collects cow and goat milk samples from dairies in communities surrounding the Site. The number listed in parentheses in the "location" column indicates the number of locations in the named state that provide samples to SRS. For the 2023 reporting year, all Georgia dairies were not detected; therefore, they were not reported in this table.

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All cobalt-60 and tritium (H-3) results were not detected; therefore, they were not reported in this table.

Location	Nuclide	Number of Samples	Number of Results > Detection Limit	Mean Sample Concentration (pCi/L)	Minimum Sample Concentration (pCi/L)	Maximum Sample Concentration (pCi/L)
SC–Dairies (4) Cow Milk	Sr-90	15	2	6.13E-01	-1.37E-01	**2.12E+00**
SC–Dairies (1) Goat Milk	Sr-90	1	1	2.30E+00	**2.30E+00**	**2.30E+00**
	Cs-137	1	1	6.48E+00	**6.48E+00**	**6.48E+00**

Appendix Table D-11 Radiation in Liquid Source Releases

Tritium is the main contributing radionuclide in liquid source releases. Although the remaining radionuclides are contributors, their contributions in liquid source releases are minimal.

In the facility (Reactor, Separations, and SRNL) columns, a blank indicates the radionuclide was not analyzed. A 0.00E+00 in the facility columns indicates the result was not significant.

All cobalt-60 results were not detected; therefore, they were not reported in this table.

Radioactive Atmospheric Releases by Source (curies)[a]

Radionuclide	Half-Life[b]		Reactors (Ci)	Separations[c] (Ci)	SRNL (Ci)	Totals (Ci)
H-3[d]	12.3	y	1.09E+02	2.69E+02	0.00E+00	3.78E+02
C-14	5,700	y		3.48E-03	6.22E-04	4.11E-03
Sr-90	28.8	y	0.00E+00	1.90E-02		1.90E-02
Tc-99	2.11E+05	y	0.00E+00	1.24E-02	0.00E+00	1.24E-02
I-129	1.57E+07	y	0.00E+00	1.45E-02	0.00E+00	1.45E-02
Cs-137[e]	30.2	y	0.00E+00	8.83E-03	0.00E+00	8.83E-03
U-234	2.46E+05	y	1.95E-03	5.59E-02	1.50E-04	5.80E-02
U-235	7.04E+08	y	4.75E-04	3.56E-03	7.45E-06	4.04E-03
U-238	4.47E+09	y	1.41E-03	6.82E-02	1.37E-04	6.97E-02
Np-237	2.14E+06	y		3.60E-05		3.60E-05
Pu-238	87.7	y	0.00E+00	2.51E-04	6.67E-07	2.52E-04
Pu-239	2.41E+04	y	0.00E+00	8.92E-05	4.41E-07	8.96E-05
Am-241	432	y	0.00E+00	2.35E-04		2.35E-04
Cm-244	18.1	y	0.00E+00	1.47E-04		1.47E-04
Unidentified Alpha[f]	N/A		9.85E-03	5.58E-03	0.00E+00	1.54E-02
Unidentified Beta[g]	N/A		4.33E-02	1.35E-02	5.52E-04	5.73E-02
TOTAL						3.78E+02

Note:

SRNL = Savannah River National Laboratory

[a] One curie equals 3.7E+10 becquerels

[b] ICRP 107, *Nuclear Decay Data for Dosimetric Calculations* (2008). Half-life time intervals are given in years (y).

[c] Includes separations, waste management, and tritium processing facilities

[d] The tritium release total, which includes direct + migration releases, is used in the dose calculations for SRS impacts.

[e] Depending on which value is higher, the Cs-137 release total is based on concentrations measured in Steel Creek mouth fish near RM-141.5 or on the actual measured effluent release total from the Site. Refer to Chapter 6, *Radiological Dose Assessment*, for more information.

[f,g] For dose calculations, unidentified alpha and beta/gamma releases are assumed to be Pu-239 and Sr-90, respectively.

Appendix Table D-12 Summary of Liquid Effluent DOE DCS Sum of Fractions by Facility

As discussed in Chapter 5, *Radiological Environmental Monitoring Program*, SRS evaluates the effluent monitoring program by comparing the annual average concentrations to the U.S. Department of Energy (DOE)-derived concentration standards (DCSs). DOE's *Derived Concentration Technical Standard*, DOE-STD-1196-2022 (DOE 2022), establishes numerical standards for DCSs to support implementing DOE Order 458.1. This table presents the liquid effluent DCS sum of fractions for continuously monitored sources where at least one analyte had at least one detected value. Continuously monitored sources include outfalls where water flows continuously as well as those that discharge intermittently following rain events and batch discharges from facilities.

Facility (Sampling Location)	Radionuclides Included in the DCS Sum of Fractions	DCS Sum of Fractions	DCS Sum of Fractions Excluding Tritium
A Area (TB-2 Outfall at Road 1A)	C-14, Pu-238, Pu-239/240, U-233/234, U-235, U-238	7.76E-04	7.76E-04
E Area (E-003-EFF)	H-3, Sr-90, Tc-99	2.96E-03	1.09E-03
F Area (F-013 200-F Cooling Basin)	Cm-243/244, H-3, Pu-238, Pu-239/240, Tc-99, U-233/234, U-238	5.88E-04	2.77E-04
F Area (F-05)	Am-241, C-14, Cm-243/244, H-3, Pu-238, Pu-239/240, Sr-90, Tc-99, U-233/234, U-235, U-238	2.45E-03	2.18E-03
F Area (FM-3 F-Area Effluent)	Am-241, Cm-243/244, H-3, I-129, Pu-238, Pu-239/240, Tc-99, U-233/234, U-235, U-238	1.36E-03	1.20E-03
F Tank Farm (F-012 281-8F Retention Basin)	H-3, Cm-243/244, Cs-137, Pu-238, Pu-239/240, U-235, U-238	3.86E-03	3.51E-03
G Area (G-010)	Am-241, Cm-243/244, H-3, Pu-238, Sr-90, Tc-99, U-233/234, U-235, U-238	1.19E-03	7.83E-04
H Area (FM-1C H-Area Effluent)	Am-241, C-14, Cm-243/244, H-3, Np-237, Pu-238, Pu-239/240, Sr-90, U-233/234, U-238	1.30E-03	8.85E-04
H Area (H-004)	H-3, Pu-238, Pu-239/240, U-233/234, U-235, U-238	3.35E-03	1.77E-03
H ETP (U3R-2A ETP Outfall at Road C)	Am-241, C-14, Cm-243/244, Cs-137, H-3, Np-237, Pu-238, Pu-239/240, U-235, U-238	2.34E-01	2.66E-03
H-Tank Farm (H-017 281-8H Retention Basin)	Cm-243/244, Cs-137, H-3, I-129, Np-237, Pu-238, Pu-239/240, Sr-90, Tc-99, U-233/234, U-235, U-238	7.63E-03	7.16E-03
H-Tank Farm (HP-52 H-Area Tank Farm)	Am-241, Cm-243/244, Cs-137, H-3, Pu-238, Pu-239/240, U-233/234, U-235, U-238	3.80E-03	3.22E-03
K Area (K Canal)	H-3	2.00E-04	0.00E+00
L Area (L-07)	H-3	2.40E-04	0.00E+00
S Area (S-004)	H-3, Pu-238 U-238	2.25E-03	5.17E-05
Tritium (HP-15 Tritium Facility Outfall)	H-3	1.15E-02	0.00E+00

Appendix Table D-13 Summary of Radionuclides in Sediments

SRS collected annual sediment samples at 40 locations in 2023—11 Savannah River, 21 stream, and 8 stormwater basins—totaling 457 analytes.

Locations sampled are as follows:

- Savannah River locations River Miles (RM): 118.7, 129.0, 134.0, 141.5 (Steel Creek river mouth), 150.2, 150.4, 151.0, 152.3 (Beaver Dam Creek river mouth), 157.2, 161.0, and 170.5. The control location for the river sediment samples is RM-161.0.
- SRS Stream locations: FM-2, FM-3A, FM-A7, FM-A7A, FMC @ Rd A, FMC Swamp, L3R-1A , L3R-2, L3R-3, McQueens Branch (McQB) @ Monroe Owens, Meyers Branch, PB @ Rd A, PB Swamp, R Area (downstream of R-1), SC-2A, SC-4, TB-5, TC-1, U3R-1A, U3R-3, and U3R-4.
- SRS Stormwater Basin locations: E-001, E-002, E-003, E-004, E-05, E-06, Pond 400, and Z Basin. The control location for the river samples is RM-161.0. The control locations for the stream and stormwater basin sediment samples are TC-1 and U3R-1A.

