

# Savannah River Site

## Environmental Report



2022

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The cover of the *2022 SRS Environmental Report* features photographs by Ken Cheeks. Ken was the manager of the Environmental Bioassay Laboratory and the Environmental Monitoring Program at the Savannah River Site before retiring in 2022 from Savannah River Nuclear Solutions. In this role, he was responsible for the monitoring programs that the *SRS Environmental Report* describes. An undisputed nature enthusiast, Ken has also delighted his former coworkers with his avid and undeniable talent behind a lens.

The background cover photograph is of L Lake at the Savannah River Site. The inset photograph on the front cover is of an anhinga and great egret at Phinizy Swamp Nature Park in Augusta, Georgia. The top inset photograph on the back cover is of a belted kingfisher below the dam recreation area in McCormick, South Carolina. The bottom inset photograph is of an alligator and dragonfly at Audubon's Silver Bluff Center and Sanctuary in Jackson, South Carolina.

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or go to the SRS Environmental Report webpage at  
<http://www.srs.gov/general/pubs/ERsum/index.html>  
and under the SRS Environmental Report 2022, complete the electronic  
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**Savannah River Site**

# **Environmental Report 2022**

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# Acknowledgements

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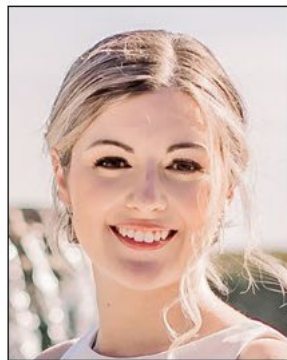
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# To Our Readers

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## *Highlights*

The U.S. Department of Energy (DOE) Order 231.1B (Environment, Safety, and Health Reporting) requires Annual Site Environmental Reports (ASERs) to assess field environmental program performance, sitewide environmental monitoring and surveillance effectiveness, and to confirm 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* on the World Wide Web at the following address:

<http://www.srs.gov/general/pubs/ERsum/index.html>

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he *SRS Environmental Report 2022* is an overview of environmental management activities conducted on and in the vicinity of SRS from January 1 through December 31, 2022. 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 the 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 doses 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 this year in response to the challenges these emerging contaminants of concern present to SRS and the environment.

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 links to supplemental and technical reports and websites that support the annual report. The links to these reports may be found in the chapters or on the *SRS Environmental Report 2022* webpage. 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 2022* webpage or through direct links. 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 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 *SRS Environmental Report* webpage contains reports from multiple years with the 2022 report being the latest. The report folders feature:

- The full report with hyperlinks 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); Parsons Government Services, Inc.; Centerra-SRS; Ameresco Federal Solutions; the Savannah River Ecology Laboratory (SREL); and the United States Forest Service-Savannah River (USFS-SR).

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# Acronyms and Abbreviations

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## A

ACP	Area Completion Projects
AIM	American Innovation and Manufacturing
AFFF	Aqueous Film Forming Foam
AIP	Agreement in Principle
ALARA	As Low As Reasonably Achievable
AP	Advanced Placement
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 & Sewer Authority
BLLDF	Barnwell Low-Level Disposal Facility
BSRA	Battelle Savannah River Alliance
BWRE	Bulk Waste Removal Efforts

## C

CaCO <sub>3</sub>	Calcium Carbonate
C&D	Construction and Demolition
CA	Composite Analysis
CAA	Clean Air Act
CAB	SRS Citizens Advisory Board
CEC	Contaminant of Emerging Concern

CEI	Compliance Evaluation Inspection
CEPLT	Comprehensive Environmental Permits Linking Tool
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMP	Chemicals, Metals, and Pesticides
COC	Contaminant of Concern
COVID-19	Coronavirus Disease 2019
CPF	Creek Plantation Floodplain
CSRA	Central Savannah River Area
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
DoD	United States Department of Defense
DO	Dissolved Oxygen
DOE	United States Department of Energy
DOECAP	DOE 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
DWPF	Defense Waste Processing Facility

**E**

EA	Environmental Assessment
ECA	Environmental Compliance Authority
ECHO	Enforcement and Compliance History Online
ECM	Energy Conservation Measure
ECODS	Early Construction and Operational Disposal Site
E. coli	Escherichia coli
EDAM	Environmental Dose Assessment Manual
EEC	Environmental Evaluation Checklist
EFCOG	Energy Facilitators Contractors Group
EIS	Environmental Impact Statement
EISA	Energy Independence Security Act
EIS/ODIS	Environmental Impact Statement/Overseas Environmental Impact Statement
EJ	Environmental Justice
EM	Environmental Management
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPEAT	Electronic Product Environmental Assessment Tool
EPP	Environmentally Preferable Purchasing
ERO	Emergency Response Organization
ERT	Electrical Resistivity Tomography
ESA	Endangered Species Act
ESOP	Environmental Surveillance Oversight Program
ESPC	Energy Saving Performance Contracting
ETP	Effluent Treatment Project

EV	Electric Vehicle
E-85	85% Ethanol, 15% Unleaded Gasoline

## **F**

FCA	Fast Critical Assembly
FDB	Federal Diversion Box
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
FR	Federal Register
FRS	Facility Register Service
FY	Fiscal Year

## **G**

GHG	Greenhouse Gas
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## **H**

HBCU	Historically Black Colleges and Universities
HFC	Hydrofluorocarbons
HLW	High-Level Waste
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
INL	Idaho National Laboratory
IOU	Integrator Operable Unit
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
IT	Information Technology

**L**

LED	Light-Emitting Diode
LLW	Low-Level Waste
LRP	L-Area Rubble Pit
LTR	Lower Three Runs
LUC	Land Use Control

**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
mrem	Millirem

MW	Mixed Waste
MWMF	Mixed Waste Management Facility

## N

NA-MRF	North Augusta, South Carolina Material Recovery Facility
NBN	No Building Number
NDAA	National Defense Authorization Act
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NNIPS	Non-native Invasive Plant Species
NNSA	National Nuclear Security Administration
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

OFI	Opportunities for Improvement
ORPS	Occurrence Reporting and Processing System
OSLD	Optically Stimulated Luminescence Dosimeters
OU	Operable Unit

## P

PA	Performance Assessment
PAR	P and R Reactor
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
pH	Potential of Hydrogen
PRB	P-Area Permeable Reactive Barrier
PUE	Power-Usage Effectiveness
PVC	Polyvinyl Chloride
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
RFI	RCRA Facility Inspection
RI	RCRA Investigation
RICE	Reciprocating Internal Combustion Engine
RM	River Mile
ROD	Record of Decision
RPD	Relative Percent Difference

RQ	Reportable Quantity
RSL	Regional Screening Levels
RSV	Regional Screening Values

## S

SA	Supplement Analysis
SARA	Superfund Amendment and Reauthorization Act of 1986
SCDHEC	South Carolina Department of Health and Environmental Control
SCRS	Sustainable Climate Ready Sites
SDF	Saltstone Disposal Facility
SDU	Saltstone Disposal Unit
SDWA	Safe Drinking Water Act
SEER	Seasonal Energy Efficiency Ratio
SME	Subject Matter Expert
SNAP	Significant New Alternatives Policy
SNF	Spent Nuclear Fuel
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 Math
STEP	Science and Technology Enrichment Program
STP	Site Treatment Plan
SWDF	Solid Waste Disposal Facility
SWPF	Salt Waste Processing Facility
SWPPP	Stormwater Pollution Prevention Plan

## T

TCCR	Tank Closure Cesium Removal
TCE	Trichloroethylene
TFF	Tritium Finishing Facility
TNX	678-T Facilities
TOC	Total Organic Carbon
TREAT	Teaching Radiation, Energy, and Technology
TRI	Toxic Release Inventory
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facilities
TSS	Total Suspended Solids

## U

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
VTR	Versatile Test Reactor
VSDS	Visual Survey Data System

## W

WIPP	Waste Isolation Pilot Plant
WORC	Workforce Opportunities Regional Careers
WSRC	Westinghouse Savannah River Company
WTP	Water Treatment Plant

## Z

ZVI	Zero-valent Iron
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# Sampling Location Information

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*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.)*

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

*Sampling Location Information*

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**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

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**T**he “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.” The “SRS Environmental Report” 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 Background

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. Du Pont de Nemours Company with designing, building, and operating what was then 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, 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 DOE complex and a steward of conserving water and energy 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 SRS mission 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, while sustaining 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 treating and processing waste, environmental cleanup and remediation, tritium processing, and protecting nuclear material.

The DOE Office of Environmental Management (DOE-EM) and the National Nuclear Security Administration (NNSA) oversee the Site mission. DOE-EM's primary mission at the Savannah River Operations Office is to ensure that SRS operations and the cleanup of legacy waste protect 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), 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. The USFS-SR oversees SRS's natural resources through an interagency agreement with DOE-Savannah River. 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 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 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.

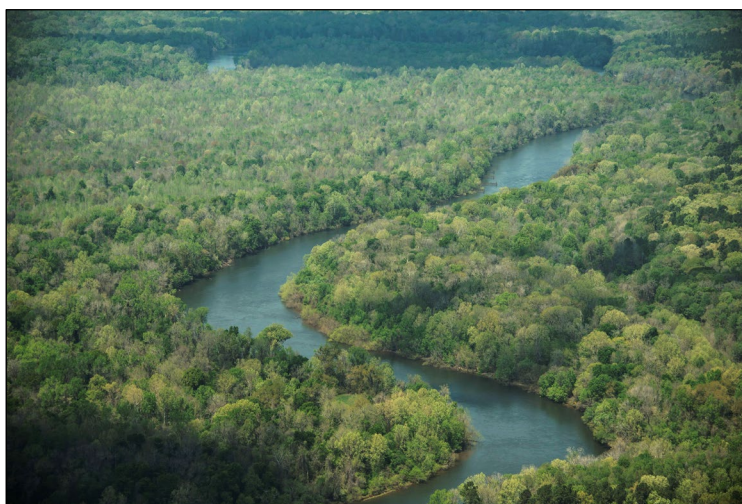
## 1.3 SITE LOCATION, DEMOGRAPHICS, AND ENVIRONMENT

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 1-1). The Savannah River flows along the Site's southwestern border. The capital letters on the Figure 1-1 map reference the operational areas within the SRS borders.

Based on the U.S. Census Bureau's 2020 data, the population within a 50-mile radius of H Area (where most of the Site's radiological releases occur) 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.

### 1.3.1 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, and boaters also use the river. The



**An Aerial View of the Savannah River**

Savannah River is not currently used for any large-scale irrigation projects downriver of the Site. The groundwater at SRS migrates through the subsurface, primarily discharging into the Savannah River and its tributaries. SRS uses groundwater for both industrial processes and drinking water.

### 1.3.2 Geology

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

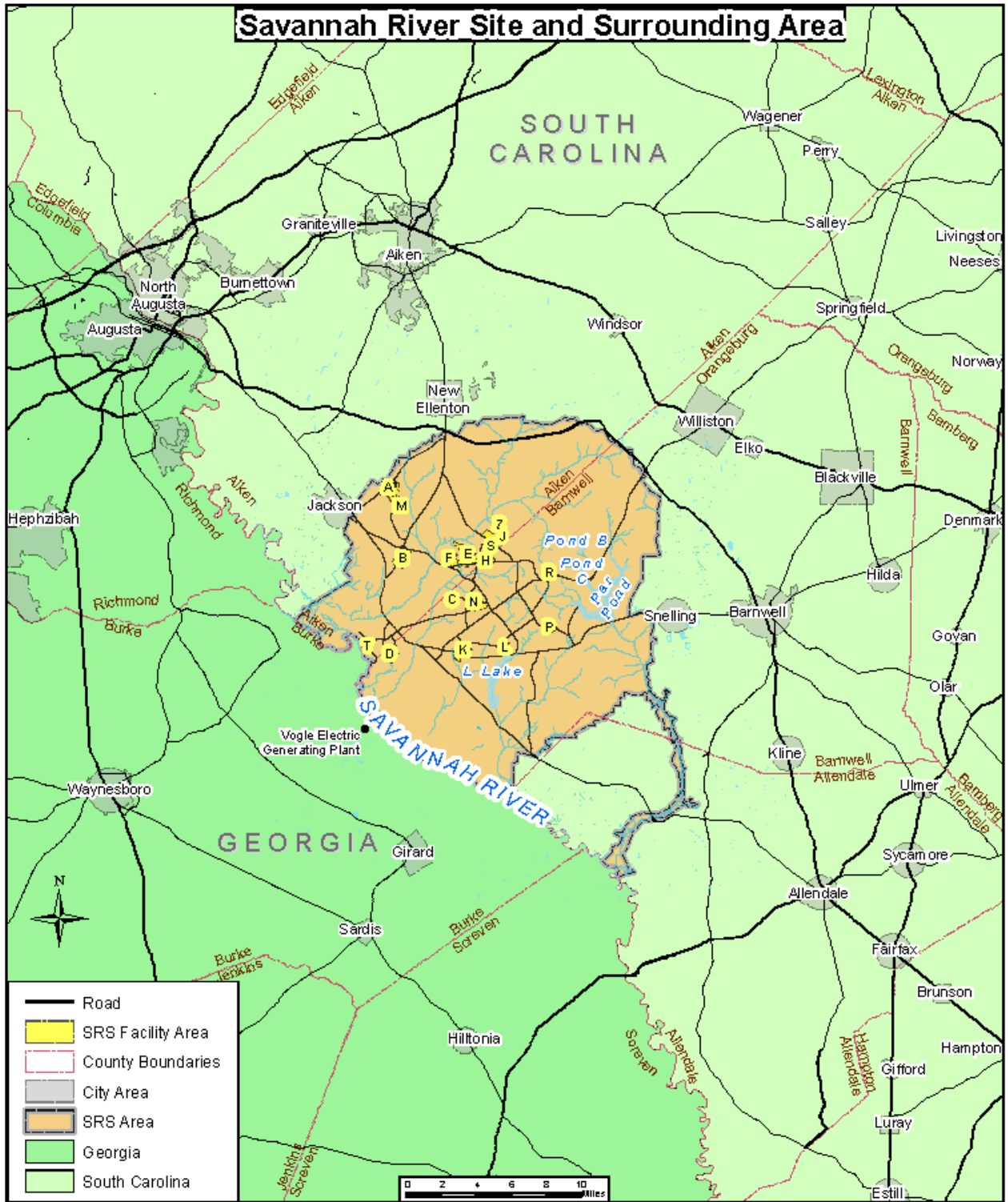
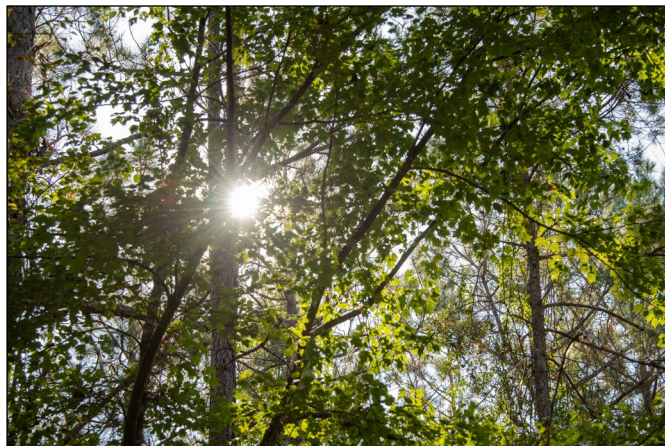


Figure 1-1 The Savannah River Site and Surrounding Areas

### 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. Carolina bays provide important wetland habitat and refuge for many plants and animals. As many as 300 Carolina bays exist on SRS.



**Ninety Percent of the Site Consists of Natural and Managed Forests.**

### 1.3.4 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



**A USDA Forestry Lumberjack Installs an Artificial Nest Box.**

The Site also provides habitat for 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.

## 1.4 DOE-EM PRIMARY SITE ACTIVITIES

DOE's Environmental Management Program oversees many Site activities. The following sections highlight key programs. Additional information is available on the [SRS website](#).

### 1.4.1 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 safe storage of plutonium and to support the Surplus Plutonium Disposition project, which will increase SRS's capacity for disposition of surplus plutonium.

### 1.4.2 Nuclear Materials Disposition

H Canyon is the only operating radiologically shielded chemical separations facility in the United States. From 2003 to 2019, H Canyon has 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 utilized to dissolve spent nuclear fuel and discard 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 the H-Canyon facility.

### 1.4.3 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.

### 1.4.4 Waste Management

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

#### 1.4.4.1 Radioactive Liquid Waste Management

SRS generates radioactive liquid waste as the byproduct of processing nuclear materials for national defense, research, and medical programs. The Site safely stores approximately 34 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.



**Excavation and Groundwork were Initiated for SDU-11 and SDU-12, the Final Mega-Vaults Planned for Construction.**

SRS mixes the salt solution at the Saltstone Production Facility to make saltstone and disposes of this low-activity liquid waste in cylindrical tanks, known as Saltstone Disposal Units (SDUs). In 2022, SRS continued permanently disposing of waste, processing more than 3.3 million gallons into grout and disposing of it in the cylindrical concrete SDUs. SRS continued construction of SDU-8 and SDU-9 and initiated construction of SDU-10, the next three mega-vaults. All three mega-vaults have a capacity of 34.5 million gallons. In addition, SRS started excavation and groundwork for SDU-11 and SDU-12, the final planned mega-vaults.

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 16.8 million pounds of glass—immobilizing 64.2 million curies of radioactivity—and pouring more than 4,346 canisters. In 2022, DWPF produced 58 canisters of glass, weighing 218,200 pounds and immobilizing 992,000 curies of radioactivity.

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. Parsons Corporation, which designed and built the first-of-a-kind facility, completed its first year of operations on January 17, 2022. 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 2.4 million gallons of salt solution in 2022.

#### 1.4.4.2 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 (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



**Inspection of a K-Area Shipment before it Leaves SRS for the Waste Isolation Pilot Plant**

To meet environmental and regulatory requirements, SRS treats, stores, and disposes of all low-level radioactive and hazardous waste that it generates. The Site disposes of all hazardous waste 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 the Waste Isolation Pilot Plant (WIPP), DOE's geologic repository near Carlsbad, New Mexico. SRS began shipping TRU waste to WIPP in May 2001 and has made more than 1,700 shipments. SRS made 16 TRU shipments in 2022, including the first shipment from K Area of downblended surplus plutonium.

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

#### **1.4.5 Area Completion Projects**

SRS's Area Completion Projects organization 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 Environmental Management facilities; and using natural remedies, such as bioremediation (employing naturally occurring microbes) and phytoremediation (using plants to clean up a contaminated environment).

#### **1.4.6 Environmental Monitoring**

SRS has an extensive environmental monitoring program, with records and documents from 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*.

SRS continues to conduct 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.

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## 1.5 NNSA PRIMARY SITE ACTIVITIES

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 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.

### 1.5.1 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 byproduct 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 2022, Savannah River Tritium Enterprise continued facility infrastructure improvements to ensure robust plant operation, contributing to overall efficiency and the ability to meet future mission needs.

SRS tritium facilities are part of NNSA's Defense Program at SRS. The [Defense Programs](#) page of SRS's website includes more information.

### 1.5.2 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 priority on disposition and removing plutonium previously consolidated onsite.

### 1.5.3 Pit Production

The plutonium pit production mission is an essential part of the NNSA's long term strategy for nuclear stockpile sustainment. In June 2021, NNSA approved the recommended approach to produce at least 50 plutonium pits per year at the Savannah River Plutonium Processing Facility (SRPPF). During 2022, SRS began design work for the conversion of an unfinished NNSA facility, which will become the SRPPF.

## 1.6 SPECIAL ENVIRONMENTAL STUDIES

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

Since 1951, SRS has served as an invaluable outdoor laboratory for SREL researchers and others. The facility'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.

The [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 2022 webpage](#), present and discuss environmental studies and research that occurred during the reporting year. Special environmental studies and research directly impacting the SRS environmental monitoring program and dose calculations are presented and discussed in their respective chapters.

# Chapter 2: Environmental

## Management System

**T**he 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. The "SRS Site Sustainability Plan" (SSP) contains more information on DOE and SRS goals and the progress the Site has made toward achieving these goals.

### 2022 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 the goals for the Site. Below are the highlights of the EMS program:

#### **Pollution Prevention and Waste Minimization**

SRS recycled 84.3% (812 metric tons) of 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 79.4% and Scope 3 GHG emissions by 90.8% since 2008.

#### **Transportation and Fleet Management**

SRS continued to exceed its fleet management goals. Approximately 86% of the current light-duty fleet are plug-in hybrids or vehicles that use E-85 (85% ethanol, 15% unleaded gasoline) fuel.

## 2022 Highlights (continued)

### Awards

- SRS won the 2022 DOE Sustainability Award in the “Innovative Approach to Sustainability” category for the SRS Phytoremediation Project.
- The Accelerated Basin De-Inventory, SRS Lower Three Runs Final Remedial Decision, and SRS Phytoremediation Project Teams received the Secretary of Energy Achievement Award.
- SRS received the Global Electronics Council Electronic Product Environmental Assessment Tool (EPEAT) Purchasers Award in three categories: computers and displays, mobile phones, and servers.
- SRS was also recognized for participating in the Sustainable Climate-Ready Sites (SCRS) pilot project.

## 2.1 SRS ENVIRONMENTAL MANAGEMENT SYSTEM

DOE Order 436.1, *Departmental Sustainability*, requires federal facilities to use EMS as a platform to implement their SSP. Sites must also maintain their EMS as being certified to or conforming to the International Organization for Standardization’s (ISO) 14001. The DOE Site Manager has determined the Savannah River Nuclear Solutions, LLC (SRNS) EMS (which covers Battelle Savannah River Alliance, LLC [BSRA] and Savannah River Mission Completion, LLC [SRMC]) conforms 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 of the ISO 14001:2015 standard continually improves environmental performance.

The SRS EMS is a systematic approach or 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,

### 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.

environmental objectives SRS sets forth to encompass both compliance and environmental sustainability goals address environmental impacts. These sustainability goals promote and integrate initiatives such as energy and natural resource conservation, waste minimization, green remediation, and using sustainable products and services.

### 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

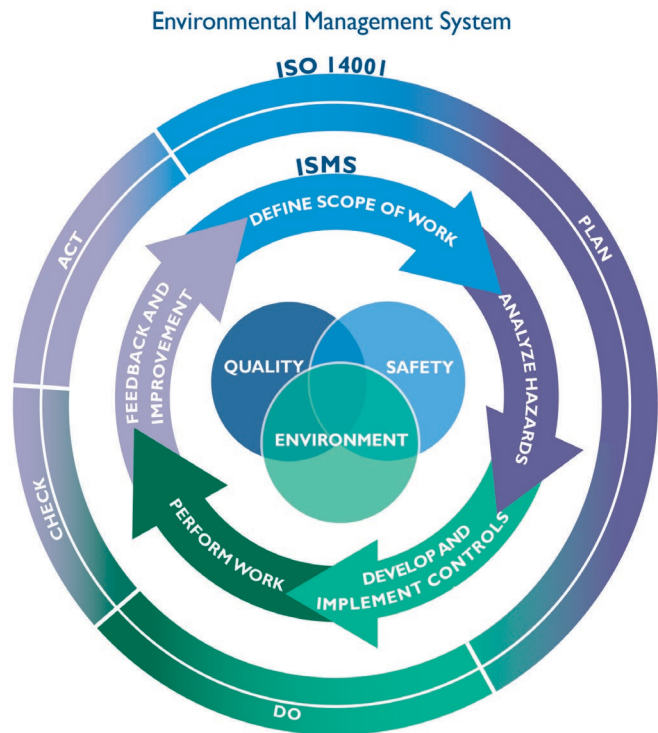
- Complying with environmental laws and regulations
- Continuing process improvements
- Conducting safe operations
- Communicating with the workforce, public, and stakeholders

### 2.1.2 Integration with Integrated Safety Management System

SRS incorporates the Integrated Safety Management System (ISMS) with EMS to provide a comprehensive framework under which it manages the 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



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

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)
- **Check**—evaluates performance (feedback) and management reviews
- **Act**—embodies corrective actions, improvements, and incorporating 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 an integral part of the Site's overall management of environmental compliance and performance.

### **2.2.1 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 Safety Administration-Savannah River Field Office (NNSA-SRFO) take any actions, the Site develops a National Environmental Pollution 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, as well as 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 General Employee Training or Consolidated Annual Training at a minimum, annually, for every employee so they will be 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 Do

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

DOE requires SRS to develop its annual *SRS Environmental Report* 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 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 Check

### 2.2.3.1 Internal Checks

SRS assesses and evaluates Site work to make certain that personnel are performing it 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 (ALARA). 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 to 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 make certain that personnel are performing it as planned, and that Site operations are not adversely impacting worker and public health and the environment. Regulators from various state and 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 (FFA)-driven inspections. The EPA may participate alongside SCDHEC in compliance evaluation inspections for waste management. 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 the 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 436.1 requires SRNS EMS to conform to ISO 14001:2015. Every three years, a qualified independent certification auditor performs a conformity assessment. Since the last audit was in 2021, the next formal SRNS EMS compliance audit will be in 2024. As Centerra-SRS is certified to ISO 14001:2015, an accredited independent certification body conducts yearly certification assessments.

#### 2.2.4 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 deals with actual or potential conditions of nonconformity, such as Notices of Violation 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 (such as the public, academia, SRS Citizen's Advisory Board, regulators, and other DOE sites).

### 2.3 SUSTAINABILITY AND STEWARDSHIP GOALS AND IMPLEMENTATION

DOE Order 436.1, *Departmental Sustainability*, defines DOE Sites' requirements and responsibilities to manage operations and activities necessary for sustainability and ensure that they are carrying out the DOE mission in a manner that addresses energy efficiency goals, GHG reductions, waste minimization, and pollution prevention. SRS has integrated environmental stewardship into many remediation and closure projects, addressing requirements for resource conservation, pollution reduction, and

environmental surveillance. The current DOE sustainability goals align with and are on target with reaching those set forth in the following executive orders:

- 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 set new Federal-level sustainability goals—based on statutory requirements—and require agencies to
  - Reach 100% carbon pollution-free electricity by 2030, including 50% on a 24-hours-a-day, 7 days-a-week basis
  - 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 environmental justice (EJ) and equity-focused operations
  - Accelerate progress through domestic and international partnerships

SRS uses the SSP to document the sustainability goals SRS plans to achieve and to provide a strategic roadmap for accomplishing those essential activities. As Figure 2-2 illustrates, this includes a summary of actions implemented to meet sustainability goals, progress, results, cost savings, and strategies for continued progress and performance improvements. 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) 2022. This chart names sustainability goals as well as environmental compliance goals for 2022, identifies the related environmental objectives and strategies for implementation, and provides the status of SRS’s progress toward achieving them. This chapter contains additional information on how SRS is making progress in supporting DOE objectives.



Figure 2-2 SRS Environmental Management System and Sustainability Goals

Updated annually, the SRS SSP outlines the strategies in place and identifies the Site’s contributions to meeting DOE’s sustainability targets outlined in the Sustainability Report and Implementation Plan. 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 2022 performance against the sustainability goals to complement the more general discussion in the text that follows.

Table 2-1 FY 2022 Sustainability Goals, Metrics, and SRS Performance

Energy Management	
<p><b>Goal:</b> 25% energy intensity reduction by FY 2025 from FY 2015 baseline</p> <p><b>Interim Target (FY 2022):</b> 17.5% reduction from FY 2015 baseline</p>	<p><b>Goal Met:</b> 27.3% energy intensity reduction from various Energy Conservation Measures (ECMs)</p> <p><b>Interim Target Met</b></p>
Renewable Electricity	
<p><b>Goal:</b> 30% renewable energy as a percentage of total agency electric use by FY 2025</p> <p><b>Interim Target (FY 2022):</b> 25%</p>	<p><b>Goal On Track:</b> 28% of the electric energy in FY 2022 is from renewable resources (biomass plants)</p> <p><b>Interim Target Met</b></p>
Water Management	
<p><b>Goal:</b> 36% reduction in potable water intensity by FY 2025 from FY 2007 baseline</p> <p><b>Interim Target (FY 2022):</b> 30% reduction from FY 2007 baseline</p>	<p><b>Goal Not Met</b></p> <p><b>Interim Target Not Met:</b> 28% potable water intensity reduction</p>
<p><b>Goal:</b> 36% reduction in non-potable water intensity by FY 2025 from FY 2010 baseline</p> <p><b>Interim Target (FY 2022):</b> 24% reduction from FY 2010 baseline</p>	<p><b>Goal Met:</b> 89% non-potable water intensity reduction</p> <p><b>Interim Target Met</b></p>
Performance Contracting	
<p><b>Goal:</b> Implement life-cycle, cost-effective efficiency and conservation measures with appropriated funds and performance contracting, or both</p>	<p><b>Goal Met:</b> 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.</p>
Sustainable Buildings	
<p><b>Goal:</b> 17% of owned existing buildings comply with Guiding Principles for Sustainable Buildings by FY 2025.</p> <p><b>Interim Target (FY 2022):</b> 16.3%</p>	<p><b>Goal at Risk</b></p> <p><b>Interim Target Not Met:</b> 0% of SRS's buildings qualify as sustainable. This is due to a recent update to the Guiding Principles guidance, which increased the square footage requirements to be greater than 25,000 square feet.</p>
Waste Management	
<p><b>Goal for Municipal Solid Waste:</b> Divert at least 50% of nonhazardous solid waste (excluding construction and demolition [C&amp;D] debris)</p> <p><b>Interim Target (FY 2022):</b> 50%</p>	<p><b>Goal Met:</b> SRS diverted 84.3% of municipal solid waste from the waste stream through recycling.</p> <p><b>Interim Target Met</b></p>

**Table 2-1 FY 2022 Sustainability Goals, Metrics, and SRS Performance (continued)**

<b>Waste Management (continued)</b>	
<p><b>Goal for C&amp;D Waste:</b> Divert at least 50% of C&amp;D material and debris</p> <p><b>Interim Target (FY 2022):</b> 50%</p>	<p><b>Goal Not Met:</b> SRS diverted 14.5% of waste from the onsite C&amp;D landfill by recycling items such as concrete and asphalt, and office furniture identified in Table 2-2.</p> <p><b>Interim Target Not Met</b></p>
<b>Fleet Management</b>	
<p><b>Goal for Petroleum Reduction:</b> 20% reduction in petroleum use by FY 2015 and thereafter relative to FY 2005 baseline</p> <p><b>Interim Target (FY 2022):</b> 20% reduction from FY 2005 baseline</p>	<p><b>Goal Exceeded:</b> 72.5% reduction in petroleum consumption relative to the FY 2005 baseline</p> <p><b>Interim Target Met</b></p>
<p><b>Goal for Alternative Fuel Use:</b> 10% increase in alternative fuel use by FY 2015 and thereafter relative to FY 2005 baseline</p> <p><b>Interim Target (FY 2022):</b> 10%</p>	<p><b>Goal Met:</b> 38.2% alternative fuel usage increased, relative to the FY 2005 baseline.</p> <p><b>Interim Target Met</b></p>
<b>Acquisition and Procurement</b>	
<p><b>Goal:</b> 95% of new contract actions for products and services meet sustainable acquisition requirements.</p> <p><b>Interim Target (FY 2022):</b> 95%</p>	<p><b>Goal Met:</b> SRS reviewed 100% of purchase-order line descriptions of eligible contract actions to determine whether the products met the BioPreferred® definition.</p> <p><b>Interim Target Met</b></p>
<b>Electronics Stewardship</b>	
<p><b>Goal for Environmentally Sustainable Electronics Acquisition:</b> 100% of eligible electronics procurements must be environmentally sustainable (for example, Electronic Product Environmental Assessment Tool [EPEAT]).</p> <p><b>Interim Target (FY 2022):</b> 95%</p>	<p><b>Goal at Risk</b></p> <p><b>Interim Target Not Met:</b> 92.2% of eligible electronics procured are environmentally sustainable, meeting EPEAT standards. However, 100% of eligible electronics were ENERGY STAR® qualified.</p>
<p><b>Goal for Disposal of Electronics:</b> 100% of electronics disposed through government programs and certified recyclers</p> <p><b>Interim Target (FY 2022):</b> 100%</p>	<p><b>Goal Met:</b> SRS recycled 100% of used electronics using authorized recycling companies.</p> <p><b>Interim Target Met</b></p>
<p><b>Goal for Power Management:</b> 100% of eligible computers (desktops and laptops) and monitors implement and actively use power management features.</p> <p><b>Interim Target (FY 2022):</b> 100%</p>	<p><b>Goal Met:</b> 100% of eligible desktops, laptops, and monitors have power management enabled.</p> <p><b>Interim Target Met</b></p>

**Table 2-1 FY 2022 Sustainability Goals, Metrics, and SRS Performance (continued)**

<b>Electronics Stewardship (continued)</b>	
<b>Goal for Duplex Printing:</b> 100% of eligible printers implement and actively use duplex printing features.	<b>Goal Met:</b> 100% of eligible printers have duplex enabled.
<b>Interim Target (FY 2022):</b> 100%	<b>Interim Target Met</b>
<b>Data Center Efficiency</b>	
<b>Goal:</b> Implement practices that promote energy efficient management of servers and federal data centers	<b>Goal on Track:</b> SRS utilizes power usage effectiveness (PUE) for data centers that have meters to obtain a baseline of energy-use effectiveness.
<b>Resiliency</b>	
<b>Goal:</b> Enhance the resilience of the federal infrastructure and operations and enable more effective accomplishment of its mission	<b>Goal Met:</b> SRS utilized a Vulnerability Assessment and Climate Change Resilience Plan and Active Risk Manager tool to address resilience of SRS infrastructure and operations for the future.
<b>Greenhouse Gas (GHG) Management</b>	
<b>Goal for Direct (Scope 1 and 2) GHG Emissions:</b> 50% reduction in direct GHG emissions by FY 2025 from FY 2008 baseline	<b>Goal Met:</b> 79.4% reduction in direct GHG emissions relative to FY 2008 baseline.
<b>Interim Target (FY 2022):</b> 40% reduction in direct GHG emissions from FY 2008 baseline	<b>Interim Target Met</b>
<b>Goal for Indirect (Scope 3) GHG Emissions:</b> 25% reduction in indirect GHG emissions by FY 2025 from FY 2008 baseline	<b>Goal Exceeded:</b> 90.8% reduction in indirect GHG emissions relative to FY 2008 baseline
<b>Interim Target (FY 2022):</b> 19% reduction in indirect GHG emissions from FY 2008 baseline	<b>Interim Target Met</b>

### 2.3.1 Energy Management

The DOE Sustainability Performance Division’s Sustainability Dashboard tracks energy intensity metrics. SRS has a goal of reducing the amount of energy per square foot (energy intensity) used in an identified class of buildings annually. By the end of FY 2022, SRS reduced energy intensity by 27.3% relative to the FY 2015 baseline, thereby meeting the FY 2025 goal of 25%. SRS has implemented a wide variety of energy-efficient strategies:

- Upgrading utility and heating, ventilation, and air conditioning (HVAC) systems
- Improving chiller plant efficiencies
- Using the Biomass Cogeneration Facility (BCF) and biomass facilities in A Area, K Area, and L Area
- Upgrading through right sizing the pumps
- Upgrading to light-emitting diodes (LED) lighting

- Using more energy-efficient equipment in facilities (lighting timers, lighting sensors, and programmable thermostats).

SRS has deactivated and decommissioned outdated facilities and buildings that are energy inefficient. Additional reductions might have been due to a percentage of the workforce teleworking, which was likely a factor in achieving and surpassing the FY 2025 goal.

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 63 Site buildings that are responsible for 76.3% of the Site's energy consumption. The Site completed the third cycle of audits in FY 2022. SRS has completed 75% of the audits to date. Focusing on these buildings allows EISA audits, which identify energy conservation measures (ECMs), to be most effective. Of the 16 buildings audited, 18 ECMs were identified primarily for LED lighting upgrades.

During FY 2022, SRS updated its contract to reflect that all roof replacements and retrofitting will use cool-roof technology. Additionally, SRS has 38 buildings equipped with individual electrical meters. The metering program in place includes 237 electrical meters and 16 steam meters, providing energy use data to determine each building's energy consumption.

### **2.3.2 Renewable Energy**

The Sustainability Dashboard tracks 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 2022, SRS used 28% renewable energy, thereby meeting the FY 2022 interim target of 25%. The Site has achieved the interim target by generating power onsite from the BCF, A-Area, K-Area, and L-Area biomass plants. SRS no longer uses coal to generate energy from on-site 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.

### **2.3.3 Water Management**

The Sustainability Dashboard tracks 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 2022, SRS decreased potable water use by 28%, thereby not meeting the FY 2022 interim target of a 30% reduction relative to the FY 2007 baseline. The Site has been significantly decreasing its potable water use over many 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. 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](#) products, a U.S. 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 budget limitations for upgrading to new major water-efficient equipment. Additionally, SRS's gross square footage increased from 7.450 million square feet in FY 2007 to 9.004 million square feet in FY 2022. Since potable water intensity is a function of water usage over gross square footage, the increase in gross square footage offsets the decrease in potable water use. This additional square footage and the transition away from maximum use of telework (an anticipated increase in potable water demand by returning personnel) may make the FY 2025 goal of a 36% reduction against the baseline more challenging. The amount of water used is also dependent on facilities such as H Canyon, Tank Farms, Savannah River National Laboratory (SRNL), and Salt Waste Processing Facility, which have processes that require potable water. The water management sustainability goal also does not account for potable water conservation measures, such as the primary domestic water system, installed prior to 2007. 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, such as the number of employees and the amount of potable water used for non-potable purposes.

By the end of FY 2022, SRS decreased non-potable water use by 89% 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 512.9 million gallons, which is a 78.1% 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, full-time basis. 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 tracks 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 2022, SRS had 0% of its building count complying with the Guiding Principles for sustainable buildings, thereby not meeting the FY 2022 interim target of

16.3%. The Guiding Principles address the following six sustainable principles for new construction and modernization, as well as 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 includes 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 future possible 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 energy conservation measures 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 2022, SRS diverted 84.3% of municipal solid waste, thereby surpassing the annual goal of 50% diversion. SRS diverted 812 metric tons of municipal solid waste out of 964 metric tons. The Site recycled 141 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 671 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 and 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 2022, SRS diverted 3.8% 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 2022, the Site diverted 6,293.4 metric tons of the 38,517.5 metric tons of C&D waste generated. The minimal amount of C&D waste diverted was primarily due to the limited concrete and asphalt recovery or reuse from 2020 to 2022. 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 by initiatives such as recycling nonradioactive scrap metal and scrap furniture. 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 2022.

**Table 2-2 SRS Recycling and Sustainability in 2022 by Amount**

<b>Items Recycled in FY 2022</b>	<b>Amount Recycled</b>
<b>Concrete and Asphalt</b>	13,720,000 pounds
<b>Clean Lead Salvage<sup>a</sup></b>	0 pounds
<b>Lead Acid Batteries</b>	54,288 pounds
<b>Scrap Metal</b>	1,892,930 pounds
<b>Silver Fixative</b>	581 pounds
<b>Consumer Electronics (including cell phones)</b>	150,237 pounds
<b>Toner Cartridges</b>	15,789 pounds
<b>Mixed Paper</b>	310,764 pounds
<b>Furniture and Cabinets</b>	156,860 pounds
<b>Used Tires</b>	26,320 pounds
<b>Used Motor Oil<sup>a</sup></b>	0 gallons
<b>Refrigerants</b>	1,400 pounds
<b>Universal Waste—Fluorescent Lamps</b>	14,520 pounds
<b>Universal Waste—Rechargeable Batteries</b>	4,566 pounds
<b>Universal Waste—Mercury Containing Devices</b>	3 pounds
<b>Industrial Sludge (land applied)<sup>b</sup></b>	0 cubic yards

<sup>a</sup> These items are being generated and stored but have not been shipped offsite for recycling.

<sup>b</sup> Industrial sludge is being generated but land application only occurs periodically.

### **2.3.7 Fleet Management**

The Sustainability Dashboard tracks fleet petroleum use, alternative fuel use, and GHG emissions per mile metrics. 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 prior to 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 2022 was less than the FY 2005 baseline. SRS has continued to decrease use of unleaded gasoline and diesel and consume more E-85.

By the end of FY 2022, SRS increased its alternative fuel usage by 38.2% relative to the FY 2005 baseline, thereby meeting the goal of 10% usage. The primary goal for fleet management is to use less petroleum and more alternative fuel. Figure 2-4 shows SRS FY 2022 performance in meeting key fleet-management goals.

SRS continues to implement the Site Vehicle Allocation Methodology Plan completed in 2016. This plan helps organizations eliminate fleet vehicles that are unnecessary, oversized, or not fuel-efficient. SRS updates its plan at least every five years. Each year, SRS emphasizes leasing alternative fuel vehicles in the light-duty fleet. At the end of FY 2022, SRNS (fleet for DOE, SRNS, and SRMC) managed an inventory of 951 vehicles. Of these, 817 (85.9%) were either E-85, hybrid, or electric, which accounted for the reduction in petroleum consumption and the continued use of E-85. In FY 2022, SRS continued working on developing the infrastructure to support transition of 10% of the light-duty fleet to electric vehicles (EVs) by 2023. Of the 107 vehicles that the Site ordered, 62 were light-duty EVs. SRS is increasing the federal EV charging infrastructure to add to the one charger onsite. It completed design of a charging station with eight charging points in B Area and started designing four charging points in A Area and four charging points in N Area in FY 2022.

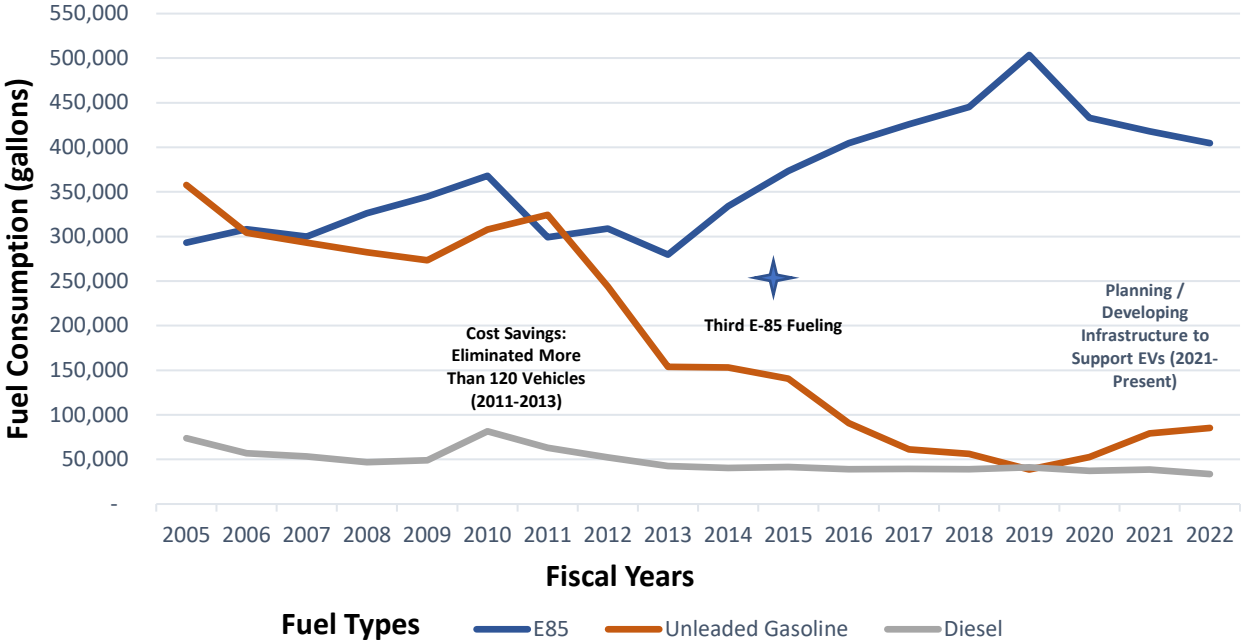


Figure 2-3 GSA Fuel Consumption by Type for FY 2005 to FY 2022

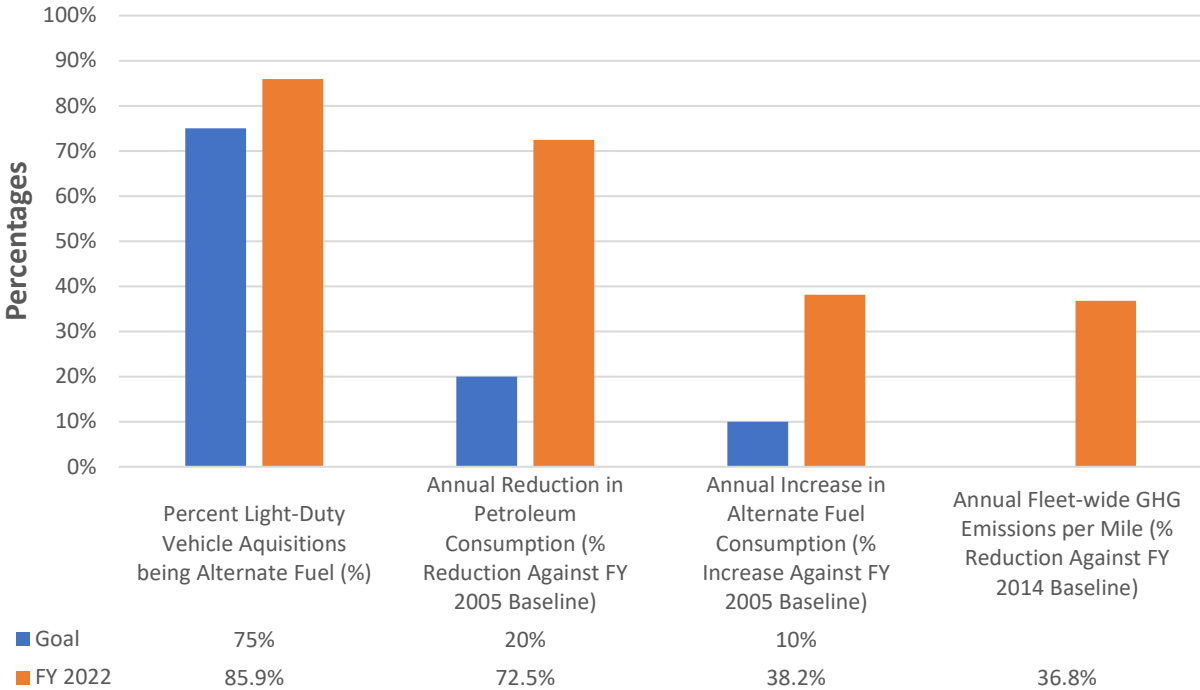


Figure 2-4 SRS Performance in Meeting Fleet Management and Transportation Goals for FY 2022

### 2.3.8 Acquisition and Procurement

The Sustainability Dashboard tracks 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 purchase-order line descriptions of eligible contract actions to determine whether the product meets the definition of BioPreferred.
- Products that maximize substituting alternatives to ozone-depleting substances identified under the EPA's [Significant New Alternatives Policy \(SNAP\)](#)
- 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 products (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).