Bolded concentration results were reported as detected. Concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

River Sediment Results

Ten River Locations Plus One Control

(Samples from some locations analyzed only for cesium-137, cobalt-60, gross alpha, and gross beta)

Radionuclide	Number > DL	Control RM-161.0 (pCi/g)	Location of Maximum Result	Maximum Result (pCi/g)
Americium-241	5 of 9	**1.93E-03**	BDC RM	**5.21E-03**
Cesium-137	5 of 11	< 8.71E-02	RM-129.0	**4.20E-01**
Cobalt-60	0 of 11	< 6.68E-02	All < DL	All < DL
Curium-243/244	3 of 9	< 7.19E-04	RM-150.2	< 1.02E-03
Gross Alpha	11 of 11	**2.30E+01**	BDC RM	**4.30E+01**
Gross Beta	11 of 11	**2.14E+01**	BDC RM	**3.42E+01**
Neptunium-237	0 of 9	< 1.04E-03	All < DL	All < DL
Plutonium-238	0 of 9	< 1.36E-03	All < DL	All < DL
Plutonium-239/240	3 of 9	< 1.28E-03	RM-157.2	**5.64E-03**
Strontium-90	0 of 9	< 1.40E-01	All < DL	All < DL
Uranium-233/234	9 of 9	**2.20E+00**	BDC RM	**3.74E+00**
Uranium-235	9 of 9	**1.20E-01**	BDC RM	**1.72E-01**
Uranium-238	9 of 9	**2.14E+00**	BDC RM	**3.66E+00**

Appendix Table D-13 Summary of Radionuclides in Sediments (continued)

Stream Sediment Results

Nineteen Stream Locations Plus Two Controls
(Some locations sampled only for cesium-137, cobalt-60, gross alpha, and gross beta)

Radionuclide	Number > DL	Control TC-1 (pCi/g)	Control U3R-1A (pCi/g)	Location of Maximum Result	Maximum Result (pCi/g)
Americium-241	14 of 16	**2.50E-03**	**2.07E-02**	Downstream of R-1	< 1.07E+00
Cesium-137	16 of 21	< 5.23E-02	**3.01E-01**	Downstream of R-1	**5.18E+01**
Cobalt-60	0 of 21	< 5.77E-02	< 1.69E-01	All < DL	All < DL
Curium-243/244	8 of 16	< 4.58E-04	**2.33E-03**	Downstream of R-1	< 1.16E+00
Gross Alpha	21 of 21	**8.96E+00**	**4.54E+01**	U3R-3	**4.18E+01**
Gross Beta	21 of 21	**5.01E+00**	**4.24E+01**	Downstream of R-1	**5.24E+01**
Neptunium-237	3 of 16	< 9.83E-04	< 8.07E-04	Downstream of R-1	< 6.32E-02
Plutonium-238	11 of 16	**1.21E-03**	**2.08E-03**	Downstream of R-1	< 8.31E-01
Plutonium-239/240	15 of 16	**2.97E-03**	**1.82E-02**	Downstream of R-1	< 9.32E-01
Strontium-90	5 of 16	< 1.31E-01	< 1.31E-01	FMC Swamp	**1.04E+00**
Uranium-233/234	16 of 16	**5.77E-01**	**2.14E+00**	TB-5	**3.47E+00**
Uranium-235	13 of 16	**3.15E-02**	**1.21E-01**	FM-3A	**3.38E-01**
Uranium-238	16 of 16	**5.27E-01**	**2.54E+00**	TB-5	**4.03E+00**

Stormwater Basin Sediment Results

Eight Basin Locations Plus Two Stream Control Locations

Radionuclide	Number > DL	Control TC-1 (pCi/g)	Control U3R-1A (pCi/g)	Location of Maximum Result	Maximum Result (pCi/g)
Americium-241	7 of 10	**2.50E-03**	**2.07E-02**	Z Basin	< 4.11E-01
Cesium-137	2 of 10	< 5.23E-02	**3.01E-01**	Z Basin	**1.16E+03**
Cobalt-60	0 of 10	< 5.77E-02	< 1.69E-01	All < DL	All < DL
Curium-243/244	4 of 10	< 4.58E-04	**2.33E-03**	Z Basin	< 4.06E-01
Gross Alpha	9 of 10	**8.96E+00**	**4.54E+01**	Pond 400	**2.28E+01**
Gross Beta	9 of 10	**5.01E+00**	**4.24E+01**	Z Basin	**7.98E+02**
Neptunium-237	0 of 10	< 9.83E-04	< 8.07E-04	All < DL	All < DL
Plutonium-238	8 of 10	**1.21E-03**	**2.08E-03**	Z Basin	< 3.89E-01
Plutonium-239/240	7 of 10	**2.97E-03**	**1.82E-02**	Z Basin	< 5.38E-01
Strontium-90	1 of 10	< 1.31E-01	< 1.31E-01	E-003	**2.24E+00**
Uranium-233/234	10 of 10	**5.77E-01**	**2.14E+00**	E-003	**2.41E+00**
Uranium-235	9 of 10	**3.15E-02**	**1.21E-01**	Z Basin	< 3.41E-01
Uranium-238	10 of 10	**5.27E-01**	**2.54E+00**	E-003	**2.40E+00**

Note:
The two stream and stormwater basin control locations, TC-1 and U3R-1A, are included in the number of results greater than the detection limit for both the stream and stormwater basin sediment results tables.

Appendix Table D-14 Summary of Radionuclides in Drinking Water

Samples at the treatment plants are collected monthly. These samples are analyzed for tritium, cobalt-60, cesium-137, gross alpha, and gross beta.

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

For the treatment plants samples, all results for cobalt-60, cesium-137, and gross alpha were below detection limits; therefore, they were not reported in the table below.

Treatment Plants—Finished Water Summary

Tritium					
Locations	**Number of Samples**	**Number of Detects**	**Mean Concentration (pCi/L)**	**Minimum Concentration (pCi/L)**	**Maximum Concentration (pCi/L)**
BJWSA Purrysburg WTP	12	12	3.75E+02	**2.75E+02**	**5.47E+02**
North Augusta Public Water Works	12	1	1.00E+02	1.08E+01	**1.93E+02**

Gross Beta					
Locations	**Number of Samples**	**Number of Detects**	**Mean Concentration (pCi/L)**	**Minimum Concentration (pCi/L)**	**Maximum Concentration (pCi/L)**
BJWSA Purrysburg WTP	12	12	1.55E+00	**1.07E+00**	**2.10E+00**
North Augusta Public Water Works	12	12	1.79E+00	**1.12E+00**	**2.76E+00**

Note:
BJWSA Purrysburg WTP is Beaufort-Jasper Water and Sewer Authority Purrysburg Water Treatment Plant.

Appendix Table D-14 Summary of Radionuclides in Drinking Water (continued)

Samples are collected onsite annually from 10 locations for tritium, cobalt-60, cesium-137, gross beta, gross alpha, americium-241, strontium-90, uranium-233/234, uranium-235, uranium-238, plutonium-238, plutonium-239/240, and curium-243/244. Site 905-112G was inoperable for 2023.

For the onsite annual samples, all results for tritium, cobalt-60, cesium-137, strontium-90, plutonium-238, plutonium-239/240, americium-241, and curium-243/244 were below detection limits; therefore, they were not reported in this table.

Onsite Location Summary—Annual Samples

		Gross Alpha	Gross Beta	Uranium-233/234	Uranium-235	Uranium-238
Location	Number of Samples	Concentration (pCi/L)	Concentration (pCi/L)	Concentration (pCi/L)	Concentration (pCi/L)	Concentration (pCi/L)
617-8G	1	2.12E-01	**8.37E-01**	**1.13E-02**	2.96E-03	**6.80E-03**
681-3G	1	**1.10E+01**	**7.66E+00**	1.49E-03	9.02E-04	3.33E-04
704-16G	1	**8.50E+00**	**4.55E+00**	2.59E-04	-1.10E-03	2.23E-03
709-1G	1	4.54E-01	**1.33E+00**	1.44E-03	2.96E-03	**6.79E-03**
737-G	1	4.92E-01	**1.32E+00**	**1.38E-02**	**9.85E-03**	**1.65E-02**
782-3A	1	**6.29E-01**	**1.12E+00**	**3.00E-02**	5.48E-03	**4.46E-02**
905-113G Well	1	**1.68E+00**	**2.02E+00**	**1.76E-02**	6.61E-04	**4.10E-02**
905-125B	1	**1.26E+00**	**1.58E+00**	**3.61E-02**	5.25E-03	**5.16E-02**
905-67B	1	**2.28E+00**	**1.42E+00**	**1.51E-02**	5.15E-03	**2.89E-02**

Appendix Table D-15 Summary of Radionuclides in Freshwater Fish

To provide a representative sample of the fish from each survey location, samples taken from each fish type are grouped into composite samples (three) and analyzed. Strontium-90 is the only analysis performed in both flesh (edible) and bone (nonedible) samples.

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All cobalt-60, iodine-129, and technitium-99 results were not detected; therefore, they were not reported in this table.

Cesium-137 (Edible)												
	Bass			Catfish			Flathead Catfish			Panfish		
Location	Mean (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Mean (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Mean (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	Mean (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)
Augusta L&D	1.71E-03	-8.16E-05	4.11E-03	1.40E-02	1.15E-03	**3.53E-02**	1.38E-02	3.54E-03	2.48E-02	1.43E-02	8.61E-03	**2.47E-02**
Four Mile Creek River Mouth	6.90E-02	**3.47E-02**	**1.03E-01**	2.29E-02	**1.67E-02**	**2.85E-02**	1.64E-02	4.53E-03	**3.12E-02**	1.74E-02	1.55E-02	**1.86E-02**
Hwy 301 Bridge Area	1.40E-02	1.09E-02	**1.66E-02**	9.69E-03	4.98E-03	**1.34E-02**	2.32E-02	**2.06E-02**	**2.74E-02**	8.29E-03	4.36E-03	1.35E-02
Lower Three Runs Creek River Mouth	1.44E-01	**2.31E-02**	**3.49E-01**	4.28E-02	**2.54E-02**	**5.89E-02**	1.29E-01	**9.86E-02**	**1.81E-01**	2.02E-02	1.48E-02	**2.83E-02**
Steel Creek River Mouth	4.26E-02	1.28E-02	**9.73E-02**	9.04E-02	**4.46E-02**	**1.66E-01**	7.98E-02	**3.02E-02**	**1.65E-01**	7.07E-02	**3.79E-02**	**1.02E-01**
Upper Three Runs Creek River Mouth	1.43E-02	-7.86E-04	**3.04E-02**	2.13E-02	9.57E-03	**4.18E-02**	1.13E-02	-9.70E-04	**1.79E-02**	4.29E-02	4.24E-03	**8.67E-02**

Appendix Table D-15 Summary of Radionuclides in Freshwater Fish (continued)

Strontium-90 (Edible)

Location	Bass Mean (pCi/g)	Bass Minimum (pCi/g)	Bass Maximum (pCi/g)	Catfish Mean (pCi/g)	Catfish Minimum (pCi/g)	Catfish Maximum (pCi/g)	Flathead Catfish Mean (pCi/g)	Flathead Catfish Minimum (pCi/g)	Flathead Catfish Maximum (pCi/g)	Panfish Mean (pCi/g)	Panfish Minimum (pCi/g)	Panfish Maximum (pCi/g)
Augusta L&D	-2.65E-04	-7.67E-04	5.52E-04	1.35E-03	-9.49E-05	**3.81E-03**	1.04E-03	-7.12E-06	1.58E-03	1.62E-03	-7.07E-04	5.62E-03
Four Mile Creek River Mouth	1.33E-03	2.60E-04	2.63E-03	1.38E-03	7.00E-04	1.76E-03	2.84E-04	-6.24E-04	9.46E-04	2.20E-03	7.02E-04	3.89E-03
Hwy 301 Bridge Area	1.86E-03	1.49E-03	2.22E-03	1.32E-03	1.02E-03	1.66E-03	1.15E-04	-9.86E-04	1.66E-03	1.56E-03	-4.11E-04	4.99E-03
Lower Three Runs Creek River Mouth	8.82E-04	4.57E-04	1.73E-03	7.92E-04	2.25E-04	1.21E-03	9.44E-04	6.74E-04	1.37E-03	2.63E-03	2.56E-03	2.75E-03
Steel Creek River Mouth	-2.22E-05	-1.53E-03	1.42E-03	8.47E-05	-4.03E-04	8.06E-04	8.30E-04	4.37E-04	1.26E-03	9.66E-04	2.58E-04	1.43E-03
Upper Three Runs Creek River Mouth	9.12E-04	3.73E-04	1.56E-03	1.12E-03	4.52E-04	2.33E-03	8.75E-04	1.51E-04	1.70E-03	2.38E-03	9.48E-04	**3.85E-03**

Strontium-90 (Nonedible)

Location	Bass Mean (pCi/g)	Bass Minimum (pCi/g)	Bass Maximum (pCi/g)	Catfish Mean (pCi/g)	Catfish Minimum (pCi/g)	Catfish Maximum (pCi/g)	Flathead Catfish Mean (pCi/g)	Flathead Catfish Minimum (pCi/g)	Flathead Catfish Maximum (pCi/g)	Panfish Mean (pCi/g)	Panfish Minimum (pCi/g)	Panfish Maximum (pCi/g)
Augusta L&D	3.87E-01	2.69E-01	**4.60E-01**	5.44E-01	**4.60E-01**	**6.35E-01**	5.55E-01	**4.74E-01**	**6.76E-01**	6.57E-01	**3.46E-01**	**1.23E+00**
Four Mile Creek River Mouth	8.92E-01	**6.34E-01**	**1.34E+00**	7.82E-01	**4.17E-01**	**1.25E+00**	4.18E-01	2.42E-01	**6.72E-01**	7.80E-01	**6.22E-01**	**9.06E-01**
Hwy 301 Bridge Area	5.48E-01	**3.49E-01**	**8.40E-01**	3.06E-01	1.32E-01	**5.91E-01**	4.48E-01	1.44E-01	**6.34E-01**	7.20E-01	**6.04E-01**	**8.94E-01**
Lower Three Runs Creek River Mouth	4.56E-01	**3.41E-01**	**5.47E-01**	4.53E-01	**4.04E-01**	**5.44E-01**	3.77E-01	1.98E-01	**5.02E-01**	4.34E-01	2.45E-01	**7.28E-01**
Steel Creek River Mouth	8.90E-01	**5.73E-01**	**1.23E+00**	7.59E-01	**5.11E-01**	**9.96E-01**	5.60E-01	**3.67E-01**	**9.08E-01**	8.86E-01	**7.76E-01**	**9.73E-01**
Upper Three Runs Creek River Mouth	5.80E-01	**5.07E-01**	**6.56E-01**	4.67E-01	**3.87E-01**	**5.09E-01**	4.60E-01	**3.91E-01**	**5.08E-01**	7.67E-01	**4.84E-01**	**9.64E-01**

Appendix Table D-15 Summary of Radionuclides in Freshwater Fish (continued)

Gross Alpha (Edible)

Location	Bass Mean (pCi/g)	Bass Minimum (pCi/g)	Bass Maximum (pCi/g)	Catfish Mean (pCi/g)	Catfish Minimum (pCi/g)	Catfish Maximum (pCi/g)	Flathead Catfish Mean (pCi/g)	Flathead Catfish Minimum (pCi/g)	Flathead Catfish Maximum (pCi/g)	Panfish Mean (pCi/g)	Panfish Minimum (pCi/g)	Panfish Maximum (pCi/g)
Augusta L&D	-1.97E-03	-4.07E-02	4.10E-02	3.81E-02	-4.38E-02	1.30E-01	-7.82E-03	-4.36E-02	2.53E-02	6.92E-03	-6.25E-03	3.02E-02
Four Mile Creek River Mouth	4.75E-03	-2.84E-02	3.68E-02	-1.72E-02	-5.82E-02	3.59E-02	-5.07E-02	-6.22E-02	-2.79E-02	1.60E-02	-2.88E-02	7.10E-02
Hwy 301 Bridge Area	-9.13E-04	-4.25E-03	2.17E-03	3.30E-04	-5.57E-03	8.61E-03	2.99E-03	1.93E-03	4.86E-03	4.03E-03	-1.81E-03	8.48E-03
Lower Three Runs Creek River Mouth	1.41E-01	-3.41E-03	**2.49E-01**	3.09E-02	-3.43E-02	1.29E-01	-2.60E-03	-3.70E-02	6.30E-02	2.18E-02	-3.01E-02	6.37E-02
Steel Creek River Mouth	-5.95E-04	-1.70E-03	5.78E-04	-1.94E-03	-3.62E-02	3.22E-02	5.50E-02	6.45E-04	9.81E-02	4.51E-02	-3.56E-02	1.36E-01
Upper Three Runs Creek River Mouth	5.29E-02	2.06E-02	8.62E-02	-2.73E-02	-5.08E-02	-1.53E-02	4.07E-02	-1.65E-02	8.57E-02	-1.76E-02	-3.74E-02	-7.29E-03

Gross Beta (Edible)