### 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 as well as 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 2022, 92.2% of eligible electronics procurements were EPEAT products, thereby falling short of the FY 2022 interim target of 95%. Of the 5,204 electronic acquisitions 4,799 met EPEAT standards, and the remaining 406 were ENERGY STAR-compliant.

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 2022, 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 timeframe for replacing a computer from three to five years has significantly reduced the number of computers being retired and the amount of generated scrap electronics.

### **2.3.10 Data Center Efficiency**

The SSP tracks data center efficiency goals and metrics. SRS has the goal 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 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 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, as well as 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. The process identifies climate-related vulnerabilities and solutions. SRS provides support to 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

The Sustainability Dashboard tracks direct (Scope 1 and 2) and indirect (Scope 3) GHG metrics. SRS has the goal to track and report on GHG emissions. By the end of FY 2022, SRS reduced direct emissions by 79.4% relative to the FY 2008 baseline, thereby meeting the goal of 50% reduction by FY 2025. Scope 1 GHG emissions consist of direct emissions from sources that SRS owns or controls, such as onsite combustion of fossil fuels and fleet fuel consumption. Scope 2 GHG emissions consist of indirect 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



**Biomass Cogeneration Facility**

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 such as Site energy use, alternative workplace arrangements and space optimization, as well as vehicle and equipment use.

By the end of FY 2022, SRS reduced indirect emissions by 90.8% 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 by such efforts as 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 2022 Awards and Recognitions

SRS won the 2022 DOE Sustainability Award in the “Innovative Approach to Sustainability” category for the SRS Phytoremediation Project. The project uses an effective, low-energy process that remediates groundwater contaminated with tritium by irrigating a 60-acre pine tree forest. Since the project began in 2001, approximately 190 million gallons of water containing nearly 7,000 curies of tritium have been responsibly irrigated. This remediation method prevents contaminated groundwater from discharging into a nearby stream.

The Secretary of Energy Achievement Award recognized the contributing members of seven SRS teams, based on their accomplishments in 2022.

The Office of the Assistant Secretary for Environmental Management presented two of these awards to projects related to sustainability and environmental restoration: the SRS Phytoremediation Project and the Lower Three Runs (LTR) Final Remedial Decision. The LTR Final Remedial Decision reached for the LTR Integrator



**SRS Pines Phytoremediation Project**

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 over 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 all contaminated sediments would have cost more than \$1 billion. Instead, 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 requires only a small excavation in an easily accessible canal within the LTR system.

Additionally, the Global Electronics Council recognized SRS at a virtual ceremony in July 2022 for its efforts in procuring sustainable technology. SRS received the EPEAT Purchaser Award in three categories: computers and displays, mobile phones, and servers. 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 Sustainable Climate-Ready Sites Pilot Project

SRS participated in the Sustainable Climate-Ready Sites (SCRS) pilot project. Through the Self-Assessment Tool, the Site provided a full-site perspective on environmental performance. It did this through reporting on 15 component program categories spanning natural and cultural resource stewardship, sustainability, climate resilience, and environmental justice (EJ). SRS presented on its experience at the DOE-HQ Environmental Management and Fossil Energy and Carbon Management Sustainable Acquisition Workshop.

## 2.4.3 Environmental Justice

SRS is committed to EJ and will continue to provide opportunities for community engagement and decision-making through information sharing and empowering the 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.

### 2.4.3.1 Educational Opportunities

SRS works with community educators to increase interest in science, technology, engineering, and mathematics (STEM) fields. Sponsorships and partnerships with educators and students create a conduit of college- and career-ready students. The following are some of the programs related to educational opportunities in 2022:

- The annual Teaching Radiation, Energy, and Technology (TREAT) workshop focuses on Central Savannah River Area (CSRA) middle school math and science teachers. As a partner with Savannah State University (a Historically Black College and University [HBCU] institution in Savannah, Georgia), SRS presents the basics of radiation and provides an overview of the environmental monitoring program and a demonstration of equipment. Other workshop presentations include workforce initiatives and opportunities for scholarship and leadership programs across the CSRA.
- The SRS Science and Technology Enrichment Program (STEP) is a cooperative effort by DOE-SR, SRNS, the Ruth Patrick Science Education Center at the University of South Carolina Aiken, the National Audubon Society, and the United States Forest Service-Savannah River (USFS-SR). Through this program, teachers and students participate in onsite and virtual environmental science field trips. The STEP lessons correlate to academic STEM standards for third through twelfth grade students and utilize real-world investigations that focus on responsible environmental stewardship.
- The Traveling Science Program is a cooperative effort between SRNS and the Ruth Patrick Science Education Center. The Education Outreach Programs at SRS invite individuals to request Site volunteers, who explain STEM concepts, conduct STEM demonstrations, mentor, judge, and

offer career information for teachers and students to bring science to life in kindergarten through twelfth grade classrooms.

- The SRNS Innovative Teaching Mini Grants Program recognizes innovative teaching methods by providing funds to enhance elementary, middle, and high school curriculum. SRS presents mini grants to teachers in neighboring counties.
- SRNS donated funds to help develop STEM-related Advanced Placement (AP) coursework at South Aiken and North Augusta High Schools in Aiken County, South Carolina. This encourages those who had previously not been able to qualify for AP coursework to experience a positive change in academic aptitude. This has also allowed for students who do not qualify for college credit through the AP exam to be more likely to enroll in college and perform well in introductory classes, as described in *A Broader View of College Readiness*, an article written in *The Elective*, the College Board's solution-oriented education magazine.
- SRNS and the Ruth Patrick Science Education Center, along with various special award sponsors, presented the South Carolina Regional Future City Competition on January 22. The competition is a project-based learning experience that asks sixth through eighth grade students to design cities of the future. This competition covers all STEM curriculum as well as writing and presentation skills.
- The DOE Savannah River Regional Science Bowl is a competition that tests students' academic skills in areas such as biology, chemistry, earth and space science, mathematics, and physics. DOE-SR, SRNS, and the Ruth Patrick Science Education Center, sponsored the event held on February 20.
- The CSRA Regional Science and Engineering Fair is for students in fourth through twelfth grade who have won local school science fairs in South Carolina and Georgia. This fair covers all STEM curriculum, provides hands-on learning, and is affiliated with the International Science and Engineering Fair. SRNS and Ruth Patrick Science Education Center held the annual event on March 11-12.
- CSRA College Night, held on September 15, is a cooperative effort by DOE-SR, SRNS, Centerra, SRP (Savannah River Plant) Federal Credit Union, iHeartRadio, and other local businesses and industries. The event informs local high school students and their parents of college education opportunities and professional and technical societies. This gives students the opportunity to speak with representatives from accredited colleges and universities across the United States. CSRA College Night offers seminars on financial aid, financial literacy, SRS apprenticeships, and Workforce Opportunities in Regional Careers (WORC) scholarship opportunities. SRS also provides resources and information on workforce opportunities at the Site. Students attending the event visit the career exploration center and counseling center to receive guidance on school and career paths. Seniors can register for the opportunity to win a \$1,000 scholarship.

### 2.4.3.2 Workforce Development

SRS engages the local workforce through funding, outreach programs, and hands-on training to create a capable workforce. 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 affected surrounding communities in Site operations. The following are some of the programs in 2022 related to workforce development:

- SRNS hosted two job fairs to enhance technical and skilled worker job recruitment in the local area and provide on-the-spot job offers.
- SRNS partnered 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. This program provides highly skilled service members to the benefit of both SRNS and military veterans.
- Local universities and colleges partnered with DOE and SRS are educating the workforce on DOE-Environmental Management (DOE-EM) and NNSA missions. The WORC Grants discussed above and in Section 2.4.3.3. also fund this mission and work with various local colleges to ensure their success. WORC I academic partners in South Carolina are Aiken Technical College, the University of South Carolina Aiken, and the University of South Carolina Salkehatchie; and in Georgia are Augusta Technical College and Augusta University. WORC II academic partners are Aiken Technical College, Augusta Technical College, Augusta University, Claflin University, the University of South Carolina Aiken, and the University of South Carolina Salkehatchie.
- SRS internships 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 and creates a conduit for transitioning from internships to jobs at SRS. Additionally, the internship program educates students on historical and current operation missions at the Site and provides opportunities to network and volunteer in the community.
- The SRNS apprenticeship program, partnering with Apprenticeship Carolina and the Lower Savannah Council of Governments, is developing a viable workforce in the counties neighboring SRS. This provides apprentices paid on-the-job experience while they pursue a technical education. Unlike internships, apprenticeships promote and document knowledge transfer and provide participants with proof of skill mastery. The program also consists of youth- and collegiate-levels, which provide an important avenue for students who are facing social, educational, and economic barriers.
- SRS holds many events for collegiate students. SRNS personnel sponsor events that encourage casual conversations about professional development. The South Carolina HBCU Science, Technology, Engineering, and Math Program sponsored one of these events in May, known as a "Fireside Chat." As part of National Nuclear Science Week in October, SRS hosted technical college students for a tour to learn about SRS missions and the SRNS apprenticeship program.

### 2.4.3.3 Community Advocacy and Outreach

SRS engages the community by working with advocacy groups, updating residents on current operations, and providing resources and materials. These programs provide individuals in the communities meaningful involvement in 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 DOE advice, information, and recommendations 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 ensures that SRS excess and operating resources benefit the economic well-being of the surrounding areas. SRSCRO also assists new and expanding businesses and industries through its programs. SRSCRO has several grants from U.S. 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 a boost to 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 workforce that changed the face of nearby counties and helped the United States during the Cold War. Guests will also learn about current and future DOE Environmental Management 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.
- SRS 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](#).

#### 2.4.4 Earth Day

For 2022, 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 EMS program. Earth Day Booths were available during the SRS 2022 Safety Exposition. The booths consisted of SRNS Environmental Compliance, SRNS Environmental



Monitoring, and the South Carolina Department of Health and Environment Control (SCDHEC) State and Aiken County offices. SRNS Environmental Compliance conducted a trivia game on the history of Earth Day and discussed environmental programs in the United States. Environmental Monitoring displayed a portable air monitoring device and discussed surveillance monitoring around SRS. The SCDHEC State Office discussed recycling initiatives such as the “Don’t Waste Food SC” program and consumer electronics waste. The SCDHEC Aiken County Office discussed local environmental concerns. Additionally, SRS produced an Earth Day video, which featured a roundtable of senior leadership from across the Site discussing their personal and professional commitment to leaving the earth a better place. The video entitled, “[SRS Earth Day 2022 Round Table](#),” is available on the SRS YouTube channel.

#### 2.4.5 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 takes in items that the Site no longer needs through the Asset Transition Program and Asset Removal Projects. The organization sells these items and uses the proceeds for the economic good of numerous businesses throughout the large region surrounding SRS. In FY 2022, SRS dispositioned to SRSCRO more than \$14.7 million in usable assets for reuse and recovery. Based on SRSCRO’s 2022 annual report, the program generated approximately \$350,315 during the SRSCRO’s fiscal year (July 1, 2021 to June 30, 2022).

SRS utilizes the Federal Prison Industries, Inc. (UNICOR) services to recycle electronics. UNICOR operates electronics recycling centers to 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% (150,237 pounds) of SRS scrap electronics for recycling in FY 2022.

## 2.4.6 Sustainable Environmental Compliance and 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 requires management as waste.

In 2022, 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 (See photograph below.)

In both examples, using these in-situ remediation systems utilizes the natural flow of the groundwater plume so 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 reinject into the subsurface, and the iron by design is effective for decades with little maintenance.



**A Subcontractor Loads Zero-Valent Iron Filings during Injections to Support Installation of the P-Area Reactive Barrier**

SRS continues to deploy innovative methods to address compliance. From 2019 to 2022, SRNS Environmental Compliance implemented a commercially available Comprehensive Environmental Permits Linking Tool (CEPLT) to track regulatory and DOE commitments. The SRS CEPLT web applications achieve the following criteria:

- Track regulatory commitments (tasks) that can be assigned to a user
- Organize permits, regulations, and other environmental requirement documents (for example, Consent Orders and DOE Orders)
- Provide Geographic Information System capability for mapping data to associated Site location (compliance points)

From 2020 to 2022, SRS has expanded the CEPLT to integrate remaining Site tenants and organizations. This includes DOE (Environmental Quality Management Division), BSRA, SRMC, Savannah River Tritium

Enterprises, USFS-SR, SREL, Ameresco, NNSA Capital Projects, and Centerra-SRS. Additionally, several air-, water-, and waste-related permits link to specific permit requirements and conditions.

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 compliance, improve worker safety, and increase productivity, but they also decrease vehicle and fuel use, thereby supporting fleet management goals.

#### **2.4.7 Challenges and Barriers to Implementation**

In 2022, SRS continued to conserve and manage resources to meet the sustainability goals in the SSP. However, infrastructure continually presents challenges 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 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. Likewise, SRS reduces energy intensity when possible in maintenance and repair situations through such actions as replacing fluorescent lighting with a more energy-efficient LED lighting, replacing HVAC systems with higher Seasonal Energy Efficiency Ratio units, and rightsizing pumps. Retrofitting entire buildings or systems is not typically cost-effective.

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, SNAP, and others). SRS continues to determine and implement ways to increase end-user awareness of sustainable acquisitions.

At the end of FY 2022, 86% of the SRS vehicle fleet for DOE, SRNS, and SRMC consisted of E-85, hybrid, or EVs. In FY 2022, the Site ordered 107 vehicles, of which 62 were light-duty EVs. At the end of FY 2022, supply chain complications prevented the delivery of most (103) of the vehicles. In FY 2022, SRS continued developing the infrastructure to support transitioning 10% of the light-duty fleet to EVs by the end of FY 2023. Given the Site has one charger, SRS is increasing the Federal EV charging infrastructure by completing the design of eight charging stations and starting the design of eight additional charging stations.

In FY 2022, SRS diverted 3.8% of C&D waste generated, which is below the 50% Interim Target. The decrease was primarily the result of no concrete or asphalt recovery or reuse in 2022. Future road projects and construction projects may present opportunities to divert 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 being executed.

SRS identified the following programmatic opportunities for improvement (OFIs) 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 that are more aware and well-informed of ISO 14001:2015 programmatic requirements

SRNS continued to make progress on these OFIs in 2022 by formalizing the integration of EMS principles and promoting awareness across the Site. This was done through the following mechanisms:

- Developing a drafted EMS awareness training course
- Creating a stringent template to determine Significant Environmental Aspects
- Collaborating on the SCRS pilot program between EMS and sustainability personnel
- Integrating sustainability into EMS through continual initiatives

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# Chapter 3: Compliance Summary

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**T**he 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.

## 2022 Highlights

### Permitting

SRS managed 515 operating and construction permits. SRS did not receive any Notices of Violation (NOVs).

### Remediation (Environmental Restoration and Cleanup)

As of December, SRS completed the cleanup of 412 of the 515 operable units containing or having contained solid or hazardous waste. The Site is currently remediating an additional eight operable units.

### Radioactive Waste Management

- The annual reviews for the E-Area Low-Level Waste (LLW) 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.
- SRS sent 16 transuranic (TRU) waste shipments to the Waste Isolation Pilot Plant (WIPP) for deep geologic disposal.

### Resource Conservation and Recovery Act (RCRA)

- The U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC) conducted the unannounced RCRA Compliance Evaluation Inspection (CEI) for FY 2022 at select RCRA facilities on December 1-2. The inspection noted one deficiency, which SRS corrected on the spot.
- SCDHEC performed a Comprehensive Groundwater Monitoring Evaluation on September 27, 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 (MWMF), and F- and H-Area HWMFs. The inspection did not note any deficiencies.

### Air Quality and Protection

- SRS met all Clean Air Act (CAA) requirements.
- SCDHEC issued the Air Operating Permit (Title V) for Air Quality and Protection for the Site on January 19 with an effective date of April 1, 2022.

## 2022 Highlights (continued)

### Water Quality and Protection

- All 33 SRS Industrial stormwater outfalls in the General Permit complied with the Site's Stormwater Pollution Prevention Plan (SWPPP). The outfalls are covered by the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges associated with Industrial Activities (Except Construction) (General Permit) and are included in the SWPPP. As required by the new General Permit, SRS updated and issued the SWPPP in August 2022.

### 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 873 National Environmental Policy Act (NEPA) reviews to identify potential environmental impacts from proposed federal activities. SRS identified 817 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 (EPCRA); the Superfund Amendments and Reauthorization Act (SARA), Title III; the Endangered Species Act (ESA); the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); the National Historic Preservation Act (NHPA); and the Migratory Bird Treaty Act (MBTA).

### Release Reporting

SRS made two regulatory notifications pertaining to releases to the environment. On February 8, a lift station had a failure and discharged approximately 8,000 gallons of sewage onto soil. Sewage flowed to a nearby drainage ditch, which leads to the H-12 NPDES Outfall. An estimated 200 gallons reached the outfall. The Site notified SCDHEC, which performed a walkdown the following day.

On March 19, routine facility checks detected acidic liquid material upstream of NPDES-permitted Outfall H-12. A bladder was installed to minimize flow to the outfall, but it failed on March 22. At that time, SRS reported an estimated release of 1,300 pounds, exceeding a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) reportable quantity (RQ) of 1,000 pounds for nitric acid. The Site notified SCDHEC, the EPA Region 4, and the National Response Center, as required. Upon further investigation and identification of the source, SRS revised the amount released to 83 pounds, which is below the CERCLA RQ of 1,000 pounds, and communicated this to SCDHEC and the National Response Center. The regulatory agencies did not require further action. More information on these releases is in Section 3.3.9.

## 2022 Highlights (continued)

### 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 (FERC) performed a dam safety inspection in May.

### Tank Closure (Radioactive Liquid Waste Processing and Dispositioning)

- The Salt Waste Processing Facility (SWPF) treated more than 2.4 million gallons of salt solution.
- More than 3.3 million gallons of waste was processed into grout and disposed of in the SDF.
- The Defense Waste Processing Facility (DWPF) filled 58 canisters with 218,200 pounds of glass waste mixture, immobilizing 992,000 curies of high-level radioactive waste.
- The F- and H-Area Effluent Treatment Facility (ETF) processed approximately 4.8 million gallons of treated wastewater.

## 3.1 INTRODUCTION

Complying with environmental regulations and DOE Orders is integral to 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 EPA, and SCDHEC—integrates CERCLA and 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 web page](#).

### 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 the SRS RCRA permit covers. At the end of fiscal year (FY) 2022, 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 2022* explains the status of FFA activities at SRS for FY 2022.

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.

SRS prepared the following reports to satisfy CERCLA requirements:

- *Sixth Five-Year Remedy Review Report for Savannah River Site Operable Units with Geosynthetic or Stabilization/Solidification Cover Systems.* SRS received approval from the EPA on August 1 and from SCDHEC on August 23, respectively. SRS issued the report to the public on December 28.
- *Sixth Five-Year Remedy Review Report for Savannah River Site Operable Units with Operating Systems.* DOE submitted the report to SCDHEC and the EPA on December 20.

SRS issued the Record of Decision (ROD) for the Lower Three Runs (LTR) Integrator Operable Unit (IOU) in December 2021. In 2022, the Site completed planning and documentation for implementing the LTR IOU remedial action in 2023. The D-Area Groundwater OU treatability study that began in 2021 is ongoing to support a remedial investigation report (due in 2024) and an evaluation of remedial alternatives (due in 2026).

SRS negotiated a preferred remedial action and regulatory strategy for the remaining SRS coal ash and coal fines operable units, decommissioned the D-Area Coal Handling Houses and associated facilities, and began field characterization at the Early Construction and Operational Disposal Site (ECODS) L-3, L-Area Rubble Pit (131-1L), and L-Area Rubble Pit (131-4L) Operable Unit.

### ***Coal Ash and Coal Fines Operable Units Strategy***

Over the last several years, SRS has implemented remedial decisions for several units containing coal ash and residual coal. SRS has closed these units in accordance with their individual remedial decisions and schedules. These units include, but are not limited to, the P- and R-Area Ash Basins, A-Area Ash Pile (788-2A), D-Area Ash Basins (488-488-1D and 48-2D), and Wetland Area at Dunbarton Bay and associated buffer area.

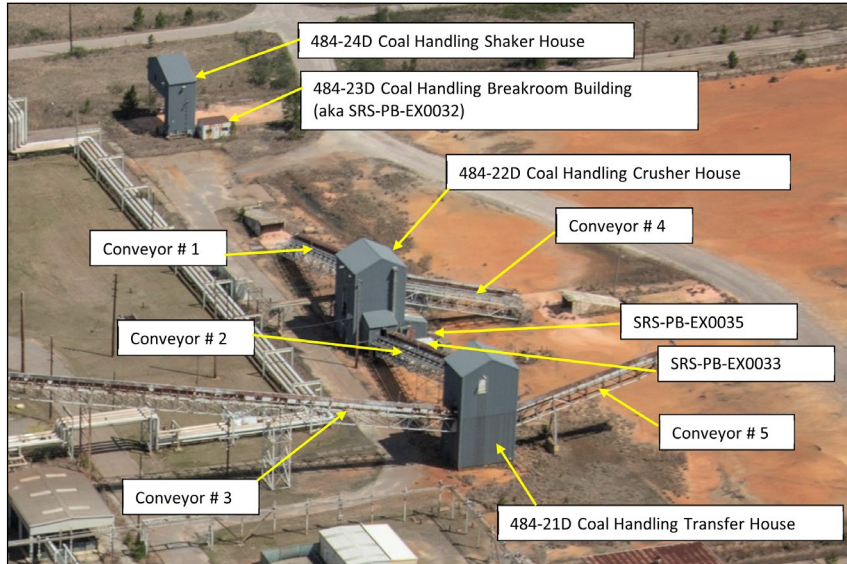
SRS proposed a comprehensive remedial approach to address the additional 10 units depicted in Figure 3-1 more cost-effectively and efficiently. The remaining units are A-Area Coal Pile Runoff Basin (788-3A), A-Area Ash Pile (788-A), D-Area Effluent Discharge Canal (no building number [NBN]) and Ash Area Adjacent to and Easterly of D-Area Ash Basins 488-1D and 488-2D (NBN) (referred to as the D-Area Ash Overflow), D-Area Ash Basin Wetlands (NBN), K-Area Ash Basin (188-K), Wetland Area at Dunbarton Bay (Phase II), L-Area Ash Basin (188-L), H-Area Ash Basin (288-H), H-Area Coal Pile Runoff Basin (289-H), and F-Area Ash Landfill (288-F). SRS combined units for maximum efficiency in preparing regulatory documents, engineering design, project planning, and construction execution and cost. Regulatory decision documents will aid in prioritizing and revising FFA milestones to implement cost-effective remedies. The recommended paths maximize the footprint reduction of the ash and coal fines units at SRS.



**Figure 3-1 Remaining Ash and Coal Fines Operable Units**

DOE, the EPA, and SCDHEC (known as the Core Team) met throughout 2022 to reach an agreement on the end-state vision for the remaining ash and coal fines operable units at SRS. The Core Team agreed on preferred remedial and administrative strategies for the remaining coal and ash units. The team grouped the A-Area Coal Pile Runoff Basin (788-3A), A-Area Ash Pile (788-A), F-Area Ash Landfill (288-F), H-Area Ash Basin (288-H), K-Area Ash Basin (188-K), and L-Area Ash Basin (188-L) to a preferred remedial alternative of Land Use Controls (LUCs) with Beneficial Reuse. The LUCs will be used to prevent exposure until they are excavated for beneficial reuse. The preferred remedial action for the Wetland Area at Dunbarton Bay (NBN) (Phase II) is to expand the existing LUCs. The documentation for this exists in *Explanation of Significant Difference for the Revision 1 Record of Decision (ROD) Remedial Alternative Selection for the*

*Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit*, which was submitted in January 2023. DOE issued the ROD on June 20, 2018. The remedial decision for the D-Area Ash Basin Wetlands (NBN) will be either No Further Action or LUCs because it is within the Savannah River floodplain, and excavating more than 90 acres would damage a sensitive ecological habitat. The H-Area Coal Pile Runoff Basin (289-H) and the D-Area Effluent Discharge Canal (NBN) and Ash Area Adjacent to and Easterly of D-Area Ash Basins 488-1D and 488-2D (NBN) (referred to as the D-Area Ash Overflow) will be evaluated as part of the Savannah River and Floodplain Swamp Integrator Operable Unit.



**Aerial View of Coal Handling Facilities before Decommissioning**

***D-Area Coal Handling Houses and Associated Facilities***

The D-Area Coal Handling system was south of the 484-D Powerhouse and consisted of three major structures (Coal Handling Shaker House [484-24D], Coal Handling Crusher House [484-22D], and Coal Handling Transfer House [484-21D]) as well as track hoppers, coal feeders, conveyors, chutes, a coal crusher, magnetic pulleys, a tripper car, a reclaim hopper, and equipment to move the coal within the coal yard (front-end loaders and bulldozers). The coal handling system supplied coal to the 484-D Powerhouse, which was on the south side of D Area. The 484-D Powerhouse primarily provided steam and electric power for the 400-D Area, power for the 681-5G Pump House, supplemented standby power for all other SRS areas, and provided start-up power for the 100 Areas. A system of coal-handling facilities was necessary to deliver the fuel source to the 484-D Powerhouse to generate the power. Those facilities include the following:

Portable Buildings:

- 484-23D—Coal Handling Breakroom Building (also known as SRS-PB-EX0032)



**D-Area Coal Handling Crusher House (484-22D) after Decommissioning (Looking East)**



**D-Area Coal Handling Transfer House (484-21D) after Decommissioning (Looking Southwest)**

- SRS-PB-EX0033—Coal Handling Breakroom Building for Crusher House
- SRS-PB-EX0033—Coal Handling Breakroom Building for Crusher House
- SRS-PB-EX0035—Storage Shed for Portable Equipment, Lube, and Spare Parts

#### Coal Conveyor Systems:

- Conveyor #1 from 484-24D to 484-22D
- Conveyor #2 from 484-22D to 484-21D
- Conveyor #3 from 484-21D to 484-D Powerhouse
- Conveyor #4 from Reclaim Hopper to 484-22D
- Conveyor #5 from 484-21D to Coal Pile in 484-17D

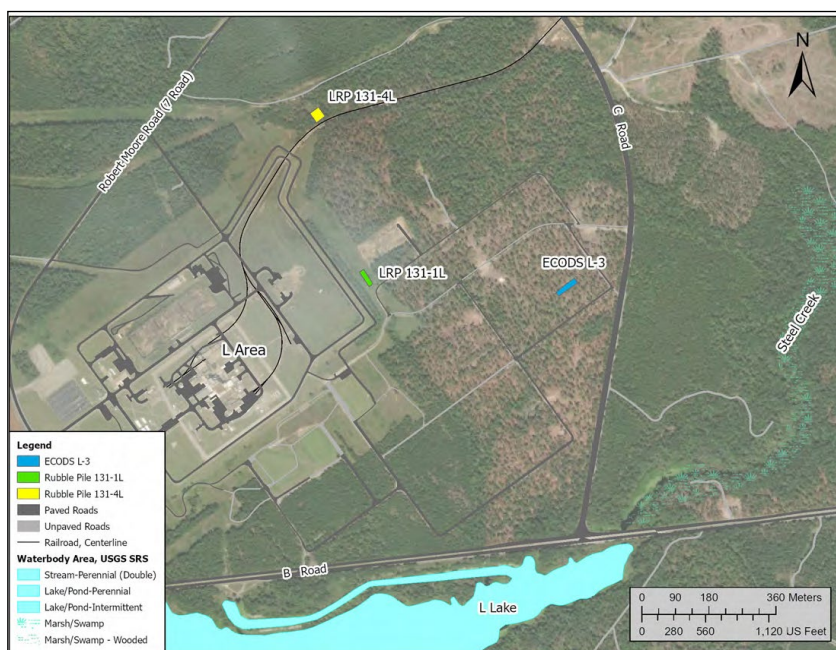


**D-Area Coal Handling Shaker House (484-24D) after Decommissioning (Looking North)**

SRS demolished the coal-handling houses and associated facilities, leaving in place the remaining concrete slabs, underground portions of concrete conveyor tunnels, and the basins for the track hoppers and reclaim hopper. The concrete slabs for 484-22D, 484-21D, SRS-PB-EX0033, and SRS-PB-EX0035 all remain. SRS completed decommissioning in accordance with federal and state regulations. The remaining structures are free of physical, chemical, and radiological hazards; therefore, they do not need further decommissioning, evaluation, surveillance, or maintenance because they pose no threat to human health or the environment while awaiting area completion.

#### ***ECODS L-3, L-Area Rubble Pit (131-1L), and L-Area Rubble Pit (131-4L) Operable Unit***

ECODS L-3 subunit is 1 of 25 similar sites, which Site personnel identified during a review of early 1950s aerial photographs. SRS used these sites during the construction and early operation of the Site to dispose of construction debris and other nonradioactive waste materials such as rubble and concrete. The subunit is estimated to have been in use from



**Location of ECODS L-3, L-Area Rubble Pit (131-1L), and L-Area Rubble Pit (131-4L) Operable Unit**

November 1953 to June 1954, and there are no records of hazardous or radioactive waste disposal at the subunit. Sections of the trenches may have been used as a burn pit, used to dispose of combustible waste. Based on the 2002 site evaluation of the subunit, the characterization data is of sufficient quality and quantity to conduct a baseline risk assessment and contaminant migration analysis to support remedial decision-making.



**ECODS L-3 Unit in 2022**

The L-Area Rubble Pit (LRP) (131-1L) subunit is a former waste disposal area reportedly used for various types of construction debris. Records indicate SRS disposed of materials such as metal, lumber, poles, and concrete in the subunit. No characterization activities have been conducted at this subunit before sampling in 2022.



**L-Area Rubble Pit (131-1L) Unit in 2022**

The LRP (131-4L) subunit is an unlined pit that reportedly operated from 1973 to 1983, before SRS filled and seeded it in 1983. The subunit received inert rubble from the L-Area Powerhouse Stack and Silo demolition. The rubble consisted primarily of concrete and asphalt material with some metal. Operating procedures indicate the pit was to receive inert, nonhazardous materials. Records indicate that no hazardous or radioactive materials were disposed there. A site evaluation of the subunit was conducted from 1992 to 1994; however, the data is not of sufficient quality and quantity to warrant a baseline risk assessment and contaminant migration evaluation to support remedial decision-making.



**L-Area Rubble Pit (131-4L) Unit in 2022**

In 2022, DOE developed and SCDHEC and the EPA approved the RCRA Facility Investigation (RFI) and RCRA Investigation (RI) document, *RFI/RI Work Plan for the Early Construction and Operational Disposal Site L-3, L-Area Rubble Pit (131-1L), and L-Area Rubble Pit (131-4L) Operable Unit (U)*. DOE based this document on the characterization data required to define the nature and extent of contamination, to screen for risks,

and to identify problems and the likely response to them. This document specified the strategy for characterizing LRP 131-1L and LRP 131-4L, including ground-penetrating radar, soil sampling and analysis, and visually inspecting for the presence of asbestos-containing material during sampling at LRP 131-1L and LRP 131-4L. Characterization sampling at LRP 131-1L began in October 2022 and ended in November 2022. Sampling at LRP 131-4L began in November 2022 and ended in January 2023.

### 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 3-2 depicts.

#### 3.2.2.1 Tank Closure

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*.

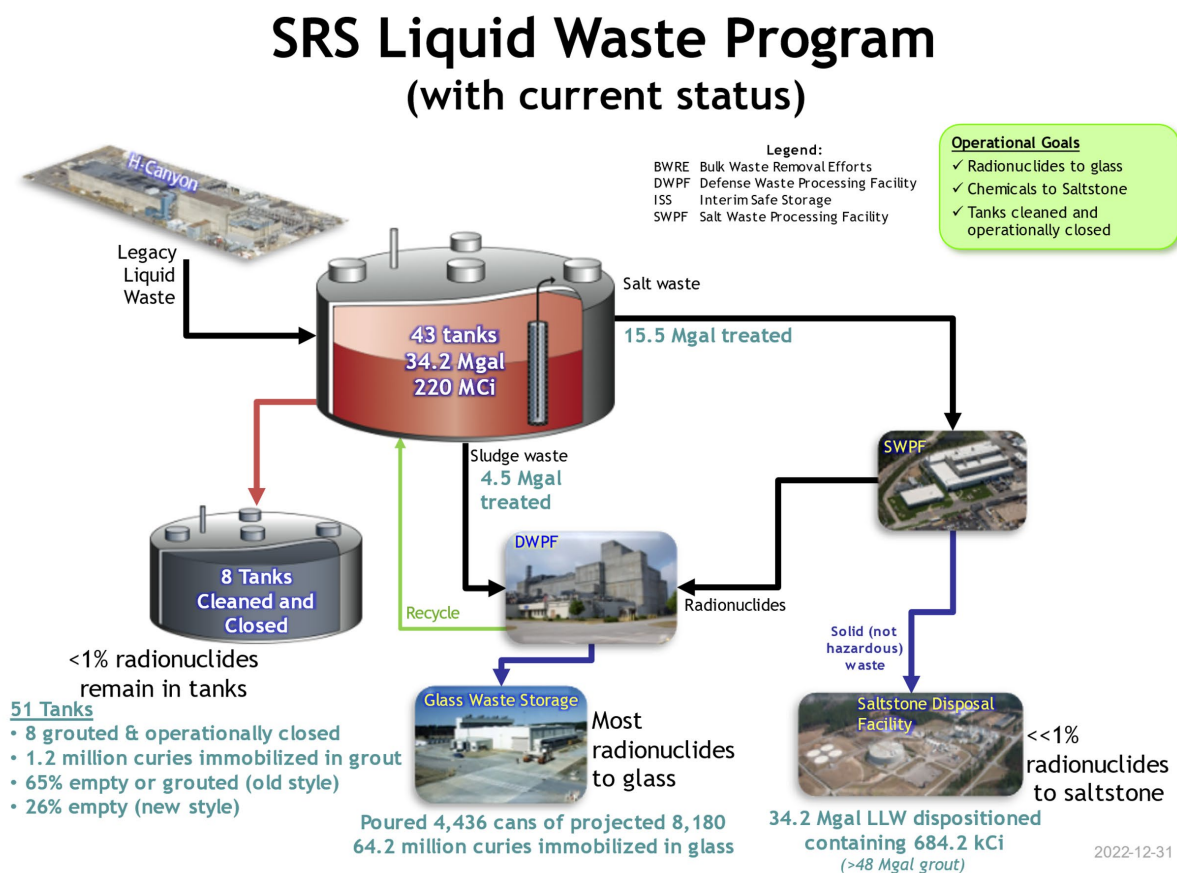


Figure 3-2 Processing and Dispositioning Radioactive Liquid Waste at SRS

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.



**FDB-5 After Entombment**

*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 2022, DOE supported NRC monitoring F-Tank Farm and H-Tank Farm under Section 3116 of the NDAA by providing routine documentation (for example, groundwater monitoring reports and PA maintenance plan), as the NRC requested. The NRC did not conduct onsite observation visits for the liquid waste tank farms in 2022; however, several virtual meetings were held between the NRC, DOE, and DOE Contractor staff. Prior to SRS closing 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 2022. 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.

In 2022, the Site completed the first operational closures of ancillary structures in the liquid waste tank farms. SRS completed internal grouting of F-Area Diversion Box (FDB)-5 in 2021 and internal grouting of FDB-6 in 2022. Both structures were entombed in concrete in 2022, thereby completing the operational closure of these structures and meeting the FFA commitment to operationally close FDB-5 and FDB-6 by the end of 2022.

### 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 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 operation 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 2.4 million gallons of salt solution in 2022.

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, which are submerged in the water table.

### 3.2.2.3 Salt Disposition

After ARP/MCU and TCCR interim processing, the decontaminated salt solution is processed into grout waste at the Saltstone Production Facility and disposed of in the 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.



**Construction in Progress on SDU-8, SDU-9, SDU-10, and SDU-11**

During 2022, DOE supported the NRC in monitoring the SDF under Section 3116 of the NDAA by providing routine documentation (groundwater monitoring reports and PA maintenance plan), as requested. The NRC did not conduct an onsite observation visit for salt waste disposal during 2022; however, several virtual meetings between the NRC, DOE, and DOE Contractor staff took place.

In 2022, SRS continued permanently disposing of waste, processing more than 3.3 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-foot diameter vaults having a capacity of 2.8 million gallons each. In 2022, SRS continued constructing SDU-8 and SDU-9 and initiated construction of SDU-10, all with capacities of 34.5 million gallons each. In addition, excavation and groundwork were initiated for SDU-11 and SDU-12, the final mega-vaults currently planned.

#### 3.2.2.4 Sludge Waste Processing—Vitrification of High-Activity Waste

SCDHEC permits 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 3-2 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 58 canisters, collectively containing 218,200 pounds of glass and immobilizing 992,000 curies of radioactivity during 2022. Since DWPF began operating in March 1996, it has produced more than 4,346 canisters collectively, containing 16.8 million pounds of glass and immobilizing 64.2 million curies of radioactivity.

#### 3.2.2.5 Low-Level Liquid Waste Treatment

The F- and H-Area 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 2022. 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 2022.

### **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 (LLW, high-level waste [HLW], and 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 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 2021 annual reviews for the



**TRU Drum Ready for Characterization in Real-time Radiography Unit**

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 annual *SRS Environmental Report*.

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 job waste such as clothing, tools, rags, residues, debris, and other items contaminated with trace amounts of plutonium. SRS sends TRU waste to 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 16 TRU shipments to WIPP for disposal in 2022.

### **3.3.2 Resource Conservation and Recovery Act (RCRA)**

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 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. It also issues permits to implement RCRA.

Through the SCDHEC-issued RCRA hazardous waste permit, SRS closed the referenced Solvent Storage Tanks (SSTs) S33–S36 and submitted the final certification of closure to SCDHEC in October 2019. 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 (effective on December 15). This



**Final View of the SSTs**

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 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. SRS submitted and requested approval of the SSTs postclosure plan to SCDHEC in December 2022. Until final closure, the area surrounding the SSTs is a designated Underground Radioactive Material Area.

SRS submitted Revision 3 of the 2013 RCRA Permit Renewal Application, M-Area and Metallurgical Laboratory (Met Lab) HWMFs Post-closure (Volume III), to SCDHEC on September 26, 2022. This submittal was in accordance with the schedule for corrective action in the Final Permit Decision that



**Recovery Well RWM 17B**

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 Operable Unit 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 since the stripper was approved for permanent shutdown in 2021. Four wells were abandoned, and two wells were converted to monitoring wells. At the end of 2022, SCDHEC was in the process of reviewing the Revision 3 application.

During 2022, SRS installed Electrical Resistivity Tomography (ERT) as a technology demonstration at the F-Area HWMF (Figures 3-3 and 3-4). Installation and startup were completed on August 17, 2022. This DOE technology demonstration is a collaborative effort between Savannah River Nuclear Solutions (SRNS), Savannah River National Laboratory, and Pacific Northwest National Laboratory with approximately five years of data collection. This technology demonstration evaluates the application and feasibility of ERT and its potential application within the DOE complex. This study is being performed under SCDHEC acknowledgement.



**Figure 3-3 Trench Installation to Bury Electrode Cables**



Figure 3-4 Installation of ERT Electrode Cables

The purpose of the study is to evaluate the application of ERT as a nonintrusive, long-term monitoring technology of the F-Area HWMF RCRA cover system performance. ERT is a geophysical measurement tool that images the electrical conductivity distribution of the subsurface beneath the cover. For this application, ERT will monitor subsurface conductivity to identify areas where soil moisture is changing beneath the cover system's low-permeability clay layer. The images taken of soil moisture content over an estimated five-year study period will be compared and used to diagnose anomalous conditions, such as a breach or failure of the low-permeability layer of the cap system. Lines of horizontally placed electrodes were installed into the top 6 inches of soil (called arrays) across the north end of the F-Area HWMF Seepage Basin cap (Basin F-3). SRS believes that this is the first application of ERT to measure changes in soil moisture beneath a low-permeability cover system.

### **3.3.2.2 Solid Waste Permit Activities**

SRS 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.). All solid waste landfills were active and operated in compliance with their permits during 2022. SCDHEC conducted quarterly landfill inspections of the 632-G and 288-F landfills and monthly SDF inspections in 2022 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 permitted USTs, each requiring an annual compliance certificate from SCDHEC. SCDHEC performed its annual inspection on December 16, 2021, 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 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 August 25 to discuss the 2022 update. Consistent with prior years, the parties agreed to a reduced scope update for 2022, consisting of only revised appendices to Volumes I and II. SRS submitted the STP 2022 Update to SCDHEC on November 10. SCDHEC approved the STP 2021 Update on October 13, 2022. 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 2022, SRS and SCDHEC held STP Cleanup Credit validation meetings in January, May, August, and November. SRS earned 789 validated Cleanup Credits during FY 2022.

### 3.3.4 Toxic Substances Control Act (TSCA)

SRS complies with TSCA regulations when storing and disposing of lead, asbestos, and organic chemicals, including polychlorinated biphenyl compounds (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 two shipments of PCB waste to offsite hazardous waste facilities in 2022. On April 5, SRS submitted an exception report to the EPA Region 4, documenting the delayed receipt of a signed manifest from the contracted waste management vendor for one of the offsite shipments in accordance with 40 CFR 761.217(a)(2). Also on April 5, SRS submitted a one-year exception report for a container included in that shipment in accordance with 40 CFR 761.219(b).



**Infectious Waste is Treated and Disposed of in Accordance with SCDHEC Regulations.**

SRS also generates radioactive waste contaminated with PCBs. SRS disposes of low-level radioactive PCB bulk product waste onsite. PCB waste contaminated with TRU requires disposal at WIPP. SRS made eight shipments of PCB-containing TRU waste to WIPP in 2022.

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, which it must submit to the EPA by July 15 of each year for the preceding calendar year. SRS submitted the 2022 annual report to the EPA for this reporting period on July 11, 2023.

On March 24, SRS and the EPA Region 4 PCB staff met virtually to establish a dialogue regarding PCB topics specifically relevant to the Site. This is intended to become an annual dialogue, as done with other federal facilities in the region, to improve communication and knowledge transfer.

### 3.3.5 South Carolina Infectious Waste Management Regulation

SRS 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 2022, the vendor picked up 13 shipments. Once offsite, the vendor treats and disposes of the waste in accordance with SCDHEC regulations. In 2022, 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 for most types of air emissions to SCDHEC. 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 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)

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 five 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, as well as 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 Air Quality Operating Permit (TV-0080-0041), which became effective April 1, 2021. The Site also has two active construction permit applications, which are listed above.

#### 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 2022.

#### 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 2022 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 mandated phasing down HFCs, which are potent greenhouse gases, by 85% over a period ending 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.

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 and do not guarantee the availability of the regulated HFC covered. They allow only for the quantity to be manufactured and imported under the 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 calendar year (CY) 2022, it anticipates submitting an inventory every year. The inventory for CY 2022 emissions is due March 31, 2023.

#### 3.3.6.5 National Emission Standard for Hazardous Air Pollutants (NESHAP)

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 2022 annual report will be submitted in June 2023. SRS transmitted the *SRS Radionuclide Air Emissions Annual Report for 2021* on June 23, 2022, to the EPA, SCDHEC, and DOE Headquarters.

There were no unplanned radiological releases to the atmosphere during 2022.

SRS estimated the maximally exposed individual effective dose equivalent during 2022 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 180 asbestos notifications and conducted three permitted renovations and demolitions involving asbestos in 2022. 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 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 SRNS and 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 2022

Asbestos Type	Nonradiological, Friable	Nonradiological, Nonfriable	Radiologically Contaminated Asbestos
Linear Feet Disposed	231	576	12
Square Feet Disposed	28	9,547	10
Cubic Feet Disposed	6	36	0
Disposal Site	Three Rivers Solid Waste Authority Landfill	SRS Construction and Demolition Landfill	SRS E-Area LLW 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 2022, 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/CERCLA exemption from 40 CFR 63 Subpart GGGGG – Site Remediation NESHAP. SRS is actively determining impacts to its operations in response to this action.