Location	Bass Mean (pCi/g)	Bass Minimum (pCi/g)	Bass Maximum (pCi/g)	Catfish Mean (pCi/g)	Catfish Minimum (pCi/g)	Catfish Maximum (pCi/g)	Flathead Catfish Mean (pCi/g)	Flathead Catfish Minimum (pCi/g)	Flathead Catfish Maximum (pCi/g)	Panfish Mean (pCi/g)	Panfish Minimum (pCi/g)	Panfish Maximum (pCi/g)
Augusta L&D	2.22E+00	**1.11E+00**	**2.85E+00**	2.89E+00	**2.66E+00**	**3.25E+00**	2.83E+00	**2.40E+00**	**3.28E+00**	2.34E+00	**1.94E+00**	**2.60E+00**
Four Mile Creek River Mouth	2.49E+00	**2.12E+00**	**2.70E+00**	2.88E+00	**2.26E+00**	**3.28E+00**	2.65E+00	**2.62E+00**	**2.68E+00**	2.56E+00	**2.19E+00**	**2.85E+00**
Hwy 301 Bridge Area	2.35E-01	**2.00E-01**	**2.65E-01**	3.71E-01	**3.11E-01**	**4.10E-01**	3.32E-01	**2.77E-01**	**4.11E-01**	2.75E-01	**1.78E-01**	**3.51E-01**
Lower Three Runs Creek River Mouth	3.50E+00	**3.07E+00**	**3.96E+00**	2.88E+00	**2.71E+00**	**3.10E+00**	3.02E+00	**2.78E+00**	**3.48E+00**	1.99E+00	**1.73E+00**	**2.34E+00**
Steel Creek River Mouth	2.50E+00	**2.23E+00**	**2.75E+00**	2.70E+00	**2.56E+00**	**2.77E+00**	2.47E+00	**2.21E+00**	**2.62E+00**	2.22E+00	**1.94E+00**	**2.63E+00**
Upper Three Runs Creek River Mouth	2.51E+00	**2.27E+00**	**2.90E+00**	2.93E+00	**2.82E+00**	**3.08E+00**	2.85E+00	**2.74E+00**	**2.97E+00**	1.65E+00	**1.56E+00**	**1.75E+00**

Appendix Table D-16 Summary of Radionuclides in Saltwater Fish

All saltwater fish are collected at the location designated as RM 0–8 (mouth of Savannah River). Strontium-90 is the only analysis performed in both flesh (edible) and bone (nonedible) samples.

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. For the current reporting year, results of strontium-90 bone (nonedible) were all below method detection limits. Results of all samples for cesium-137, cobalt-60, gross alpha, iodine-129, and technetium-99 were below method detection limits.

Marine Mullet					
Radionuclide	**Number of Samples**	**Number of Results > Detection Limit**	**Mean Concentration (pCi/g)**	**Minimum Concentration (pCi/g)**	**Maximum Concentration (pCi/g)**
Gross Beta	3	3	3.26E-01	**3.10E-01**	**3.45E-01**
Sr-90 (Edible)	3	1	1.53E-03	-7.95E-04	**3.83E-03**

Appendix Table D-17 Summary of Radionuclides in Shellfish

All shellfish are collected at the location designated as RM 0-8 (at the mouth of Savannah River). The species of shellfish collected in 2023 were crab and shrimp.

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All cesium-137, cobalt-60, gross alpha, iodine-129, and technetium-99 results were not detected; therefore, they were not reported in this table. Strontium-90 is reported only for shrimp in the table below as the strontium-90 results for crab were not detected.

Shellfish Species	Radionuclide	Number of Samples	Number of Results > Detection Limit	Mean Concentration (pCi/g)	Minimum Concentration (pCi/g)	Maximum Concentration (pCi/g)
Crab	Gross Beta	1	1	2.74E+00	**2.74E+00**	**2.74E+00**
Shrimp	Gross Beta	1	1	2.56E+00	**2.56E+00**	**2.56E+00**
	Sr-90	1	1	7.38E-03	**7.38E-03**	**7.38E-03**

Appendix Table D-18 Summary of Radionuclides in Wildlife

Samples collected for laboratory analysis are selected based on a set frequency, the field-measured cesium-137 activity concentration, and exposure limit considerations as mentioned in section 5.6, *Wildlife Results Summary.* Strontium-90 is the only analysis performed in both flesh and bone samples.

Bolded concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All cobalt-60 results were below detection limits; therefore, they are not reported in this table.

Sample Type	Radionuclide	Number of Samples	Number of Results > Detection Limit	Mean Concentration (pCi/g)	Minimum Concentration (pCi/g)	Maximum Concentration (pCi/g)
Deer Flesh	Cs-137	41	41	1.82E+00	**1.13E-01**	**5.26E+00**
	Sr-90	41	1	1.42E-03	-2.60E-03	**7.43E-03**
Hog Flesh	Cs-137	6	6	1.46E+00	**8.32E-02**	**3.54E+00**
	Sr-90	6	0	2.43E-03	-5.07E-04	4.71E-03
Deer Bone	Sr-90	41	41	2.12E+00	**9.81E-01**	**5.18E+00**
Hog Bone	Sr-90	6	6	4.83E+00	**1.24E+00**	**1.17E+01**

Appendix E: Groundwater Management Program Supplemental Information

Appendix Table E-1 Summary of Documents that Report Groundwater Monitoring Data

Document Title	Submittal Frequency
Data Report for the C-Area Groundwater (CAGW) Operable Unit	Quinquennial
K-Area Burning/Rubble Pit (131-K) and Rubble Pile (631-20G) (KBRP), L-Area Burning/Rubble Pit (131-L), Gas Cylinder Disposal Facility (131-2L) and L-Area Rubble Pile (131-3L) (LBRP), and P-Area Burning/Rubble Pit (131-P) (PBRP) Operable Units Combined Groundwater Monitoring Report Sampling Summary	Annual
K-Area Burning/Rubble Pit (131-K) and Rubble Pile (631-20G) (KBRP) and P-Area Burning/Rubble Pit (131-P) (PBRP) Operable Units Combined Groundwater Monitoring Report Sampling Summary	Annual when Full Monitoring Report is not submitted
Annual Comprehensive TNX Area Groundwater Monitoring and Remedial Action Effectiveness Interim Report	Annual
R-Area Groundwater Effectiveness Monitoring Report in Support of R-Area Operable Unit	Biennial
Effectiveness Monitoring Report (EMR) for Monitored Natural Attenuation (MNA) at the L-Area Southern Groundwater (LASG) Operable Unit	Biennial
Five-Year Remedy Review Report for Savannah River Site Operable Units	Phased—Annual
Groundwater Monitoring Report for the D-Area Groundwater Operable Unit	Annual
Groundwater Mixing Zone Report for the D-Area Oil Seepage Basin	Annual
Groundwater Mixing Zone Sampling Summary Report for the R-Reactor Seepage Basin, 108-4R Overflow Basin Operable Unit	Biennial
632-G C&D Class Two Landfill Groundwater Monitoring Report	Biannual
Z-Area Saltstone Disposal Facility Groundwater Monitoring Report	Biannual
288-F Class Two Landfill Annual Groundwater Monitoring Report	Biannual
Interim Sanitary Landfill (Class Three) Annual Groundwater Monitoring Report	Biannual
Annual M-Area and Metallurgical Laboratory Hazardous Waste Management Facilities Groundwater Monitoring and Corrective Action Report	Annual
Annual Corrective Action Report for the F-Area Hazardous Waste Management Facility, the H-Area Hazardous Waste Management Facility, and the Mixed Waste Management Facility	Annual
Performance Evaluation Report for the A-Area Burning/Rubble Pit (731-A, 731-1A) and Rubble Pit (731-2A) and the Miscellaneous Chemical Basin/Metals Burning Pit (731-4A, 731-5A) Operable Unit	Annual

Appendix Table E-1 Summary of Documents that Report Groundwater Monitoring Data (continued)

Document Title	Submittal Frequency
Effectiveness Monitoring Report (EMR) for the Monitored Natural Attenuation (MNA) at the Chemicals, Metals, and Pesticides (CMP) Pits Operable Unit	Annual
Biennial Effectiveness Monitoring Report (EMR) for Monitored Natural Attenuation (MNA) at the C-Area Burning/Rubble Pit (131-C) and Old C-Area Burning/Rubble Pit (NBN) Operable Unit	Biennial
Scoping Summary for the General Separations Area Eastern Groundwater Operable Unit	Annual
Scoping Summary for the General Separations Area Western Groundwater Operable Unit	Annual
Sanitary Landfill Groundwater Monitoring and Corrective Action Report	Annual
Annual Groundwater Monitoring Report for the F- and H-Area Radioactive Liquid Waste Tank Farms	Annual
Effectiveness Monitoring Report (EMR) for the P-Area Groundwater (PAGW) Operable Unit Zero Valent Iron Permeable Reactive Barrier Removal Action	Annual
Groundwater Report for the P-Area Groundwater (PAGW) Operable Unit	Annual
Treatability Study Data Report for Groundwater Injection and Discharge Canal Neutralization at the D-Area Groundwater Operable Unit	Annual
Five-Year Monitoring Report (Data Summary Letter) for K-Area Groundwater Operable Unit	Quinquennial
Groundwater Mixing Zone Report for the R-Reactor Seepage Basin, 108-4R Overflow Basin (Full Report)	Quadrennial
Groundwater Mixing Zone Sampling Summary Report for the Report for the R-Reactor Seepage Basin, 108-4R Overflow Basin	Quadrennial (2 years after full report)
SRS Environmental Report	Not applicable[a]

[a] The *SRS Environmental Report* is not submitted to the regulatory agencies as a regulatory requirement. The annual report is a publicly available document. The *SRS Environmental Report* summarizes information on offsite wells and onsite wells that are not included in regulatory submittals.