### 3.3.7

### 3.3.7 Water Quality and Protection

#### 3.3.7.1 Clean Water Act (CWA)

Except for Ameresco, which has its own CWA NPDES permit, SRS operated pursuant to the following CWA permits in 2022:

- Land Application Permit (Permit No. ND0072125)
- NPDES Permits for Discharge to Surface Waters (Permit Nos.: SC0000175 and SC0047431 [closed May 31, 2022])—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)

#### 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 two NPDES permits for industrial activities that discharge to surface water: one covering D Area (SC0047431 [closed May 31, 2022]) and the other for the remainder of the Site (SC0000175). Throughout the year, SRS monitors 11 of 28 NPDES-permitted industrial wastewater outfalls across the Site on a frequency the permits specify. The remaining 17 industrial wastewater outfalls have no current flow and will be removed when the Industrial Wastewater NPDES Permit (SC0000175) is renewed. Monitoring requirements vary from as much 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 2022, following issuance of the new Industrial Stormwater General Permit.
- SCDHEC did not require construction stormwater monitoring on any of the active construction projects underway at SRS during 2022.
- SRS undertook permitting actions 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 2022, SCDHEC approved the interim closure of the A-2 Air Stripper System.
- In April 2022, SRS submitted a Discharge Monitoring Report for Industrial Stormwater Outfall H-07B indicating it did not monitor discharge during the previous year.

Chapter 4 of this report summarizes the sampling results of both industrial and stormwater outfalls.

#### 3.3.7.1.2 Section 404(e) Dredge and Fill Permits

Wetlands make up 25% of the total SRS area, or 48,973 acres. SRS wetlands account for more than 80% of the wetlands across the entire DOE complex nationwide. 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. The program is for projects that have minimal impact on the aquatic environment.

SRS wetlands staff reviewed 60 site-use applications for potential wetland impacts in 2022. During this time, SRS permitted the following actions under the NWP program:

- FM-1H Environmental Monitoring Station Maintenance and Upgrades under NWP 5—Scientific Measurement Devices

- L3R-2 Environmental Monitoring Station Maintenance and Upgrades under NWP 5—Scientific Measurement Devices
- Tadpole Depuration Study under NWP 5—Scientific Measurement Devices
- D-Area Wildlife Study under NWP 5—Scientific Measurement Devices
- Biofilm Study under NWP 5—Scientific Measurement Devices
- Monitoring Uptake of Legacy Radiocesium and Trace Element Contaminants on SRS Biota under NWP 5—Scientific Measurement Devices
- Contaminant Distribution and Transport in Aquatic Systems Study under NWP 5—Scientific Measurement Devices
- Biotic Sampling in SRS Streams under NWP 5—Scientific Measurement Devices
- Deployment and Long-term Monitoring of Sensors at F-Area Wetlands under NWP 5—Scientific Measurement Devices

### 3.3.7.2 Safe Drinking Water Act (SDWA)

SCDHEC regulates drinking water facilities under the 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 2022 bacteriological samples for the A-Area drinking water system that SRS collected met state and federal drinking water quality standards.

The Advanced Tactical Training Academy (ATTA) drinking water system was placed on quarterly bacteriological monitoring following a positive total coliform sample SCDHEC collected in November 2021. SCDHEC collected samples in all four quarters of 2022; none indicated the presence of total coliform bacteria. The ATTA system will be back on annual monitoring beginning in 2023. In 2022, SRS sampled for lead and copper at 20 locations throughout the A-Area drinking water system. The sampling results met all state and federal drinking water standards. SRS samples the A-Area drinking water system for lead and copper on a three-year cycle. The next sampling will be in 2025.

There were no sanitary surveys of the SRS drinking water systems in 2022. However, SCDHEC performed a site visit of the ATTA drinking water system in 2022. This inspection identified no issues or concerns. SCDHEC is expected to conduct sanitary surveys of the A-Area and ATTA drinking water systems in 2023.

### 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, SRS 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 2022, 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 surface water more than 3 million gallons during any one month. SRS has a surface water withdrawal permit and reports annual water use to SCDHEC. In 2022, SRS surface water use was within permitted limits.

### 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 873 NEPA reviews of proposed activities in 2022 (Table 3-2). Categorical Exclusion (CX) determinations accounted for more than 90% of completed reviews. The [SRS NEPA](#) web page contains additional information on SRS NEPA activities.

The following major NEPA reviews were either completed or in progress in 2022:

- *Supplement Analysis for the Spent Nuclear Fuel Accelerated Basin De-inventory Mission for H-Canyon at the Savannah River Site (EIS-0279-SA-07)*. DOE issued this Supplement Analysis (SA) in March 2022. It evaluates DOE’s proposal to implement the Accelerated Basin De-inventory mission, which allows SRS to process all remaining spent nuclear fuel in L Basin through H Canyon

**Table 3-2 Summary of 2022 NEPA Reviews**

Type of National Environmental Policy Act (NEPA) Review	Number
Categorical Exclusion (CX) Determinations <sup>a</sup>	817
“All No” Environmental Evaluation Checklist (EEC) Determinations <sup>a</sup>	22
Previous NEPA Review <sup>a</sup>	32
Environmental Impact Statement (EIS)	1
Supplement Analysis (SA)	1
Interim Action	0
Revised Finding of No Significant Impact	0
Environmental Assessment	0
<b>Total</b>	<b>873</b>

<sup>a</sup> Proposed action that requires no further NEPA action

without the recovery of highly enriched uranium and immobilize the resulting dissolved material to be disposed of at a future repository.

- Amended Record of Decision (ROD) to the *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement* (SRS SNF EIS) (DOE/EIS-0279). On April 14, 2022, DOE amended its August 7, 2000, ROD to the *SRS SNF EIS*. The changes to the August 7, 2000, ROD memorialize DOE's decision to manage approximately 29.2 metric tons of heavy metal of SNF and target materials (hereafter referred to collectively as SNF), using conventional processing without the recovery of uranium at the H-Canyon facility at SRS.
- *Final Versatile Test Reactor Environmental Impact Statement* (VTR EIS) (DOE/EIS-0542). On May 20, 2022, DOE announced the availability of the *Final Versatile Test Reactor Environmental Impact Statement*, which evaluates the potential environmental impacts of proposed alternatives for constructing and operating a new test reactor, as well as the associated facilities needed to perform postirradiation evaluation of test articles and manage SNF and the activities necessary for VTR driver fuel production.
- *Record of Decision for the Final Versatile Test Reactor Environmental Impact Statement* (VTR EIS) (DOE/EIS-0542). On August 3, 2022, DOE announced the decision to implement its Preferred Alternative, to construct and operate a VTR at the Idaho National Laboratory (INL) Site, and to establish, through modifications and construction, colocated facilities for postirradiation examination of test products and for managing spent VTR driver fuel at INL. DOE has not decided whether to establish VTR driver fuel production capabilities at the INL Site, SRS, or a combination of the two sites. Once a Preferred Alternative or option for VTR driver fuel production is identified, DOE will announce its preference in a Federal Register (FR) notice.

The following drafts are in progress and not included in Table 3-2:

- Draft Environmental Assessment (EA) for the South Carolina Army National Guard *Proposal to Construct and Operate Training Facilities and Infrastructure on 750 Acres at the Department of Energy Savannah River Site* (DOE/EA-1999)
- *Draft Environmental Impact Statement/Overseas Environmental Impact Statement for Disposal of Decommissioned, Defueled Ex-Enterprise (CVN 65) and Its Associated Naval Reactor Plants* (DOE/EIS-0524). On August 19, 2022, the U.S. Department of the Navy, with DOE as a cooperating agency, prepared the Draft Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) to evaluate the potential environmental impacts of alternatives for disposal of the decommissioned, defueled ex-Enterprise (CVN 65) aircraft carrier, including its reactor plants.
- *Draft Environmental Impact Statement for the Surplus Plutonium Disposition Program* (DOE/EIS-0549) (Draft SPDP EIS). In December 2022, the National Nuclear Security Administration (NNSA) prepared the Draft SPDP EIS to evaluate the potential environmental impacts of dispositioning 34 metric tons of plutonium using capabilities at multiple sites across the nation. NNSA's preferred alternative would implement a dilute and dispose strategy, which includes processing surplus plutonium to plutonium oxide, diluting it with an adulterant to inhibit plutonium recovery, and disposing the resulting contact-handled TRU waste in the existing WIPP facility. The Draft SPDP EIS analyzes the preferred alternative including various subalternatives that would require capabilities at SRS, Los Alamos National Laboratory in New Mexico, the Pantex Plant

in Texas, the WIPP facility in New Mexico, and the Y-12 National Security Complex in Tennessee. The Draft SPDP EIS also analyzes a No Action Alternative.

- *Draft Environmental Assessment for the Commercial Disposal of Savannah River Site Contaminated Process Equipment* (DOE/EA-2154). On December 21, 2021, DOE published the *Draft Environmental Assessment for the Commercial Disposal of Savannah River Site Contaminated Process Equipment*. The Draft EA evaluates the potential impacts from a proposed action to dispose of certain SRS-contaminated process equipment at a commercial low-level radioactive waste (LLW) disposal facility outside of South Carolina, licensed by either the NRC or an Agreement State pursuant to NRC's regulations for land disposal of radioactive waste.

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

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 report on February 28, 2023. SRS submitted the 2021 hazardous chemical storage information to state and local authorities on February 23, 2022. The 2021 report included 50 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 those above each threshold value to the EPA. SRS will submit the annual report for this reporting period in June 2023. SRS submitted the 2021 annual report on June 29, 2022, for each of the following regulated chemicals: ammonia, chromium compounds, lead compounds, mercury compounds, naphthalene, nitrate compounds, nitric acid, and sodium nitrite. Details are on the [EPA TRI Program](#) website.

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

The objective of 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 pesticide application. 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 per 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 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, 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.



**Gopher Tortoise, Subject of SREL Study**

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 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 2022, the USFS-SR, SREL, and the South Carolina Department of Natural Resources partnered to restore wetland and upland habitats to maintain viable gopher frog populations onsite.



**SRS is One of Two State Strongholds for the Carolina Gopher Frog**

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 2022, golden eagles were recorded at SRS. The mid-winter bald eagle survey shows an active nest site and bald eagles present on both Par Pond and L Lake.

The USFS-SR actively manages more than 65,000 acres in the red-cockaded woodpecker (RCW) habitat management areas. It further improved RCW habitat in 2022 by prescribe burning 13,987 acres and thinning forests, and by removing brush and small hardwoods from more than 1,500 acres through mechanical or chemical treatments. Restoring the natural fire regime improves native plant diversity in the understory, enhancing 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 2022, active RCW clusters increased from 5 to 163 due to successful habitat restoration. As of 2022, the USFS-SR managed 180 cluster sites for the RCW, with an average expected population growth rate of 5% each year. The growth rate over the past five years at SRS has been an outstanding average of 12%. In addition to managing endangered wildlife species, the USFS-SR actively manages six endangered plant populations: four smooth coneflower and two pondberry.

The USFS-SR continues to perform biological evaluations to determine whether forest implementation plans are likely to affect federally listed endangered or threatened species due to beneficial, insignificant, or discountable effects.

### 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 Christmas Bird Count is conducted annually in December. The 2022 SRS count found 89 species, which is down from the number of species normally observed due to unfavorable weather on the day of the survey.



**Active Bird Nest**

In 2022, SRS conducted walkdowns of 122 bird nests at 87 locations for MBTA compliance. The walkdowns identified 77 active nests with incubating eggs or chicks and 45 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*), 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 2022, the USFS-SR found an Osprey (*Pandion haliaetus*) nest on a platform staff built in 2014. This marked the seventh 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*), 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.



**Wild Pigs at SRS**

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 57 acres each year to control across target areas that either contain former homesites and community areas or that are in proximity 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 2022, the USFS-SR applied chemical and mechanical treatment to 70 acres of NNIPS infestations to support RCW habitat improvement utilizing contracts and internal resources. Additionally, USFS-SR employees treated six new infestations as part of early detection and rapid response efforts. All 2021 treatments were monitored in 2022 to assess treatment efficacy and retreatment needs.

Wild pigs 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 pigs present safety hazards due to vehicle collisions and disease transmission, and 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 pigs onsite. In 2022, the USFS-SR removed 1,200 pigs 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 pig 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 2022, SRARP investigated 370 acres onsite for cultural resource management, including conducting 27 field surveys and testing. It recorded 7 newly discovered sites and revisited 15 previously recorded sites.

#### 3.3.9 Release Reporting

Releases to the air, water, and land must comply with legally enforceable licenses, permits, regulations, or orders. 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 EPCRA, CERCLA, CWA, and CAA require SRS to send a notice to either the National Response Center or applicable state agencies, or both.

In 2022, SRS made two regulatory notifications pertaining to releases to the environment. On February 8, a lift station had a failure and discharged approximately 8,000 gallons of sewage onto soil. Sewage flowed to a nearby drainage ditch, which leads to the H-12 NPDES Outfall, with an estimated 200 gallons reaching the outfall. SRS notified SCDHEC, which performed a walkdown the following day. SCDHEC requested that the Site measure pH at the H-12 Outfall; pH results were within permit limits. Site personnel operated the lift station pump manually to stop the overflow. Additionally, SRS placed sandbags at the low point upstream of H-12 to minimize impact to the outfall. Most of the wastewater was recovered and disposed at the onsite wastewater treatment plant. Disinfectant was also applied to the affected areas.

On March 19, routine facility checks detected acidic liquid material upstream of NPDES-permitted Outfall H-12. SRS personnel installed a bladder to minimize flow to the outfall, but it failed on March 22. At that time, SRS reported an estimated release of 1,300 pounds, exceeding a CERCLA RQ of 1,000 pounds for nitric acid. SRS notified SCDHEC, the EPA Region 4, and the National Response Center, as required. Upon further investigation and identification of the source, SRS revised the amount released to 83 pounds, which is below the CERCLA RQ of 1,000 pounds. SRS communicated the revised amount to SCDHEC and the National Response Center. The regulatory agencies required no further action.

### 3.3.10 Permits

SRS had 515 construction and operating permits in 2022 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	4 <sup>a</sup>
U.S. Army Corps of Engineers (USACE—Nationwide Permits)	9
Asbestos Demolition Licenses/Abatement Licenses/Temporary Storage of Asbestos Waste Notices	187
Asbestos Abatement Group License	1
Asbestos Temporary Storage of Waste License	1
Domestic Water	99
Industrial Wastewater Treatment	55
National Pollutant Discharge Elimination System (NPDES) Permits	9 <sup>b</sup>
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	92
South Carolina Department of Health and Environmental Control (SCDHEC) 401	0
SCDHEC Infectious Waste Registration	1
SCDHEC Bureau of Drug Control Controlled Substances Registration	5
Nondispensing Drug Outlet License	4
SCDHEC Navigable Waters	0
Underground Injection Control	10
Scientific Collecting Permits <sup>c</sup>	7
Groundwater Withdrawal	9
Surface Water Withdrawal	1
<b>Total</b>	<b>515</b>

<sup>a</sup> This count includes the Ameresco CAA permit (TV-00800-144).

<sup>b</sup> This count includes the Ameresco NPDES permit (SC0049107).

<sup>c</sup> 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. SRNS and SREL 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 436.1, *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 2022.

### 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 2022 audits and inspections. During 2022, 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 2022 External Agency Audits and Inspections of the SRS Environmental Program and Results

Audit/Inspection	Action	Results
<b>632-G Construction and Demolition (C&amp;D) Landfill and 288-F Ash Landfill Inspections</b>	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.
<b>Federal Energy Regulatory Commission (FERC) Inspection</b>	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.
<b>Comprehensive Groundwater Monitoring Evaluation</b>	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 September 27. SCDHEC also completed a records review of groundwater-related files.	The inspection noted no problems or concerns.
<b>SCDHEC Sanitary Survey of SRS Drinking Water Systems</b>	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 (ATTA [Advanced Tactical Training Academy] 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 did not conduct any Sanitary Surveys of SRS Drinking Water systems in 2022. Sanitary Surveys of the A-Area and ATTA Drinking Water systems are expected to be conducted in 2023.	While no Sanitary Surveys of SRS Drinking Water systems were conducted in 2022, SCDHEC did perform a “Site Visit” on the ATTA Drinking Water system. No issues or concerns were noted during the visit.
<b>Interim Sanitary Landfill and the F-Area Railroad Crosstie Pile Landfill Post-Closure Inspection</b>	SCDHEC conducted an annual review of the closed landfills in September.	SCDHEC identified no compliance issues.

**Table 3-4 Summary of 2022 External Agency Audits/Inspections  
of the SRS Environmental Program and Results (continued)**

<b>Audit/Inspection</b>	<b>Action</b>	<b>Results</b>
<b>Air Compliance Inspection</b>	SCDHEC conducted a site Air Compliance Inspection on March 23, 2022. This inspection included a review of facility operational information, control device data, and regulatory compliance reports	SCDHEC identified no issues.
<b>Resource Conservation and Recovery Act (RCRA) Compliance Evaluation Inspection (CEI)</b>	The Environmental Protection Agency (EPA) and SCDHEC conducted the unannounced RCRA CEI for fiscal year (FY) 2022 on December 1-2.	The inspectors identified one labeling deficiency during the FY 2022 inspection, which was corrected on the spot.
<b>Underground Storage Tank (UST) CEI</b>	SCDHEC inspected 17 USTs on December 16, 2021.	SCDHEC identified no issues.
<b>Saltstone Disposal Facility (SDF), identified in the permit as Z-Area Saltstone Solid Waste Landfill, Inspections</b>	SCDHEC performed monthly inspections of the SDF. This included reviewing facility procedures and performing walkdowns of the SDF.	SCDHEC identified no issues.
<b>National Pollutant Discharge Elimination System (NPDES) CEI</b>	SCDHEC did not conduct a CEI in 2022 covering permit SC0000175. SCDHEC did complete an inspection of four wastewater treatment plants	SCDHEC identified no compliance issues.

### 3.7 KEY FEDERAL LAWS COMPLIANCE SUMMARY

The CFR 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 2022 compliance status with applicable key federal environmental laws.

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

Regulatory Program Description	2022 Status
<p><b>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.</b></p>	<p>The FY 2021 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.</p>
<p><b>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.</b></p>	<p>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.</p>
<p><b>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).</b></p>	<p>The SRS NPDES program complies with all NPDES Permits.</p>
<p><b>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.</b></p>	<p>SRS continues to comply with CERCLA and the requirements of the Federal Facility Agreement (FFA).</p>
<p><b>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.</b></p>	<p>SRS continues to comply with all reporting and emergency planning requirements.</p>
<p><b>The Endangered Species Act (ESA) prevents the extinction of federally listed endangered or threatened species and conserves critical habitats.</b></p>	<p>SRS continues to protect these species and their habitats as outlined in the Natural Resource Management Plan for SRS.</p>

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

Regulatory Program Description	2022 Status
<b>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 and sets annual work priorities and establishes milestones to clean up and close the high-level radioactive waste tanks at SRS.</b>	SRS continues to meet all the milestones contained within the FFA (55 milestones met on or ahead of schedule in FY 2022).
<b>The Federal Facility Compliance Act (FFCA) requires federal agencies to comply with federal, state, and local solid and hazardous waste laws.</b>	SRS continues to comply with the FFCA.
<b>The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates restricted-use pesticides through a state-administered certification program.</b>	SRS continues to comply with FIFRA requirements.
<b>The Migratory Bird Treaty Act (MBTA) protects migratory birds, including their eggs and nests.</b>	SRS continues to comply with the MBTA.
<b>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 NRC and SCDHEC.</b>	SRS provided routine documents as requested by the NRC to support monitoring of 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, or the Saltstone Disposal Facility. However, several virtual meetings were held between the NRC, DOE, and DOE Contractor staff.
<b>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.</b>	SRS continues to comply with NEPA.
<b>The National Historic Preservation Act (NHPA) protects historical and archaeological sites.</b>	The Savannah River Archaeological Research Program (SRARP) provides cultural resource management guidance to DOE to ensure continued compliance with the NHPA.
<b>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.</b>	SRS continues to manage hazardous waste, nonhazardous solid waste, and USTs 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	2022 Status
<b>The Safe Drinking Water Act (SDWA) protects drinking water and public drinking water resources.</b>	All drinking water samples of the A-Area Drinking Water System taken in 2022 met drinking water quality standards.  SCDHEC collected a sample from the Advanced Tactical Training Academy (ATTA) Drinking Water System in November 2021, which was positive for total coliform. The system was placed back into normal operations after disinfection and two confirmed negative samples. SCDHEC's bacteriological sampling of this system increased from annually to quarterly for 2022. No further positive results were seen.
<b>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.</b>	SRS manages all regulated materials in compliance with TSCA requirements.

### 3.8 ENVIRONMENTAL COMPLIANCE SUMMARY

SRS was not involved in any environmental lawsuits during 2022. No Notices of Violation (NOVs) were issued in 2022. Table 3-6 summarizes the NOVs/Notices of Alleged Violation (NOAVs) SRS received from 2017–2022.

Table 3-6 NOV/NOAV Summaries, 2017–2022

Program Area	Notice of Violation (NOV)/Notice of Alleged Violation (NOAV)				
	2018	2019	2020	2021	2022
Clean Air Act (CAA)	1 <sup>a</sup>	0	0	0	0
Clean Water Act (CWA)	0	1	1	0	0
Resource Conservation and Recovery Act (RCRA)	1 <sup>b</sup>	0	0	0	0
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	0	0	0	0	0
Others	0	0	0	0	0
<b>Total</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>

<sup>a</sup>This NOV was issued to Ameresco, a direct contractor to DOE.

<sup>b</sup>NOAV

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# Chapter 4: Nonradiological Environmental Monitoring Program

**T**he Savannah River Site (SRS) nonradiological environmental monitoring program serves two purposes: 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.

## 2022 Highlights

### Effluent Releases

- Nonradiological effluent releases for all categories except industrial wastewater met permit limits and applicable standards.
- SRS reported only four exceptions out of 2,334 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 (SCDHEC) and U.S. Environmental Protection Agency (EPA) water quality standards.

### Surveillance Program

- SRS 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.
- Fish flesh sample results were consistent with historical levels.

## 4.1 INTRODUCTION

Environmental monitoring programs at SRS examine both radiological and nonradiological constituents that Site activities could release into the environment. Chapter 5, *Radiological Environmental Monitoring Program*, discusses the radiological components of this monitoring program, while this chapter focuses on the nonradiological constituents.

The nonradiological monitoring program collects and analyzes air, water, sludge, sediment, and fish samples from numerous locations throughout SRS and the surrounding area. The program consists of 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.

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)
- River, stream, and stormwater basin sediment
- Fish

Figure 4-1 shows the types and typical locations (for example, upstream and downstream of SRS influence) of the nonradiological sampling SRS performs.

This chapter summarizes the nonradiological environmental monitoring programs and data results. 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.

### 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.

***Effluent monitoring*** is the collection of samples or data from the point a facility discharges liquids or releases gases.

***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.

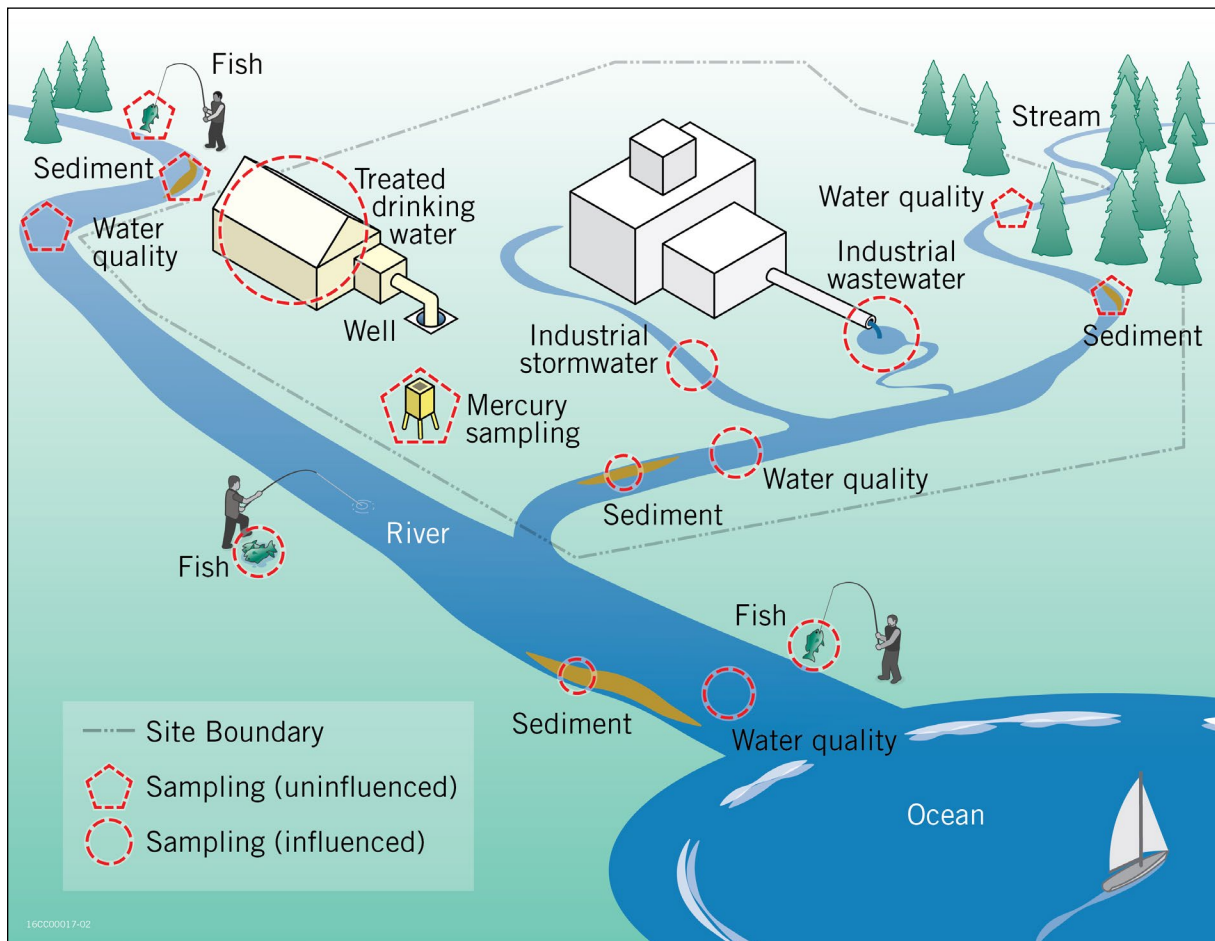


Figure 4-1 Types and Typical Locations of Nonradiological Sampling

## 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. 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. Because of 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 (that is, 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 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, sludge, and sediment samples and 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. Chapter 7, *Groundwater Management Program*, discusses SRS groundwater monitoring.

#### 4.3.1 Wastewater, Stormwater, and Sludge Monitoring

Nonradiological surface water monitoring primarily consists of sampling water discharges (industrial wastewater and industrial stormwater) associated with SRS NPDES-permitted outfalls. SRS monitors nonradiological liquid discharges to surface waters through the NPDES program, as mandated by the Clean Water Act. 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.

#### Wastewater

Through May 2022, SRS monitored 28 industrial wastewater outfalls for physical and chemical properties, including flow, dissolved oxygen, acidity (pH), ammonia, biochemical oxygen demand, fecal coliform, metals, oil and grease, volatile organic compounds, and total suspended solids (TSS). At the end of May, Permit SC0047431 concluded, and sampling at D-Area outfalls was halted permanently, leaving 20 outfalls. Figure 4-2 shows these locations. The permit specifies how often SRS is to monitor the outfalls. Typically, SRS



**A Refrigerated Sampler Allows for Remote Temperature Verification.**

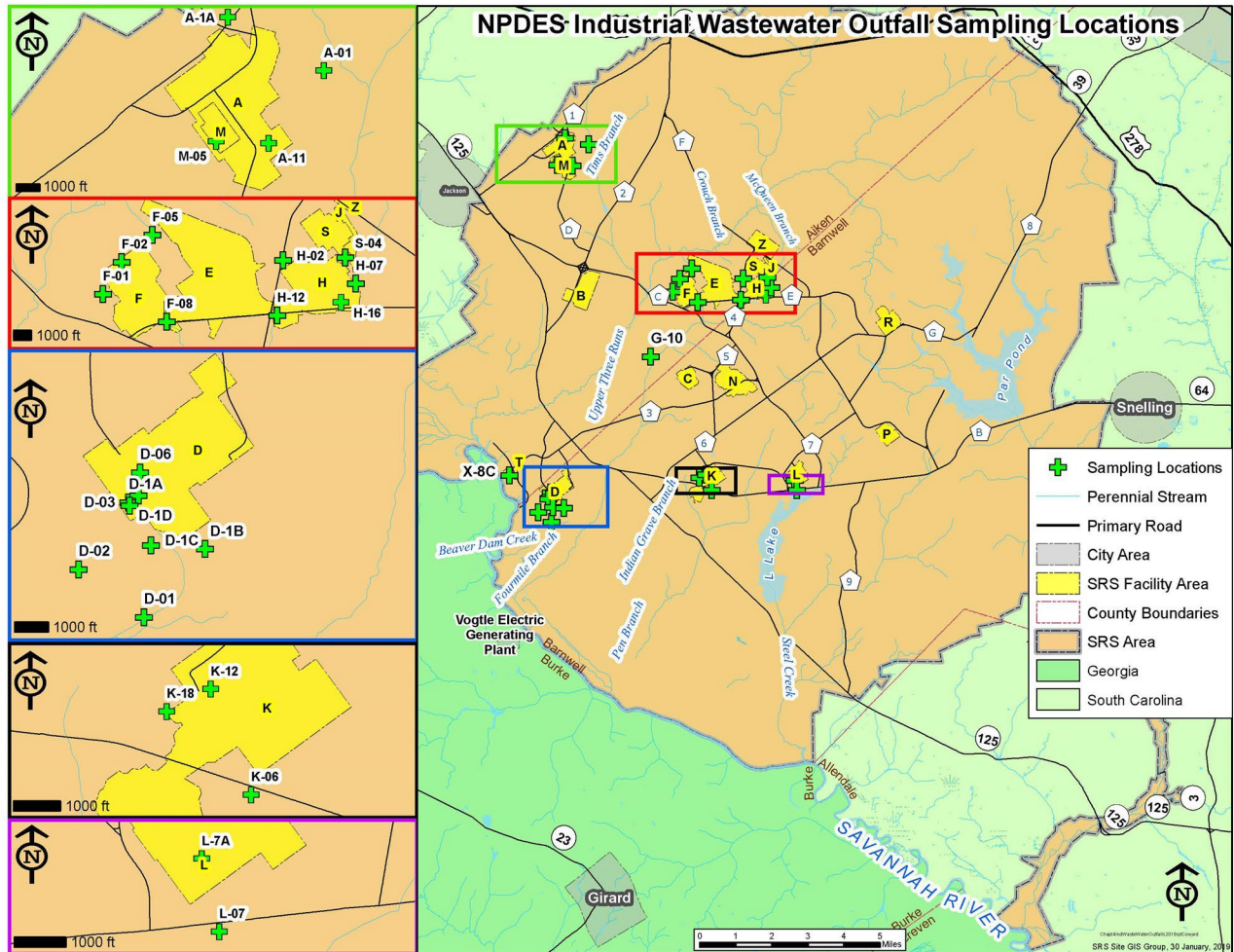


Figure 4-2 NPDES Industrial Wastewater Outfall Sampling Locations

collected samples at the locations once a month, although some locations required monitoring as frequently as once a day and others as infrequently as once a quarter. As specified by the permit, SRS collected either grab samples (individual sample collected all at one time) or composite samples collected over a specific period, typically 24 hours. SRS has also continued to utilize new technology to more efficiently collect samples and improve QA/QC methods. A refrigerated sampler coupled with a modem allowed personnel to verify the sample temperature and communicate with the equipment by remote control. SRS reported results to SCDHEC in required monthly discharge monitoring reports. 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 2022.

## Stormwater

SCDHEC issued a new five-year Industrial Stormwater permit effective July 2022 that covers 33 outfalls. The previous general permit, which was effective through June 2022, covered 36 industrial stormwater outfalls, which Figure 4-3 illustrates. Three outfalls—B-10, Y-01, and Y-03—were deactivated in 2022, effective with the new permit. 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 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 continued 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 allowed 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.

**Effluent Limitations Guidelines Monitoring**—Certain outfall sectors have specific limitations imposed. SRS has one outfall that falls in this category because the runoff is from 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, in the event that 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. When a receiving stream is impaired, SRS samples stormwater discharges to that stream to ensure they are not contributing to an existing problem. Under the impaired water monitoring program, SRS does not sample and analyze for *Escherichia coli* (*E. coli*) because SRS processes do not contribute that contaminant to either of the two *E. coli*-impaired streams onsite.

**Benchmark Monitoring**—SRS must monitor for any benchmark parameter specified for the outfall's assigned industrial sector(s). Not all outfalls have required benchmark monitoring. Under the previous permit, which expired in July, benchmark sampling requirements had been met at all but one outfall, N-12A, which did not meet the copper limit. The Site implemented corrective measures, and the results are trending in a positive direction. Under the current permit, benchmark sampling for an analyte must continue until the average of four consecutive quarters meets the benchmark limit. The requirement is then met until year four of the permit, when it must be repeated. Because only two quarters of the new permit elapsed in 2022, benchmark sampling continues at all outfalls with benchmark limits.

**Visual Assessment**—Visual assessment outfalls are divided into groups with substantially identical effluents. 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. Trained Site employees collect samples and inspect them for clarity, odor, oil and grease, and other simple parameters. The inspector completes visual assessment forms to document the assessment results.

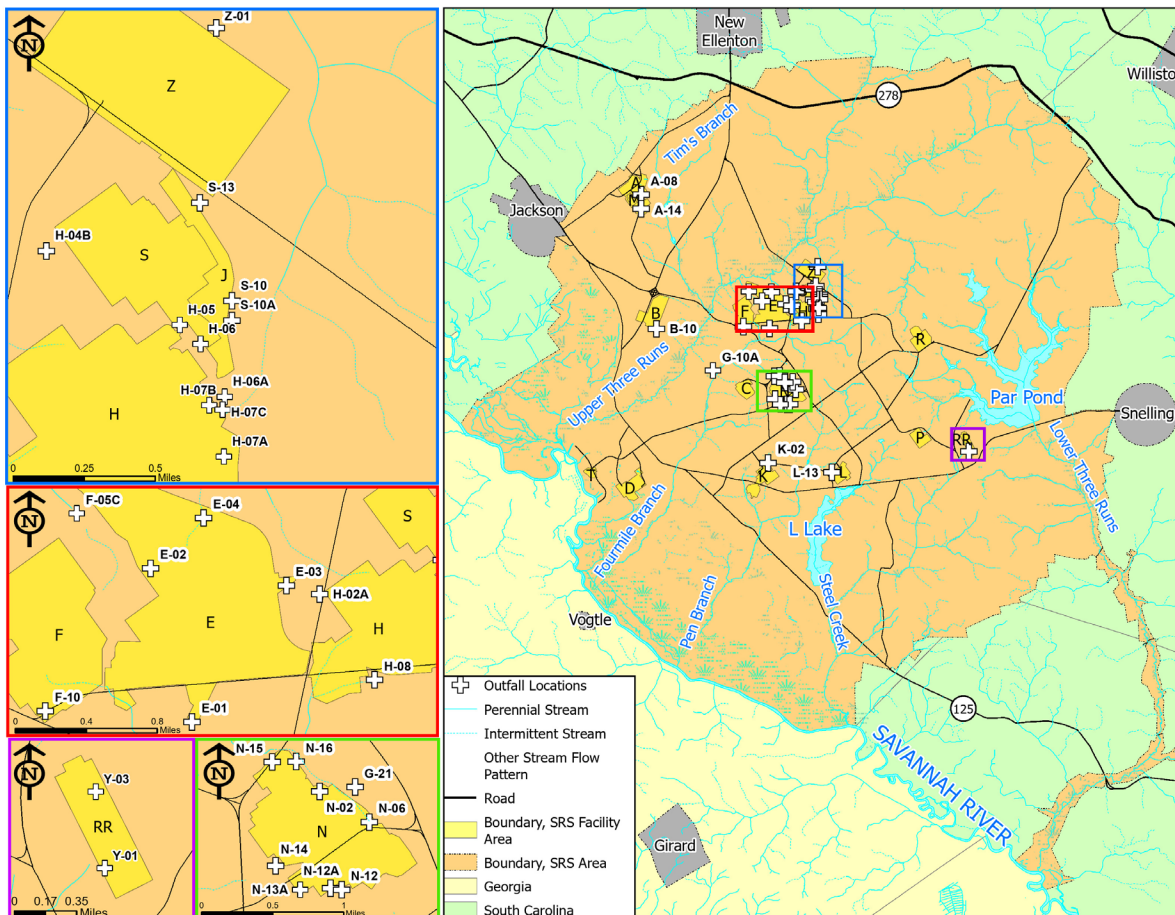


Figure 4-3 NPDES Industrial Stormwater Outfall Sampling Locations

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.

4.3.1.1 Wastewater, Stormwater, and Sludge Results Summary

**Wastewater**

SRS reports NPDES industrial wastewater analytical results to SCDHEC through monthly Discharge Monitoring Reports. The Site reported only four permit exceptions to the permit requirements for the 2,334 analyses performed during 2022, a 99.8% compliance rate. All exceptions were due to flow meter issues at Central Sanitary Outfall G-10. A permit limit exceedance is when a sample’s analyte exceeds the permit amount limits minimum or maximum value. A permit exception is a failure to comply with permit conditions other than listed effluent volumes. SRS received no Notices of Violation in 2022.

## Stormwater

SRS monitored all industrial stormwater outfalls according to permit requirements in the following manner:

- SRS did not collect samples at the one outfall (H-07B) that required effluent sampling because there was no discharge in 2022. SRS reported results to SCDHEC in a required annual discharge monitoring report.
- Under the previous permit, which expired in July, SRS met benchmark sampling requirements at all but one outfall (N-12A). Sampling all benchmark outfalls under the new permit began in July and continues.
  - There was no discharge in 2022, so SRS could not collect samples at Outfalls G-10A or Z-01.
  - Under the previous permit, SRS met benchmark sampling requirements for all analytes except copper at Outfall N-12A; however, corrective measures (installing oyster shells and bone char) implemented in 2017 and 2018 are expected to be effective for several years. Oyster shells and bone char adsorb metals to reduce concentrations in the stormwater.
  - Under the current permit, zinc results for the third and fourth quarters at Outfall N-06 have made it mathematically impossible to meet the benchmark limit. These elevated zinc results led to corrective actions, and oyster shells were installed at check dams upstream of the outfall in December 2022. High copper results at Outfall N-12A continued but were lower than the highest historical result.
  - Based on evaluations of the current operations in the watersheds, SRS deactivated Outfalls B-10, Y-01, and Y-03 because the discharges do not meet the criteria SCDHEC specified.
- For visual assessment sampling, SRS groups substantially identical outfalls—30 of the 36 outfalls in 9 groupings—and designates 1 outfall to represent a group each year. SRS samples the remaining six outfalls individually and not in groups. In 2022, Site personnel visually assessed the water of these outfalls for color, odor, clarity, solids, foam, and oil sheen. Visual assessments identified no industrial impacts.



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

## Sludge

The Site generally applies treated sludge from the Central Sanitary Wastewater Treatment Facility once every two years. SRS did not perform sludge land application in 2022.

### 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 that SCDHEC regulates, 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 15 samples each month from various locations throughout the system.

#### 4.3.2.1 Drinking Water Results Summary

All drinking water bacteriological samples that SRS collected in 2022 met the state and federal drinking water quality standards.

#### 4.3.3 **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:

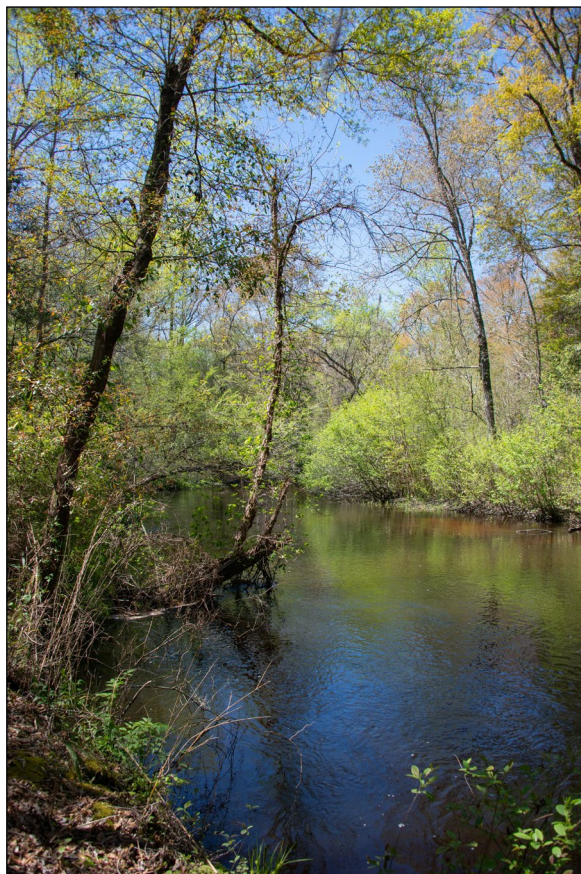
- Primary and secondary contact recreation and as a drinking water source after conventional treatment in accordance with SCDHEC requirements
- Fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora
- Industrial and agricultural uses

SRS surveys river and stream water quality to identify: 1) any degradation that could be attributable to the water discharges site NPDES permits regulate, and 2) materials coming from inadvertent releases at 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. In calendar year 2022, herbicides, pesticides, and polychlorinated biphenyls (PCBs) were removed from the water quality program because historical data typically indicated nondetectable levels; this

change also aligned with the SCDHEC Environmental Surveillance and Oversight Program changes.

Figure 4-4 shows the sampling locations. The river and stream sampling locations 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 surrounding area. SRS samples the water quality locations monthly by the conventional grab-collection



**SRS Surveys River and Stream Water Quality.**

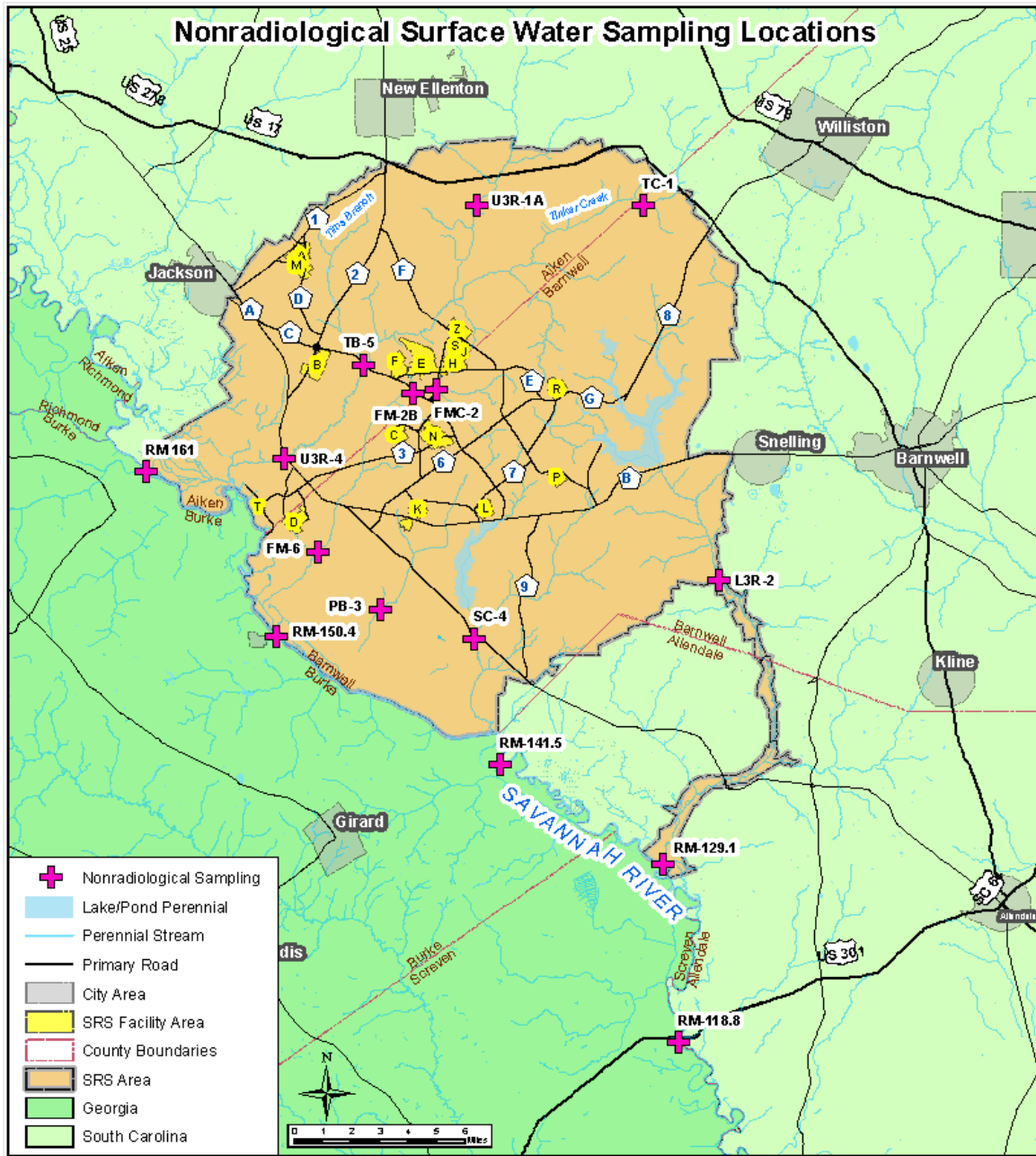


Figure 4-4 Nonradiological Surface Water Sampling Locations

technique. SCDHEC also collects samples at several onsite stream locations as a quality-control check of the SRS program. SRS collects quality control samples throughout the year, as documented in Section 8.5, *Environmental Monitoring Program QC Activities*.

4.3.3.1 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 2022, with 2,712 of 3,009 (90.1%) meeting South Carolina Freshwater Quality Standards, as available. (Not all analytes sampled have a standard.) All samples met standards for beryllium, chromium, mercury, nickel, nitrite, and zinc. Averages for each river and stream location met standards for cadmium, copper, lead, nitrate, temperature, thallium, and dissolved oxygen. Additionally,

all locations met pH maximum standards. Appendix Table C-1 summarizes the analytical results. These results continue to indicate that SRS discharges are not significantly affecting the water quality of onsite streams or the Savannah River.

#### 4.3.4 Sediment Sampling

SRS's nonradiological sediment surveillance program measures the concentrations of various inorganic contaminants that Site releases deposit in stormwater basins, stream systems, and the Savannah River, where they accumulate or disperse.

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 quality control, as documented in Section 8.5, *Environmental Monitoring Program QC Activities*.

##### 4.3.4.1 Stream and River Sediment Results Summary

SRS collected and analyzed 384 individual sediment analytes from 24 locations (10 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 2022 results, 96.1 % (369 of 384 analyses) met the EPA Region 4 Sediment Refinement Screening Values (RSVs). Barium accounted for 12 of the 15



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

samples that exceeded its RSV (60 mg/kg), while manganese accounted for the remaining three exceeding its RSV (1,100 mg/kg). SRS considers the barium exceedances as background, as evidenced by Agency for Toxic Substances and Disease Registry 2007 Toxicological Profile for Barium (mean values ranging between 265 and 835 mg/kg), and because there are similar results in both control locations and in historical trending. Appendix Table C-2 summarizes the analytical results. All results compare to those of the previous five years and demonstrate SRS activities are not significantly affecting the metals concentrations of onsite basins and 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

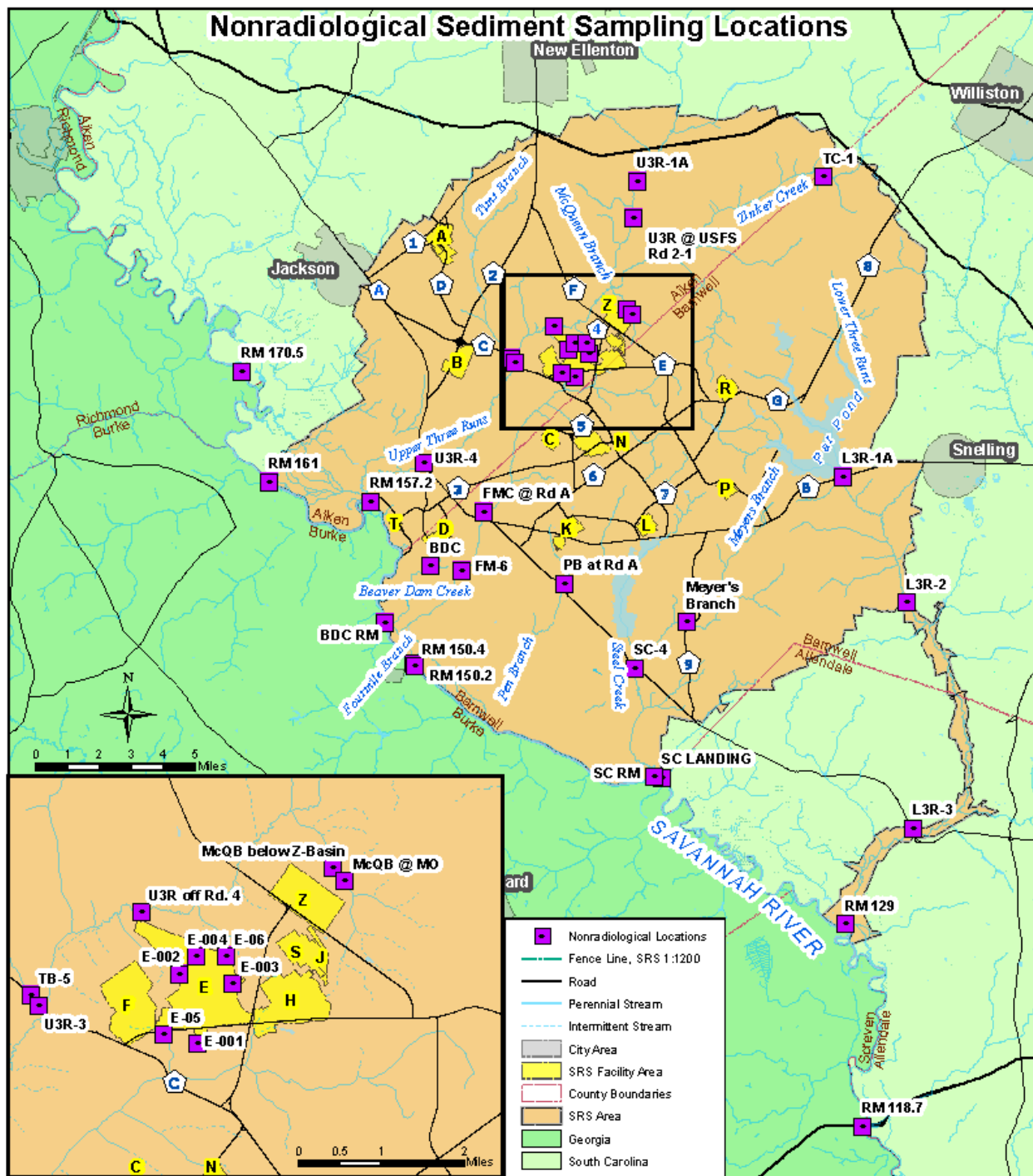
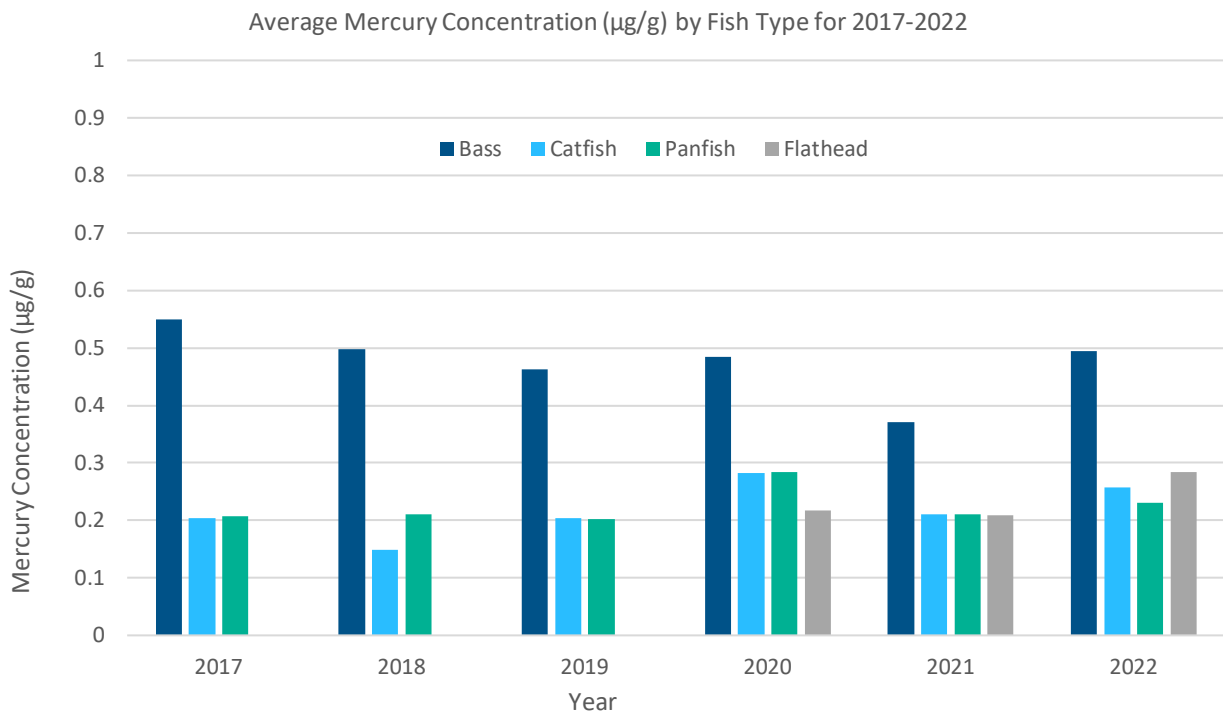


Figure 4-5 Nonradiological Sediment Sampling Locations

Savannah River from above SRS at Augusta, Georgia, to the coast at Savannah, Georgia. SRS collects freshwater fish at the mouth of the streams that flow through the Site and gathers saltwater fish (mullet) at the Savannah River mouth near Savannah. SRS analyzes samples of the edible flesh for metals uptake. SRS performs nonradiological analyses for antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc.

### 4.3.5.1 Fish Results Summary

In 2022, SRS performed 1,720 individual analyses on 172 fish flesh samples. In 2020, SRS added flathead catfish to the freshwater fish surveillance program as the flathead have become established in most waters where they have been introduced, including the Savannah River. Appendix Tables C-3 and C-4 summarize the analytical results. SRS detected and quantified 17%, or 287 results, of the 1,720 individual analyses. The only analytes that had results that were detected and quantified were copper, mercury, and zinc. Sixty-four percent of the results were nondetects (less than the method detection limit), with the remaining 19% being estimated values. This indicates SRS detected the analyte, and the concentration was close to the method detection limit. The 2022 data is comparable to the results for the previous five years. Figure 4-6 shows the average mercury results by fish type for 2017 through 2022.



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

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# Chapter 5: Radiological Environmental Monitoring Program

**T**he 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 (EPA), South Carolina Department of Health and Environmental Control (SCDHEC), 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 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.

## 2022 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 319 animals.

## 5.1 INTRODUCTION

Environmental monitoring at 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 monitors radiological contaminants from both air and liquid sources, as well as collects and analyzes environmental samples 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 Radiological Environmental Monitoring Program 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 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 2011) establishes numerical standards for DCSs to implement DOE Order 458.1. This document was updated in 2022 (DOE 2022). DCSs are radiological quantities for certain radionuclides specific to a surface or concentration used in surveying or characterizing radiation to comply with DOE Order 458.1. 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 SRS surveillance program samples the types of media that the Site's releases, as measured in the effluent monitoring program, 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
- 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)

## 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 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.

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.

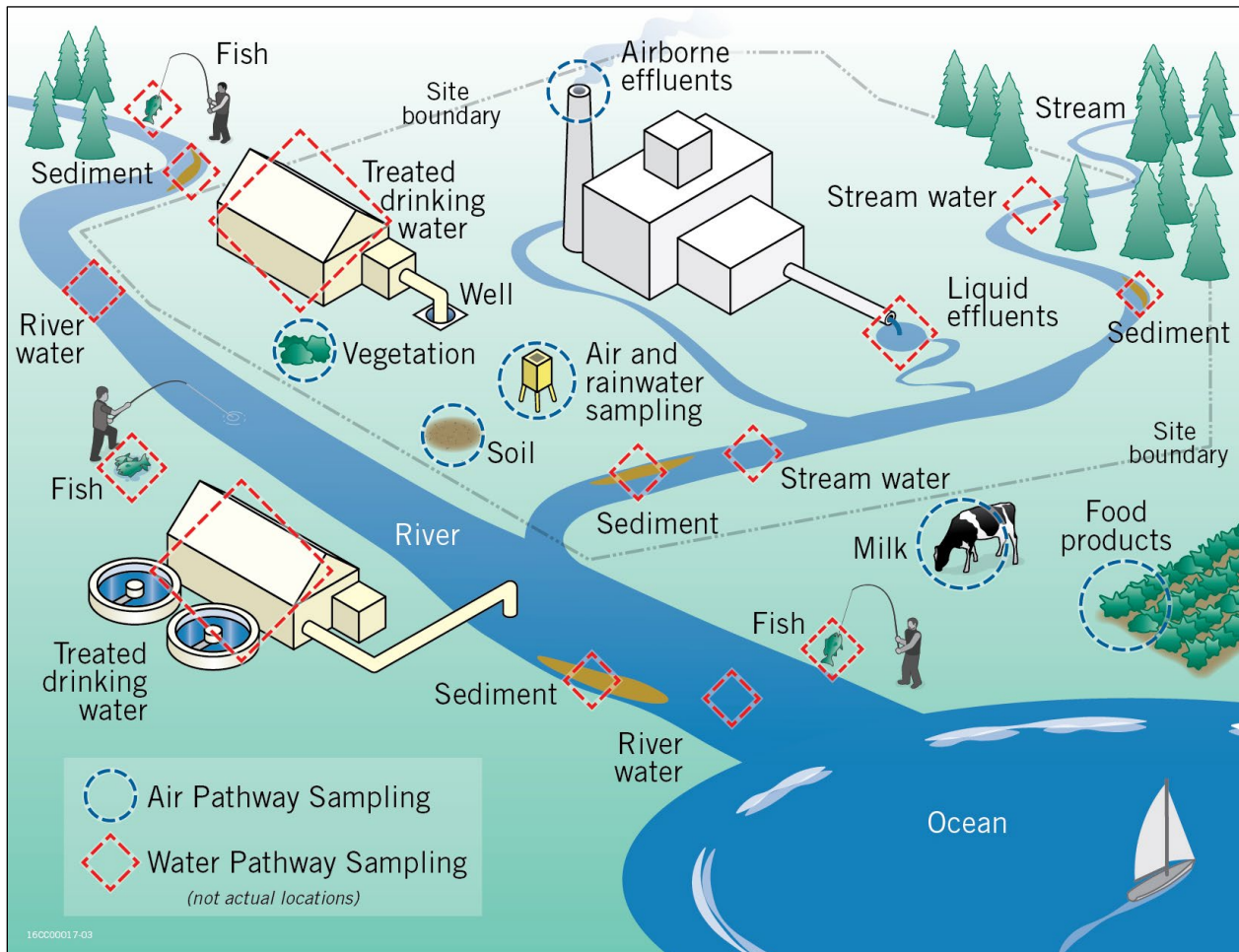


Figure 5-1 Types and Typical Locations of Radiological Sampling

## 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 has on the environment and to assess long-term trends of the contaminants in the environment. SRS collects samples beyond the Site perimeter in Georgia and in South Carolina at 25- and 100-mile intervals. 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 located above the Site at River Mile (RM) 161. Media-specific chapter figures and [Environmental Maps](#) show offsite environmental sampling locations. Chapter 7, *Groundwater Management Program*, provides information on SRS groundwater monitoring. Table 5-1 summarizes SRS offsite radiological sampling performed in Georgia and South Carolina, excluding samples collected from the Savannah River.

**Table 5-1 SRS Offsite Radiological Sample Distribution by State**

Environmental Sampling Media	Approximate Number of Samples (Number of Locations)	
	South Carolina	Georgia
<b>Air Filters</b>	26 (1)	52 (2)
<b>Silica Gel</b>	26 (1)	52 (2)
<b>Ambient Gamma Radiation Monitoring</b>	56 (7)	32 (4)
<b>Rainwater</b>	13 (1)	26 (2)
<b>Food Products</b>	16 (4)	4 (1)
<b>Milk</b>	16 (4)	12 (3)
<b>Soil</b>	4 (4)	2 (2)
<b>Grassy Vegetation</b>	1 (1)	2 (2)
<b>Drinking Water</b>	24 (2)	0 (0)
<b>Total</b>	<b>182 (25)</b>	<b>182 (18)</b>

Note:

This table excludes groundwater monitoring locations and samples discussed in Chapter 7, *Groundwater Management Program*, as well as samples collected from the Savannah River.

### 5.3 AIR PATHWAY

The media 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 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. SCDHEC 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 contained in Appendix D 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

Appendix Table D-1 presents SRS radioactive release totals from monitored and unmonitored (calculated) sources, while Table 5-2 provides a summary for the calendar year (CY). During the past 10 years, the total annual tritium release has ranged from about 7,030 to 40,000 Ci per year, with an annual average tritium release of 18,200 Ci (Figure 5-2). The 2022 SRS tritium releases totaled 9,590 Ci. 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).

Table 5-2 SRS Radiological Atmospheric Releases for CY 2022

Release Type	Total (curies)
Tritium	9.59E+03
Krypton-85 ( <sup>85</sup> Kr)	1.30E+04
Short-Lived Fission and Activation Products (T1/2 < 3 hr) <sup>a,b</sup>	1.69E-05
Fission and Activation Products (T1/2 > 3 hr) <sup>a,b</sup>	5.51E-02
Total Radio-iodine	7.08E-03
Total Radio-strontium <sup>c</sup>	7.01E-03
Total Uranium	5.65E-05
Plutonium <sup>d</sup>	4.83E-04
Other Actinides	2.30E-04
Other	2.96E-06

<sup>a</sup>International Commission on Radiological Protection (ICRP) 107 half-life data, *Nuclear Decay Data for Dosimetric Calculations (2008)*

<sup>b</sup>International Atomic Energy Agency (IAEA) Common Fission and Activation Products

<sup>c</sup>Includes unidentified beta releases

<sup>d</sup>Includes unidentified alpha releases

In 2022, tritium and krypton-85 accounted for most of the total radiation SRS operations released to the air. 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. Appendix Table D-1 and Figures 5-2 and 5-3 show the tritium releases from the separations areas, legacy reactor facilities, and unmonitored sources.

Appendix Table D-2 summarizes the 2022 air effluent-derived concentration standards 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 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. In 2022, Appendix D-2 includes two tables: 1) using the historical *Derived Concentration Technical Standard* (DOE 2011) and 2) using the updated Standard (DOE 2022). Some dose coefficients and DCSs have moderately significant changes as a result of the improved dosimetry and updated population distribution in the updated standard.

Most SRS stacks and facilities release small quantities of radionuclides at concentrations below the DOE DCSs. The F-Canyon stack analytical results were elevated in 2022, as they were from 2017 to 2021. The elevated levels continue to result in a DCS exceedance (using DOE 2011 Standard) with plutonium-239 as the primary contributing radionuclide. As mentioned earlier in the chapter, compliance with the DCS is when the sum of the ratios of each radionuclide's observed concentration to its corresponding DCS does not exceed 1.00. Using the DCSs provided in DOE 2011, as has been used in previous ASERs, the DCS sum of fractions exceedance for 2022 is 1.58, a significant decrease from the 2021 value of 2.47. However, using the DOE 2022 standard, the F Canyon DCS sum of ratios is 0.693. The difference in DCS sum of ratios between the 2011 and the 2022 Standards is primarily due to a 220% change in DCS associated with the primary contributing radionuclide, plutonium-239.

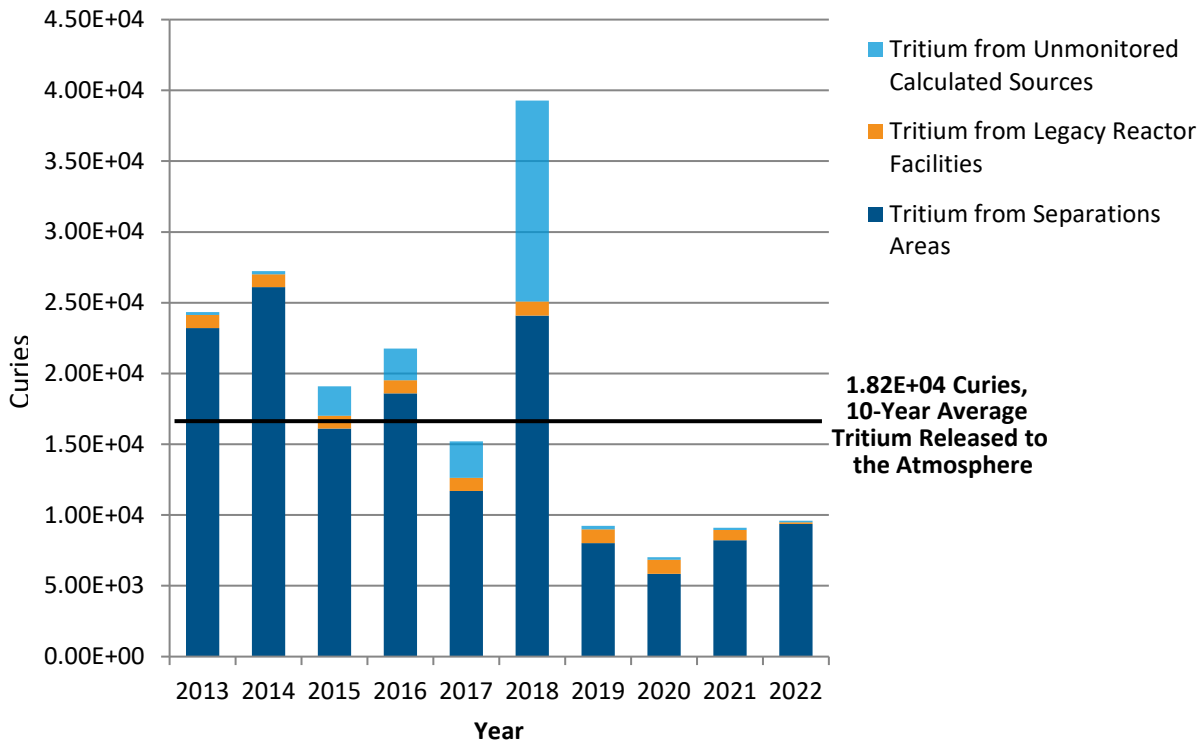


Figure 5-2 10-Year History of SRS Annual Tritium Releases to the Air

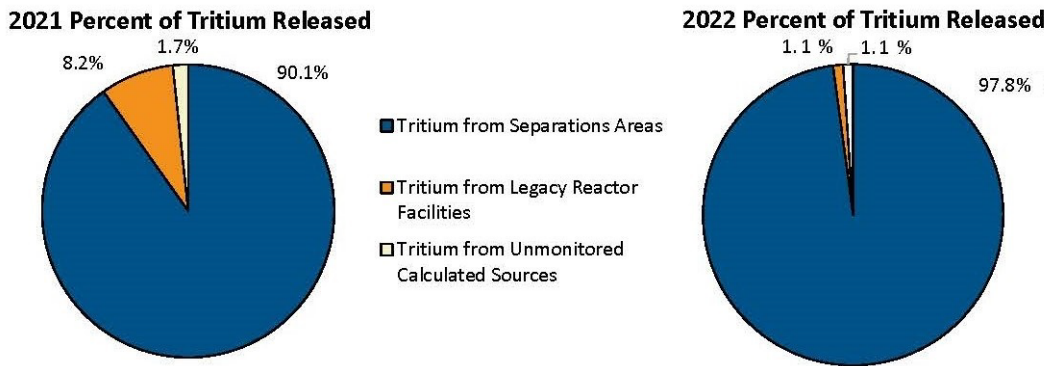


Figure 5-3 Percent of Tritium Released to the Air for 2021 and 2022

Because of the nature of several SRS facilities operations, tritium oxide releases exceeded DOE’s tritium air DCS. However, DOE recognizes that tritium oxide, which is essentially water vapor, cannot be filtered or removed from the effluent. 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, the Site maintains tritium releases according to the ALARA principle to comply with DOE Order 458.1. The ALARA process manages radiological activities so that doses to members of the public (both individual and collective) and releases to the environment are kept as low as reasonably achievable.

### 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.

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 placed air-sampling stations near the Site boundary and beyond to be representative of the atmospheric distribution of airborne releases in the environment. Each air sampling station collects air and rainwater samples as Table 5-3 lists.

SRS selected the radionuclides Table 5-3 presents based on known SRS airborne emission sources. 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-89/90, and cesium-137 [a manmade gamma-emitting radionuclide]).

#### 5.3.3.1 Results Summary

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 2022 results for tritium in air showed detectable levels in 52 of the 417 samples, or 12%, compared to 2021 results with detectable levels in 13% of the samples.

The 2022 results for tritium in rainwater showed detectable levels in 16 of the 208 rainwater samples, or 8%, as compared to 2021 results with detectable levels in 13% of the samples. Thirteen of 13 results for Burial Ground North were detected, which is at the center of the Separations Area at SRS. Barricade 8, D Area, and Darkhorse @Williston Gate each had 1 of 13 results detected.

Charcoal canisters analyzed quarterly for radioiodine in 2022 showed one detection of iodine-129. Charcoal canister results for radioiodine were within the historical trends for the previous 10 years. Glass fiber filter results for gamma-emitting radionuclides showed no detectable levels of cesium-137 and no detectable levels of cobalt-60 at any air surveillance stations during 2022. All offsite location results were near the levels observed at the control location at the U.S. Highway 301 bridge. Appendix Table D-5 summarizes the results.

SRS also selected offsite and plant perimeter glass fiber filter samples for actinide and strontium-89/90 analysis. Sample selection was dependent on dates of elevated concentrations at F-Canyon stack and the wind direction during the corresponding time period. Actinide and strontium-89/90 analysis was also performed on glass fiber filter samples collected biweekly at the Burial Ground North onsite. Appendix Table D-5 summarizes all glass fiber filter results, and all are comparable to historical trends.

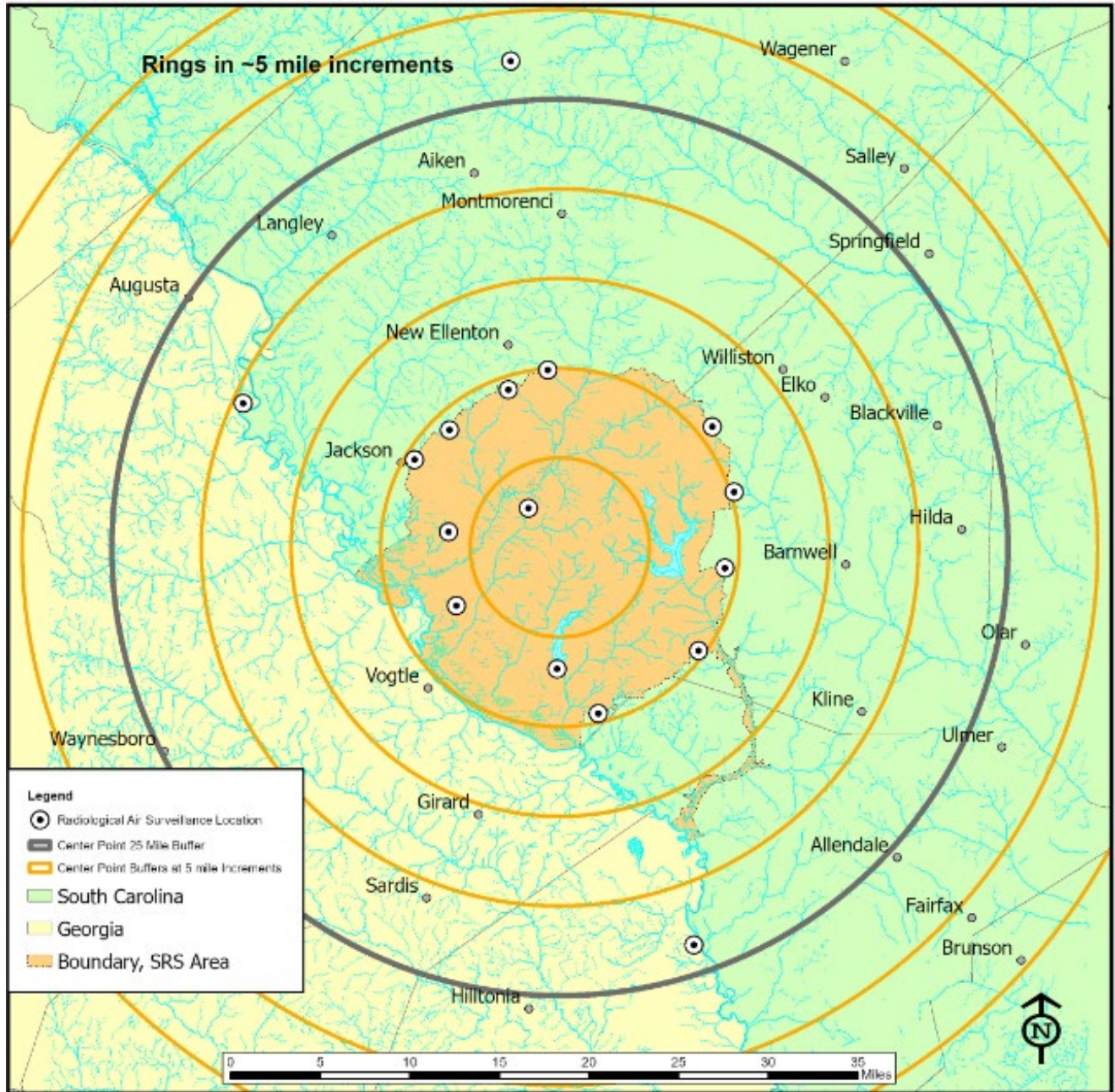


Figure 5-4 Air Sampling Locations Surrounding SRS up to 25 Miles

**Table 5-3 Air Sampling Media**

Media	Purpose	Radionuclides
Glass-Fiber Filter	Airborne particulate matter	Gamma-emitting radionuclides, gross alpha/beta emitting radionuclides, actinides, strontium-89/90
Charcoal Canister	Gaseous states of radioiodine	Iodine-129
Silica Gel	Tritiated water vapor	Tritium
Rainwater	Tritium in rainwater	Tritium

**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 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 Employee Measures Environmental Gamma Exposure Rates with OSLDs Placed Across the Site.**

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**

Appendix Table D-6 summarizes the gamma results. 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 2022, ambient gamma exposure rates onsite varied between 93 mR/yr at location Allendale Gate and 147 mR/yr at A-14. Rates at population centers ranged from 110 mR/yr at the McBean, South Carolina, location to 157 mR/yr at the Beech Island, South Carolina, location.

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 2022, SRS collected soil samples from 5 onsite locations, 12 Site perimeter locations, 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 in different types of soils. 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 devices to collect soil samples to a depth of 6 inches at each sampling location. 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-89/90, and actinides.

#### 5.3.5.1 Soil Results Summary

In 2022, SRS detected radionuclides in soil samples from all 24 sampling locations. Analyses detect uranium isotopes (uranium-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 pCi/g, with an average concentration of 2 pCi/g in soils in the United States. Uranium results both onsite and at the Site perimeter are consistent with naturally occurring uranium levels. Many factors affect the uranium concentration in soil over time. These include 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.



**Collecting a Soil Sample**

The concentrations of other radionuclides at these locations are consistent with historical results, with a maximum cesium-137 concentrations of 35.9 pCi/g at the Creek Plantation Trail 1 1805' location and 0.15 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 the plant, or internally, when the 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-89/90, technetium-99, and actinides.

#### 5.3.6.1 Grassy Vegetation Results Summary

SRS collected all 16 annual samples for 2022. SRS detected various radionuclides in the grassy vegetation samples at all air sampling locations (1 onsite, 12 at the perimeter, and 3 offsite). Appendix Table D-8 summarizes the results. All radionuclides are within the trends of the previous 10 years for all locations.



**SRS Analyzes Grassy Vegetation Both Onsite and Offsite.**

### 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. They analyze these samples for radionuclides. The results reveal whether radionuclides are present in the environment. Tritium releases from SRS sources are the primary contributors to tritium in food products.

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. 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. Once a quarter, the Site collects milk samples. Food product

samples 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.

Laboratory analysis of the food samples include those for gamma-emitting radionuclides, tritium, strontium-89/90, technetium-99, gross alpha, gross beta, and actinides (including neptunium). Laboratory analysis of the dairy samples include those for gamma-emitting radionuclides, tritium, and strontium-89/90.

#### 5.3.7.1 Terrestrial Food Results Summary

In 2022, SRS sampled milk and the following terrestrial foodstuffs: greens, fruit (watermelons), beef, cabbage, and grains. Based on availability, the collected grains were wheat. SRS collected all food types from all four quadrants and the control area. Appendix Tables D-9 and D-10 summarize the foodstuffs and dairy results. 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 about 94% for dairy) did not detect radionuclides. About 39% of the detected terrestrial foodstuff results were associated with natural uranium.

## 5.4 WATER PATHWAY

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

SRS routinely samples, analyzes for radionuclides, and monitors flow at each liquid effluent discharge point that releases, 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

Appendix Table D-11 provides SRS liquid radionuclide releases for 2022. 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). Table 5-4 summarizes the liquid effluent releases of radioactive materials. The direct releases (including migration) of tritium decreased by 28% (from 483 Ci in 2021 to 348 Ci in 2022).

The total amount of tritium released directly from process areas to SRS streams (not including shallow groundwater migration) during 2022 was 52.1 Ci, compared to 88.4 Ci released in 2021. Figure 5-6 presents the tritium released by source area and shows that while oftentimes variable, the total direct releases of tritium in 2022 is consistent with the 10-year historical measurements.

As the chapter mentions earlier, compliance with the 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 2022 liquid effluent sum of fractions and radionuclides detected at each outfall or facility.

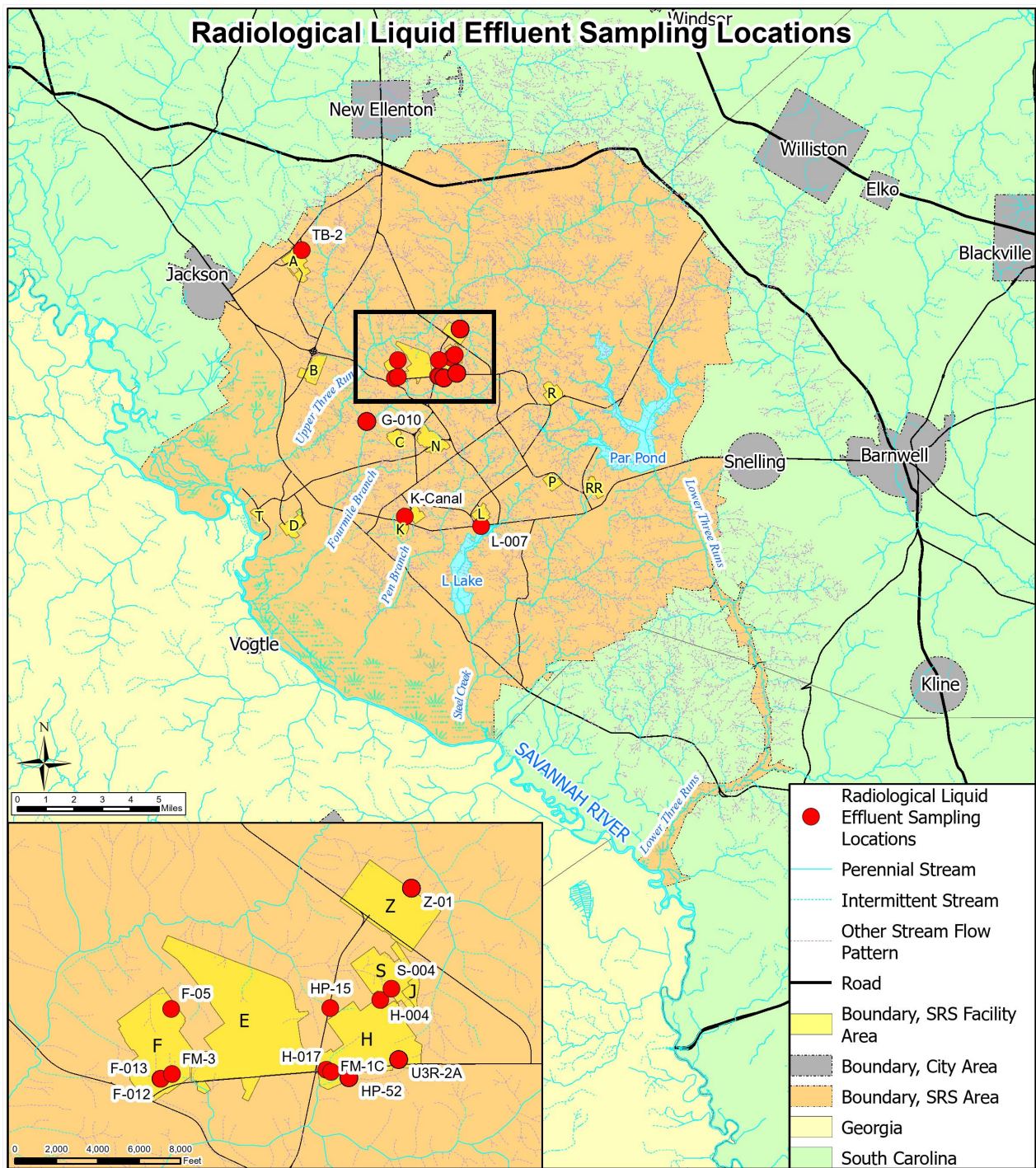


Figure 5-5 Radiological Liquid Effluent Sampling Locations

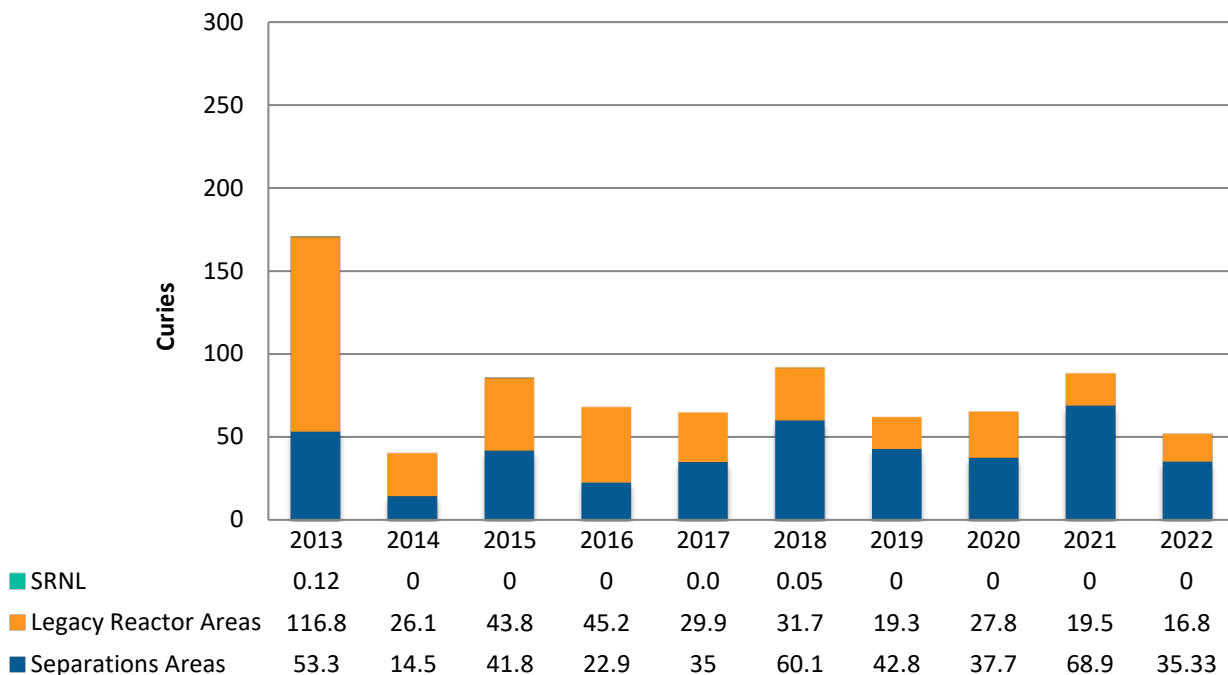


Figure 5-6 10-Year History of Direct Releases of Tritium to SRS Streams

Table 5-4 SRS Radiological Liquid Effluent Releases<sup>a</sup> of Radioactive Material for CY 2022

Release Type	Totals (curies)
<b>Tritium</b>	3.48E+02
<b>Fission and Activation Products (half-life &gt; 3 hr)<sup>b,c</sup></b>	3.33E-02
<b>Total Radioiodine</b>	1.30E-02
<b>Total Radio-strontium<sup>d</sup></b>	6.02E-02
<b>Total Uranium</b>	1.39E-01
<b>Plutonium<sup>e</sup></b>	1.07E-02
<b>Other Actinides</b>	1.27E-04
<b>Other</b>	0

<sup>a</sup> Includes direct releases and shallow groundwater migration from SRS seepage basins and SWDF

<sup>b</sup> International Commission on Radiological Protection (ICRP) 107 half-life data, *Nuclear Decay Data for Dosimetric Calculations (2008)*

<sup>c</sup> International Atomic Energy Agency (IAEA) Common Fission and Activation Products

<sup>d</sup> Includes unidentified beta releases

<sup>e</sup> Includes unidentified alpha releases

### 5.4.2 Stormwater Basin Surveillance

SRS monitors the accumulated stormwater in the Site’s stormwater basins for gross alpha, gross beta, tritium, strontium, technetium, gamma-emitting radionuclides, and carbon. Additional analytes may include actinides (including neptunium). 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. Z-Area Stormwater Basin receives stormwater from Z Area (Saltstone processing and disposal facilities). Stormwater basins may release to monitored outfalls during heavy rainfall. As part of the surface water surveillance program, Figure 5-7 identifies all the Site’s stormwater basin locations, along with the Site’s stream surveillance location, which are discussed later in this chapter.

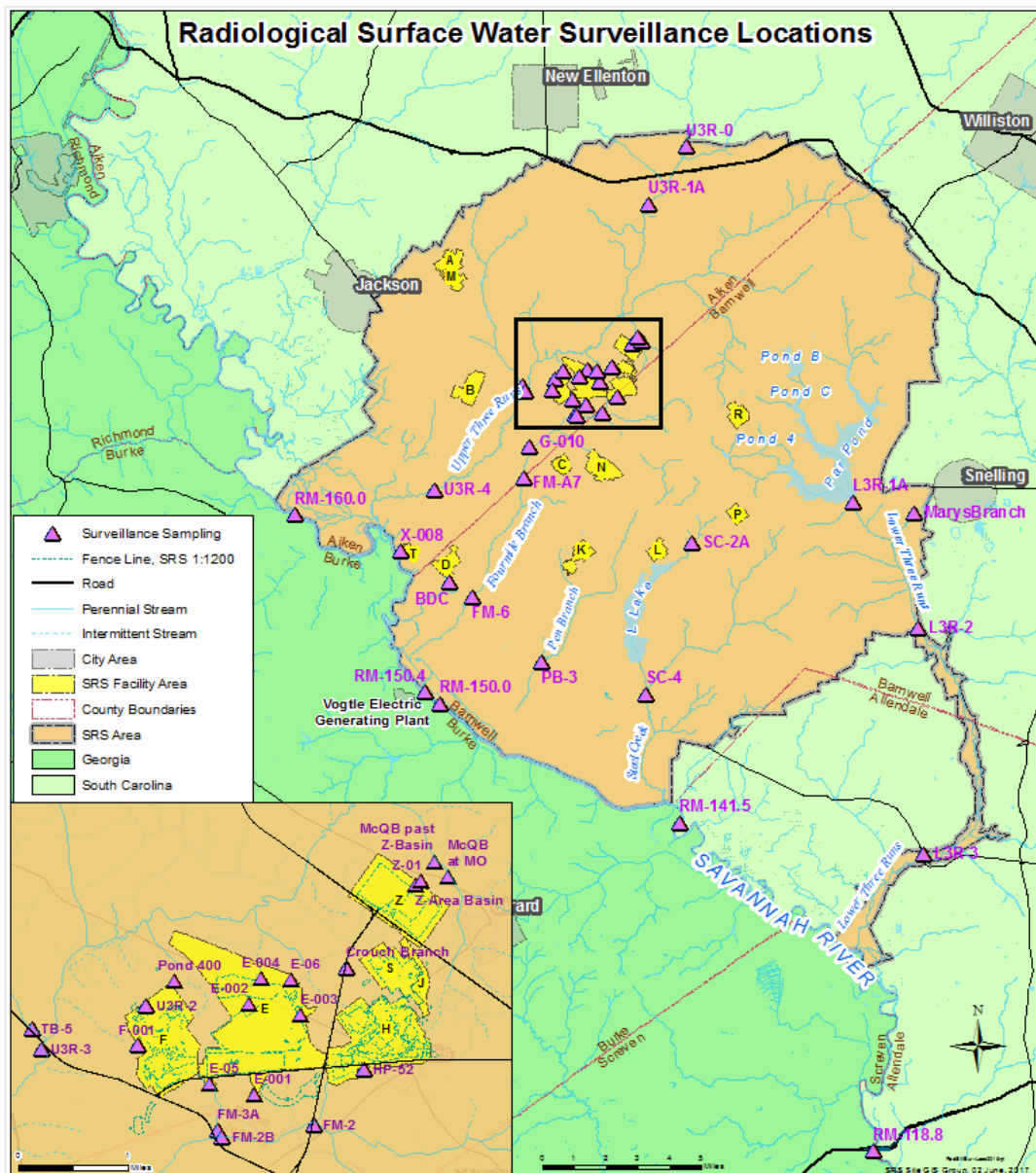


Figure 5-7 Radiological Surface Water Sampling Locations

### 5.4.2.1 Stormwater Basin Results Summary

In 2022, SRS sampled at six E-Area basins (E-001, E-002, E-003, E-004, E-005, E-006), as well as at the Z-Area Stormwater Basin and F-Area Pond 400. Table 5-5 summarizes gross alpha, beta, and tritium results for stormwater basins. E-002 Basin had the highest tritium concentration (45,000 picocuries/liter [pCi/L]), which is consistent with the results reported for the E-002 Basin in 2021 (46,800 pCi/L). Tritium results for all basin locations are consistent with the 10-year historical measurements.