Appendix F: **Glossary**

A

accuracy—Closeness of the result of a measurement to the true value of the quantity.

actinide—Group of radioactive metallic elements of atomic number 89 through 103. Laboratory analysis of actinides by alpha spectrometry generally refers to the elements plutonium, americium, uranium, and curium but may also include neptunium and thorium.

activity—See radioactivity.

alpha particle—Positively charged particle emitted from the nucleus of an atom having the same charge and mass as that of a helium nucleus (two protons and two neutrons)

ambient—Existing in the surrounding area. Completely enveloping.

ambient air—Surrounding atmosphere as it exists around people, plants, and structures.

analyte—Constituent or parameter that is being analyzed.

aquifer—Saturated, permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients.

Area Completion Projects—U.S. Department of Energy program that directs the assessment and cleanup of inactive waste units and groundwater (remediation) contaminated as a result of nuclear-related activities.

Atomic Energy Agency—Federal agency created in 1946 to manage the development, use, and control of nuclear energy for military and civilian application. It was abolished by the Energy Reorganization Act of 1974 and succeeded by the Energy Research and Development Administration. Functions of the Energy Research and Development Administration eventually were taken over by the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission.

audit—A systematic evaluation to determine the conformance to quantitative specifications of some operational function or activity.

B

background control location—A sampling point that is not impacted by SRS operations.

background radiation—Naturally occurring radiation, fallout, medical, consumer products, and cosmic radiation. Generally, the lowest level of radiation obtainable within the scope of an analytical measurement, that is, a blank sample.

benchmark — A standard or point of reference against which things may be compared or assessed.

best management practices—Sound engineering practices that are not required by regulation or by law.

beta particle—Negatively charged particle emitted from the nucleus of an atom. It has a mass and charge equal to those of an electron.

Biopreferred® —A program the U.S. Department of Agriculture (USDA) manages to increase the purchase and use of biobased products. The program's purpose is to spur economic development, create new jobs, and provide new markets for farm commodities. For more information, please see the USDA website.

biota—Plant and animal life.

blind sample—A subsample for analysis with a composition known to the submitter. The analyst or laboratory may know the identity of the sample, but not its composition. It tests the analyst's or laboratory's proficiency in the execution of the measurement process.

C

calibration—Process of applying correction factors to equate a measurement to a known standard. Generally, a documented measurement control program of charts, graphs, and data that demonstrate that an instrument is properly calibrated.

canyon—Two facilities located at SRS where nuclear materials are chemically recovered and purified. They are called "canyons" because of their similarity to how a canyon looks, open space with high wall-like mountains on either side of a valley.

Carolina bay—Type of shallow depression commonly found on the coastal Carolina plains. Carolina bays are typically circular or oval. Some are wet or marshy, while others are dry.

categorical exclusion—Categories of actions that do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an environmental assessment nor an environmental impact statement is required.

cleanup—Actions taken to deal with release or potential release of hazardous substances. This may mean complete removal of the substance; it also may mean stabilizing, containing, or otherwise treating the substance so that it does not affect human health or the environment.

closure—Control of a hazardous waste management facility under Resource Conservation and Recovery Act requirements.

compliance—Fulfillment of applicable requirements of a plan or schedule ordered or approved by government authority.

composite—A blend of more than one portion to be used as a sample for analysis.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)—This Act addresses the cleanup of hazardous substances and establishes a National Priority List of sites targeted for assessment and, if necessary, restoration (commonly known as "Superfund").

concentration—Amount of a substance contained in a unit volume or mass of a sample.

contamination—State of being made impure or unsuitable by contact or mixture with something unclean, bad, etc.

continuous assessment—Evaluation of a program or employee carried out on a fixed interval (for example, weekly, monthly, annually)

control chart—A graph of some measurement plotted over time or sequence of sampling, together with control limit(s) and, usually, a central line and warning limit(s). Control charts provide a graphical representation of accuracy and precision, a long-term mechanism for self-evaluation of analytical data, and an assessment of analytical capability of the laboratory analyst.

control standard—A standard prepared independently of and run with the calibration. It is used to verify the accuracy of the calibration.

cool roof—A thick white rubber-type roof that lowers the temperature of standard roofs from about 150 degrees Fahrenheit to 100 degrees or less.

criteria pollutant—Six common air pollutants found all over the United States. They are particle pollution (often referred to as particulate matter), ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen oxides, and lead. The Clean Air Act requires the Environmental Protection Agency to set National Ambient Air Quality Standards for these six pollutants.

curie—Unit of radioactivity. One curie is defined as 3.7×10^{10} (37 billion) disintegrations per second. Several fractions and multiples of the curie are commonly used:

- **kilocurie (kCi)**—10^{3} Ci, one thousand curies; 3.7×10^{13} disintegrations per second.
- **millicurie (mCi)**—10^{-3} Ci, one-thousandth of a curie; 3.7×10^{7} disintegrations per second.
- **microcurie (µCi)**—10^{-6} Ci, one-millionth of a curie; 3.7×10^{4} disintegrations per second.
- **picocurie (pCi)**—10^{-12} Ci, one-trillionth of a curie; 0.037 disintegrations per second.

D

DCS sum of fractions—The sum of the ratios of the average concentration of each radionuclide to its corresponding DCS value. (See definition of derived concentration standard [DCS].)

decay (radioactive)—Spontaneous transformation of one radionuclide into a different radioactive or nonradioactive nuclide, or into a different energy state of the same radionuclide.

deactivation—The process of placing a facility in a stable and known condition, including removing hazardous and radioactive materials to ensure adequate protection of the worker, public health and safety, and the environment, thereby limiting the long-term cost of surveillance and maintenance.

decommissioning—Process that takes place after deactivation and includes surveillance and maintenance, decontamination, and dismantlement.

derived concentration standard (DCS)—Concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure mode (that is, ingestion of water, submersion in air, or inhalation), would result in an effective dose equivalent of 0.1 rem (1 mSv). The guides for radionuclides in air and water are given in U.S. Department of Energy Derived Concentration Technical Standard (DOE-STD-1196-2011) (DOE 2011).

detection limit—See analytical detection limit, lower limit of detection, minimum detectable concentration.

disposal—Permanent or temporary transfer of U.S. Department of Energy control and custody of real property to a third party, which thereby acquires rights to control, use, or relinquish the property.

disposition—Those activities that follow completion of program mission including, but not limited to, surveillance and maintenance, deactivation, and decommissioning.

dissolved oxygen—Desirable indicator of satisfactory water quality in terms of low residuals of biologically available organic materials. Dissolved oxygen prevents the chemical reduction and subsequent leaching of iron and manganese from sediments.

DOE Consolidated Audit Program (DOECAP)—A comprehensive audit program for contract laboratories and treatment, storage, and disposal facilities with the intent of conducting consolidated audits to eliminate redundant audits previously conducted independently by DOE field element sites and to achieve standardization in audit methodology, processes, and procedures.

dose—Energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joules per kilogram in any medium.

- **effective dose**—Sum of the equivalent dose received by all organs or tissues of the body after each one has been multiplied by an appropriate tissue weighting factor.
- **collective dose**—Sum of the effective dose of all individuals in an exposed population within a 50-mile (80-km) radius and expressed in units of person-rem (or person-sievert). The 50-mile distance is measured from a point located centrally with respect to major facilities or U.S. Department of Energy program activities.

dosimeter—Portable detection device for measuring the total accumulated exposure to ionizing radiation.

drinking water standards—Federal primary drinking water standards, both proposed and final, as set forth by the Environmental Protection Agency.

duplicates or duplicate results—Results derived by taking a portion of a primary sample and performing the same analysis on that portion that is performed on the primary sample.