**Table 5-5 Radionuclide Concentrations Summary for Stormwater Basins for CY 2022**

Basin Location	Average Gross Alpha (pCi/L)	Average Gross Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
E-001	0.328	3.07	2,830	3,930
E-002	0.281	3.76	18,300	45,000
E-003	All < DL	25.6	6,598	15,300
E-004	0.314	2.02	11,780	18,200
E-005	0.658	2.11	4,219	8,580
E-006	All < DL	3.10	ALL < DL	ALL < DL
Pond 400	0.904	4.33	826	1,840
Z Basin	All < DL	140	1,300	2,660

Note:

DL = detection limit

### 5.4.3 SRS Stream Sampling and Monitoring

SRS routinely samples streams down gradient of several process areas to detect and quantify levels of radioactivity that liquid effluents and shallow groundwater 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 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 5-6 provides information on the stream sampling locations used to determine radioactivity migration in streams and the direct release sample locations associated with the contributing migration source. Figure 5-7 displays the radiological surface water sampling locations. 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 5-6 Radionuclide Concentrations in the Primary SRS Streams by Location for CY 2022

	Average Alpha (pCi/L)	Average Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
<b>Onsite Stream Locations</b>				
Lower Three Runs (L3R-3)	1.75	2.42	354	646
Steel Creek (SC-4)	1.78	2.51	1,198	1,710
Pen Branch (PB-3)	3.10	2.86	8,231	9,710
Fourmile Branch (FM-6)	1.63	5.48	17,358	19,900
Upper Three Runs (U3R-4)	15.0	8.45	415	773
<b>Onsite Control Locations (for comparison)</b>				
Upper Three Runs (U3R-1A)	5.71	3.71	66.7	637

#### 5.4.3.1 SRS Stream Results Summary

Table 5-6 presents the average 2022 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. SRS found detectable concentrations of tritium at all major stream locations. 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. Figure 5-8 indicates that average tritium levels in Fourmile Branch are trending to the EPA drinking water standard of 20 pCi/mL (20,000 pCi/L), although onsite streams are not a direct source of drinking water. The surveillance program uses the EPA standard as a benchmark for comparing stream surface-water results. Tritium levels are 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 efforts to reduce tritium to Fourmile Branch. Figure 5-9 presents a graphical representation of releases of tritium via migration to Site streams from 2013 through 2022. As seen in the figure, 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 2022, the total quantity of tritium migrating from SRS seepage basins and SWDF into SRS streams was 296 Ci, compared to 395 Ci in 2021, which represents a 25.1% decrease. Furthermore, the 10-year trend displays an overall decreasing trend in tritium migration.

SRS measured 206 Ci (69.6%) of the 296 Ci of tritium migrating into SRS streams in Fourmile Branch. Migration releases of other radionuclides vary from year-to-year but have remained below 1 Ci the past 10 years. 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 90 Ci migrated in 2022, compared to 98 Ci in 2021. 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.)

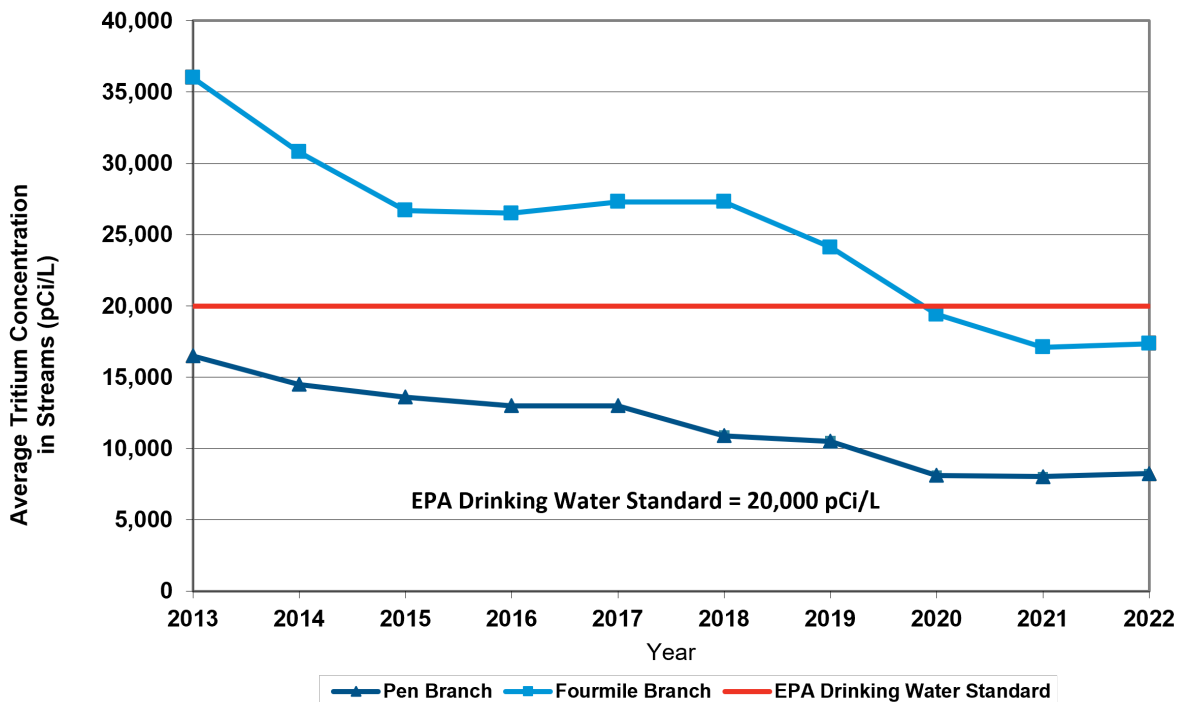


Figure 5-8 10-Year Trend of Tritium in Pen Branch and Fourmile Branch

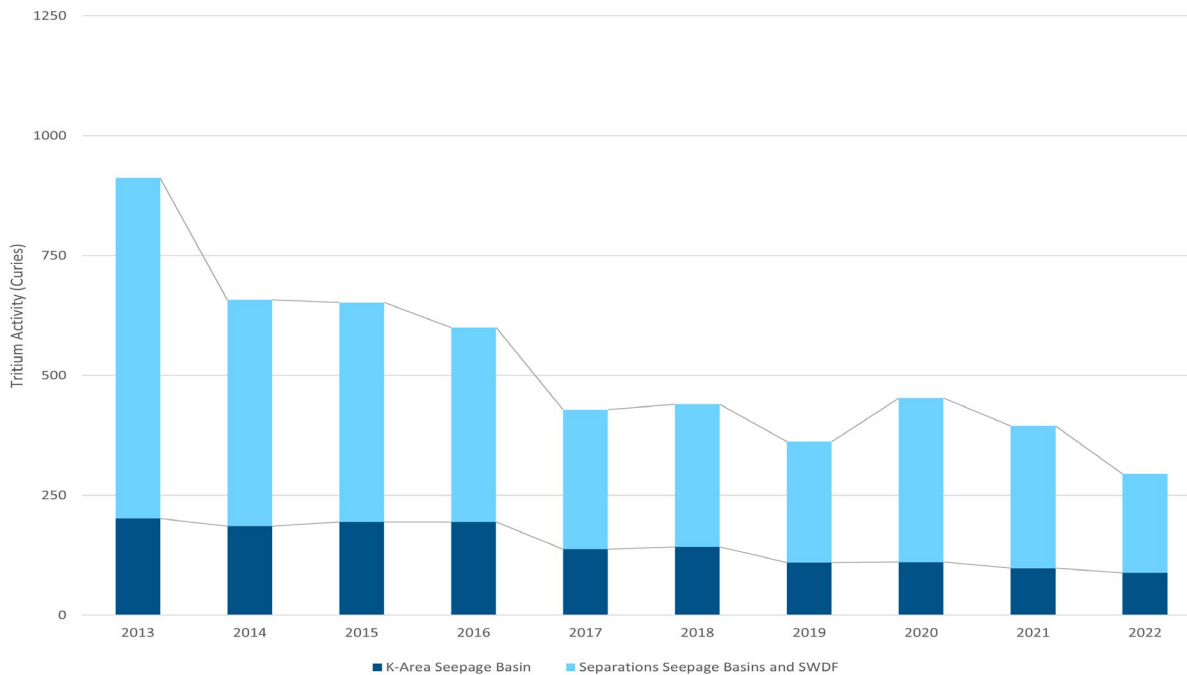


Figure 5-9 10-Year History of Tritium Migration from SRS Seepage Basins and SWDF to SRS Streams

### 5.4.4 Savannah River Sampling and Monitoring

SRS routinely samples along the Savannah River at locations up and downstream of SRS tributaries, including at a location where liquid discharges from Vogtle Electric Generating Plant (VEGP) enter the river.

Five locations along the river, as Figure 5-7 shows, continued to serve as environmental surveillance points in 2022. SRS collects samples weekly at these river locations for tritium, gross alpha, gross beta, and gamma analyses. SRS also collects samples annually for strontium, technetium, and actinides to provide a more comprehensive suite of radionuclides.

#### 5.4.4.1 Savannah River Results Summary

Table 5-7 lists the average 2022 concentrations of gross alpha, gross beta, and tritium, and the maximum 2022 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 the predominant radionuclide detected above background levels in the Savannah River. 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 1,556 Ci in 2022 compared to 1,918 Ci in 2021. This decrease was due to decreased releases from SRS and BLLDF. Total releases from SRS were 348 Ci in 2022, compared to 483 Ci in 2021. Total releases from BLLDF were 13 Ci in 2022, compared to 29 Ci in 2021.

Average radionuclide concentrations for gross alpha, gross beta, tritium, strontium-89/90, technetium-99, actinides, and gamma-emitting radionuclides are consistent with the results from the previous 10 years.

**Table 5-7 Radionuclide Concentrations in the Savannah River for CY 2022**

Location	Average Gross Alpha (pCi/L)	Average Gross Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
CONTROL (RM-161)	0.204	2.06	85.1	737
RM-150.4 (VEGP)	0.253	2.28	478	3,510
RM-150	0.242	2.20	133	275
RM-141.5	0.297	2.26	241	1,210
RM-118.8	0.259	2.11	243	1,080

### 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 60 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 measured 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, the BLLDF, which EnergySolutions, LLC operates. The tritium continues to enter the SRS stream system at Marys Branch, which deposits 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 2022 to be 13 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 2022, tritium levels in stream transport and river transport showed a decrease, specifically as described below:

- The total liquid effluent releases (including migration) of tritium decreased by 28% (from 483 Ci in 2021 to 348 Ci).
- The stream transport of tritium decreased by 42.5% (from 428 Ci in 2021 to 246 Ci).
- The river transport of tritium decreased by 18.9% (from 1,918 Ci in 2021 to 1,556 Ci). VEGP, BLLDF, and SRS contributed to these values.

Tritium transport in the Savannah River includes the 13 Ci migration value attributed to BLLDF and the 1,430 Ci release value attributed to VEGP.

SRS tritium transport data from 1960–2022 (Figure 5-10), shows the history of direct releases plus migration, stream transport, and river transport, while Table 5-8 shows a decrease from 2021 to 2022 for most quantified contributors of these three tritium transport categories. The general downward trend over the past 60 years is attributable 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

As Chapter 6, *Radiological Dose Assessment*, discusses, the direct plus migration releases value was higher than the tritium stream transport value. Therefore, the compliance dose calculations for 2022 use the direct releases and migration value of 348 Ci.

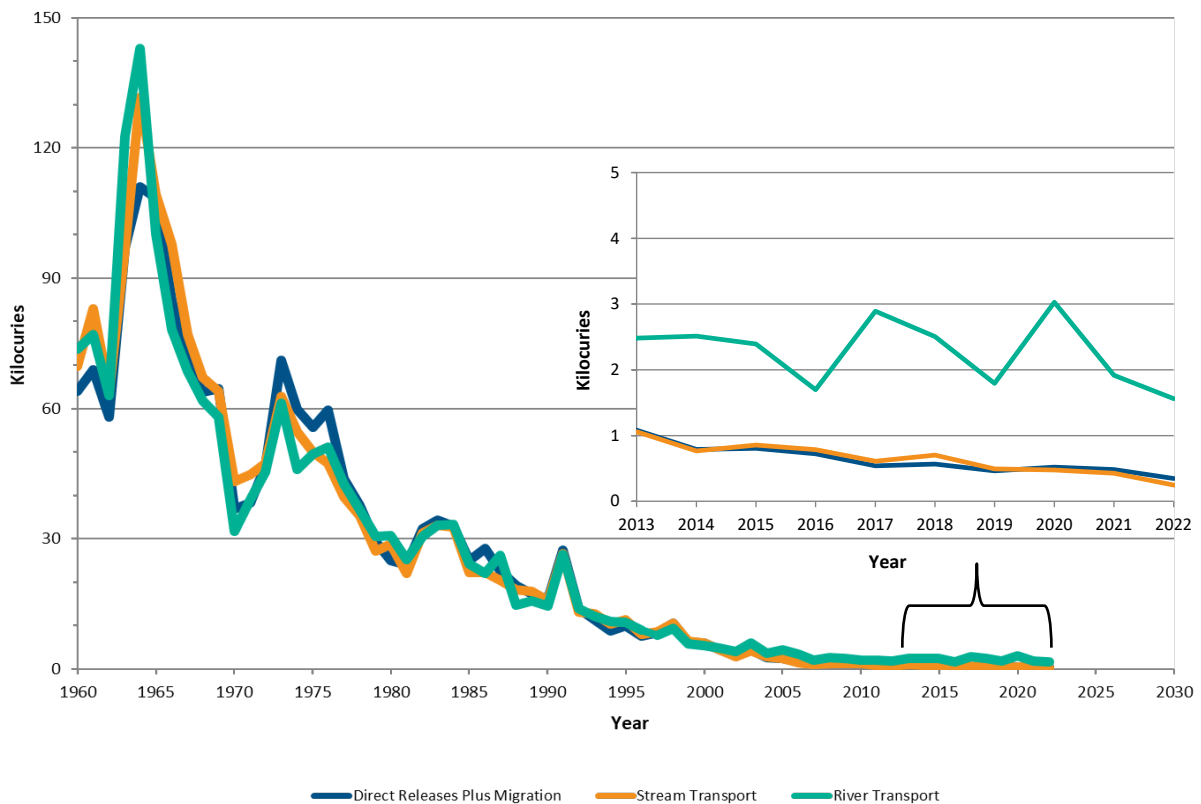


Figure 5-10 History of SRS Tritium Transport (1960 to 2022)

Table 5-8 Liquid Tritium Releases and Transport

Releases/Transport (curies)	CY 2021	CY 2022
<b>Liquid Effluent Releases</b>		
Direct releases	88	52
Shallow groundwater migration from Separations Areas Basins, K-Area Seepage Basins, and Percolation Field below K-Area Retention Basin	395	296
<b>Total Liquid Effluent Releases (direct releases and migration)</b>	<b>483</b>	<b>348</b>
<b>Total Stream Transport</b>		
Stream transport and shallow groundwater migration from C-Area, L-Area, and P-Area Seepage Basins	428	246
<b>River Transport</b>		
SRS contribution	483	348
VEGP contribution	986	1,430
BLLDF contribution	29	13
<b>Total River Transport (SRS, VEGP, and BLLDF)</b>	<b>1,918</b>	<b>1,556</b>

## Note:

For compliance dose calculations, the Site uses whichever value is higher: SRS direct releases and migration or the stream transport measurements. Therefore, in 2022, SRS used direct releases and migration to calculate the dose. See Chapter 6, *Radiological Dose Assessment*.

#### 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, National Pollutant Discharge Elimination System outfalls that are collocated at or near radiological liquid effluent locations, and water quality surveillance 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 2022, 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.

In 2022, 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 SCDHEC, 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

Appendix Table D-13 shows the maximum of each radionuclide compared to the applicable SRS control location. The Z-Area Stormwater Basin, a posted soil contamination area, had the maximum cesium-137 concentration of 1430 pCi/g. Soil contamination areas at SRS are locations where the contamination levels exceed 150 pCi/g for beta and gamma radionuclides. Table 5-9 shows the maximum cesium-137 concentrations found in river, stream, and basin sediment, by sampling 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 5-9 Maximum Cesium-137 Concentration in Sediments Collected in 2022**

Location	Maximum Location	Maximum Concentration (pCi/g)
Savannah River Sediment	Steel Creek River Mouth	1.54E+00
SRS Stream Sediment	FM-2	3.37E+01
SRS Basin Sediment	Z Basin	1.43E+03

### 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 for 2022. Onsite sample analyses consist of tritium, gross alpha, gross beta, gamma-emitting radionuclides, strontium-89/90, and actinides.

SRS monitors potable water at offsite treatment facilities to ensure that SRS operations do not adversely affect the water supply and to assure that drinking water does not exceed 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.

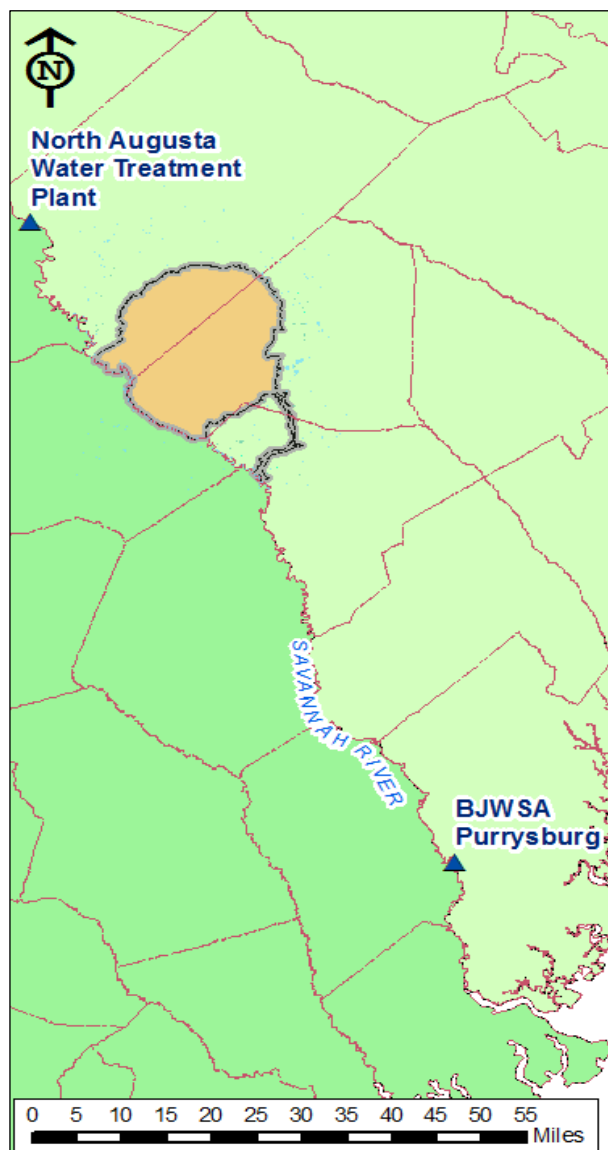
The North Augusta Water Treatment Plant samples determine concentrations in drinking water upstream of SRS. The Beaufort-Jasper Water and Sewer Authority's Purrysburg Water Treatment Plant is the furthest downriver sampling location. SRS compares these locations to evaluate potential impacts from upstream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

#### 5.4.8.1 Drinking Water Results Summary

In 2022, 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 pCi/mL (20,000 pCi/L) EPA standard for tritium, and no onsite drinking water samples exceeded the 8 pCi/L strontium-89/90 maximum contaminant level.

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 RM 141.5. The average tritium concentration at RM 141.5 is approximately 1.2% 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-89/90, uranium-235, plutonium-239, and curium-244 in onsite drinking water test locations. Sample results indicated detectable levels of americium-241 in one onsite sample, plutonium-238 in two onsite samples, uranium-234 in two onsite samples, and uranium-238 in three onsite samples. Appendix Table D-14 summarizes the results. Americium-241 and plutonium-238 concentrations are near the method detection limit, and the uranium is natural. All analytical results are well below the EPA standard.



**Figure 5-11 Offsite Drinking Water Sampling Locations**

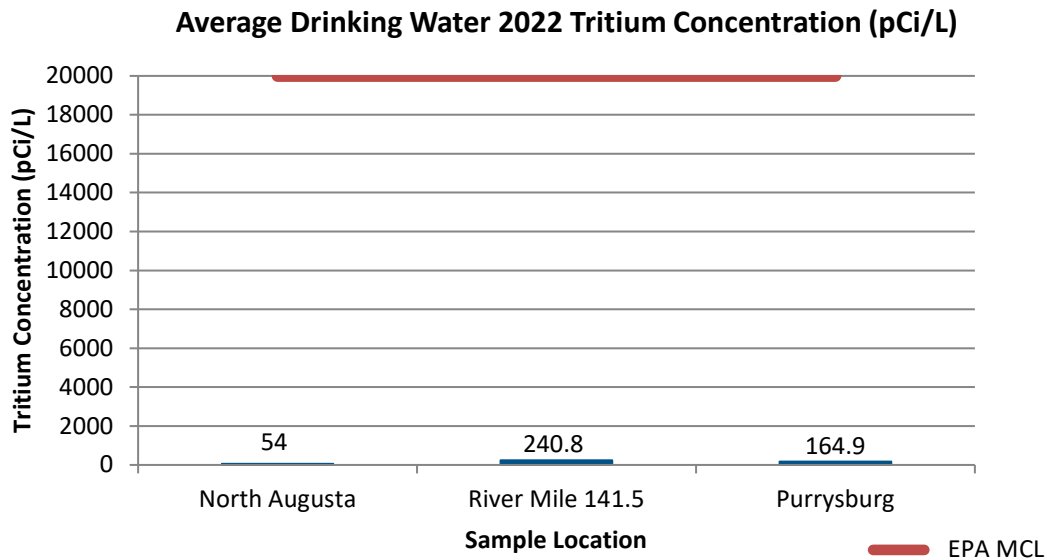


Figure 5-12 Tritium in Offsite Drinking Water and River Mile 141.5

## 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. During 2020, the flathead fish was added to the routine freshwater fish types collected. 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 5-10 identifies the aquatic products collected in 2022. 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 (that is, cesium-137 and cobalt-60), strontium-89/90, technetium-99, and iodine-129. Strontium-89/90 is the only analysis SRS conducts on the nonedible samples.

Table 5-10 Aquatic Products Collected by SRS in 2022 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 2022, 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 in the Savannah area from a supplier that harvests from saltwater potentially influenced by Savannah River water. SRS analyzed 69 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, and shellfish collected are consistent with results for the previous 10 years. Most of the results for the specific radionuclides associated with SRS operations were nondetectable (63% for freshwater fish, 71% for saltwater fish, and 86% for shellfish). Table 5-11 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 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 all freshwater and saltwater fish and shellfish. 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 the fish monitoring.

**Table 5-11 Location and Fish Type for the Maximum Detected Concentration of Specific Radionuclides Measured in Flesh Samples Collected in 2022**

Radionuclide	Maximum Concentration	Location	Fish Type
<b>Cesium-137</b>	0.814 pCi/g	Lower Three Runs Creek Mouth	Catfish
<b>Strontium-89/90</b>	0.00576 pCi/g	Four Mile Creek River Mouth	Catfish
<b>Technetium-99</b>	0.0681 pCi/g	Lower Three Runs Creek Mouth	Bass

## 5.6 WILDLIFE SURVEILLANCE

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 mrem/yr. Annual game animal hunts for deer, coyote, and feral hogs are open to the public. During 2022, SRS held one turkey hunt for Wounded Warriors and residents with mobility impairments in the spring and nine game animal

hunts in the fall. The Site holds the annual hunts to reduce animal-vehicle collisions and control Site 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 picocuries per gram (pCi/g) for hogs (Morrison et al., 2019) and 2.59 pCi/g for the deer and coyote (Aucott et al., 2017), decay corrected for hunt date. In addition to the 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, 2) the field measured cesium-137 activity concentration, or 3) exposure limit considerations. These laboratory-analyzed data provide 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-89/90, 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-89/90.

### **5.6.1 Wildlife Results Summary**

During the hunts in 2022, SRS monitored a total of 261 deer, 39 feral hogs, 12 coyotes, and seven turkeys. SRS did not assign a dose to any hunter during the turkey hunt and two of the nine game animal hunts. This indicates that all animals harvested during those hunts were at or below the decay corrected background cesium-137 concentration of 1.97 pCi/g for the hogs and 2.59 pCi/g for all other animals. All animals harvested during the 2022 hunts were below the administrative game animal release limit of 22 mrem. SRS released all animals to the hunters.

Appendix Table D-18 summarizes the muscle and bone laboratory sample results from a subset of the monitored deer and hogs. As seen in previous years, laboratory analysis detected cesium-137 in muscle tissue. Laboratory analysis detected strontium-89/90, a beta-emitting radionuclide, in bone and in some muscle tissue.

Generally, the field detector results are similar to that of laboratory methods. Figure 5-13 compares the 2022 field versus laboratory measurement for each deer muscle sample collected. Table 5-12 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. Figure 5-14 shows the historical trend analysis.

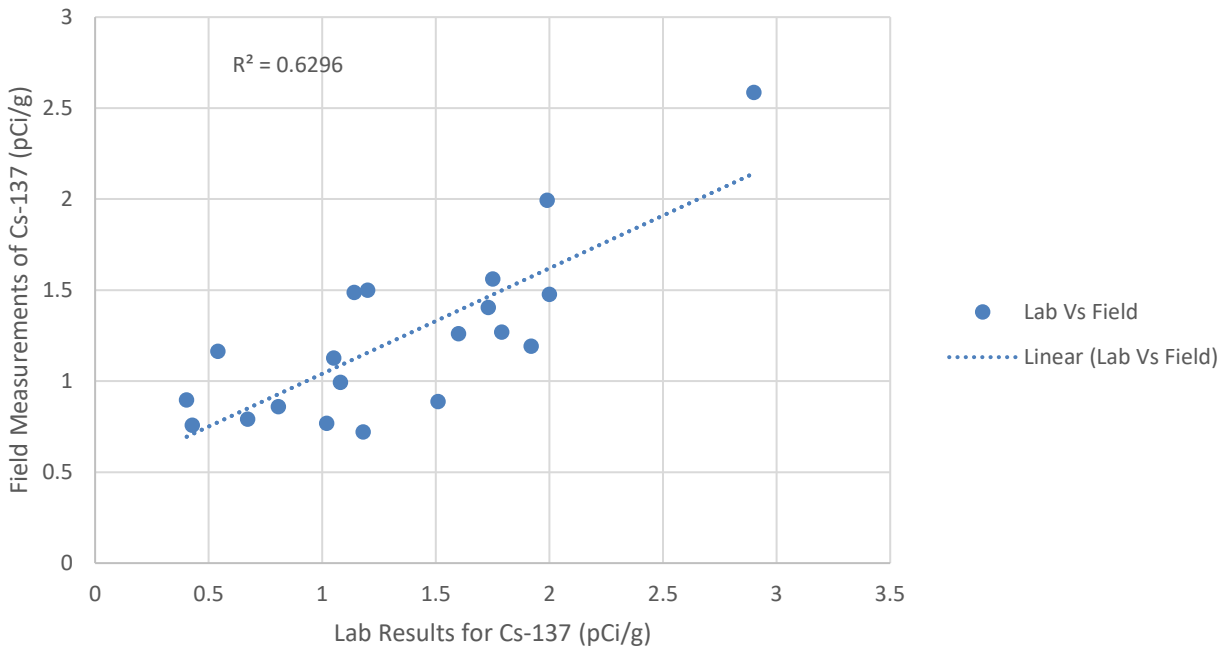


Figure 5-13 Field Results versus Laboratory Results for Cs-137

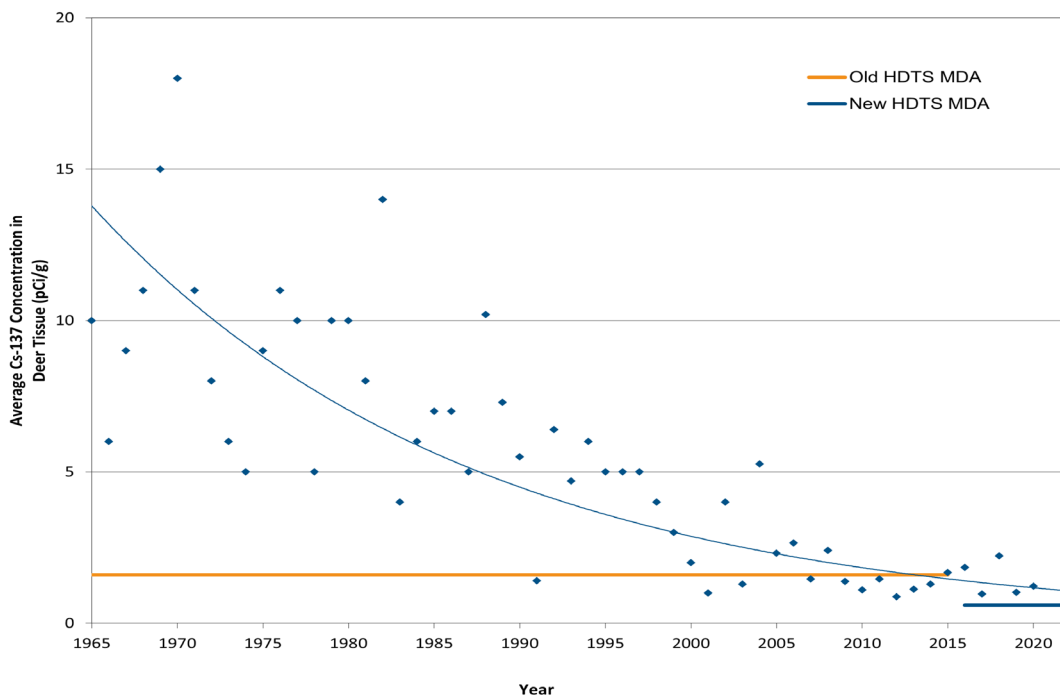


Figure 5-14 Yearly Average Cs-137 Concentration in Wildlife, 1965-2022

**Table 5-12 Cesium-137 Results for Laboratory and Field Measurements in Wildlife for CY 2022**

	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	261	1.25	6.9	34	34	1.02	2.9
Hog	39	1.29	2.38	6	6	1.39	3.05
Coyote	12	0.98	2.09	----	----	----	----
Turkey	7	0.69	0.75	----	----	----	----

Because its chemistry is similar to that of calcium, strontium is found in higher concentration in bone than in muscle tissue. In 2022, all 34 deer bone and all 6 hog bone samples had detectable levels of strontium-89/90. Strontium-89/90 was detected in deer bone with an average of 2.41 pCi/g and a maximum of 5.83 pCi/g. Strontium-89/90 was detected in hog bone with an average of 4.36 pCi/g and a maximum of 11.1 pCi/g.

Chapter 6, *Radiological Dose Assessment*, presents the calculation of dose from consuming wildlife harvested on SRS.

## 5.7 ENHANCEMENTS TO THE CREEK PLANTATION MONITORING PROGRAM

The Creek Plantation property is a privately owned area located in Allendale County, South Carolina, along the Savannah River that borders the southeast portion of SRS (Figure 5-15). The property includes undeveloped and agricultural land use supporting equestrian, cattle-related operations, and timber production. The portion of the Creek Plantation property that runs adjacent to the Savannah River is within the Savannah River floodplain and includes low-lying swamp habitat. It is uninhabited, not easily accessible, and is of monitoring interest because historically during the 1960s approximately 25 curies (Ci) of cesium-137, 1 Ci of cobalt-60, and trace amounts of strontium-89/90 deposited in the area during high rain and flood events. During high river stage, water from Steel Creek transported radioactive materials that were deposited in the Creek Plantation Floodplain (CPF). CPF is bounded to the northwest by Steel Creek, the source of contamination, and by Little Hell Landing to the southeast (Figure 5-13). It has been part of the SRS Environmental



**Savannah River Swamp at Creek Plantation**

Monitoring Program since 1974. The concentration of cesium-137 found vegetation within the CPF has decreased since 1974.

In general, the long-term monitoring of the CPF has consisted of annual cursory surveys, supplemented by a comprehensive survey every five years. The subsequent cursory field sampling entails soil and vegetation samples analyzed for cobalt-60, cesium-137, and strontium-89/90, as well as dosimeter deployment to measure ambient gamma exposure levels. The comprehensive survey entails multiple soil and vegetation sampling locations along 10 trails located within the CPF,



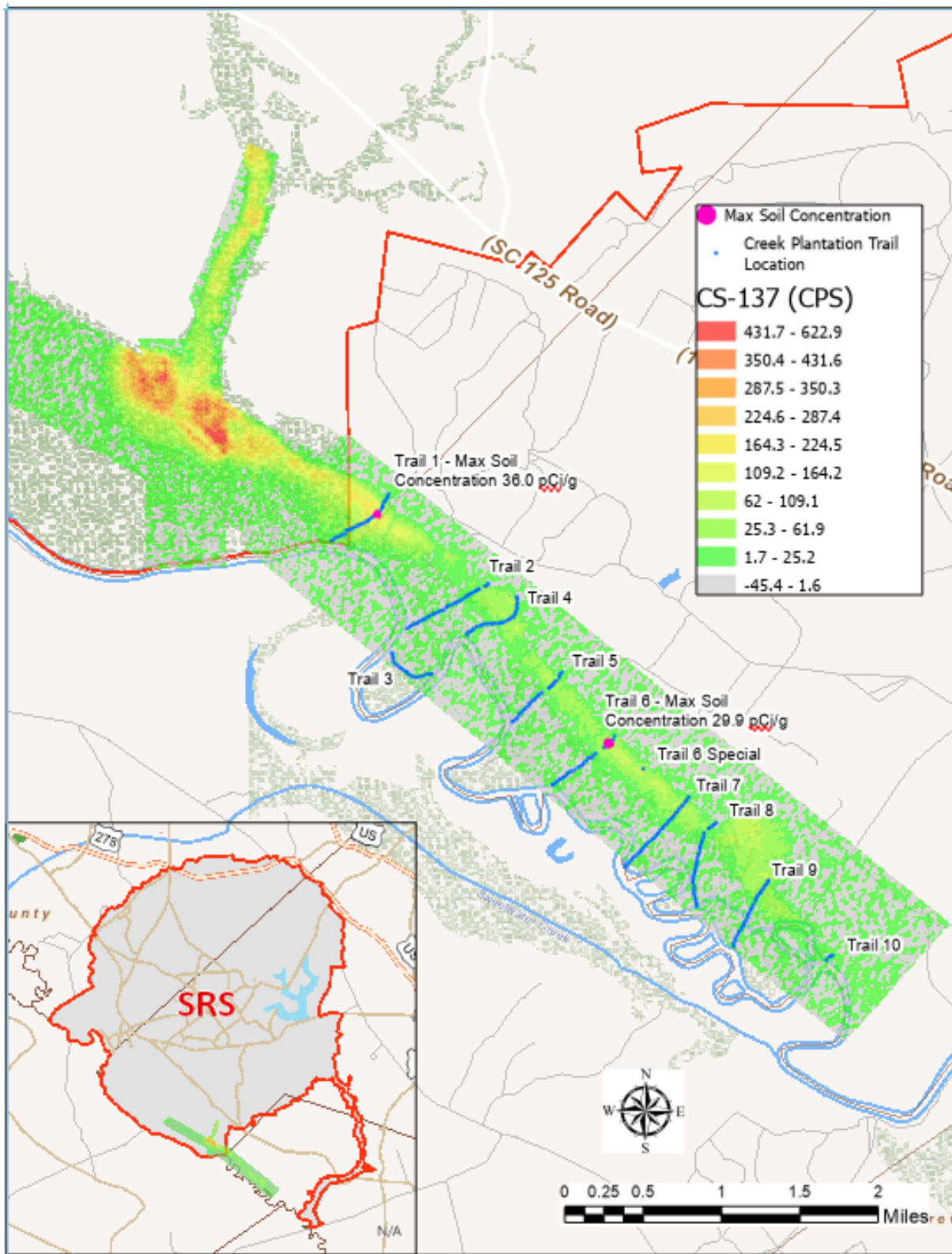
**Creek Plantation Trail 5**

with each trail beginning at the edge of the Savannah River and progressing inland (Figure 5-15). The annual cursory surveys focus on field sampling and dosimeter deployment from the locations with the highest cesium-137 soil activities that the previous five-year comprehensive study identified. In 2011, gamma overflight surveys of the CPF were initiated and conducted again in 2016 to supplement the comprehensive field survey. The gamma overflight measurements are obtained using gamma spectroscopy instrumentation mounted from a helicopter flying over the floodplain at low altitudes and slow ground speeds. The purpose of the gamma survey is to determine whether the vegetation sampling locations should move or if additional survey locations are warranted. The 2016 gamma overflight survey indicated an additional potential area of contamination between Trails 6 and 7. An additional sampling trail location (Trail-6 Special) was added to account for this area. The last comprehensive survey was completed in 2017, and the results of annual monitoring activities have shown that cesium-137 activity concentrations are decreasing in soil and vegetation in the CPF.

With technological advancements and the potential availability of further SRS overflight surveying, enhancements to the monitoring program were envisioned to: 1) identify areas of elevated activities of cesium-137 in the CPF; and 2) use SRS resources more efficiently to target areas with elevated cesium-137 activity for long-term monitoring. Conducting the comprehensive field surveys requires extensive up-front planning. It is labor-intensive and difficult to implement because of river stage, hard to navigate swampy terrain, and increased costs for adequate worker protection measures. Timber production in the area results in additional access, safety, and maneuverability and navigation concerns including lost or missing OSLDs and signs marking trails and access areas.

### **5.7.1 Creek Plantation Results Summary**

SRS collected soil samples at four creek plantation trail locations: three on Trail 1 and one on Trail 6. Annual soil sample results are summarized in Section 5.3.5.1 and displayed in Appendix D-7. The maximum cesium-137 soil concentration at Creek Plantation was 36 pCi/g on Trail 1 – 1805 feet. Figure 5-15 presents the 2022 gamma flyover results, showing cesium-137 activity in counts per second. The survey confirmed trail locations are still in the optimal location for soil sampling.



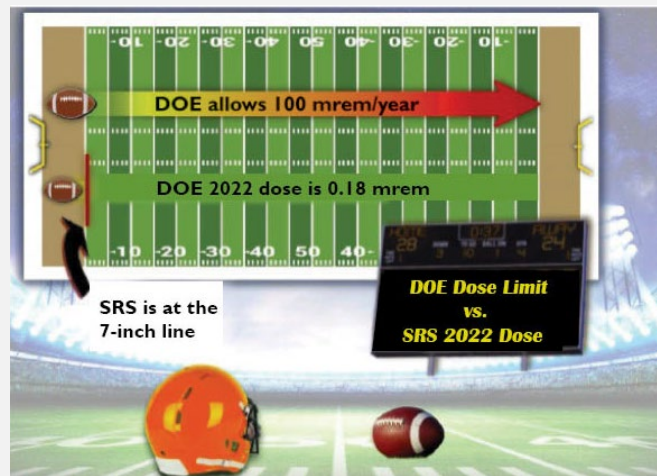
**Figure 5-15 2022 Gamma Overflight Survey of Creek Plantation**  
 (Gamma Activity in Counts Per Second [CPS], maximum Cs-137 Concentrations Found in 2022 Annual Soil Samples are Displayed Next to Trail Name)

# Chapter 6: Radiological Dose Assessment

**D**epartment of Energy (DOE) Order 458.1, “Radiation Protection of the Public and the Environment,” establishes dose limits for the public and 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 (mrem)/year (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.

## 2022 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 2022, the dose to the offsite representative person was 0.17 mrem from liquid releases and 0.016 mrem from air releases. The total representative person dose was 0.18 mrem, which is 0.18% of the 100 mrem/yr DOE dose limit.



Comparison of DOE’s 100 mrem/yr Dose Limit to SRS’s 2022 All-Pathway Dose of 0.18 mrem

## 2022 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 2022, the maximum potential dose an onsite hunter received was 8.76 mrem, or 8.76% of DOE’s 100 mrem/yr all-pathway dose standard.
- **Creek Mouth Fisherman**—SRS estimated the maximum potential dose from fish consumption from catfish collected at the mouth of Lower Three Runs at 0.57 mrem. This dose is 0.57% of the 100 mrem/yr DOE dose limit. SRS bases this hypothetical dose on the low probability that, during 2022, a fisherman consumed 53 pounds (lbs) of catfish 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 2022. SRS unconditionally released 13,488 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 for evaluating radiation doses to aquatic and terrestrial biota to comply with DOE Order 458.1. For 2022, 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 SRS operations release controlled amounts of radioactive materials to the environment through air and water. These releases could expose people offsite to radiation. To confirm that this 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 DOE biota dose limits. This chapter explains radiation doses, describes how SRS calculates doses, and presents the estimated doses from SRS activities for 2022.

*Radiological Impact of 2022 Operations at the Savannah River Site* (Stagich, Dixon, and Peyton 2023) details SRS dose calculation methods and results. SRS used the data from the monitoring programs described in Chapter 5, *Radiological Environmental Monitoring Program*, to calculate the potential doses to the public.

## 6.2 WHAT IS RADIATION DOSE?

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. 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).

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. 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

## 6.3 CALCULATING DOSE

To comply with DOE Order 458.1, SRS can calculate dose to the maximally exposed individual (MEI) or to a representative person. The MEI is usually assumed to be an adult male, and the representative person is representative of all ages and genders of the highly exposed individuals in the population. Since 2012, SRS has used the representative person concept to determine whether the Site is complying with the DOE public dose limit. SRS calculates the representative person dose using Site-specific reference person parameters. The SRS representative person falls at the 95th percentile of national and regional data. The

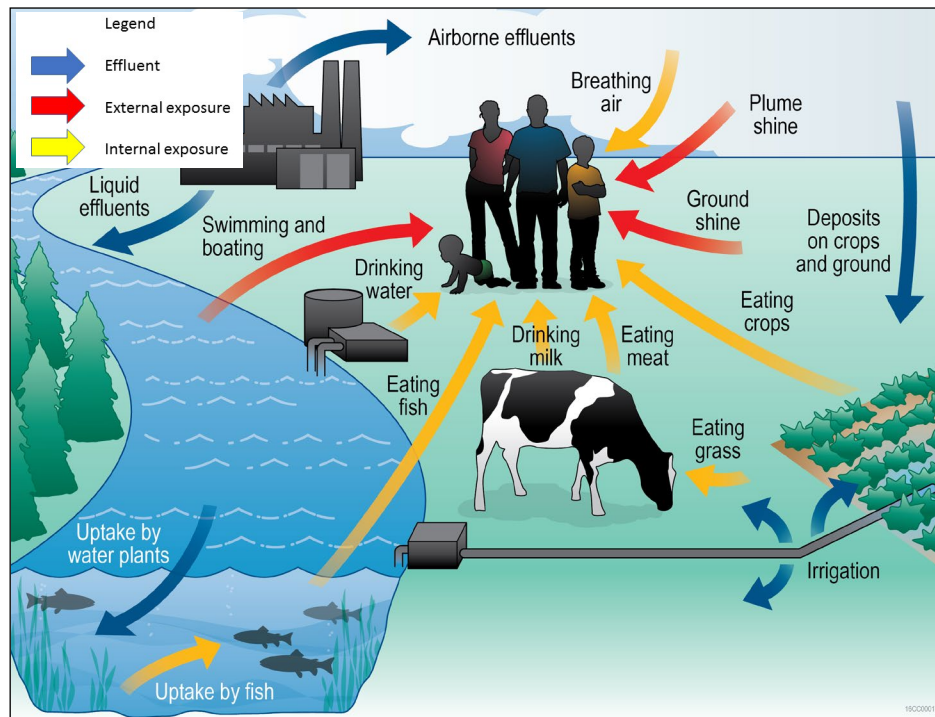
### Chapter 6—Key Terms

***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.



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

applicable national and regional data used are 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).

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. 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

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<sup>®</sup> 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-1196-2021 (DOE 2021).
- 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. SRS calculated potential offsite doses from radioactive releases to the air with quality-assured weather data from 2014 to 2018 (Bell 2020).

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.

### 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

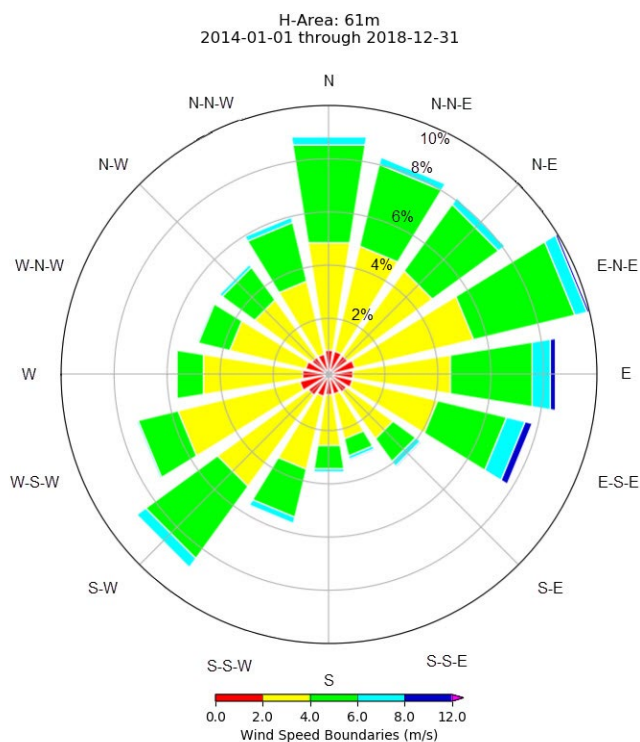


Figure 6-2 2014-2018 Wind Rose Plot for H Area (Showing Direction and Frequency Toward Which the Wind Blows)

within a 50-mile radius of H Area is 838,833 people. This translates to about 107 people per square mile outside the SRS boundary, with the largest concentration in the Augusta metropolitan area.

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

The total population dose from routine SRS liquid releases is 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 Regional Water Supply Service**

<b>Water Supply Plant</b>	<b>Nearest City</b>	<b>Population Served</b>
<b>City of Savannah I&amp;D</b>	Port Wentworth, Georgia	37,637 people
<b>BJWSA Chelsea Water Treatment Plant</b>	Beaufort, South Carolina	107,000 people
<b>BJWSA Purrysburg Water Treatment Plant</b>	Beaufort, South Carolina	83,000 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 1982 to 2022. It also shows that the average river flow rate for these years is about 10,013 cubic feet per second (cfs). However, except for in 2020, there has been a downward trend in these data, with an average measured flow rate of 9,321 cfs.

For 2022, SRS used a calculated “effective” Savannah River flow rate of 7,230 cfs in the dose calculations. The 2022 effective flow rate is about 14% less than the 2021 effective flow rate of 8,456 cfs. This effective flow rate (based on actual measured tritium concentrations in the river) is more conservative than the 2022 USGS measured flow rate of 8,773 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.

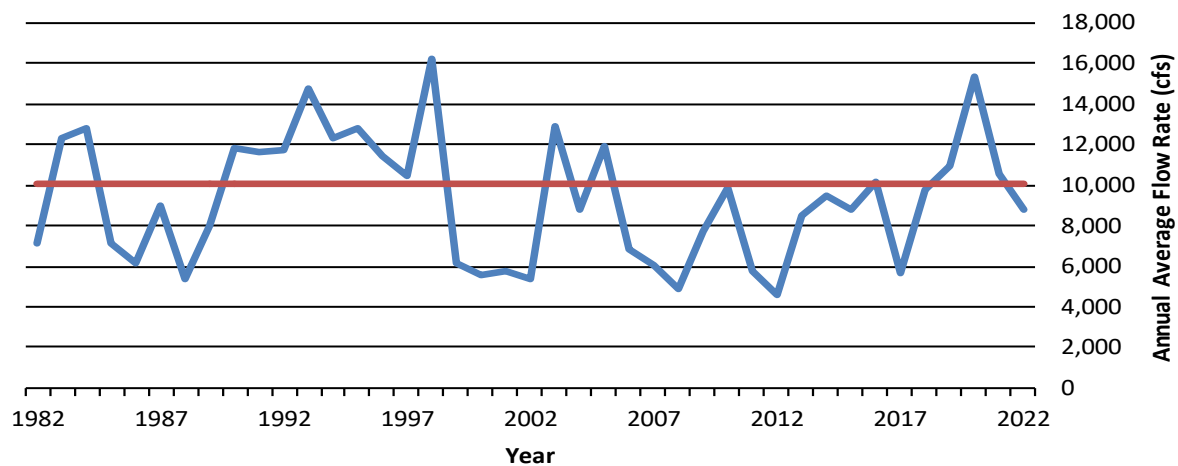


Figure 6-3 Savannah River Annual Average Flow Rates Measured by USGS at River Mile 118.8

## 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

#### 6.4.1.1 Liquid Release Source Terms

Table 6-2 shows, by radionuclide, the amount of radioactivity in liquid form that SRS released in 2022. SRS uses these release amounts in the dose calculations. Chapter 5, *Radiological Environmental Monitoring Program*, discusses these sources of data.

Tritium accounts for more than 99% of the total amount of radioactivity released from the Site to the Savannah River. In 2022, SRS released 348 curies (Ci) of tritium to the river, a 28% decrease from the 2021 amount of 483 Ci. For compliance dose calculations, SRS used the measured direct release total (348 Ci), which was higher than the stream transport measurement (246 Ci).

During 2022, in addition to the 348 Ci SRS released, the Georgia Power Company's Vogtle Electric Generating Plant (VEGP) released 1,430 Ci of tritium to the Savannah River, and about 13.2 Ci migrated from the Barnwell Low-Level Disposal Facility (BLLDF). In Table 6-2, SRS used the "river transport" total of 1,556 Ci of tritium, which includes SRS, VEGP, and BLLDF contributions. Refer to Chapter 5, *Radiological Environmental Monitoring Program*, Section 5.4.5 for details concerning these measurements.

**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 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) maximum contaminant level (MCL) for each radionuclide.

**Table 6-2 2022 Liquid Release Source Term and 12-Month Average Downriver Radionuclide Concentrations Compared to the EPA's Drinking Water Maximum Contaminant Levels (MCLs)**

Nuclide	Curies Released	12-Month Average Concentration (pCi/L)		
		Below SRS <sup>a</sup>	BJWSA Purrysburg Plant <sup>b</sup>	EPA MCL <sup>c</sup>
H-3 <sup>d</sup>	1.56E+03	2.41E+02	1.65E+02	2.00E+04
C-14	7.09E-03	1.10E-03	7.51E-04	2.00E+03
Sr-90	1.63E-02	2.52E-03	1.72E-03	8.00E+00
Tc-99	1.22E-02	1.89E-03	1.29E-03	9.00E+02
I-129	1.30E-02	2.02E-03	1.38E-03	1.00E+00
Cs-137 <sup>e</sup>	1.91E-01	2.95E-02	2.02E-02	2.00E+02
Eu-154	6.35E-02	9.83E-03	6.73E-03	6.00E+01
U-234	6.35E-02	9.83E-03	6.73E-03	1.03E+01
U-235	3.73E-03	5.78E-04	3.96E-04	4.67E-01
U-238	7.20E-02	1.11E-02	7.63E-03	1.00E+01
Np-237	9.07E-05	1.40E-05	9.61E-06	1.50E+01
Pu-238	2.53E-04	3.92E-05	2.68E-05	1.50E+01
Pu-239	2.72E-05	4.21E-06	2.88E-06	1.50E+01
Am-241	2.60E-05	4.02E-06	2.76E-06	1.50E+01
Cm-244	1.02E-05	1.58E-06	1.08E-06	1.50E+01
Gross Alpha	1.04E-02	1.61E-03	1.10E-03	1.50E+01
Nonvolatile Beta	4.39E-02	6.79E-03	4.65E-03	8.00E+00

<sup>a</sup> Near Savannah River Mile 141.5, downriver of SRS near the Steel Creek mouth

<sup>b</sup> Beaufort-Jasper Water and Sewer Authority, drinking water at the Purrysburg Water Treatment Plant

<sup>c</sup> MCLs for uranium based on radioisotope-specific activity X 30 µg/L X isotopic abundance

<sup>d</sup> 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 VEGP and the BLLDF. In 2022, SRS used the effective river flow rate of 7,230 cfs (see Section 6.3.3) to calculate all other radionuclide concentrations.

<sup>e</sup> 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.)

**Radionuclide Concentrations in River Water and Treated Drinking Water**—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. In 2022, the 12-month average tritium concentration measured in Savannah River water near RM 141.5 was 241 picocuries per liter (pCi/L). This concentration is well below the EPA's MCL for tritium of 20,000 pCi/L. Table 6-2 also provides the calculated concentrations 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.

**Radionuclide Concentrations in Fish—**

Consuming fish is an important dose pathway for the representative person. Fish exhibit a high degree of bioaccumulation 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).

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 2022, SRS used the Steel Creek fish concentrations to determine the Site's overall cesium-137 release value of 0.191 Ci, which is conservatively higher than the measured cesium-137 effluent release value of 0.00959 Ci.

**6.4.1.2 Dose to the Representative Person**

SRS estimates the 2022 potential dose to the representative person from all liquid pathways (including irrigation) to be 0.17 mrem (0.0017 mSv), which is 39% less than the comparable dose of 0.28 mrem in 2021.

Table 6-3 shows that the total liquid pathway dose is 0.17% of the DOE public dose limit of 100 mrem/yr (1 mSv/yr).

About 28% of the 2022 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. The fish consumption pathway accounted for 64%, and the drinking water pathway accounted for 6%. As Figure 6-4 shows, cesium-137 (70%), nonvolatile beta (6%), uranium-234 (5%) and uranium-238 (5%) contributed the most to the liquid pathway dose.

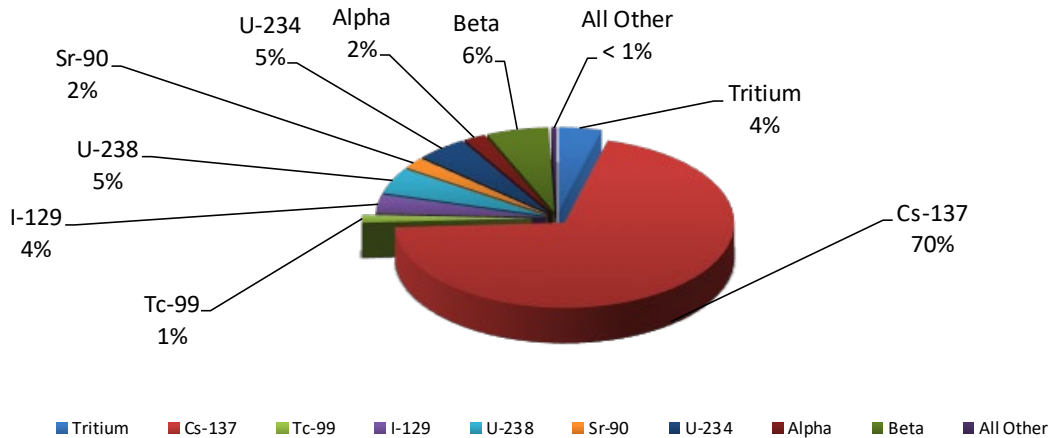


**SRS Samples Fish from the Savannah River Using Electrofishing Methods. Radionuclide Concentrations in Fish Harvested from the Steel Creek Mouth are Used in the Representative Person Dose Calculations.**

**Table 6-3 Potential Dose to the Representative Person from SRS Liquid Releases in 2022**

	Dose (mrem)	Applicable Limit (mrem)	Percent of Limit (%)
<b><i>Near Site Boundary (All Liquid Pathways)</i></b>			
<b>All Liquid Pathways Except Irrigation</b>	0.12		
<b>Irrigation Pathways</b>	0.048		
<b>Total Liquid Pathways</b>	0.17	100 <sup>a</sup>	0.17%

<sup>a</sup> DOE dose limit: 100 mrem/yr (DOE Order 458.1)



**Figure 6-4 Radionuclide Contributions to the 2022 SRS Total Liquid Pathway Dose of 0.17 mrem (0.0017 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 from VEGP and BLLDF. In 2022, SRS estimated the maximum potential drinking water dose from all sources to be 0.024 mrem (0.00024 mSv). Tritium in downriver drinking water represented the highest percentage of the dose (about 71%) received by customers of the three downriver water treatment plants.

SRS-only releases were responsible for a maximum potential drinking water dose of 0.011 mrem (0.00011 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 2022 maximum drinking water dose of 0.011 mrem is well below this value.

### 6.4.1.4 Collective (Population) Dose

SRS calculates the collective drinking water consumption dose for the separate population groups that are customers of the BJWSA and City of Savannah I&D water treatment plants. Calculations of collective doses from agricultural irrigation assume that major food types (vegetables, milk, and meat) 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 2022, the collective dose from all liquid pathways was 2.0 person-rem (0.020 person-Sv).

## 6.4.2 **Air Pathway**

### 6.4.2.1 Air Release Source Terms

Chapter 5, *Radiological Environmental Monitoring Program*, documents the 2022 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 2022, 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 2022 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 2022 dose is 6% lower than the 2021 dose of 0.017 mrem (0.00017 mSv). SRS attributes most of this decrease to the 14% decrease in tritium oxide releases during 2022. 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.

As Figure 6-5 shows, tritium releases were 71% of the air pathway dose to the representative person. Iodine-129 accounted for 14% of the dose. Cesium-137 (7%), krypton-85 (4%), strontium-90 (2%), and plutonium-239 (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.

**Table 6-4 Potential Doses to the Representative Person and to the MEI from SRS Air Releases in 2022 and Comparison to the Applicable Dose Limit**

	DOE Representative Person (MAXDOSE-SR)	EPA NESHAP MEI (CAP88-PC)
Calculated dose (mrem)	0.016	0.029
Applicable Limit (mrem)	10 <sup>a</sup>	10 <sup>b</sup>
Percent of Limit (%)	0.16	0.29

<sup>a</sup> DOE: DOE Order 458.1

<sup>b</sup> EPA: (NESHAP) 40 CFR 61, Subpart H

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.

For 2022, 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 2022, SRS estimated the airborne-pathway collective dose to be 0.74 person-rem (0.0074 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.

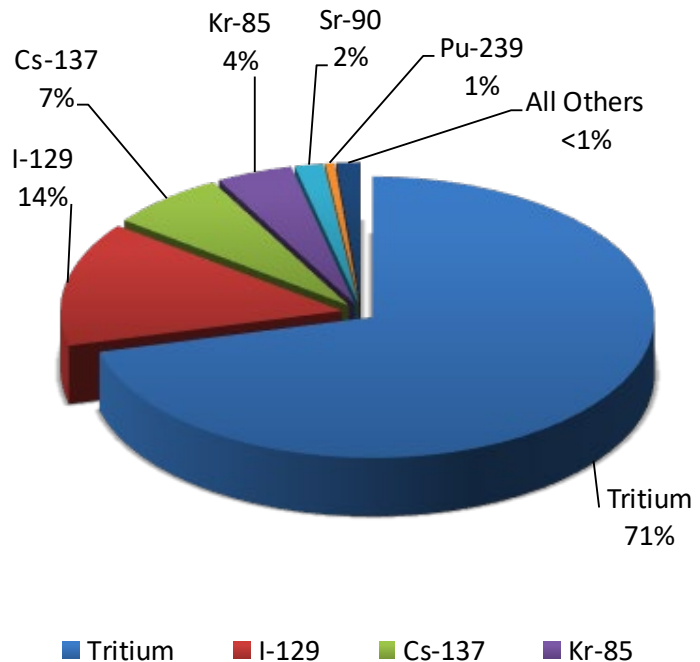
#### 6.4.2.5 National Emission Standards for Hazardous Air Pollutants (NESHAP) Compliance

DOE Order 458.1 requires the Site to comply with the EPA’s NESHAP regulations (EPA 2002). To demonstrate this compliance, SRS calculated the 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 2022 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 2022, 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 boundary in the north compass point direction. 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.



**Figure 6-5 Radionuclide Contributions to the 2022 SRS Air Pathway Dose of 0.016 mrem (0.00016 mSv)**

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 0.0292 mrem (0.000292 mSv). SRS estimated the MEI dose for the Three Rivers Landfill worker to be 0.0307 mrem (0.000307 mSv). For 2022, SRS reported the slightly higher Three Rivers Landfill worker dose of 0.0307 mrem for NESHAP compliance. This dose is 0.31% of the 10 mrem/yr EPA limit, as Table 6-4 shows.

The radionuclides that accounted for most of the MEI dose, were tritium oxide (41%), iodine-129 (29%), elemental tritium (20%), cesium-137 (3.7%), strontium-90 (1.1%), and krypton-85 (1.0%). No other radionuclide contributed 1% or more to the total MEI dose. The 2022 NESHAP compliance dose (Three Rivers Landfill dose) is 54% more than the 2021 dose of 0.0199 mrem (0.000199 mSv). SRS attributes most of this increase to the 94% increase in elemental tritium and 27% increase in iodine-129 releases during 2022, and the change in the I-129 dose factor. 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 2022, the potential representative person all-pathway dose is 0.18 mrem (0.0018 mSv), calculated as 0.17 mrem from liquid pathways plus 0.016 mrem from air pathways. As Table 6-5 shows, the all-pathway representative person dose is 0.18% of the 100 mrem/yr (1 mSv/yr) DOE dose limit. The all-pathway total dose is less than the 2021 total dose of 0.30 mrem (0.0030 mSv). As discussed previously, SRS attributes this decrease in 2022 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 2022**

Pathways	Committed Dose (mrem)	Applicable Limit (mrem)	Percent of Limit
<b>Near Site Boundary (All Pathways)</b>			
<b>Total Liquid Pathways</b>	0.17	100 <sup>a</sup>	0.17%
<b>Total Air Pathways</b>	0.016	10 <sup>a,b</sup>	0.16%
<b>Total All Pathways</b>	0.18	100 <sup>a</sup>	0.18%

<sup>a</sup> DOE: DOE Order 458.1

<sup>b</sup> EPA: (NESHAP) 40 CFR 61, Subpart H

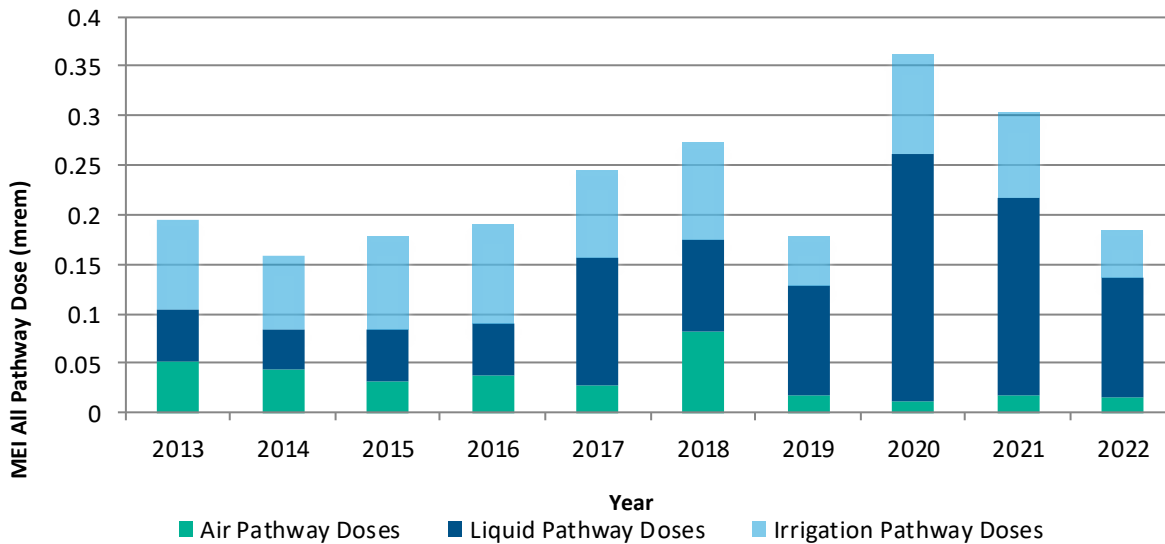


Figure 6-6 10-Year History of SRS Maximum Potential All-Pathway Doses

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 2022, the total potential collective all-pathway dose is 2.7 person-rem (0.027 person-Sv), calculated as 2.0 person-rem from liquid pathways plus 0.75 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 2.7 person-rem is less than 0.01% of the annual collective background dose from natural resources.

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 2022)

Pathways	Collective Dose (person-rem)	Natural Background Dose (person-rem)	Percent of Natural Background
<b>50-mile Population Dose (All Pathways)</b>			
Total Liquid Pathways	2.0	Not Applicable	Not Applicable
Total Air Pathways	0.75	Not Applicable	Not Applicable
<b>Total All Pathways</b>	<b>2.7</b>	261,000 <sup>a</sup>	< 0.01%

<sup>a</sup> 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).

## 6.5 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 2022, the maximum potential dose an onsite hunter received was 8.76 mrem (0.0876 mSv), or 8.76% 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 2022 hunts. For the hunter-dose calculation, SRS conservatively assumes that the hunter individually consumed the entire edible portion of this animal, about 23 kilograms (kg) (50 lbs).

**Turkey Consumption Pathway**—SRS typically hosts a special turkey hunt in April for hunters with mobility impairments. Hunters harvested eight turkeys in 2022. 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 (1.25 pCi/g) and hogs (1.29 pCi/g) harvested from SRS during 2022, the potential maximum doses from this pathway were estimated to be 3.06 mrem (0.0306 mSv) for the offsite deer hunter and 3.22 mrem (0.0322 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 hog consumption pathway dose (3.22 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 5.08 mrem (0.0508 mSv). This potential dose is 5.08% of the DOE 100 mrem/yr dose limit.

**Table 6-7 2022 Sportsman Doses Compared to the DOE Dose Limit**

	Committed Dose (mrem)	Applicable Standard (mrem) <sup>a</sup>	Percent of Standard (%)
<b>Sportsman Dose</b>			
Onsite Hunter	8.76	100	8.76
Creek-Mouth Fisherman <sup>b</sup>	0.57	100	0.57
<b>Savannah River Swamp Hunter</b>			
Offsite Hog Consumption	3.22		
Offsite Deer Consumption	3.06		
Soil Exposure <sup>c</sup>	1.86		
Maximum Offsite Hunter Dose (Hog + Soil Exposure)	5.08	100	5.08
<b>Savannah River Swamp Fisherman</b>			
Steel Creek Fish Consumption	0.57		
Soil Exposure <sup>d</sup>	2.08		
Total Offsite Fisherman Dose (Fish + Soil Exposure)	2.65	100	2.65

<sup>a</sup> DOE dose limit; 100 mrem/yr (DOE Order 458.1)

<sup>b</sup> The 2022 maximum dose to a hypothetical fisherman resulted from consuming catfish from the mouth of Lower Three Runs

<sup>c</sup> Includes the dose from combining external exposure and incidentally ingesting and inhaling the worst-case Savannah River swamp soil

<sup>d</sup> 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 2022, 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 0.57 mrem (0.0057 mSv) from catfish collected at the mouth of Lower Three Runs. SRS bases this hypothetical dose on the low probability scenario that during 2022, a fisherman consumed 24 kg (53 lbs) of catfish caught exclusively from the mouth of Lower Three Runs. All this potential dose was from cesium-137. As Table 6-6 shows, this dose is 0.57% of the DOE 100 mrem/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 6-6 shows, SRS added the maximum Lower Three Runs fish consumption dose (0.57 mrem) and the Savannah River Swamp fisherman soil exposure dose (2.08 mrem) to conservatively obtain a total offsite fisherman dose of 2.65 mrem (0.0265 mSv). This potential dose is 2.65% 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 2022, SRS estimated the maximum potential lifetime risk of developing fatal and nonfatal cancer from consuming SRS creek-mouth fish to be 4.3E-07. That is, if 10 million people each received a dose of 0.57 mrem, there is a potential for 4.3 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 2022; 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-SR 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 (VSIDS). In some areas, SRS documents equipment and material release directly on the radiological survey form. SRS subsequently compiled these VSIDS and survey forms and coordinated a sitewide review to determine the amount of material and equipment SRS released from its facilities in

2022. These measures ensure that radiological material releases from SRS are consistent with DOE Order 458.1 requirements.

SRS unconditionally released 13,488 items of personal property from radiological areas in 2022. 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 2022 Operations at the Savannah River Site (Stagich, Dixon, and Peyton 2023), 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 2022, 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 2022 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 2022, all land-based locations passed their initial Level 1 pathway screenings.

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# Chapter 7: Groundwater Management Program

**T**he purpose of the Savannah River Site's (SRS's) 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

## 2022 Highlights

**Drinking Water Standards**—The data show no exceedances of drinking water standards (measured by maximum contaminant limit [MCLs] or regional screening levels [RSLs]) in SRS boundary wells near A/M Area.

**Groundwater Contaminant Removal**—SRS removed 12,730 pounds (lbs) of volatile organic compounds (VOCs) from groundwater and the vadose zone, and prevented 45.2 curies (Ci) of tritium from reaching SRS streams.

**Offsite Groundwater Monitoring (Georgia)**— Since 2001, tritium has been detected in only a few offsite wells at concentrations less than 0.25 picocuries/milliliter (pCi/ml). This data supports the conclusions of a U.S. Geological Survey that indicate there is no mechanism by which groundwater could flow under the Savannah River and contaminate Georgia wells (Cherry 2006).

## 7.1 INTRODUCTION

Some of SRS's past operations have released chemicals and radionuclides into the soil and 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. The well monitoring meets sampling requirements in the [Federal Facility Agreement \(FFA\) for the Savannah River Site](#) (FFA 1993) and in Resource Conservation and Recovery Act (RCRA) permits, and ensures the Site is meeting 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 MCLs or the RSLs. Remediation includes closing waste units to reduce the potential for contaminants to reach groundwater, actively treating contaminated water, and employing passive and natural (attenuation) remedies.

Groundwater remediation at SRS focuses on VOCs 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 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 into SRS streams and the Savannah River.

## 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

## 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 zone; 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.

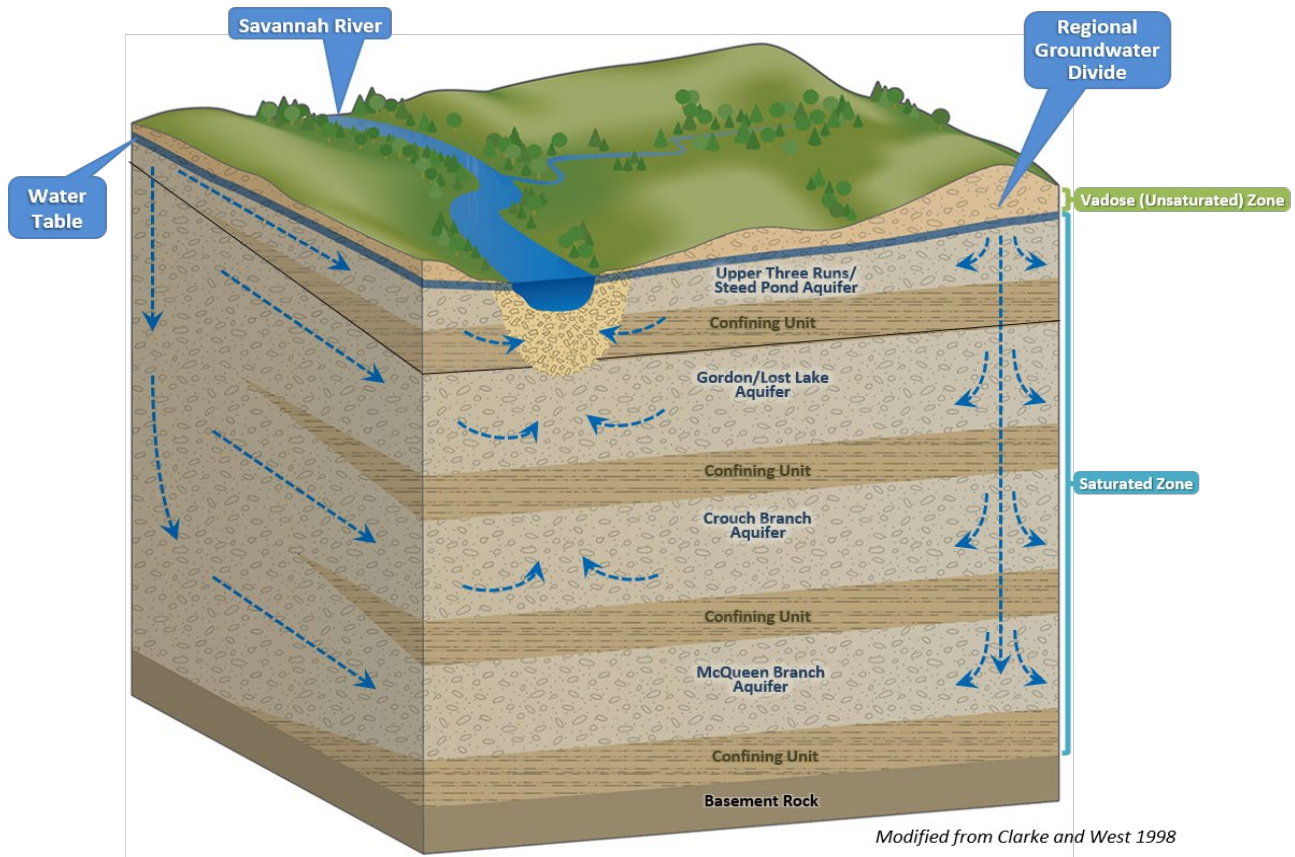


Figure 7-1 Groundwater at SRS

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).

### 7.3 GROUNDWATER PROTECTION PROGRAM AT SRS

SRS has designed and implemented a groundwater protection 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 groundwater
- Conserves groundwater

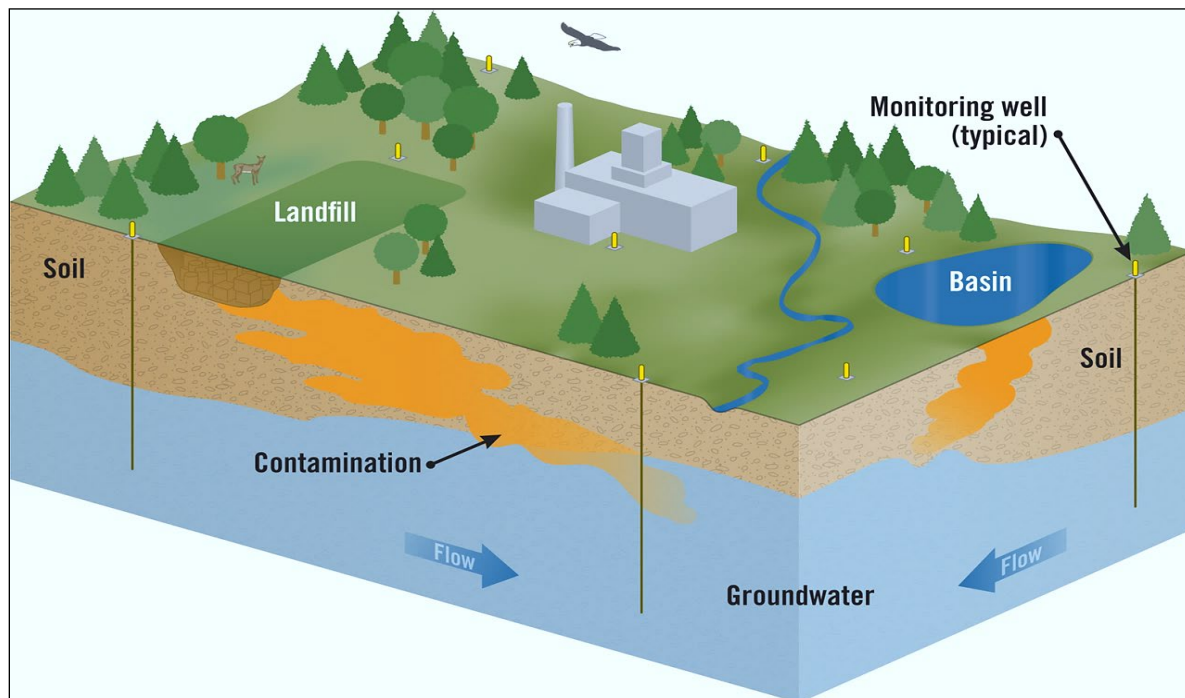


Figure 7-2 How Contamination Gets to Soil and Groundwater

### 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.

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 groundwater plume footprint
- Enhancing groundwater remediation through basic and applied research projects

Monitoring the groundwater around SRS facilities, waste disposal sites, and associated streams is the best way to detect and track contaminant migration. Through careful monitoring and analysis, SRS implements appropriate remedial or corrective actions. Figure 7-3 shows the groundwater plumes associated with SRS.

Increasing national attention to “emerging contaminants” or contaminants of emerging concern (CEC) can prompt a call for action from federal, state, and local government. 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 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 associated with a former firefighting training area. Sampling has continued into 2022. Results from 2022 groundwater sampling range from <1 nanogram/liter (ng/L) up to 1,980 ng/L, which are similar to the 2020 and 2021 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.



**SRS Engineers Inspect a Solar-powered MicroBlower™.**

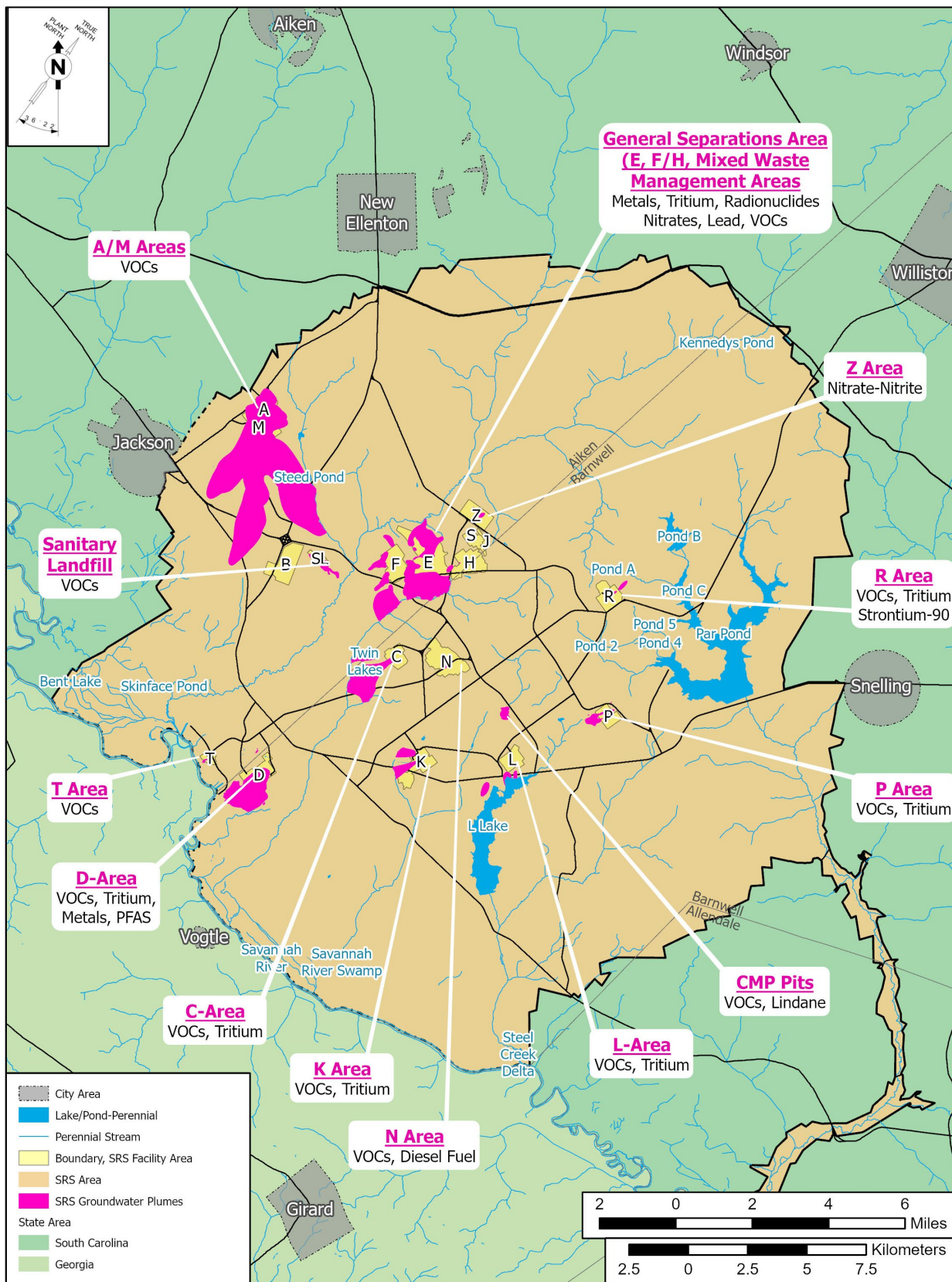


Figure 7-3 Groundwater Plumes at SRS

### 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 help define 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 2022 Groundwater Data 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, groundwater flow direction 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 2023a). The data show no exceedances of drinking water standards (MCLs or RSLs) in SRS boundary wells near A/M Area. 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 2022 monitoring data, and compares the maximum concentrations to the appropriate drinking water standards. Table 7-2 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
<b>Gross Alpha</b>	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.
<b>Nonvolatile Beta</b>	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.
<b>Tritium</b>	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.
<b>Trichloroethylene (TCE) and tetrachloroethylene (PCE)</b>	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.
<b>Vinyl Chloride</b>	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.
<b>1,4-Dioxane<sup>a</sup></b>	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. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
<b>Per- and polyfluoroalkyl substances (PFAS)<sup>a</sup></b>	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. It causes low birth weights, effects on the immune system, cancer, and thyroid disruption.

<sup>a</sup> 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	2022 Max Concentration	Well	MCL/RSL	Likely Stream Endpoints
<b>A/M Area</b>	Tetrachloroethylene	µg/L	91,900	MSB002CR	5	Upper Three Runs
	Trichloroethylene	µg/L	48,000	MSB002CR	5	
	1,4-Dioxane	µg/L	480	MCB037C	6.1 <sup>a</sup>	
<b>C Area</b>	Tetrachloroethylene	µg/L	9.95	CRP 5C	5	Fourmile Branch
	Trichloroethylene	µg/L	2,430	CRP 20CU	5	
	Tritium	pCi/mL	1,210	CRW024C	20	
	Vinyl Chloride	µg/L	59.9	CRP 50B	2	
	cis-1,2-Dichloroethylene	µg/L	37.3	CRP 20CU	5	
<b>CMP Pits (G Area)</b>	Tetrachloroethylene	µg/L	2,700	CMP 35D	5	Pen Branch
	Trichloroethylene	µg/L	1,860	CMP 35D	5	
	Lindane	µg/L	8.54	CMP 35D	0.2	
	1,4-Dioxane	µg/L	87.1	CMP 35D	0.46	
<b>D Area</b>	Beryllium	µg/L	122	DCB 21B	4	Savannah River
	Tetrachloroethylene	µg/L	6.74	DCB 45C	5	
	Trichloroethylene	µg/L	104	DCB 62	5	
	Vinyl Chloride	µg/L	12.2	DOB 15	2	
	Tritium	pCi/mL	152	DCB 26AR	20	
	PFAS	ng/L	1,980	DCB 62	70 <sup>b</sup>	
<b>E Area (MWMF)</b>	Trichloroethylene	µg/L	369	HSB120C	5	Upper Three Runs/ Fourmile Branch
	1,4-Dioxane	µg/L	558	BSW 6C3	6.1 <sup>a</sup>	
	Tritium	pCi/mL	76,400	BGO 15D	20	
	Nonvolatile Beta	pCi/mL	31.9	HSP-097A	50 <sup>c</sup>	
	Gross Alpha	pCi/mL	24.3	BSW 3D2	15	
<b>F Area</b>	Trichloroethylene	µg/L	17.9	FBP 43DL	5	Fourmile Branch
	Tritium	pCi/ml	127	FGW005C	20	
	Gross Alpha	pCi/L	1,390	FGW005C	15	
	Nonvolatile Beta	pCi/L	970,000	FGW005C	50 <sup>c</sup>	
<b>F-Area HWMF</b>	Trichloroethylene	µg/L	11.8	FSB 78C	5	Fourmile Branch
	Tritium	pCi/ml	798	FSB 95CR	20	
	Gross Alpha	pCi/L	281	FSB 126D	15	
	Nonvolatile Beta	pCi/L	477	FSB 126D	50 <sup>c</sup>	
<b>F-Area Tank Farm</b>	Tritium	pCi/ml	3.66	FTF012R	20	Fourmile Branch/ Upper Three Runs
	Nonvolatile Beta	pCi/L	603	FTF 28	50 <sup>c</sup>	
<b>H Area</b>	Trichloroethylene	µg/L	3.5	HGW 2D	5	Upper Three Runs/ Fourmile Branch
	Gross Alpha	pCi/L	20.1	HAA 5D	15	
	Nonvolatile Beta	pCi/L	13.5	HAA 9AR	50 <sup>c</sup>	
	Tritium	pCi/mL	22.9	HGW 2D	20	
<b>H-Area HWMF</b>	Trichloroethylene	µg/L	61.4	HSB120C	5	Fourmile Branch
	Tritium	pCi/mL	1,990	HSB120C	20	
	Gross Alpha	pCi/L	36.7	HSB102D	15	
	Nonvolatile Beta	pCi/L	385	HSB102D	50 <sup>c</sup>	

Table 7-2 Summary of the Maximum Contaminant Concentrations for Major Areas within SRS (continued)

Location	Major Contaminant	Units	2022 Max Concentration	Well	MCL/RSL	Likely Stream Endpoints
<b>H-Area Tank Farm</b>	Tritium	pCi/mL	35.9	HAA 12C	20	Fourmile Branch/ Upper Three Runs
	Nonvolatile Beta	pCi/L	24.7	HAA 12B	50 <sup>c</sup>	
<b>K Area</b>	Tetrachloroethylene	µg/L	5.4	KDB 1	5	Indian Grave Branch
	Trichloroethylene	µg/L	2.2	KRP 9	5	
	Tritium	pCi/mL	1,130	KRB 19D	20	
<b>L Area</b>	Tetrachloroethylene	µg/L	68.4	LSW 25DL	5	Steel Creek
	Trichloroethylene	µg/L	3.56	LSW025DL	5	
	Tritium	pCi/mL	392	LSW 25DL	20	
<b>P Area</b>	Trichloroethylene	µg/L	7,250	PGW026DLL	5	Steel Creek/ Lower Three Runs
	Tritium	pCi/mL	11,100	PSB002B	20	
	Tetrachloroethylene	µg/L	671	PAO003DU	5	
	cis-1,2-Dichloroethylene	µg/L	131	P003L	5	
	1,1-Dichloroethylene	µg/L	8.5	PRP 6	7	
<b>R Area</b>	Trichloroethylene	µg/L	24.2	RAG008B	5	Lower Three Runs
	Tritium	pCi/mL	376	RPS004DR	20	
	Carbon-14	pCi/L	35.4	RDB 3D	2,000	
	Strontium-90 <sup>d</sup>	pCi/L	14.4	RSE029D	8	
<b>Sanitary Landfill</b>	1,4-Dioxane	µg/L	130	LFW 62C	6.1 <sup>a</sup>	Upper Three Runs
	Trichloroethylene	µg/L	5.06	LFW 32	5	
	Vinyl Chloride	µg/L	31.8	LFW 21	2	
<b>TNX</b>	Trichloroethylene	µg/L	32.1	TRW 2	5	Savannah River
<b>Z Area</b>	Nitrate-Nitrate as Nitrogen	mg/L	15.4	ZBG002D	10	Upper Three Runs

## 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.

µg = micrograms

<sup>a</sup> The 1,4-Dioxane standard is a Resource Conservation Recovery Act-permitted Groundwater Protection Standard.

<sup>b</sup> The PFAS standard is a U.S. Environmental Protection Agency Drinking Water Lifetime Health Advisory Limit (µg/L).

<sup>c</sup> 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, samples greater than 50 pCi/L are required to have additional analyses to determine the specific radionuclides.

<sup>d</sup> At R Area, strontium-90 is sampled every two years. It was last sampled in 2020.

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 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. Detections of tritium in these Georgia offsite wells have been below 1.5 pCi/mL (1,500 pCi/L) since 1999. The MCL, or drinking water standard, for tritium is 20 pCi/mL (20,000 pCi/L). For 2022, tritium was detected in only one of nine locations sampled at a concentration less than 1 pCi/mL. A tenth location was not sampled due to inaccessibility because of livestock and road issues.

### 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 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 2022, SRS removed 12,730 lbs of VOCs from the groundwater and the vadose zone (SRNS 2023b). The amount of VOCs removed from the groundwater is approximately 30% less than the previous year due to an average reduction of 70 hours of operational time per month in 2022 than in 2021 as a result of maintenance, equipment failure, and operational efficiency to maximize contaminant removal.



**Phytoremediation Uses Trees and Plants to Remove or Break Down Contaminants.**

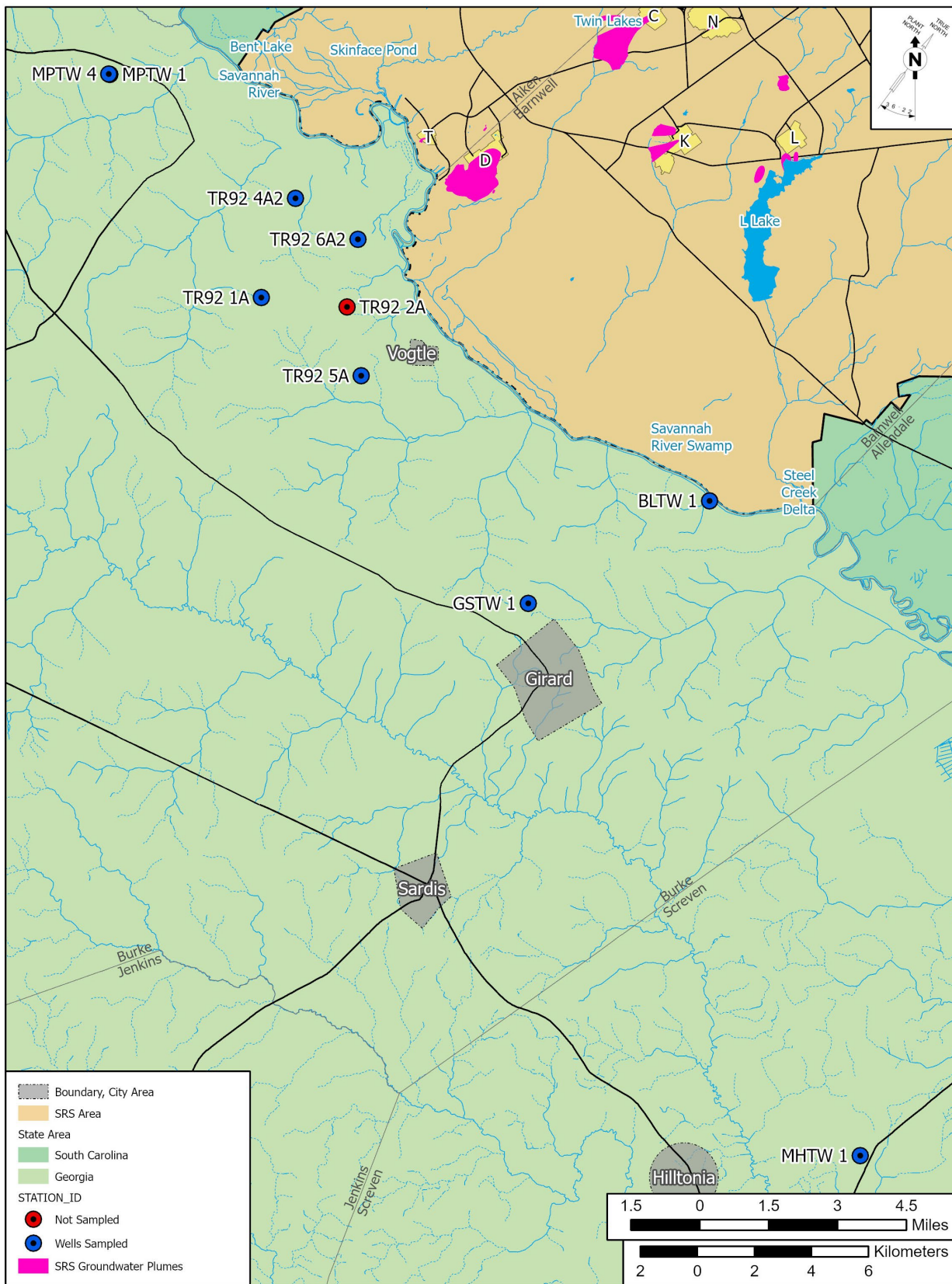


Figure 7-4 Locations of Tritium Monitoring Wells in Burke and Screven Counties, Georgia

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 phytoremediation). The Mixed Waste Management Facility (MWMF) Phytoremediation Project has the largest reductions of the technologies currently in use on the Site. In 2022, the MWMF Phytoremediation Project prevented 45.2 Ci of tritium from reaching SRS streams. Chapter 2, *Environmental Management System*, discusses 2022 DOE Sustainability Award the Site won for the SRS Phytoremediation Project.