E

effluent—A release of treated or untreated water or air from a pipe or a stack to the environment. Liquid effluent flows into a body of water such as a stream or lake. Airborne effluent (also called emission) discharges into the atmosphere.

effluent monitoring—Collection and analysis of samples or measurements of liquid and gaseous effluents to characterize and quantify the release of contaminants, assess radiation exposures to members of the public, and demonstrate compliance with applicable standards.

emission—A release of a gas.

ENERGY STAR®—A U.S. Environmental Protection Agency program that helps businesses and individuals save money and protect the climate through energy efficiency. For more information, please visit the ENERGY STAR website.

environmental compliance—Actions taken in accordance with government laws, regulations, orders, etc., that apply to Site operations' effects on onsite and offsite natural resources and on human health; used interchangeably in this document with regulatory compliance.

environmental monitoring—Vital role in determining health and safety issues for the purpose of public health or environmental health. Environmental monitoring at Savannah River Site includes effluent monitoring and environmental surveillance with the dual purpose of 1) showing compliance with federal, state, and local regulations, as well as with U.S. Department of Energy orders, and 2) monitoring any effects of Site operations on onsite and offsite natural resources and on human health.

environmental occurrence—Any sudden or sustained deviation from a regulated or planned performance at a DOE operation that has environmental protection and compliance significance.

environmental surveillance—Collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media from U.S. Department of Energy sites and their environs and the measurement of external radiation to demonstrate compliance with applicable standards, assess radiation exposures to members of the public, and assess effects, if any, on the local environment.

EPEAT—A product database that registers products based on the devices' ability to meet various criteria developed and agreed upon by diverse stakeholders to address the full lifecycle of an electronic product. This system ensures all products listed in the EPEAT database truly represent environmental leadership. For more information, please visit the EPEAT website.

exception (formerly "exceedance")—Term used by the Environmental Protection Agency and the South Carolina Department of Health and Environmental Control that denotes a reported value is more than the guide limit. This term is found on the discharge monitoring report forms that are submitted to the Environmental Protection Agency or the South Carolina Department of Health and Environmental Control.

exclusion or exclusion device—Material or equipment used for wildlife control. These devices may be used to deter animal use of an area, to provide a method of collecting animals, or to provide a means of exit for an animal.

exposure (radiation)—Incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation or man-made radiation that is not specific to a person's occupation. Occupational exposure is the exposure to ionizing radiation that takes place during a person's working hours. Population exposure is the exposure to the total number of persons who inhabit an area.

exposure pathway—The way that a person could be impacted from releases of radionuclides into the water and air.

F

fallout—The settling to the ground of airborne particles ejected into the atmosphere from the earth by explosions, eruptions, forest fires, etc. or from human production activities such as found at nuclear facilities.

Federal Facility Agreement (FFA)—Agreement negotiated among the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the South Carolina Department of Health and Environmental Control, specifying how the Savannah River Site will address contamination or potential contamination to meet regulatory requirements at Site waste units identified for evaluation and, if necessary, cleanup.

feral hog—Hog that has reverted to the wild state from domestication.

field duplicate—An independent sample collected as closely as possible to the same point in space and time as the original sample. The duplicate and original are two separate samples taken from the same source, stored in separate containers, and analyzed independently.

fiscal year (FY)—An established period of time when an organization's annual financial records start and end. In the federal government, this period is from October 1 to September 30.

G

global fallout—Radioactive debris from atmospheric weapons tests that has been deposited on the earth's surface after being airborne and cycling around the earth.

grab sample—Sample collected instantaneously with a glass or plastic bottle placed below the water surface to collect surface water samples (also called dip samples).

graded approach (to sampling)—A decision process in which the requirements on the system vary with the risk of exposure to radionuclides.

groundwater—Water found underground in cracks and spaces in soil, sand, and rocks.

H

half-life (radiological)—Time required for half of a given number of atoms of a specific radionuclide to decay. Each nuclide has a unique half-life.

hazardous waste—Any waste that is a toxic, corrosive, reactive, or ignitable material that could affect human health or the environment.

I

impaired water— Water for which technology-based regulations and other required controls are not stringent enough to meet the water quality standards set by states.

International Organization for Standardization (ISO)—Creates documents that provide requirements, specifications, guidelines, or characteristics that can be used consistently to ensure that materials, products, processes, and services are compatible with their purpose. For more information, please visit the ISO website.

intralaboratory checks—Compare performance within a laboratory by analyzing duplicate and blind samples throughout the year.

isotope—Each of two or more forms of the same element that contain equal numbers of protons but different numbers of neutrons in their nuclei and, hence, differ in relative atomic mass but not in chemical properties; in particular, a radioactive form of an element.

L

legacy—Anything handed down from the past; inheritance.

low-level waste—Waste that includes protective clothing, tools, and equipment that have become contaminated with small amounts of radioactive material.

M

Mixed Analyte Performance Evaluation Program (MAPEP)—A laboratory comparison program that tracks performance accuracy and tests the quality of environmental data reported to DOE.

maximally exposed individual (MEI)—Hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible radiation dose.

maximum contaminant level (MCL)—The maximum allowable concentration of a drinking water contaminant as legislated through the Safe Drinking Water Act.

mercury—Silver-white, liquid metal solidifying at -38.9°C to form a tin-white, ductile, malleable mass. It is widely distributed in the environment and biologically is a nonessential or nonbeneficial element. Human poisoning due to this highly toxic element has been clinically recognized.

migration—Transfer or movement of a material through the soil or groundwater.

minimum detectable concentration (radionuclides)—Smallest amount or concentration of a radionuclide that can be distinguished in a sample by a given measurement system at a preselected counting time and at a given confidence level.

minimum detectable concentration (chemicals)—Smallest amount or concentration of a chemical that can be distinguished in a sample by a given measurement system at a given confidence level.

mixed waste—Waste that has both hazardous and radioactive components.

monitoring—Process whereby the quantity and quality of factors that can affect the environment or human health are measured periodically to regulate and control potential impacts.

N

nuclide—Atom specified by its atomic weight, atomic number, and energy state. A radionuclide is a radioactive nuclide.

O

organic—Of, relating to, or derived from living organisms (plant or animal).

optically stimulated luminescence dosimeter (OSLD)— A reusable passive device that measures the exposure from ionizing radiation. In 2019, SRS transitioned from TLDs to OSLDs to obtain a higher and more accurate absorption rate to radiation exposure.

outfall—Place where treated or untreated water flows out of a pipe to mix with water from a water body, such as a stream or lake.

P

parameter—Analytical constituent; chemical compound(s) or property for which an analytical request may be submitted.

passive device—A device that does not require a source of energy for its operation.

performance evaluation (PE) sample—A sample, the composition of which is unknown to the analyst, that is provided to test whether the analyst or laboratory can produce analytical results within specified performance limits.

person-rem—Collective dose to a population group. For example, a dose of 1 rem to 10 individuals results in a collective dose of 10 person-rem.

pH—Measure of the hydrogen ion concentration in an aqueous solution (acidic solutions, pH <7; basic solutions, pH>7; and neutral solutions, pH 7).

plume—Volume of contaminated water originating at a waste source for example, a hazardous waste disposal site). It extends downward and outward from the waste source.

point source—Any defined source of emission to air or water such as a stack, air vent, pipe, channel, or passage to a water body.

population dose—See collective dose equivalent under dose.

potable water—Water that is safe to drink.

precision—An estimate of the degree to which a set of observations or measurements of the property, usually obtained under similar conditions agree. It is a data quality indicator.

proficiency testing—An evaluation of a laboratory's performance against preestablished criteria by means of interlaboratory comparison. It is also known as comparative testing.

purge—To remove water prior to sampling, generally by pumping or bailing.

Q

quality assurance (QA)—An integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure quality in the processes by which products are developed.

quality control (QC)—A set of activities for ensuring quality in products by identifying defects in the actual products.

R

rad—Unit of absorbed dose deposited in a volume of material.

radioactivity—Spontaneous emission of radiation, generally alpha or beta particles, or gamma rays, from the nucleus of an unstable isotope.

radioisotopes—Radioactive isotopes.

radionuclide—Unstable nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.

recovery criteria—The ratio of the observed mean result and the value of a standard.

reference person—A hypothetical age and gender averaged individual that is a combination of human (male and female) physical and physiological characteristics arrived at by international consensus to standardize radiation dose calculations.

RCRA/CERCLA Units—Units subject to the remedial action process established in the Federal Facilities Agreement.

regional screening level (RSL)—The risk-based concentration derived from standardized equations combining exposure assumptions with toxicity data.

regulatory compliance—Actions taken in accordance with government laws, regulations, orders, etc., that apply to Savannah River Site operations' effects on onsite and offsite natural resources and on human health; used interchangeably in this document with environmental compliance.

release—Any discharge to the environment. Environment is broadly defined as any water, land, or ambient air.

rem—Unit of equivalent dose (absorbed dose in rads times the radiation weighting factor). Equivalent dose frequently is reported in units of millirem (mrem), which is one thousandth of a rem.

remediation—Assessment and cleanup of sites contaminated with waste due to historical activities.

representative person—A hypothetical individual receiving a dose that is representative of the more highly exposed individuals in the population.