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 2022, these technologies have removed 1.61 million lbs of solvent, consisting of TCE and PCE.

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.

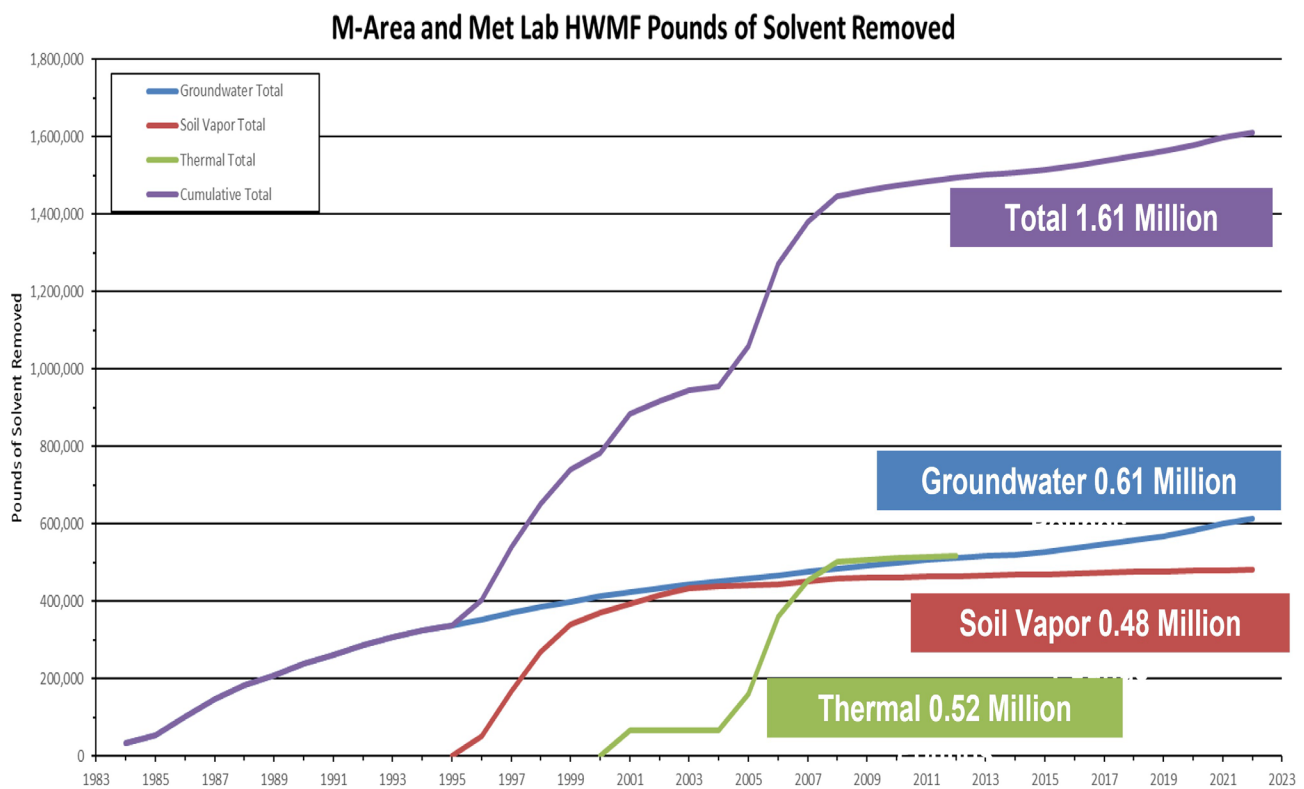


Figure 7-5 Solvent Removed from A/M-Area Groundwater Plume

### 7.3.4 Conserving SRS Groundwater

As in the past, SRS continues to report its drinking and process water use to SCDHEC. In 2022, SRS used 2.80 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 2022 [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 2022 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)*.

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

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**T**he 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 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.

## 2022 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.

The U.S. Department of Energy (DOE) Consolidated Audit Program (DOECAP) requires the analytical laboratories providing service to DOE have accreditation through the program. In 2022, 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 2022, DOECAP conducted three audits of treatment, storage, and disposal facilities (TSDFs). The audits determined that the facilities were in good standing and eligible to continue to provide services to DOE.

### 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

SRS implements and conducts its QA program to comply with the following regulations: 1) 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

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 program requirements.

The SRS Environmental Monitoring Program 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 personnel evaluate these elements as part of the continuous assessment process. 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 Environmental Monitoring Program 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.

### 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.

### 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 Environmental Monitoring Program to identify and implement improvements. The Environmental Monitoring Program QA efforts that lead to program improvements include the following:

- Implementing Environmental Monitoring Program enhancements
- Improving data quality in the laboratory and field
- Performing DOECAP audits of commercial 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. The ongoing QC associated with the Environmental Monitoring Program 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

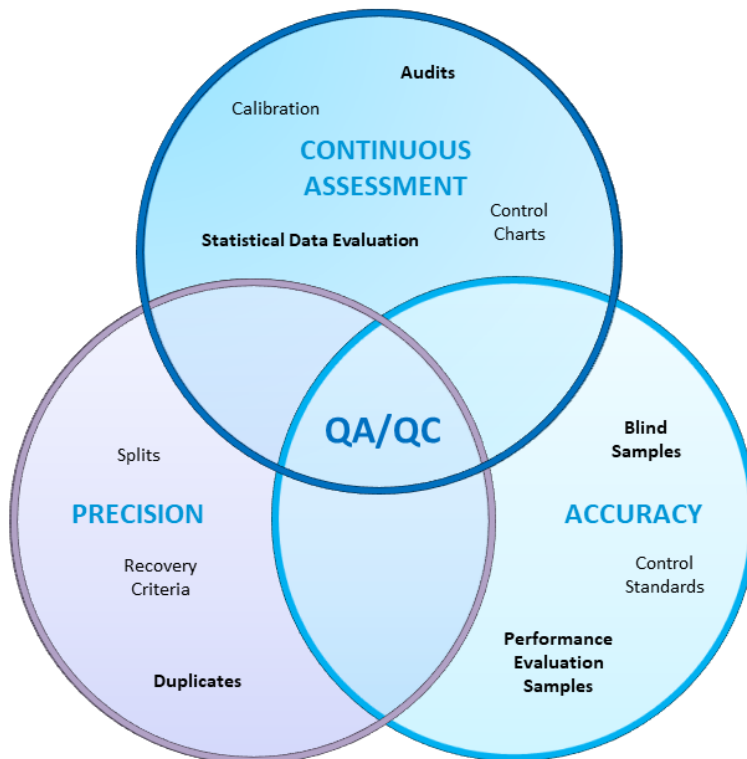


Figure 8-1 Interrelationship between QA and QC Activities

## 8.4 ENVIRONMENTAL MONITORING PROGRAM QA ACTIVITIES

SRS continuously assesses the Environmental Monitoring Program to identify and implement continuous improvements and minimize the potential for errors. During 2022, SRS implemented the following quality improvements:

- Radiological Liquid Effluent Program—SRS enhanced the program by adding a basin location.
- Radiological and Nonradiological Sediment Program—SRS removed one location from the program that was no longer needed.
- Comprehensive Environmental Data Management System—SRS transitioned to a new comprehensive environmental database system. The new system 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.
- Surface water sampling equipment—SRS added to the NPDES Wastewater Program more portable refrigerated samplers, flowmeters with modem communication, and camera technology for automation and calibration checks that can be controlled remotely from a desktop computer or a cellphone; implemented automated sampling equipment for the new NPDES Stormwater Permit; installed electronic rain gauges for improvements in determining compliant sampling conditions; and installed audio and visual sensors and modem technology to measure real-time flows at multiple outfall locations.
- Wildlife hunts—SRS continued to improve the programming code for the Hunter Dose Tracking System.
- Creek Plantation Comprehensive Surveillance Program—SRS implemented enhancements to the Creek Plantation Swamp Comprehensive Survey that utilize gamma overflight measurements and reduce ground sampling.



**Camera Technology Allows for Remote Connection and Calibration.**

### 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 2022, 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 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 2022, SRS provided three auditors who participated in three different DOECAP audits (virtual and onsite) of commercial TSDFs. A review of the final audit reports of each TSDF 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**

An important part of SRS Environmental Monitoring Program QC activities is to ensure that personnel collect and analyze samples to the highest standard and without errors. The Site collects quality control samples and analyzes them to identify any collection and analysis errors. All laboratories analyzing samples for the SRS Environmental Monitoring Program 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 personnel routinely analyze 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. Twenty-four blind sample results were 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. Table 8-1 addresses both SRS and offsite subcontracted laboratory analyses. Processing duplicate samples evaluates the accuracy of the analytical and measurement methods the laboratories use. Ninety-eight percent of the blind samples, 99% of the NPDES duplicate samples, 97% of the water-quality duplicate samples, 84% of the nonradiological sediment duplicate samples, and 97% 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**

<b>Program and Sample Type</b>	<b>Number of Analyses</b>	<b>Number of Analyses within Acceptable Limits (RPD between Results &lt; 20%)</b>	<b>Number of Analyses Outside Acceptable Limits (RPD between Results ≥ 20%)</b>	<b>Number of Impacted Analytes</b>
<b>NPDES Blind</b>	172	168	4	2
<b>NPDES Duplicate</b>	198	197	1	1
<b>Water Quality River/Stream Duplicate</b>	864	838	26	7
<b>Nonradiological River/Stream/Basin Sediment Duplicate</b>	96	81	15	9
<b>Radiological River/Stream/Basin Sediment Duplicate</b>	60	58	2	2

Although results indicate there were some differences between the quality control samples and their corresponding compliance samples, they did not impact conclusions made with the data. The results indicate that in 2022 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 program. Field blanks determine whether the field sampling and sample processing environments have contaminated the sample. One field blank came back with a result above detectable level. However, this is acceptable per EPA Standard Methods 1631, Revision E, August 2002 because the field blank result was less than one-fifth of the sample result. A trip blank documents contamination associated with shipping and field-handling procedures. All trip blank results were nondetect. The analytical results indicate 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	35	35
NPDES Field Blank	11	10

## 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 2022, 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 93% 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 MAPEP. This intercomparison program is an integral component of the DOE-EM Laboratory Management Division's QA program, ensuring that 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 2022 were MAPEP 46 and 47. The SRS Environmental Laboratory participated in the two MAPEP studies, receiving acceptable results for 100% of results on MAPEP Series 44 and 100% on MAPEP Series 45.

One SRS subcontracted laboratory participated in MAPEP Series 47 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.

When a laboratory fails an analysis, it will develop corrective actions for that failed analysis to prevent a reoccurrence. These corrective actions may include modifying procedures for preparing and analyzing samples.

## **8.6 RECORDS MANAGEMENT**

Environmental Monitoring Program documentation is an important part of the SRS Environmental Program. The annual *SRS Environmental Report* is the public record of the SRS Environmental Monitoring Program's performance. SRS compiles it every year following guidelines in DOE Order 231.1B, *Environment, Safety, and Health Reporting*.

The *SRS Environmental Report* communicates results of the Environmental Monitoring Program, and groundwater management and 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 SRS Environmental Monitoring Program, in accordance with SRS records management procedures.

# Chapter 9: Per- and Polyfluoroalkyl (PFAS)

## Substances

**E**merging contaminants of concern bring unique challenges to the Savannah River Site (SRS) as changing regulatory requirements compel reassessing and analyzing historical and current practices to maintain compliance and protect human health and the environment. SRS responds to this by

- Ensuring transparency with regulators and the public regarding Site issues
- Being proactive and responsive in anticipating regulatory changes
- Collecting data and information to assess and determine further appropriate actions

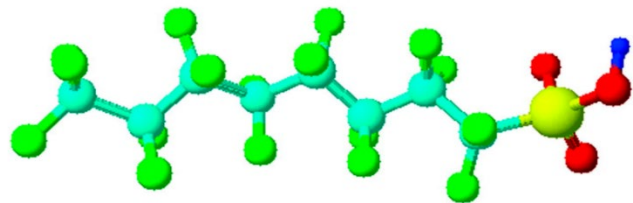
### 2022 Highlights

- In response to the DOE directives, SRS established its own PFAS Working Group (PWG) in March 2022.
- As part of the DOE Roadmap commitments, SRS submitted the draft *SRS PFAS Implementation Plan* in December 2022.
- In 2022, SRS sampled 65 wells and 10 surface water stations in D Area for PFAS constituents as part of CERCLA remedial investigation efforts.

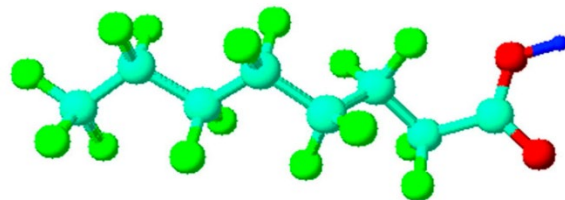
## 9.1 INTRODUCTION

Increasing national attention to 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 broad group of man-made chemicals with numerous different properties and applications.



Perfluorooctanesulfonic Acid



Perfluorooctanoic Acid

Chemical Structure of PFOS (top) and PFOA (bottom)

They include 3,000 to 5,000 individual chemicals. The most-studied PFAS are perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS).

Chemicals within the group are categorized by their chemical and physical properties, including

- Repelling oil (oleophobic), water (hydrophobic), stain, and soil
- Providing chemical and thermal stability
- Reducing friction

Because of their wide range of properties, PFAS use is ubiquitous and pervasive from both a consumer product and industrial use, which includes

- Protectants to enhance water, grease, and soil repellency for paper and cardboard packaging products, carpets, leather products, and textiles
- Processing aids in the manufacture of fluoropolymers, such as nonstick coatings on cookware and membranes for clothing that are both waterproof and breathable; electrical wire casing; fire- and chemical-resistant tubing; and plumbing thread seal tape
- Industrial surfactants, emulsifiers, wetting agents, additives, and coatings. PFAS have been used in fire-fighting foams because they are effective in extinguishing hydrocarbon-fueled fires.

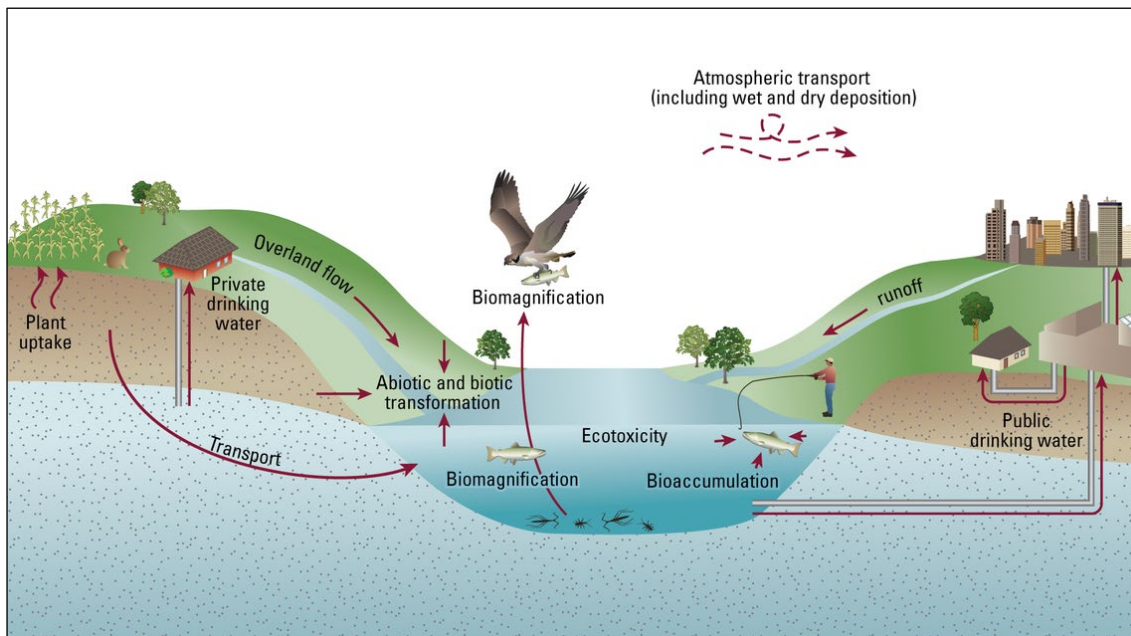
PFAS were invented in the 1930s and originally used primarily for nonstick and waterproof coatings. Their development and production skyrocketed in the 1960s in response to a deadly fire aboard the USS Forrester, an aircraft carrier, in 1967. The fire resulted from the accidental launch of a rocket into armed planes and loaded fuel tanks. This blaze nearly destroyed the ship and killed more than 130 people. In response, scientists and manufacturers developed PFAS-containing aqueous film-forming foam (AFFF), a mixture that rapidly extinguishes fire. The PFAS allow the mixture to spread, making it highly effective against petroleum fires and other flammable-liquid fires when mixed with water. PFAS-containing AFFF was subsequently installed on military and civilian ships, on airplanes, and in airports.

PFOS was last manufactured in the United States in 2002, according to Chemical Data Reporting, and the U.S. Environmental Protection Agency's (EPA's) PFOA Stewardship Program phased out the country's manufacturing and importing of PFOA.

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, 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.

Figure 9-1 shows exposure pathways, which include

- Occupational exposures—PFAS manufacturing resulting in inhalation and dermal contact
- Nonoccupational exposure—
  - Drinking water contaminated with PFAS
  - Eating foods (fish) that may contain PFAS or crops grown in contaminated soil
  - Breathing air containing PFAS
  - Inhaling and ingesting house dust
  - Having direct contact with consumer products treated or packaged with PFAS



**Figure 9-1 PFAS Exposure Pathways**

(Source: [usgs.gov/programs/environmental-health-program/science/pfas-transport-exposure-and-effects](https://www.usgs.gov/programs/environmental-health-program/science/pfas-transport-exposure-and-effects))

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 Control and Prevention show that most people in the United States have been exposed to PFAS.

Terminology is one of the confusing points when discussing PFAS both within the scientific community and 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 at this time only a small portion of the thousands of PFAS have been linked to cancer.

Current peer-reviewed scientific studies have shown that exposure to certain levels of PFAS 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 Environmental Protection Agency

The EPA's PFAS Strategic Roadmap is the driver for all the regulatory actions. The agency developed the 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 upon 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.

2022 highlights of the EPA's regulatory initiatives include

- Adding nine PFAS to the Toxic Release Inventory (TRI) list to be reported starting in reporting year 2023 (forms due July 1, 2024)
- Publishing a Proposed Rule to eliminate the *de minimis* exemption for reporting of PFAS under TRI (*Federal Register*, December 5, 2022)

- Initiating nationwide monitoring for PFAS in drinking water under the fifth Unregulated Contaminant Monitoring Rule. SRS is scheduled for groundwater monitoring in 2025.
- Publishing a Proposed Rule to designate certain PFAS as Comprehensive Environmental Response Compensation and Liability Act (CERCLA) hazardous substances requiring reporting of PFOA and PFAS releases (*Federal Register*, September 2, 2022)

## 9.2.2 U.S. Department of Energy

In response to the EPA’s roadmap, DOE issued its own PFAS Strategic Roadmap, *DOE Commitments to Action 2022-2025*, in August 2022. The Roadmap (Figure 9-2) outlines DOE’s overall approach, goals, objectives, and planned actions to assess and manage PFAS risk at DOE sites to help protect human health and the environment.

In October 2022, DOE-Headquarters (DOE-HQ) established a PFAS Panel to provide input on critical DOE-HQ guidance and policy documents.



Figure 9-2 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, SRS established its own the PFAS Working Group (PWG) in March 2022. The PWG serves as a Site-level conduit to the DOE PFAS Coordinating Committee. The PWG will research interpretation on aspects of PFAS issues. The PWG may develop advisory or tactical recommendations to DOE-Savannah River (DOE-SR) management on specific PFAS issues or objectives. The PWG recognizes that decision-making and communications with regulators and stakeholders rests with the DOE-SR management and coordination with DOE-HQ.

As part of the DOE Roadmap commitments, SRS submitted the draft *SRS PFAS Implementation Plan* in December 2022. This plan documents the actions that SRS will take to implement the goals, objectives, and actions described in DOE’s strategic roadmap.

### 9.3 A PFAS CASE STUDY: 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, the most commonly identified PFAS contaminants. 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 CERCLA Federal Facility Agreement Core Team (U.S. DOE, the EPA, and 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. The groundwater data has been included in the Chapter 7 of the *Annual Site Environmental Report*.

In 2022, SRS sampled 65 wells and 10 surface water stations in D Area for PFAS constituents as part of CERCLA remedial investigation efforts (Figure 9-3). Current work is focusing on obtaining a complete data set to adequately assess the nature and extent of the plume in support of future decision making as part of the feasibility study. 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 Core Team. Public notice of all actions will follow the existing CERCLA process and data will be shared within the *Annual Site Environmental Report*. SRS is working closely with federal and state regulators to comply with rapidly changing regulations and directives associated with PFAS contaminants.

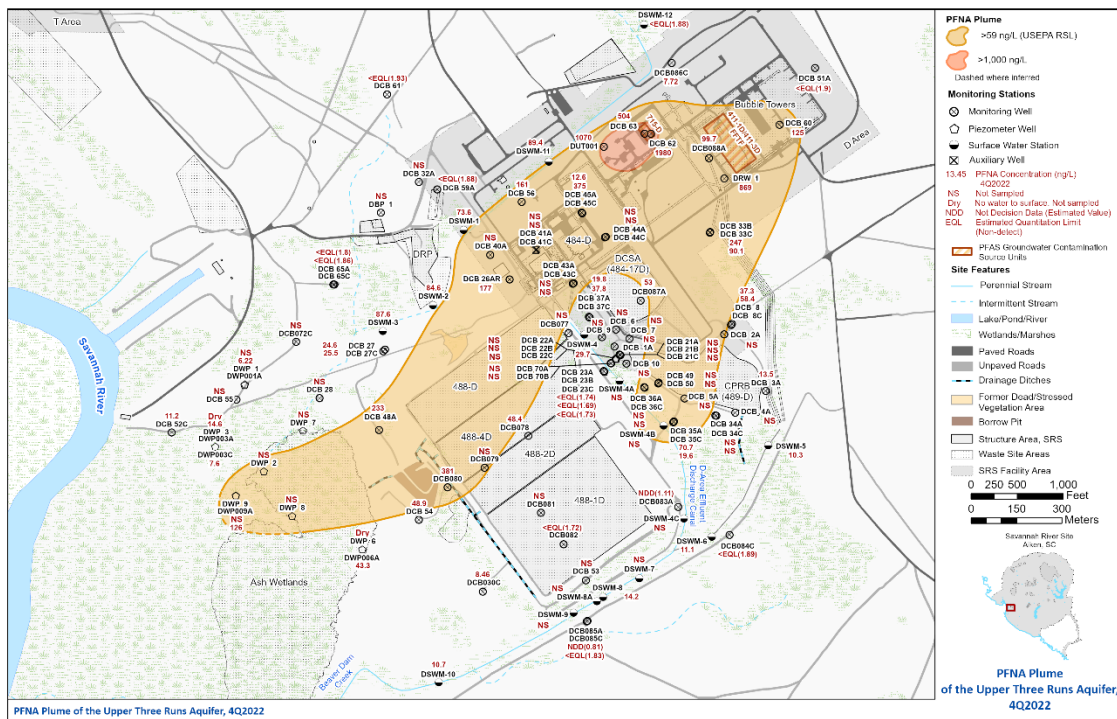


Figure 9-3 D-Area Wells and Surface Water Stations Sampled for PFAS Constituents

# Appendix A: Environmental Management System

FY 2022 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		
Goal	Significant Environmental Aspect	Strategy	Implementation
<b>DOE EMS Sustainability Goals</b>			
#1 Energy Management	<ul style="list-style-type: none"> <li>Air pollutants</li> <li>Renewable energy</li> </ul>	<ul style="list-style-type: none"> <li>Operate four biomass plants</li> <li>Identify and implement Environmental Conservation Methods</li> </ul>	Site Sustainability Plan
#2 Renewable Energy	<ul style="list-style-type: none"> <li>Air pollutants</li> <li>Renewable energy</li> </ul>	Operate Biomass Cogeneration Facility	Site Sustainability Plan
#3 Water Management	<ul style="list-style-type: none"> <li>Discharge to wastewater systems</li> <li>Water use</li> </ul>	<ul style="list-style-type: none"> <li>Reduce water use through low-flow device installation</li> <li>Continue to seek new industrial, landscaping, and agricultural reductions</li> </ul>	Site Sustainability Plan
#4 Performance Contracting	<ul style="list-style-type: none"> <li>Air pollutants</li> <li>Renewable energy</li> </ul>	Continue to look for new opportunities for Energy Saving Performance Contracting in addition to the existing one	Site Sustainability Plan
#5 Sustainable Buildings	Building performance and sustainable design	Preventive maintenance and energy-efficient repairs	Site Sustainability Plan
#6 Waste Management	<ul style="list-style-type: none"> <li>Solid waste</li> <li>Pollution prevention</li> <li>Use, reuse, and recycling resources</li> </ul>	<ul style="list-style-type: none"> <li>Continue to divert at least 50% of sanitary waste to recycle</li> <li>Continue to recycle excess- and construction-related waste</li> </ul>	Site Sustainability Plan
#7 Energy Management, Building Evaluations, Benchmarking	Energy efficiency and greenhouse gases (GHGs)	Continue Energy Independence and Security Act of 2007 audits (25% of applicable buildings per year)	Site Sustainability Plan
#8 Fleet Management	<ul style="list-style-type: none"> <li>Alternative fuel use</li> <li>Transportation</li> </ul>	<ul style="list-style-type: none"> <li>Continue to replace gasoline vehicles with E-85 vehicles when possible</li> <li>Develop plan to meet FY 2023 goal of a light-duty fleet with 10% electrical vehicles</li> </ul>	Site Sustainability Plan Site Sustainability Plan
#9 Acquisition and Procurement	Procurement of Environmental Preferable Purchasing goods	<ul style="list-style-type: none"> <li>Include statutory requirements for sustainable acquisition in applicable contract actions</li> <li>Evaluate actions to ensure sustainable acquisitions</li> </ul>	Site Sustainability Plan Site Sustainability Plan
#10 Electronic Stewardship	<ul style="list-style-type: none"> <li>Electronics management</li> <li>Renewable energy</li> </ul>	95% eligible acquisitions are sustainable (for example, EPEAT); recycled or reused electronics	Site Sustainability Plan
#11 Data Center Management	Electronics management	Continue collecting data to support energy-efficient management of data centers	Site Sustainability Plan
#12 Greenhouse Gases Management and Reporting	Energy efficiency and GHGs transportation	<ul style="list-style-type: none"> <li>Operate four biomass plants</li> <li>Continue E-85 usage and alternate fuel vehicle leases</li> </ul>	Site Sustainability Plan
#13 Resilience	All aspects	<ul style="list-style-type: none"> <li>Develop Vulnerability Assessment and Resilience Plan for SRS and submit to DOE-Headquarters</li> <li>Participate in pilot for Sustainable Climate-Ready Sites Program</li> </ul>	Site Sustainability Plan

FY 2022 Environmental Management System (EMS) Goals and Objectives (continued)

Goal	Significant Environmental Aspect	Strategy	Implementation
SRS EMS Environmental Goals			
<p>#14 Environmental Awareness</p>	All aspects	Continue to increase environmental awareness across multiple outlets	Site-Level Environmental Compliance Manual
	<p>#15 Environmental Compliance</p>	All aspects	
Meet 100% of regulatory commitments			
Continuous improvement and development of compliance methodology			

# Appendix B: Environmental

## Surveillance Media and Sampling Frequencies

**Appendix Table B-1 SRS Nonradiological Media and Sampling Frequencies**

Media	Environmental Surveillance	Sampling Frequency		
		Monthly	Semiannually	Annually
Surface Water <sup>a</sup>	Water quality downstream of NPDES outfalls (stream and river)	✓		
Sediment	Surveillance for existence and possible buildup of the inorganic contaminants			✓
Fish	Bioaccumulation of nonradiological contaminants in fish			✓

<sup>a</sup> All water-quality parameters for surface water are sampled monthly except pesticides, herbicides, and polychlorinated biphenyls, which are sampled semiannually.

**Appendix Table B-2 SRS Radiological Media and Sampling Frequencies**

Media	Environmental Surveillance	Sampling Frequency				
		Weekly	Bi-Weekly	Monthly	Quarterly	Annually
<b>Air</b>	Airborne particulate matter		✓			
	Gaseous state of radioiodine		✓			
	Tritiated water vapor		✓			
	Tritium in rainwater			✓		
<b>Soil</b>	Radionuclide deposition into soils					✓
<b>Food Products</b>	Radionuclide uptake in the food chain					✓
<b>Vegetation</b>	Radionuclide uptake in plants					✓
<b>Optically Stimulated Luminescence</b>	Ambient gamma radiation monitoring				✓	
<b>Water</b>	Onsite drinking water				✓	✓
	Offsite drinking water			✓		
	Onsite surface water (Streams and basins)	✓		✓		✓
	Savannah River	✓				✓
<b>Sediment</b>	Radionuclides in streambeds, the Savannah Riverbed, and SRS basin beds					✓
<b>Fish and Shellfish</b>	Radionuclides in freshwater fish, saltwater fish, and shellfish					✓
<b>Wildlife</b>	Radionuclides in onsite deer, feral hogs, turkey, and coyotes during SRS-sponsored hunts					✓

# Appendix C: Nonradiological Environmental Monitoring Program Supplemental Information

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## Appendix Table C-1 River and Stream Water Quality Results Summary

SRS collected monthly water quality samples at 5 Savannah River and 10 stream locations in 2022, 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 exceeding standards are shown in **red** text. Field duplicates are not included in the generation of these tables.

DL-Detection Limit

DO-Dissolved Oxygen

TOC-Total Organic Carbon

TSS-Total Suspended Solids

### Notes:

1. The 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.

Appendix C: Nonradiological Environmental Monitoring Program Supplemental Information

Four River Locations Plus One Control

Analyte	SC Freshwater Quality Std.	Unit	No. of Results Outside Std.	No. of Results > DL	Control RM 161.0		Highest River Location				Comments
					Avg. <sup>a</sup>	Max. <sup>b</sup>		Avg. <sup>a</sup>		Max. <sup>b</sup>	
DO <sup>c</sup>	min. 4.0	mg/L	0 of 57		8.9	7.0	RM-129.1	7.8	RM-150.4	5.3	All samples met standard
pH <sup>d</sup>	6.0-8.5	SU	1 of 57		5.9	7.2	RM-150.4	6.2	RM-118.8	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 57		18.3	23.7	RM-129.1	20.1	RM-129.1	29.3	All samples met standard
Aluminum	87 <sup>e</sup>	µg/L	53 of 57	57 of 57	309	1,260	RM-118.8	310	RM-150.4	997	
Beryllium	4 <sup>f</sup>	µg/L	0 of 57	1 of 57	< DL	< DL	RM-118.8	0.1	RM-118.8	0.1	All samples met standard
Cadmium	0.25	µg/L	1 of 57	2 of 57	< DL	< DL	RM-150.4	0.11	RM-150.4	0.25	All averages met standard
Chromium	11	µg/L	0 of 57	42 of 57	2	4	RM-118.8	2	RM-118.8	6	All samples met standard
Copper	2.9	µg/L	1 of 57	53 of 57	1.4	3.0	RM-141.5	1.4	RM-129.1	2.7	All averages met standard
Hardness (total)	none	mg/L	no std.	57 of 57	19	26	RM-129.1	26	RM-129.1	42	
Iron	1,000 <sup>g</sup>	µg/L	1 of 57	57 of 57	433	834	RM-118.8	658	RM-118.8	1,110	All averages met standard
Lead	0.54	µg/L	0 of 57	56 of 57	0.25	0.51	RM-118.8	0.28	RM-150.4	0.47	All samples met standard
Manganese	none	µg/L	no std.	57 of 57	85	153	RM-118.8	82	RM-118.8	159	
Mercury	0.91	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	36 of 57	1	2	RM-129.1	1	RM-129.1	1	All samples met standard
Nitrate-Nitrogen	1 <sup>h</sup>	mg/L	0 of 57	57 of 57	0.3	0.4	RM-141.5	0.3	RM-150.4	0.4	All samples met standard
Nitrite-Nitrogen	1 <sup>h</sup>	mg/L	0 of 57	56 of 57	0.01	0.03	RM-150.4	0.01	RM-150.4	0.02	All samples met standard
Thallium	0.24 <sup>f</sup>	µg/L	0 of 57	0 of 57	< DL	< DL	< DL	< DL	< DL	< DL	All samples met standard
TOC	none	mg/L	no std.	57 of 57	3.2	4.9	RM-129.1	4.6	RM-129.1	13.0	
Phosphorus	0.06	mg/L	50 of 57	53 of 57	0.13	0.32	RM-141.5	0.15	RM-141.5	0.34	
TSS	none	mg/L	no std.	56 of 57	5	11	RM-118.8	9	RM-118.8 & RM-129.1	16	
Zinc	37	µg/L	0 of 57	56 of 57	4	9	RM-150.4	5	RM-150.4	29	All samples met standard

Eight Stream Locations Plus Two Controls

Analyte	SC Freshwater Quality Std.	Unit	No. of Results Outside Std.	Number of Results > DL	Control TC-1		Control U3R-1A		Highest Stream Location				Comments
					Avg. <sup>a</sup>	Max. <sup>b</sup>	Avg. <sup>a</sup>	Max. <sup>b</sup>		Avg. <sup>a</sup>	Max. <sup>b</sup>		
DO <sup>c</sup>	min. 4.0	mg/L	6 of 120		8.8	6.9	8.5	7.5	FMC-2	4.5	FMC-2	1.6	All averages met standard
pH <sup>d</sup>	6.0-8.5	SU	8 of 120		5.6	7.3	4.9	7.3	U3R-4	5.2	U3R-4	7.6	All maximums met standard
Temperature	< 5° F (2.8° C) above nat. cond. and not > 90° F (32.2° C)	° C	3 of 120		19	27	17	24	SC-4	20	PB-3	39	All averages met standard
Aluminum	87 <sup>e</sup>	µg/L	79 of 120	118 of 120	142	607	146	513	U3R-4	235	FM-6	978	
Beryllium	4 <sup>f</sup>	µg/L	0 of 120	8 of 120	< DL	< DL	0.1	0.1	L3R-2	0.1	L3R-2	0.2	All samples met standard
Cadmium	0.25	µg/L	0 of 120	3 of 120	< DL	< DL	< DL	< DL	TB-5	0.11	TB-5	0.19	All samples met standard
Chromium	11	µg/L	0 of 120	48 of 120	1.5	4.7	0.9	2.9	FMC-2	1.4	L3R-2	4.8	All samples met standard
Copper	2.9	µg/L	5 of 120	54 of 120	1.2	7.3	0.6	0.7	FMC-2	1.6	L3R-2	6.0	All averages met standard
Hardness (total)	none	mg/L	no std.	84 of 120	13	20	4	10	L3R-2	41	L3R-2	59	
Iron	1,000 <sup>g</sup>	µg/L	37 of 120	120 of 120	489	915	401	693	FM-2B	3,081	FM-2B	6,790	
Lead	0.54	µg/L	12 of 120	111 of 120	0.32	1.34	0.24	0.57	FM-6	0.30	L3R-2	1.33	All averages met standard
Manganese	none	µg/L	no std.	120 of 120	21	43	10	16	FM-2B	197	L3R-2	930	
Mercury	0.91	µg/L	0 of 120	6 of 120	< DL	< DL	< DL	< DL	SC-4	0.02	SC-4	0.04	All samples met standard
Nickel	16	µg/L	0 of 120	90 of 120	1	1	1	1	TB-5	4	TB-5	8	All samples met standard
Nitrate-Nitrogen	1 <sup>h</sup>	mg/L	1 of 120	119 of 120	0.1	0.2	0.4	0.4	FM-6	0.7	FM-6	1.3	All averages met standard
Nitrite-Nitrogen	1 <sup>h</sup>	mg/L	0 of 120	85 of 120	0.005	0.017	0.004	0.017	PB-3	0.006	PB-3	0.020	All samples met standard
Thallium	0.24 <sup>f</sup>	µg/L	1 of 120	3 of 120	< DL	< DL	< DL	< DL	U3R-4	0.09	U3R-4	0.5	All averages met standard

Analyte	SC Freshwater Quality Std.	Unit	No. of Results Outside Std.	Number of Results > DL	Control TC-1		Control U3R-1A		Highest Stream Location				Comments
					Avg. <sup>a</sup>	Max. <sup>b</sup>	Avg. <sup>a</sup>	Max. <sup>b</sup>	Avg. <sup>a</sup>	Max. <sup>b</sup>	Avg. <sup>a</sup>	Max. <sup>b</sup>	
TOC	none	mg/L	no std.	120 of 120	4	8	2	6	FMC-2	11	FMC-2	55	
Phosphorus	0.06	mg/L	38 of 120	48 of 120	0.06	0.12	0.03	0.13	FM-6	0.11	TB-5	0.23	
TSS	none	mg/L	no std.	115 of 120	6	15	4	7	FM-2B	9	L3R-2	66	
Zinc	37	µg/L	0 of 120	115 of 120	3	13	3	6	FMC-2	11	FMC-2	31	All samples met standard

<sup>a</sup> When results fell below the detection limit, the detection limit value was used to determine average.

<sup>b</sup> Maximum detected value

<sup>c</sup> Min. (versus Max.) value reported

<sup>d</sup> Min. (versus Avg.) value reported

<sup>e</sup> EPA Region 4 Ecological Risk Assessment Supplemental Guidance, March 2018 Update

<sup>f</sup> Standard from Human Health vs. Freshwater Aquatic Life (which has no standard)

<sup>g</sup> EPA National Recommended Water Quality Criteria - Aquatic Life

<sup>h</sup> Per SCDHEC Environmental Surveillance and Oversight Program 2020 Data Report (CR-004111 11/21)

**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 24 locations in 2022: 9 Savannah River, 12 stream, and 3 stormwater basins, totaling 384 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.

The table compares all results to EPA Region 4 Refinement Screening Values (RSVs) for sediment and shows the maximum value of each analyte for the river, stream, and stormwater basin samples. Locations exceeding RSVs are shown in **red** text.

### 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	16,000	RM-157.2	37,000	58,000	0	All samples met std.
Antimony	0 of 9	<DL	All < DL	All < DL	25	0	All samples met std.
Arsenic	9 of 9	2	RM-157.2	4	33	0	All samples met std.
Barium	9 of 9	110	RM-141.0 SC Landing	160	60	9	
Cadmium	0 of 9	<DL	All < DL	All < DL	5	0	All samples met std.
Chromium	0 of 9	22	RM-157.2	38	111	0	All samples met std.
Copper	9 of 9	13	RM-157.2	24	149	0	All samples met std.
Iron	9 of 9	18,000	RM-141.0 SC Landing	33,000	40,000	0	All samples met std.
Lead	9 of 9	11	RM-157.2	25	128	0	All samples met std.
Manganese	9 of 9	1,200	RM-141.0 SC Landing	1,900	1,100	3	
Mercury	0 of 9	<DL	All < DL	All < DL	1.1	0	All samples met std.
Nickel	9 of 9	9	RM-157.2	21.0	48.6	0	All samples met std.
Selenium	0 of 9	<DL	All < DL	All < DL	2.9	0	All samples met std.
Silver	0 of 9	<DL	All < DL	All < DL	2.2	0	All samples met std.
Uranium	0 of 9	<DL	All < DL	All < DL	1,000	0	All samples met std.
Zinc	9 of 9	46	RM-157.2	110	459	0	All samples met std.

**Stream Sediment Results**

*10 Stream Locations Plus 2 Controls*

Analyte	No. of Detected Results	Control TC-1 (mg/kg)	Control U3R-1A (mg/kg)	Location of Maximum Result	EPA Region 4		No. of Results > RSV	Comments
					Maximum Conc. (mg/kg)	RSV for Sediment (mg/kg)		
<b>Aluminum</b>	12 of 12	6,000	4,600	BDC	26,000	58,000	0	All samples met std.
<b>Antimony</b>	0 of 12	<DL	<DL	All < DL	All < DL	25	0	All samples met std.
<b>Arsenic</b>	6 of 12	<DL	<DL	L3R-2	5	33	0	All samples met std.
<b>Barium</b>	12 of 12	110	42	U3R-3	96	60	2	
<b>Cadmium</b>	4 of 12	<DL	<DL	SC-4	0.8	5	0	All samples met std.
<b>Chromium</b>	12 of 12	9	7	BDC	17	111	0	All samples met std.
<b>Copper</b>	12 of 12	4	4	BDC	10	149	0	All samples met std.
<b>Iron</b>	12 of 12	4,100	2,400	BDC	9,800	40,000	0	All samples met std.
<b>Lead</b>	11 of 12	8	8	BDC	13	128	0	All samples met std.
<b>Manganese</b>	12 of 12	170	19	SC-4	186	1,100	0	All samples met std.
<b>Mercury</b>	5 of 12	<DL	<DL	L3R-1A	0.2	1.1	0	All samples met std.
<b>Nickel</b>	11 of 12	4.5	<DL	U3R-3	8.9	48.6	0	All samples met std.
<b>Selenium</b>	6 of 12	<DL	<DL	PB @ Rd A	2.0	2.9	0	All samples met std.
<b>Silver</b>	2 of 12	<DL	<DL	U3R-3	0.93	2.2	0	All samples met std.
<b>Uranium</b>	0 of 12	<DL	<DL	All < DL	All < DL	1,000	0	All samples met std.
<b>Zinc</b>	12 of 12	15	10	U3R-3	29	459	0	All samples met std.

## Stormwater Basin Sediment Results

Three Basin Locations Compared to Two Stream Controls

Analyte	Number of Detected Results	Control TC-1 (mg/kg)	Control U3R-1A (mg/kg)	Location of Maximum Result	Maximum Conc. (mg/kg)	EPA Region 4		Comments
						RSV for Sediment (mg/kg)	Number of Results > RSV	
Aluminum	5 of 5	6,000	4,600	E-001	38,000	58,000	0	All samples met std.
Antimony	0 of 5	<DL	<DL	All < DL	All < DL	25	0	All samples met std.
Arsenic	3 of 5	<DL	<DL	E-003	8	33	0	All samples met std.
Barium	5 of 5	110	42	E-001	72	60	2	
Cadmium	0 of 5	<DL	<DL	All < DL	All < DL	5	0	All samples met std.
Chromium	5 of 5	9	7	E-003	39	111	0	All samples met std.
Copper	5 of 5	4	4	E-003	16	149	0	All samples met std.
Iron	5 of 5	4,100	2,400	E-003	38,000	40,000	0	All samples met std.
Lead	5 of 5	8	8	E-001	18	128	0	All samples met std.
Manganese	5 of 5	170	19	E-003	210	1,100	0	All samples met std.
Mercury	0 of 5	<DL	<DL	All < DL	All < DL	1.1	0	All samples met std.
Nickel	4 of 5	5	<DL	E-001	10.0	48.6	0	All samples met std.
Selenium	0 of 5	<DL	<DL	All < DL	All < DL	2.9	0	All samples met std.
Silver	0 of 5	<DL	<DL	All < DL	All < DL	2.2	0	All samples met std.
Uranium	0 of 5	<DL	<DL	All < DL	All < DL	1,000	0	All samples met std.
Zinc	5 of 5	15	10	E-003	83	459	0	All samples met std.

**Appendix Table C-3 Summary of Detected Metal Results for Freshwater Fish Tissue Collected from the Savannah River**

All antimony, 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
<b>Arsenic</b>	29	29	1.87	0.37	3.7	Catfish	Steel Creek River Mouth
<b>Cadmium</b>	53	53	0.147	0.0492	0.492	Bass	Augusta Lock and Dam 614
<b>Chromium</b>	3	3	0.293	0.163	1.63	Bass	Lower Three Runs Creek River Mouth
<b>Copper</b>	92	90	0.741	0.196	1.96	Flathead Catfish	Fourmile Creek River Mouth
<b>Manganese</b>	88	88	0.544	0.867	0.0867	Panfish	Upper Three Runs Creek River Mouth
<b>Mercury</b>	165	52	0.984	0.2	0.02	Bass	Highway 301 Bridge Area
<b>Zinc</b>	165	0	21.4	1.96	0.196	Flathead Catfish	Fourmile Creek River Mouth

Note:  
165 freshwater tissue samples were collected and analyzed for metals and mercury.