Resource Conservation and Recovery Act (RCRA)—Federal legislation that regulates the transport, treatment, and disposal of solid and hazardous wastes. This act also requires corrective action for releases of hazardous waste at inactive waste units.

retention basin—Unlined basin used for emergency, temporary storage of potentially contaminated cooling water from chemical separations activities.

routine radioactive release—Planned or scheduled release of radioactivity to the environment.

S

seepage basin—Excavation that receives wastewater. Insoluble materials settle out on the floor of the basin and soluble materials seep with the water through the soil column, where they are removed partially by ion exchange with the soil. Construction may include dikes to prevent overflow or surface runoff.

SEER—Seasonal Energy Efficiency Ratio—This is a measure of equipment energy efficiency over the cooling season. It represents the total cooling of a central air conditioner or heat pump during the normal cooling season as compared to the total electric energy input consumed during the same period.

sievert—The International System of Units (SI) derived unit of dose equivalent. It attempts to reflect the biological effects of radiation as opposed to the physical aspects, which are characterized by the absorbed dose, measured in gray. One sievert is equal to 100 rem.

Site stream—Any natural stream on the Savannah River Site. Surface drainage of the Site is via these streams to the Savannah River.

source—Point or object from which radiation or contamination emanates.

source term—Quantity of radioactivity (released in a set period of time) that is traceable to the starting point of an effluent stream or migration pathway.

spent nuclear fuel—Used fuel elements from reactors.

splits or split sample—Two or more representative portions taken from a single sample and analyzed by different analysts or laboratories. Split samples are used to replicate the measurement of the parameters of interest.

SRS Community Reuse Organization (SRSCRO)—A nonprofit organization charged with developing and implementing strategy to diversify the economy in the five South Carolina and Georgia counties surrounding the Site. For more information, please see the SRSCRO website.

stable—Not radioactive or not easily decomposed or otherwise modified chemically.

stack—Vertical pipe or flue designed to exhaust airborne gases and suspended particulate matter.

statistical data evaluation—A collection of methods used to process large amounts of data and report overall trends.

stormwater runoff—Surface streams that appear after precipitation.

Superfund—See Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

surface water—Water that has not penetrated below the surface of the ground.

T

tank farm—Interconnected underground tanks used for storage of high-level radioactive liquid wastes.

temperature—Thermal state of a body, considered with its ability to communicate heat to other bodies.

terrestrial—Living on or growing from the land.

total phosphorus—May occasionally stimulate excessive or nuisance growths of algae and other aquatic plants when concentrations exceed 25 mg/L at the time of the spring turnover on a volume-weighted basis in lakes or reservoirs.

translocation—The deliberate movement of organisms from one site for release in another. It must be intended to yield a measurable conservation benefit at the levels of a population, species or ecosystem, and not only provide benefit to translocated individuals.

transuranic (TRU) waste—Solid radioactive waste containing primarily alpha-emitting elements heavier than uranium.

trend—General drift, tendency, or pattern of a set of data plotted over time.

tritium—Elemental form of the radioactive isotope of hydrogen and occurs as a gas.

tritium oxide—Water in which the tritium isotope has replaced a hydrogen atom. Stack releases of tritium oxide typically occur as water vapor.

U

unidentified alpha and beta releases—The unspecified alpha and beta releases that are conservatively determined at each effluent location by subtracting the sum of the individually measured alpha-emitting (for example, plutonium-239 and uranium-235) and beta-emitting (for example, cesium-137 and strontium-90) radionuclides from the measured gross alpha and beta values, respectively. Unidentified alpha and beta releases also include naturally occurring radionuclides, such as uranium, thorium, radon progeny, and potassium-40.

utility water—Once-through noncontact cooling water, recirculated noncontact cooling water, boiler blowdown, steam condensate, air conditioning condensate, and other uncontaminated heating, ventilation, and air conditioning or compressor condensates.

V

volatile organic compounds (VOC)—Broad range of organic compounds, commonly halogenated, that vaporize at ambient, or relatively low, temperatures (for example, acetone, benzene, chloroform, methyl alcohol).

W

waste management—The U.S. Department of Energy uses this term to refer to the safe, effective management of various kinds of nonhazardous, hazardous, and radioactive waste generated at DOE facilities.

waste unit—A particular area that is or may be posing a threat to human health or the environment. Waste units range in size from a few square feet to tens of acres and include basins, pits, piles, burial grounds, landfills, tank farms, disposal facilities, process facilities, and groundwater contamination.

waste stream—Waste material generated from a single process or from an activity that is similar in material, physical form, isotopic makeup, and hazardous constituents.

WaterSense®—A U.S. Environmental Protection Agency partnership that offers ways to increase water efficiency through products and services. For more information, please visit the U.S. EPA website.

water table—Planar, underground surface beneath which earth materials, such as soil or rock, are saturated with water.

wetland—Lowland area, such as a marsh, swamp, bog, Carolina bay, floodplain bottom, where land is covered by shallow water at least part of the year and is characterized by somewhat mucky soil.

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Appendix G: **References**

Aucott et al. 2017. Aucott, T.J., A.D. Brand, D.P. DiPrete, T.S. Whiteside. "Improvements to the Hunter Dose Tracking System," SRNL-STI-2017-00091, Savannah River National Laboratory, Savannah River Site, Aiken, SC

Bell 2020. Bell, E.S. "Creation of CAP88 and MAXDOSE Meteorological Datasets (2014-2018) for Regulatory Dose Assessment," SRNL-STI-2020-00259, July 2020, Savannah River National Laboratory, Savannah River Site, Aiken, SC

Carlton et al. 1994. Carlton, W.H., C.E. Murphy, Jr., and A.G. Evans. "Radiocesium in the Savannah River Site Environment," *Health Physics*, Volume 67, Number 3, Williams & Wilkins, Baltimore, MD

Cherry 2006. Cherry, G.S. "Simulation and Particle Tracking Analysis of Ground-Water Flow near the Savannah River Site, Georgia and South Carolina, 2002, and for Selected Ground-Water Management Scenarios, 2002 and 2020," *Scientific Investigations Report*, 2006-5195, U.S. Geological Survey, Reston, VA

Denham 1995. Denham, M.E. "SRS Geology/Hydrogeology Environmental Information Document," WSRC-TR-95-0046, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

DOE 2006. U.S. Department of Energy. "Section 3116 Determination for Salt Waste Disposal at the Savannah River Site," DOE-WD-2005-001, January 2006. Savannah River Site, Aiken, SC

DOE 2011. U.S. Department of Energy. "DOE Derived Concentration Technical Standard," DOE-STD-1196-2011, Washington, DC

DOE 2013. U.S. Department of Energy. "Radiation Protection of the Public and the Environment," DOE Order 458.1, Change 3; 2013, Washington, DC

DOE 2015. U.S. Department of Energy. "Environmental Radiological Effluent Monitoring and Environmental Surveillance," DOE Handbook, DOE-HDBK-1216-2015, Washington, DC

DOE 2019. U.S. Department of Energy. "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota," DOE-STD-1153-2019, Washington, DC

DOE 2022. U.S. Department of Energy. "DOE Derived Concentration Technical Standard," DOE-STD-1196-2022, Washington, DC

EPA 1993. U.S. Environmental Protection Agency. "External Exposure to Radionuclides in Air, Water, and Soil," Federal Guidance Report No. 12, USEPA 402-R-93-081, Sept. 1993, Washington, DC

EPA 1999. U.S. Environmental Protection Agency. "Cancer Risk Coefficients for Environmental Exposure to Radionuclides," Federal Guidance Report No.13, USEPA 402-R-99-001, Sept. 1999, Washington, DC

EPA 2000. U.S. Environmental Protection Agency. "National Primary Drinking Water Regulations," Title 40 Code of Federal Regulations, Part 141, December 2000, Washington, DC

EPA 2002. U.S. Environmental Protection Agency. "National Emission Standards for Hazardous Air Pollutants," Title 40 Code of Federal Regulations, Part 61, Subpart H, July 2002, Washington, DC

EPA 2011. U.S. Environmental Protection Agency. "Exposure Factor Handbook," National Center for Environmental Assessment, Office of Research and Development, Sept. 2011, Washington, DC

EPA 2018a. U.S. Environmental Protection Agency. "Update for Chapter 11 of the Exposure Factors Handbook – Intake of Meats, Dairy Products, and Fats," Washington, DC: U.S. Environmental Protection Agency; EPA/600/R-17/485F

EPA 2018b. U.S. Environmental Protection Agency. "Update for Chapter 12 of the Exposure Factors Handbook – Intake of Grain Products," Washington, DC: U.S. Environmental Protection Agency; EPA/600/R-18/095F; 2018

EPA 2018c. U.S. Environmental Protection Agency. "Update for Chapter 9 of the Exposure Factors Handbook – Intake of Fruits and Vegetables," Washington, DC: U.S. Environmental Protection Agency; EPA/600/R-18/098F

EPA 2019a U.S. Environmental Protection Agency. "Update for Chapter 3 of the Exposure Factors Handbook – Ingestion of Water and Other Select Liquids," U.S. Environmental Protection Agency; EPA/600/R-18/259F, Washington, DC

EPA 2019b. U.S. Environmental Protection Agency. "External Exposure to Radionuclides in Air, Water and Soil," Federal Guidance Report No. 15, USEPA402/R19/002 Aug. 2019, Washington, DC

FFA 1993. "Federal Facility Agreement for the Savannah River Site," Administrative Docket Number 89-05-FF, WSRC-OS-94-42, Effective Date: August 16, 1993, Savannah River Site, Aiken, SC

ICRP 2002. International Commission on Radiation Protection, "Basic Anatomical and Physiological Data for Use in Radiological Protection Reference Values," Annals of the ICRP 32, Publication 89, Elmsford, NY

ICRP 2008. International Commission on Radiation Protection, "Nuclear Decay Data for Dosimetric Calculation," Annals of the ICRP 38(3), Publication 107, Elmsford, NY

Laird and Jannik 2020. Laird, M.G., G.T. Jannik. "Updated External Exposure Dose Coefficients," SRNL-L3200-2020-00014, May 2020, Savannah River National Laboratory, Savannah River Site, Aiken, SC

Minter et al 2018. Minter, K.M., G.T. Jannik, B.H. Stagich, K.L. Dixon, and J.R. Newton. "Comparison of the Current Center of the Site Annual NESHAP Dose Modeling at the Savannah River Site with Other Assessment Methods," Health Physics Society, Health-Physics.com, 408-413

Morrison et al 2019. Morrison, C., S. Hitchens, T. Edwards, J. Mayer, and K. Minter. "Determining CS-137 Background Bodyburdens for Wild Pigs at Savannah River Site," SRNL-TR-2019-00193, Savannah River National Laboratory, Savannah River Site, Aiken, SC

NCRP 2009. National Council on Radiation Protection and Measurements, "Ionizing Radiation Exposure of the Population of the United States." NCRP Report 160, Bethesda, MD

NRC 1977. U.S. Nuclear Regulatory Commission. “Regulatory Guide 1.109 - Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I,” Revision 1, Washington, DC

SCDHEC 2014. South Carolina Department of Health and Environmental Control. “Water Classifications and Standards,” South Carolina Code of Regulations, R.61-68, Columbia, SC

SRNL 2023. Savannah River National Laboratory. “Environmental Dose Assessment Manual,” SRNL-TR-2010-00274, Revision 3, Savannah River National Laboratory, Aiken, SC

SRNS 2018. Savannah River Nuclear Solutions, LLC. “Environmental Report for 2017,” SRNS-RP-2018-00470, Savannah River Site, Aiken, SC

SRNS 2020. Savannah River Nuclear Solutions, LLC. “Groundwater Management Strategy and Implementation Plan (U),” WSRC-RP-2006-4074, Updated October 2020, Savannah River Site, Aiken, SC

SRNS 2024a. Savannah River Nuclear Solutions, LLC. “Annual 2023 M-Area and Metallurgical Laboratory Hazardous Waste Management Facilities Groundwater Monitoring and Corrective Action Report (U),” SRNS-RP-2023-01452, Savannah River Site, Aiken, SC

SRNS 2024b. Savannah River Nuclear Solutions, LLC. “Annual Corrective Action Report for the F-Area Hazardous Waste Management Facility, the H-Area Hazardous Waste Management Facility, and the Mixed Waste Management Facility (U),” SRNS-RP-2024-00840, Savannah River Site, Aiken, SC

SRS EDAM 2017. Savannah River National Laboratory. “Environmental Dose Assessment Manual,” SRNL-TR-2010-00274, Revision 2, October 2017, Savannah River National Laboratory, Aiken, SC

Stagich 2021 Stagich, B.H. “Land and Water Use Characteristics and Human Health Input Parameters for Use in Environmental Dosimetry and Risk Assessments at the Savannah River Site -2021 Update,” SRNL-STI-2016-00456, Revision 2, Savannah River National Laboratory, Savannah River Site, Aiken, SC

Stagich, Dixon, and Peyton 2024. Stagich, B.H., K.L. Dixon, and M. Peyton. “Radiological Impact of 2023 Operations at the Savannah River Site,” SRNL-STI-2024-00262, Rev. 0, Savannah River National Laboratory, Savannah River Site, Aiken, SC

Stone and Jannik 2013. Stone, D.K. and G.T. Jannik. “Site Specific Reference Person Parameters and Derived Concentration Standards for the Savannah River Site,” SRNL-STI-2013-00115, Savannah River National Laboratory, Aiken, SC

Yu et al. 2001. C. Yu, A.J. Zielen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, Amish, A. Wallo III, W.A. Williams, and H. Peterson. “User’s Manual for RESRAD,” Version 6, Environmental Assessment Division, Argonne National Laboratory, Argonne, IL, July 2001

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Appendix H: **Units of Measure**

Appendix Table H-1 Base Units of Measure

This table presents the standard base units of measure that may be encountered throughout this text and the associated reference texts.

Measured Quantity	Symbol	Name
Temperature	°C	degrees Celsius
	°F	degrees Fahrenheit
Time	d	day
	h	hour
	m	minute
	s	second
	y	year
Length	ft or ′	foot
	in	inch
	m	meter
	yd	yard
Mass	g	gram
	lb	pound
Area	mi^2	square mile
	ft^2	square foot
	ft^3	cubic foot
	m^3	cubic meter
	yd^3	cubic yard
Volume	gal	gallon
	L	liter
Concentration	ppb	parts per billion
	ppm	parts per million
Rate	cfs	cubic feet per second
	gpm	gallons per minute
Conductivity	mho	mho
Radioactivity	Ci	curie
	cpm	counts per minute
	Bq	becquerel
	d/m or dpm	disintegrations per minute
Radiation Dose	rad	radiation absorbed dose
	rem	roentgen equivalent man
	Sv	sievert
	R	roentgen
	Gy	gray

Appendix Table H-2 Conversion Tables

These tables present the prefixes and conversions that may be encountered throughout this text and the associated reference texts.

Conversion Table (Fractions and Multiples of Units)

Multiple	Decimal Equivalent	Prefix	Symbol	Report Format
10^6	1,000,000	mega-	M	E+06
10^3	1,000	kilo-	k	E+03
10^2	100	hecto-	h	E+02
10	10	deka-	da	E+01
10^{-1}	0.1	deci-	d	E-01
10^{-2}	0.01	centi-	c	E-02
10^{-3}	0.001	milli-	m	E-03
10^{-6}	0.000001	micro-	µ	E-06
10^{-9}	0.000000001	nano-	n	E-09
10^{-12}	1E-12	pico-	p	E-12
10^{-15}	1E-15	femto-	f	E-15
10^{-18}	1E-18	atto-	a	E-18

Conversion Table (English and *Systeme International* Units)

Multiply	By	To Obtain	Multiply	By	To Obtain
in	2.54	cm	cm	0.394	in
ft	0.305	m	m	3.28	ft
mi	1.61	km	km	0.621	mi
lb	0.4536	kg	kg	2.205	lb
liq qt-US	0.945	L	L	1.057	liq qt-US
ft^2	0.093	m^2	m^2	10.764	ft^2
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.31	ft^3
d/m	0.450	pCi	pCi	2.22	d/m
pCi	10^{-6}	µCi	µCi	10^6	pCi
pCi/L (water)	10^{-9}	µCi/mL (water)	µCi/mL (water)	10^9	pCi/L (water)
pCi/m^3 (air)	10^{-12}	µCi/mL (air)	µCi/mL (air)	10^{12}	pCi/m^3 (air)

Conversion Table (Units of Radiation Measure)

Current System	*Systeme International*	Conversion
curie (Ci)	becquerel (Bq)	1 Ci = 3.7×10^{10} Bq
rad (radiation absorbed dose)	gray (Gy)	1 rad = 0.01 Gy
rem (roentgen equivalent man)	sievert (Sv)	1 rem = 0.01 Sv

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