**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, mercury, and nickel 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)
<b>Arsenic</b>	3	3	1.78	4.82	0.482
<b>Cadmium</b>	3	3	0.0536	0.48	0.048
<b>Chromium</b>	1	1	0.202	1.93	0.193
<b>Copper</b>	3	3	0.266	1.92	0.192
<b>Manganese</b>	4	4	0.122	0.963	0.0963
<b>Zinc</b>	7	0	14	1.93	0.193

Note:  
Seven saltwater tissue samples were collected and analyzed for metals and mercury.

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# Appendix D: Radiological Environmental Monitoring Program Supplemental Information

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*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**

All values under the "Calculated" column through "Totals" column are reported in curies.<sup>a</sup>

In the Calculated column, blanks indicate the radionuclide is not present. In the facility (Reactors, Separations, 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)<sup>a</sup>*

Radionuclide	Half-Life <sup>b</sup>		Calculated <sup>c</sup>	Reactors	Separations <sup>d</sup>	SRNL	Total
<b>Gases and Vapors</b>							
H-3 (oxide)	12.3	y	1.03E+02	1.03E+02	6.29E+03		6.49E+03
H-3 (elemental)	12.3	y			3.10E+03		3.10E+03
H-3 Total	12.3	y	1.03E+02	1.03E+02	9.38E+03		9.59E+03
C-14	5700	y	3.33E-07		4.10E-02		4.10E-02
Hg-203	46.6	d	4.02E-10				4.02E-10
Kr-85	10.8	y			1.30E+04		1.30E+04
I-129	1.57E+07	y	7.48E-05		7.01E-03	7.48E-07	7.08E-03
I-131	8.02	d	6.67E-10				6.67E-10
<b>Particles</b>							
Ag-110m	250	d	1.48E-11				1.48E-11
Am-241	432	y	1.12E-05	0.00E+00	3.48E-06	3.10E-09	1.47E-05
Am-243	7370	y	3.69E-09				3.69E-09
Ba-133	10.5	y	1.01E-08				1.01E-08
Be-7	53	d	1.17E-11				1.17E-11
Cd-109	461	d	0.00E+00				0.00E+00
Ce-139	138	d	3.78E-10				3.78E-10
Ce-141	32.5	d	4.94E-11				4.94E-11
Ce-144	285	d	2.00E-08				2.00E-08
Cm-243	29.1	y	1.47E-08				1.47E-08
Cm-244	18.1	y	2.75E-07	1.07E-09	1.11E-08	2.46E-08	3.12E-07
Co-56	77.23	d	1.20E-10				1.20E-10
Co-57	272	d	5.12E-07				5.12E-07
Co-58	70.9	d			0.00E+00		
Co-60	5.27	y	2.65E-06	0.00E+00	0.00E+00	0.00E+00	2.65E-06
Cs-134	2.06	y	3.42E-10				3.42E-10
Cs-137	30.2	y	3.98E-03	0.00E+00	1.00E-02	0.00E+00	1.40E-02
Eu-152	13.5	y	8.82E-09				8.82E-09
Eu-154	8.59	y	3.56E-07				3.56E-07
Eu-155	4.76	y	1.18E-07				1.18E-07
F-18	1.83	h	0.00E+00				0.00E+00
Fe-55	2.74	y	7.09E-09				7.09E-09

Radioactive Atmospheric Releases by Source (Curies)<sup>a</sup> (continued)

Radionuclide	Half-Life <sup>b</sup>		Calculated <sup>c</sup>	Reactors	Separations	SRNL	Total
<b>K-40</b>	1.25E+09	y	7.47E-09				7.47E-09
<b>La-140</b>	1.6781	d	5.00E-06				5.00E-06
<b>Mn-54</b>	312	d	2.91E-07				2.91E-07
<b>Na-22</b>	2.6019	y	1.50E-05				1.50E-05
<b>Nb-94</b>	2.03E+04	y	2.42E-07				2.42E-07
<b>Nb-95</b>	35.0	d	3.63E-07				3.63E-07
<b>Ni-59</b>	1.01E+05	y	5.76E-11				5.76E-11
<b>Ni-63</b>	100	y	5.56E-09				5.56E-09
<b>Np-237</b>	2.14E+06	y	1.54E-06	0.00E+00	1.04E-07	0.00E+00	1.64E-06
<b>Pa-233</b>	27.0	d	1.42E-06				1.42E-06
<b>Pb-212</b>	10.6	h	8.43E-07				8.43E-07
<b>Pm-147</b>	2.62	y	2.89E-06				2.89E-06
<b>Pm-148m</b>	41.3	d	1.90E-12				1.90E-12
<b>Pr-144</b>	17.3	m	2.00E-08				2.00E-08
<b>Pu-236</b>	2.86	y	4.21E-10				4.21E-10
<b>Pu-238</b>	87.7	y	3.13E-05	1.73E-11	1.55E-05	2.74E-09	4.68E-05
<b>Pu-239</b>	2.41E+04	y	6.92E-05	3.20E-10	4.90E-05	2.41E-09	1.18E-04
<b>Pu-240</b>	6560	y	7.68E-06				7.68E-06
<b>Pu-241</b>	14.4	y	2.07E-04				2.07E-04
<b>Pu-242</b>	3.75E+05	y	2.67E-08				2.67E-08
<b>Ra-226</b>	1600	y	2.66E-07				2.66E-07
<b>Ra-228</b>	5.75	y	2.65E-07				2.65E-07
<b>Rh-106<sup>e</sup></b>	29.8	s	3.04E-06		1.38E-05		1.68E-05
<b>Ru-103</b>	39.3	d	5.11E-10				5.11E-10
<b>Ru-106</b>	374	d	3.04E-06		1.38E-05		1.68E-05
<b>Sb-125</b>	2.76	y	1.18E-06				1.18E-06
<b>Sb-126<sup>e</sup></b>	12.4	d	1.70E-07				1.70E-07
<b>Sc-46</b>	83.79	d	1.72E-10				1.72E-10
<b>Se-79</b>	2.95E+05	y	4.90E-09				4.90E-09
<b>Sm-151</b>	90	y	2.89E-06				2.89E-06
<b>Sn-113</b>	115	d	4.56E-10				4.56E-10
<b>Sn-123</b>	129	d	6.66E-12				6.66E-12
<b>Sn-126</b>	2.30E+05	y	1.70E-07				1.70E-07
<b>Sr-85</b>	64.8	d	4.68E-10				4.68E-10
<b>Sr-89</b>	50.5	d	4.93E-10				4.93E-10
<b>Sr-90</b>	28.8	y	3.09E-03	0.00E+00	4.30E-05		3.13E-03

Radioactive Atmospheric Releases by Source (Curies)<sup>a</sup> (continued)

Radionuclide	Half-Life <sup>b</sup>		Calculated <sup>c</sup>	Reactors	Separations	SRNL	Total
<b>Tc-99</b>	2.11E+05	y	6.02E-05				6.02E-05
<b>Te-127</b>	9.35	h	1.04E-11				1.04E-11
<b>Te-129</b>	69.6	m	1.05E-12				1.05E-12
<b>Th-228</b>	1.91	y	8.66E-09	2.76E-09			1.14E-08
<b>Th-229</b>	7340	y	1.05E-09				1.05E-09
<b>Th-230</b>	7.54E+04	y	5.70E-11	5.89E-09			5.95E-09
<b>Th-231</b>	25.5	h	2.12E-04				2.12E-04
<b>Th-232</b>	1.41E+10	y	9.06E-12	1.72E-09			1.73E-09
<b>Tl-208</b>	3.05	m	1.41E-06				1.41E-06
<b>U-232</b>	68.9	y	5.48E-09				5.48E-09
<b>U-233</b>	1.59E+05	y	1.24E-08				1.24E-08
<b>U-234</b>	2.46E+05	y	5.95E-07	2.71E-09	2.31E-05	7.57E-09	2.37E-05
<b>U-235</b>	7.04E+08	y	3.84E-08	0.00E+00	1.35E-06	3.15E-10	1.38E-06
<b>U-236</b>	2.34E+07	y	3.97E-08				3.97E-08
<b>U-238</b>	4.47E+09	y	1.62E-06	2.21E-09	2.97E-05	1.04E-08	3.13E-05
<b>Y-88</b>	107	d	3.60E-10				3.60E-10
<b>Y-90<sup>(e)</sup></b>	64.1	h	3.09E-03	0.00E+00	4.30E-05		3.13E-03
<b>Y-91</b>	58.5	d	7.98E-10				7.98E-10
<b>Zn-65</b>	244	d	1.64E-06				1.64E-06
<b>Zr-95</b>	64.0	d	1.22E-07				1.22E-07
<b>Unidentified alpha</b>	N/A		9.82E-05	2.46E-06	2.16E-06	3.41E-07	1.03E-04
<b>Unidentified beta</b>	N/A		6.09E-04	5.44E-05	7.25E-05	1.24E-06	7.38E-04
<b>TOTAL</b>	N/A		1.03E+02	1.03E+02	2.24E+04	2.37E-06	2.26E+04

<sup>a</sup> One curie equals 3.7E+10 Becquerels

<sup>b</sup> ICRP 107, *Nuclear Decay Data for Dosimetric Calculations (2008)*; Half-life time intervals are given in seconds (s), hours (h), days (d), months (m), and years (y).

<sup>c</sup> 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.

<sup>d</sup> Includes separations, waste management, and tritium facilities

<sup>e</sup> Daughter products (Sb-126, Rh-106 & Y-90) in secular equilibrium with source terms (Sn-126, Ru-106 & Sr-90, respectively). In MAXDOSE/POPDOSE, they are included in the source term and their ingrowth is included in their parents' source term.

**Appendix Table D-2 Summary of Air Effluent DOE DCS Sum of Fractions**

As discussed in Chapter 5, 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-1196-2011 (DOE 2011), establishes numerical standards for DCSs to support implementing DOE Order 458.1. This document was updated in 2022 (DOE 2022). This table presents the air effluent DCS sums of fractions for continuously monitored sources where at least one analyte had at least one detected value. These sums of fractions determined by using both the 2011 and the 2022 standards are included. Discussion regarding the 291-F sum of fractions exceedance can be found in Section 5.3.2.1.

Facility (Sampling Location)	Radionuclides Included in the DCS Sum of Fractions	2011 DCS Sum of Fractions	2011 DCS Sum of Fractions		2022 DCS Sum of Fractions	
			Excluding Tritium	2022 DCS Sum of Fractions	Excluding Tritium	
<b>A Area (791-A Sandfilter Discharge)</b>	I-129	7.16E-05	7.16E-05	4.69E-05	4.69E-05	
<b>C Area (C-Area Main Stack)</b>	H-3 (oxide)	3.60E-01	0.00E+00	5.82E-01	0.00E+00	
<b>F Area (235-F Sandfilter Discharge)</b>	U-234, U-238, Am-241, Pu-239	1.79E-03	1.79E-03	2.05E-03	2.05E-03	
<b>F Area (292-F Main Stack)</b>	I-129, Cs-137, U-234, U-235, Np-237, U-238, Pu-238, Pu-239, Am-241, Cm-244, Sr-90	1.59E+00	1.59E+00	6.93E-01	6.93E-01	
<b>F Area (772-4F Stack)</b>	U-234, U-238, Pu-238, Pu-239, Am-241	8.50E-04	8.50E-04	7.30E-04	7.30E-04	
<b>H Area (292-H Main Stack)</b>	H-3 (oxide), C-14, Kr-85, I-129, Cs-137, U-234, U-235, U-238, Pu-238, Pu-239, Am-241, Cm-244, Np-237, Sr-90	1.27E+00	1.12E+00	2.97E+00	2.72E+00	
<b>K Area (K-Area Main Stack)</b>	H-3 (oxide)	2.39E-01	0.00E+00	3.86E-01	0.00E+00	
<b>L Area (L-Area Disassembly)</b>	H-3 (oxide)	2.28E-01	0.00E+00	3.68E-01	0.00E+00	
<b>L Area (L-Area Main Stack)</b>	H-3 (oxide)	1.40E-01	0.00E+00	2.26E-01	0.00E+00	
<b>Tritium (232-H Stack)</b>	H-3 (elemental), H-3 (oxide)	2.04E+01	0.00E+00	3.30E+01	0.00E+00	
<b>Tritium (233-H)</b>	H-3 (elemental), H-3 (oxide)	3.77E+00	0.00E+00	6.09E+00	0.00E+00	
<b>Tritium (234-H)</b>	H-3 (oxide)	3.20E+00	0.00E+00	5.19E+00	0.00E+00	
<b>Tritium (238-H)</b>	H-3 (oxide)	8.43E-02	0.00E+00	1.36E-01	0.00E+00	
<b>Tritium (264-H Stack)</b>	H-3 (elemental), H-3 (oxide)	1.34E+01	0.00E+00	2.17E+01	0.00E+00	

**Appendix Table D-3 Summary of Tritium in Environmental Air**

Samples were collected approximately every 2 weeks at each of the 16 locations. One sample was invalidated at site Barnwell Gate in November due to unexpected power loss. 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: 25-Mile Radius (Augusta Lock & Dam and Highway 301 @ State Line). The Highway 301 @ State Line location is the control location.

Location	Number of Detected Results	Mean Concentration (pCi/m <sup>3</sup> )	Minimum Concentration (pCi/m <sup>3</sup> )	Maximum Concentration (pCi/m <sup>3</sup> )
<b>Onsite</b>				
Burial Ground North	27 of 27	2.76E+02	<b>3.49E+01</b>	<b>6.25E+02</b>
<b>Site Perimeter</b>				
A-14	1 of 26	3.60E+00	-4.19E+00	1.36E+01
Allendale Gate	1 of 26	1.95E+00	-6.92E+00	<b>1.27E+01</b>
Barnwell Gate	1 of 25	2.93E+00	-3.68E+00	<b>8.14E+00</b>
Barricade 8	2 of 26	4.29E+00	-6.84E+00	1.56E+01
D Area	2 of 26	5.91E+00	-5.46E+00	1.51E+01
Darkhorse @ Williston Gate	3 of 26	4.81E+00	-3.41E+00	<b>1.98E+01</b>
East Talatha	3 of 27	4.27E+00	-2.44E+00	<b>1.94E+01</b>
Green Pond	1 of 26	4.00E+00	-3.81E+00	1.33E+01
Highway 21/167	2 of 26	4.49E+00	-3.59E+00	<b>1.74E+01</b>
Jackson	1 of 26	3.73E+00	-4.65E+00	1.63E+01
Patterson Mill Road	1 of 26	2.92E+00	-3.65E+00	1.26E+01
Talatha Gate	6 of 26	6.03E+00	-2.68E+00	<b>1.61E+01</b>
<b>25-Mile Radius</b>				
Aiken Airport	1 of 26	2.34E+00	-4.19E+00	1.33E+01

**Appendix Table D-4 Summary of Tritium in Rainwater**

Samples were collected approximately every 4 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: Site Perimeter (A-14, Allendale Gate, Barnwell Gate, East Talatha, Green Pond, Hwy 21/167, Jackson, Patterson Mill Road, and Talatha Gate) and 25-Mile Radius (Augusta Lock & Dam, 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)
<b>Onsite</b>				
Burial Ground North	13 of 13	2.85E+03	<b>5.35E+02</b>	<b>7.76E+03</b>
Barricade 8	1 of 13	1.23E+02	-1.61E+02	3.86E+02
D Area	1 of 13	1.35E+02	-1.30E+02	3.42E+02
Darkhorse @ Williston Gate	1 of 13	1.24E+02	-2.14E+02	<b>8.78E+02</b>

**Appendix Table D-5 Summary of Radionuclides in Environmental Air**

Glass fiber filter samples were collected approximately every 2 weeks at each of the 16 locations. Samples from all locations were analyzed biweekly for gamma emitting radionuclides, gross alpha, and gross beta. The onsite location Burial Ground North is the only location where samples were analyzed for actinides and strontium-89/90 biweekly. Due to lab prep and analysis errors, the sample collected January 12 to January 26 at Burial Ground North is missing results for Curium-244 and Americium-241, and all media collected October 19 to November 2nd was invalidated due to a pump failure at Barnwell Gate.

One sample from every perimeter location and 25-mile radius location was chosen for actinide and strontium-89/90 (Sr-89/90) analysis based on elevated releases at F-Area stacks during 2022. Highway 301 @ State Line is the control location.

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.

Cobalt-60 and cesium-137 results were not detected for any samples collected biweekly.

*Biweekly Samples: All Locations*

Radionuclide	Number of Detected Results	Location of Minimum Concentration	Minimum Concentration (pCi/m <sup>3</sup> )	Location of Maximum Concentration	Maximum Concentration (pCi/m <sup>3</sup> )
<b>Gross Alpha</b>	412 of 415	Highway 21/167	1.16E-04	East Talatha	<b>7.70E-03</b>
<b>Gross Beta</b>	415 of 415	Darkhorse@Williston Gate	<b>2.84E-03</b>	Green Pond	<b>2.89E-02</b>

Sr-89/90, Pu-239, Am-241, and U-235 results were not detected for site Burial Ground North; therefore, they were not reported in the table Biweekly Actinide and Sr-89/90 Samples.

*Biweekly Actinide and Sr-89/90 Samples*

Location: Burial Ground North				
Radionuclide	Number of Detected Results	Mean Concentration (pCi/m <sup>3</sup> )	Minimum Concentration (pCi/m <sup>3</sup> )	Maximum Concentration (pCi/m <sup>3</sup> )
<b>U-234</b>	24 of 26	1.72E-05	-3.54E-06	<b>3.28E-05</b>
<b>U-238</b>	25 of 26	1.75E-05	-2.63E-06	<b>3.57E-05</b>
<b>Pu-238</b>	3 of 26	4.03E-06	-1.82E-06	<b>3.70E-05</b>
<b>Cm-244</b>	6 of 25	1.18E-06	-2.65E-06	<b>6.62E-06</b>

Pu-238 and Cm-244 results were not detected for the annual sites; therefore, they were not reported in the table Annual Actinide and Strontium-89/90 Samples.

Appendix Table D-5 Summary of Radionuclides in Environmental Air (continued)

Annual Actinide and Strontium-89/90

Location	Number of Samples	U-234	U-238	Am-241	Pu-239	Sr-89/90	U-235
		Conc. (pCi/m <sup>3</sup> )	Conc. (pCi/m <sup>3</sup> )	Conc. (pCi/m <sup>3</sup> )	Conc. (pCi/m <sup>3</sup> )	Conc. (pCi/m <sup>3</sup> )	Conc. (pCi/m <sup>3</sup> )
A-14	1	1.33E-05	8.84E-06	2.60E-06	-2.60E-07	7.14E-04	3.39E-07
Allendale Gate	1	7.38E-06	1.05E-05	6.29E-06	-1.83E-07	1.73E-04	-1.08E-06
Barnwell Gate	1	1.68E-05	7.16E-06	2.96E-06	4.66E-06	1.27E-04	3.38E-07
Barricade 8	1	7.92E-06	9.42E-06	-6.09E-07	-2.26E-07	<b>8.84E-04</b>	1.63E-06
D Area	1	8.06E-06	<b>1.77E-05</b>	<b>5.96E-06</b>	2.55E-06	1.94E-04	2.61E-07
Darkhorse@ Williston Gate	1	4.96E-06	<b>1.56E-05</b>	-1.40E-06	5.01E-07	1.18E-03	<b>6.98E-06</b>
East Talatha	1	1.53E-05	<b>2.61E-05</b>	7.99E-07	3.25E-06	1.15E-03	5.08E-07
Green Pond	1	1.59E-05	<b>1.96E-05</b>	-1.37E-06	-2.16E-06	5.95E-04	2.64E-06
Highway 21/167	1	<b>2.31E-05</b>	<b>2.26E-05</b>	2.62E-07	6.15E-07	6.48E-05	3.19E-07
Jackson	1	<b>1.92E-05</b>	1.01E-05	7.64E-07	1.96E-06	3.16E-04	4.34E-07
Patterson Mill Road	1	5.20E-06	9.60E-06	6.97E-07	<b>5.45E-06</b>	5.21E-04	-1.21E-06
Talatha Gate	1	1.34E-05	<b>2.86E-05</b>	2.01E-06	2.25E-06	5.42E-04	<b>4.81E-06</b>
Aiken Airport	1	2.03E-05	<b>2.32E-05</b>	-3.01E-07	2.79E-06	1.55E-03	2.09E-06
Augusta Lock and Dam 614	1	1.12E-05	1.53E-05	8.56E-07	-3.47E-07	6.06E-05	4.18E-07
Highway 301 @State Line (Control Location)	1	1.13E-05	1.07E-05	-1.63E-06	-1.27E-06	1.30E-03	-1.07E-06

**Appendix Table D-6 Summary of Gamma Surveillance**

Samples were collected approximately every quarter (13 weeks) at each of the 52 locations. Typically, two samples are collected from each location. This was the case in 2022 except for Plant Vogtle location NRC\_1, which had a damaged badge for one sample for the fourth quarter, and Population Center location McBean, which was missing one first quarter sample. Also, SRS was not able to retrieve any OSLDs for Population Center location Windsor during the fourth quarter. 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	0.40	0.32	0.35	0.39	131.89	110	157
Site Perimeter	9	0.31	0.27	0.27	0.33	107.08	93	122
Air Surveillance Stations	16	0.33	0.28	0.29	0.34	113.62	93	147
Plant Vogtle Vicinity	18	0.31	0.26	0.29	0.33	108.40	91	132

### Appendix D-7 Summary of Radionuclides in Soil

Soil samples were collected from 24 locations in 2022. Bolded values are detected results. Values not bolded indicate the result was less than the analytical method detection limit, or the uncertainty is large.

The following locations were sampled: F Area (2,000 feet West), H Area (2,000 feet East), Z Area (#3), 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), and Creek Plantation Trail 1 (1175', 1600', 1805') and Trail 6 (2300'). The Highway 301 @ State Line is the control location.

All Co-60 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)
<b>Cs-137</b>	22 of 24	<b>1.50E-01</b>	Burial Ground North	4.03E-02	Trail 1 1805'	<b>3.59E+01</b>
<b>U-234</b>	20 of 20	<b>1.65E+00</b>	Allendale Gate	<b>4.62E-01</b>	Burial Ground North	<b>1.87E+00</b>
<b>U-235</b>	20 of 20	<b>9.22E-02</b>	Allendale Gate	<b>1.73E-02</b>	Burial Ground North	<b>9.43E-02</b>
<b>U-238</b>	20 of 20	<b>1.67E+00</b>	Allendale Gate	<b>4.59E-01</b>	Burial Ground North	<b>1.74E+00</b>
<b>Pu-238</b>	2 of 20	7.95E-04	Allendale Gate	-7.00E-04	F Area (2000 feet west)	<b>7.19E-02</b>
<b>Pu-239</b>	19 of 20	<b>2.29E-03</b>	A-14	8.59E-04	F Area (2000 feet west)	<b>5.62E-02</b>
<b>Np-237</b>	1 of 20	<b>1.64E-03</b>	Aiken Airport	-8.73E-04	Z Area (#3)	5.51E-04
<b>Sr-89/90</b>	1 of 24	-1.48E-02	Aiken Airport	-3.73E-02	Burial Ground (643-26E-2)	1.72E-01
<b>Am-241</b>	13 of 20	<b>9.57E-03</b>	Allendale Gate	7.43E-04	F Area (2000 feet west)	<b>6.11E-03</b>
<b>Cm-244</b>	2 of 20	1.48E-03	Patterson Mill Road	-2.84E-04	Augusta Lock and Dam 614	<b>3.57E-03</b>
<b>Gross Beta</b>	20 of 20	<b>1.65E+01</b>	Jackson	5.19E+00	A-14	<b>1.70E+01</b>
<b>Gross Alpha</b>	19 of 20	<b>1.92E+01</b>	Allendale Gate	1.31E+00	A-14	<b>2.48E+01</b>

**Appendix Table D-8 Summary of Radionuclides in Grassy Vegetation**

Vegetation samples were collected from 16 locations in 2022. Bolded values are detected results. Values not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All results for Co-60, Cm-244, Pu-239, Gross Alpha, and U-235 were not detected; therefore, they were not reported in this table.

The following locations are sampled: 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, Talatha Gate), and 25-Mile Radius Locations (Aiken Airport, Augusta Lock and Dam 614, and Highway 301 @ State Line). Highway 301 @ State Line is the control location.

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)
<b>H-3</b>	4 of 16	2.01E-02	Darkhorse @ Williston Gate	-2.65E-03	East Talatha	<b>9.57E-02</b>
<b>Cs-137</b>	8 of 16	1.11E-01	Burial Ground North	5.49E-03	Barnwell Gate	<b>4.65E-01</b>
<b>Sr-89/90</b>	14 of 16	<b>9.92E-02</b>	Augusta Lock & Dam 614	1.72E-02	Jackson	<b>2.08E-01</b>
<b>U-234</b>	16 of 16	<b>2.04E-03</b>	Darkhorse @ Williston Gate	<b>4.97E-04</b>	East Talatha	<b>7.27E-03</b>
<b>U-238</b>	16 of 16	<b>2.50E-03</b>	Darkhorse @ Williston Gate	<b>6.81E-04</b>	Burial Ground North	<b>6.78E-03</b>
<b>Np-237</b>	1 of 16	-2.26E-04	Barnwell Gate	-1.87E-04	Burial Ground North	<b>6.16E-04</b>
<b>Pu-238</b>	4 of 16	1.12E-04	Patterson Mill Road	-5.41E-06	Green Pond	<b>1.00E-03</b>
<b>Am-241</b>	1 of 16	9.30E-05	Patterson Mill Road	-4.35E-05	A-14	<b>5.24E-04</b>
<b>Tc-99</b>	1 of 16	-4.35E-02	Barnwell Gate	-8.51E-02	Green Pond	<b>1.69E-01</b>
<b>Gross Beta</b>	16 of 16	<b>8.62E+00</b>	Patterson Mill Road	<b>3.41E+00</b>	Barricade 8	<b>2.04E+01</b>

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. Six foodstuffs are collected on a rotating three-year cycle. Cabbage and wheat were the rotational crop samples for 2022. 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	Nuclide	Number of Samples	Number of Results > Detection Limit	Mean Sample Conc. (pCi/g)	Minimum Sample Conc. (pCi/g)	Maximum Sample Conc. (pCi/g)
<b>Beef</b>	Cesium-137	5	1	6.16E-03	-6.05E-03	<b>2.18E-02</b>
	Nonvolatile Beta	5	5	7.80E-01	<b>6.63E-01</b>	<b>9.08E-01</b>
	Strontium-90	5	1	2.34E-03	3.77E-04	<b>5.83E-03</b>
	Uranium-233/234	5	3	7.97E-05	-3.17E-05	<b>1.56E-04</b>
	Uranium-238	5	3	1.10E-04	4.80E-05	<b>1.76E-04</b>
Americium-241, Cobalt-60, Curium-243/244, Gross Alpha, Neptunium-237, Plutonium-238, Plutonium-239/240, technetium-99, Tritium, and Uranium-235 were not detected in beef.						
<b>Cabbage</b>	Cesium-137	4	3	2.93E-02	9.51E-03	4.80E-02
	Curium-243/244	4	1	1.44E-04	3.05E-05	4.23E-04
	Nonvolatile Beta	4	4	1.24E+01	6.56E+00	2.04E+01
	Strontium-90	4	3	4.58E-02	1.74E-02	7.60E-02
	Tritium	5	1	1.48E-02	-6.23E-03	3.23E-02
	Uranium-233/234	4	4	1.16E-02	<b>3.91E-03</b>	3.15E-02
	Uranium-235	4	2	5.95E-04	4.77E-04	7.73E-04
	Uranium-238	4	4	1.22E-02	<b>3.40E-03</b>	3.39E-02
Americium-241, Cobalt-60, Gross Alpha, Neptunium-237, Plutonium-238, Plutonium-239/240, and Technetium-99 were not detected in cabbage.						
<b>Fruit</b>	Americium-241	5	1	6.48E-05	7.91E-06	<b>1.47E-04</b>
	Nonvolatile Beta	5	5	1.11E+00	<b>9.46E-01</b>	<b>1.23E+00</b>
	Plutonium-238	5	4	1.21E-04	7.60E-05	<b>1.78E-04</b>
	Strontium-90	5	1	2.72E-03	1.30E-03	<b>6.78E-03</b>
	Uranium-233/234	5	3	7.93E-05	2.67E-06	<b>1.22E-04</b>
	Uranium-238	5	1	6.01E-05	0.00E+00	<b>1.06E-04</b>
Cesium-137, Cobalt-60, Curium-243/244, Gross Alpha, Neptunium-237, Plutonium-239/240, Technetium-99, Tritium, and Uranium-235 were not detected in fruit.						
<b>Greens</b>	Americium-241	5	2	1.30E-03	-1.79E-04	<b>5.84E-03</b>
	Cesium-137	5	5	2.55E-02	<b>1.40E-02</b>	<b>3.84E-02</b>
	Neptunium-237	5	1	6.24E-04	1.12E-05	<b>2.68E-03</b>
	Nonvolatile Beta	5	5	2.31E+00	<b>1.65E+00</b>	<b>3.07E+00</b>
	Plutonium-238	5	1	2.75E-04	1.10E-04	<b>5.89E-04</b>
	Plutonium-239/240	5	1	2.72E-04	8.52E-05	<b>5.88E-04</b>
	Strontium-90	5	4	1.09E-01	1.91E-02	<b>1.96E-01</b>
	Tritium	5	1	8.62E-03	1.15E-03	<b>2.97E-02</b>

<b>Food Type</b>	<b>Nuclide</b>	<b>Number of Samples</b>	<b>Number of Results &gt; Detection Limit</b>	<b>Mean Sample Conc. (pCi/g)</b>	<b>Minimum Sample Conc. (pCi/g)</b>	<b>Maximum Sample Conc. (pCi/g)</b>
	Uranium-233/234	5	5	1.35E-02	<b>2.51E-03</b>	<b>5.08E-02</b>
	Uranium-235	5	1	9.01E-04	1.15E-04	<b>3.39E-03</b>
	Uranium-238	5	5	1.39E-02	<b>2.45E-03</b>	<b>5.08E-02</b>
Cobalt-60, Curium-243/244, Gross Alpha, and Technetium-99 were not detected in greens.						
<b>Wheat</b>	Americium-241	5	1	4.72E-04	1.24E-04	<b>1.28E-03</b>
	Curium-243/244	5	1	5.81E-04	-7.86E-05	<b>2.85E-03</b>
	Nonvolatile Beta	5	5	3.74E+00	<b>3.18E+00</b>	<b>4.42E+00</b>
	Plutonium-238	5	1	4.41E-04	2.59E-04	<b>8.47E-04</b>
	Plutonium-239/240	5	1	4.27E-04	2.09E-04	<b>7.12E-04</b>
	Strontium-90	5	1	2.42E-02	9.32E-03	<b>5.30E-02</b>
Cesium-137, Cobalt-60, Gross Alpha, Neptunium-237, Technetium-99, Tritium, and Uranium-235 were not detected in wheat.						

**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 dairies in the named state that provide samples to SRS.

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 Co-60 and 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)
<b>SC–Dairies (4)</b>						
<b>Cow Milk</b>	Cs-137	16	3	1.90E+00	-2.08E-01	<b>7.32E+00</b>
<b>SC–Dairies (4)</b>						
<b>Cow Milk</b>	Sr-90	16	2	5.09E-01	-8.08E-01	<b>2.67E+00</b>
<b>GA–Dairies (3)</b>						
<b>Cow Milk</b>	Cs-137	12	1	1.26E+00	-5.51E-01	<b>3.24E+00</b>
<b>GA–Dairies (3)</b>						
<b>Cow Milk</b>	Sr-90	12	1	2.25E-01	-5.89E-01	<b>6.73E-01</b>

**Appendix Table D-11 Radiation in Liquid Source Releases**

All values under the “Reactors,” “Separations,” “SRNL,” and the “Totals” column are reported in curies.<sup>a</sup>

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 Co-60 results were not detected; therefore, they were not reported in this table.

Radionuclide	Half-Life		Reactors (Ci)	Separations <sup>c</sup> (Ci)	SRNL (Ci)	Totals (Ci)
	Time Interval <sup>b</sup>					
H-3 <sup>d</sup>	12.3	y	1.07E+02	2.41E+02	6.70E-03	3.48E+02
C-14	5,700	y		7.09E-03	0.00E+00	7.09E-03
Sr-90	1.94E-01	y	1.48E-04	1.61E-02		1.63E-02
Tc-99	28.8	y	0.00E+00	1.22E-02	0.00E+00	1.22E-02
I-129	2.11E+05	y	0.00E+00	1.30E-02	0.00E+00	1.30E-02
Cs-137 <sup>e</sup>	1.57E+07	y	0.00E+00	9.59E-03	0.00E+00	9.59E-03
Eu-154	30.2	y	0.00E+00	3.49E-03	9.47E-04	4.44E-03
U-234	2.46E+05	y	1.97E-04	6.33E-02	5.06E-05	6.35E-02
U-235	7.04E+08	y	0.00E+00	3.73E-03	3.65E-06	3.73E-03
U-238	4.47E+09	y	5.21E-04	7.15E-02	4.46E-05	7.20E-02
Np-237	2.14E+06	y		9.07E-05		9.07E-05
Pu-238	87.7	y	0.00E+00	2.53E-04	1.70E-07	2.53E-04
Pu-239	2.41E+04	y	0.00E+00	2.72E-05	0.00E+00	2.72E-05
Am-241	432	y	0.00E+00	2.60E-05		2.60E-05
Cm-244	18.1	y	0.00E+00	1.02E-05		1.02E-05
Alpha <sup>f</sup>	N/A		4.09E-03	6.17E-03	1.18E-04	1.04E-02
Beta-Gamma <sup>g</sup>	N/A		3.97E-02	4.20E-03	0.00E+00	4.39E-02
					<b>Sum</b>	<b>3.48E+02</b>

<sup>a</sup> One curie equals 3.7E+10 becquerels

<sup>b</sup> ICRP 107, *Nuclear Decay Data for Dosimetric Calculations* (2008). Half-life time intervals are given in years (y).

<sup>c</sup> Includes separations, waste management, and tritium processing facilities

<sup>d</sup> The tritium release total, which includes direct + migration releases, is used in the dose calculations for SRS impacts.

<sup>e</sup> 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.

<sup>f,g</sup> 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, 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-1196-2011 (DOE 2011), establishes numerical standards for DCSs to support implementing DOE Order 458.1. This document was updated in 2022 (DOE 2022). 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. These sums of fractions determined by using both the 2011 and the 2022 standards are included.

Facility (Sampling Location)	Radionuclides Included in the Sum of Fractions	2011 DCS Sum of Fractions		2022 DCS Sum of Fractions	
		2011 DCS Sum of Fractions	Excluding Tritium	202 DCS Sum of Fractions	Excluding Tritium
<b>A Area (TB-2 Outfall at Road 1A)</b>	H-3, U-234, U-235, U-238, Pu-238	6.37E-04	5.73E-04	3.60E-04	3.13E-04
<b>F Area (F-05)</b>	H-3, C-14, Sr-89/90, Tc-99, U-234, U-235, U-238, Pu-238, Pu-239, Am-241, Cm-244	3.01E-03	2.74E-03	1.83E-03	1.63E-03
<b>F Area (FM-3 F-Area Effluent)</b>	H-3, Tc-99, I-129, U-234, U-235, U-238 Pu-238, Pu-239, Am- 241, Cm-244	9.56E-03	9.31E-03	2.06E-03	1.87E-03
<b>G-010 (Central Sanitary Wastewater Treatment Facility)</b>	H-3, Sr-89/90, U-234 U-238, Pu-238, Am- 241	3.56E-03	3.25E-03 3.12E-03	2.36E-03 2.29E-03	2.04E-03 1.96E-03
<b>H Area (FM-1C H- Area Effluent)</b>	H-3, Sr-89/90, Cs- 137, U-234, U-235, U-238, Np-237, Pu- 238, Pu-239, Am- 241, Cm-244,	1.90E-02	1.85E-02	1.20E-02	1.16E-02
<b>H Area (H-004)</b>	H-3, Sr-89/90, U-234 U-235, U-238, Pu- 238, Pu-239	6.51E-03	4.64E-03	3.90E-03	2.53E-03
<b>H-Tank Farm (HP-52 H-Area Tank Farm)</b>	H-3, U-234, U-238, Pu-238, Am-241	7.37E-04	1.69E-04	4.90E-04	7.46E-05
<b>K Area (K Canal)</b>	H-3, Sr-89/90	1.14E-03	2.56E-04	8.12E-04	1.66E-04
<b>S Area (S-004)</b>	H-3, Sr-89/90, U-234 U-235, U-238, Pu- 238	2.54E-03	9.21E-04	1.76E-03	5.74E-04
<b>Tritium (HP-15 Tritium Facility Outfall)</b>	H-3	1.48E-02	0.00E+00	1.08E-02	0.00E+00

**Appendix Table D-13 Summary of Radionuclides in Sediments**

SRS collected annual sediment samples at 40 locations in 2022—11 Savannah River, 21 stream, and 8 stormwater basins—totaling 457 analytes. Qualitative results for Americium-241 and Curium-244 at Beaver Dam Creek [BDC], L3R-1A, and Steel Creek [SC] are reported. Locations sampled are as follows: Savannah River locations (mouths of Beaver Dam Creek [BDC] and Steel Creek [SC], River Miles [RM] 118.7, 129, 134, 141, 150.2, 150.4 and 157.2), SRS Stream locations (downstream of R-1, FM-2, FM-3A, FM-6, FM-A7, FM-A7A, FMC @ Rd A, FMC Swamp, L3R-1A, L3R-2, McQB @ MO,, PB @ Rd A, PB Swamp, SC-2A, SC-4, TB-5, U3R-3, and U3R-4), and 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**

*10 River Locations Plus 1 Control*

*(Some locations only analyzed for Cs-137, Co-60, gross alpha, and nonvolatile beta)*

Analyte	Number > DL	Control RM 161.0 (pCi/g)	Location of Maximum Result	Maximum Result (pCi/g)
<b>Americium-241</b>	3 of 9	<b>2.33E-03</b>	RM-161.0	<b>2.33E-03</b>
<b>Cesium-137</b>	7 of 11	< 6.65E-02	SC-RM	<b>1.54E+00</b>
<b>Cobalt-60</b>	0 of 11	< 6.34E-02	All < MDA	All < MDA
<b>Curium-243/244</b>	3 of 9	< 9.03E-04	RM-129	<b>1.56E-03</b>
<b>Gross Alpha</b>	11 of 11	<b>1.31E+01</b>	RM-157.2	<b>4.06E+01</b>
<b>Neptunium-237</b>	0 of 9	< 2.6E-03	All < MDA	All < MDA
<b>Nonvolatile Beta</b>	11 of 11	<b>2.14E+01</b>	RM-157.2	<b>3.24E+01</b>
<b>Plutonium-238</b>	0 of 9	< 2.67E-03	All < MDA	All < MDA
<b>Plutonium-239/240</b>	3 of 9	< 2.19E-03	RM-157.2	<b>1.17E-02</b>
<b>Strontium-90</b>	0 of 9	< 9.02E-02	All < MDA	All < MDA
<b>Uranium-233/234</b>	9 of 9	<b>1.95E+00</b>	BDC RM	<b>2.26E+00</b>
<b>Uranium-235</b>	9 of 9	<b>9.09E-02</b>	BDC RM	<b>1.04E-01</b>
<b>Uranium-238</b>	9 of 9	<b>1.87E+00</b>	BDC RM	<b>2.34E+00</b>

Appendix Table D-13 Summary of Radionuclides in Sediments (continued)

## Stream Sediment Results

19 Stream Locations Plus 2 Controls

(Some locations only sampled for Cs-137, Co-60, gross alpha and nonvolatile beta)

Analyte	Number >DL	Control TC-1 (pCi/g)	Control U3R-1A (pCi/g)	Location of Maximum Result	Maximum Result (pCi/g)
Americium-241	14 of 18	3.19E-03	1.87E-03	FM-2	6.96E-01
Cesium-137	20 of 23	< 4.66E-02	8.05E-02	FM-2	3.37E+01
Cobalt-60	0 of 23	< 4.04E-02	< 6.46E-02	All < MDA	All < MDA
Curium-243/244	5 of 18	< 1.07E-03	< 1.05E-03	FM-2	5.87E-01
Gross Alpha	23 of 23	8.99E+00	2.86E+01	U3R-3	4.12E+01
Neptunium-237	3 of 18	< 1.78E-03	< 1.32E-03	Downstream of R-1	6.37E-02
Nonvolatile Beta	23 of 23	6.30E+00	1.87E+01	Downstream of R-1	4.11E+01
Plutonium-238	14 of 18	3.30E-03	< 1.11E-03	Downstream of R-1	2.01E+00
Plutonium-239/240	14 of 18	2.98E-03	< 3.87E-03	Downstream of R-1	2.01E+00
Strontium-90	6 of 18	< 9.05E-02	7.58E-02	Downstream of R-1	1.92E+00
Uranium-233/234	17 of 18	7.97E-01	1.07E+00	SC-2A	3.54E+00
Uranium-235	16 of 18	3.03E-02	7.75E-02	Downstream of R-1	5.14E-01
Uranium-238	17 of 18	7.09E-01	1.11E+00	SC-2A	3.62E+00

## Stormwater Basin Sediment Results

Eight Basin Locations Compared to Two Stream Control Locations

Analyte	Number >DL	Control TC-1 (pCi/g)	Control U3R-1A (pCi/g)	Location of Maximum Result	Maximum Result (pCi/g)
Americium-241	8 of 10	3.19E-03	1.87E-03	Z-Basin	4.24E-01
Cesium-137	6 of 10	< 4.66E-02	8.05E-02	Z-Basin	1.43E+03
Cobalt-60	0 of 10	< 4.04E-02	< 6.46E-02	All < MDA	All < MDA
Curium-243/244	3 of 10	< 1.07E-03	< 1.05E-03	Z-Basin	4.92E-01
Gross Alpha	10 of 10	8.99E+00	2.86E+01	Pond 400	2.66E+01
Neptunium-237	1 of 10	< 1.78E-03	< 1.32E-03	Z-Basin	5.44E-02
Nonvolatile Beta	10 of 10	6.30E+00	1.87E+01	Z-Basin	1.21E+03
Plutonium-238	6 of 10	3.30E-03	< 1.11E-03	Z-Basin	8.42E-01
Plutonium-239/240	8 of 10	2.98E-03	3.87E-03	Z-Basin	7.78E-01
Strontium-90	2 of 10	< 9.05E-02	< 9.01E-02	E-003	1.90E+00
Uranium-233/234	9 of 10	7.97E-01	1.07E+00	Pond 400	2.13E+00
Uranium-235	9 of 10	3.03E-02	7.75E-02	Z-Basin	5.11E-01
Uranium-238	9 of 10	7.09E-01	1.11E+00	Pond 400	2.06E+00

**Appendix Table D-14 Summary of Radionuclides in Drinking Water**

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.

Samples at the treatment plants are collected monthly. These samples are analyzed for tritium, Co-60, Cs-137, gross alpha, and gross beta. For the treatment plants samples, all results for Co-60 and Cs-137 were below detection limits; therefore, they were not reported in the table below. Samples are collected onsite annually for tritium, Co-60, Cs-137, gross beta, gross alpha, Am-241, Sr-89/90, U-234, U-235, U-238, Pu-238, Pu-239, and Cm-244. For the onsite annual samples, all results for tritium, Co-60, Cs-137, Sr-89/90, U-235, Pu-239, and Cm-244 were below detection limits; therefore, they were not reported in this table.

*Treatment Plants—Finished Water Summary*

<b>Tritium</b>					
Locations	Number of Samples	Number of Detects	Mean Concentration (pCi/L)	Minimum Concentration (pCi/L)	Maximum Concentration (pCi/L)
<b>BJWSA Purrysburg WTP</b>	12	5	1.65E+02	6.76E+01	<b>3.74E+02</b>
<b>North Augusta Public Water Works</b>	12	2	5.40E+01	-2.64E+01	<b>1.48E+02</b>

<b>Gross Beta</b>					
Locations	Number of Samples	Number of Detects	Mean Concentration (pCi/L)	Minimum Concentration (pCi/L)	Maximum Concentration (pCi/L)
<b>BJWSA Purrysburg WTP</b>	12	12	1.90E+00	<b>1.49E+00</b>	<b>2.32E+00</b>
<b>North Augusta Public Water Works</b>	12	12	1.92E+00	<b>1.52E+00</b>	<b>2.81E+00</b>

<b>Gross Alpha</b>					
Locations	Number of Samples	Number of Detects	Mean Concentration (pCi/L)	Minimum Concentration (pCi/L)	Maximum Concentration (pCi/L)
<b>BJWSA Purrysburg WTP</b>	12	1	1.24E-01	-5.94E-02	<b>5.46E-01</b>
<b>North Augusta Public Water Works</b>	12	0	3.81E-02	-9.22E-02	9.98E-02

Appendix Table D-14 Summary of Radionuclides in Drinking Water (continued)

## Onsite Location Summary—Annual Samples

Location	Number of Samples	U-234	U-238	Am-241
		Concentration (pCi/L)	Concentration (pCi/L)	Concentration (pCi/L)
617-8G	1	6.70E-03	5.54E-04	6.65E-03
681-3G	1	4.07E-03	-1.85E-03	1.45E-03
704-16G	1	7.95E-03	6.05E-04	1.45E-02
709-1G	1	2.78E-03	<b>1.22E-02</b>	<b>1.29E-02</b>
737-G	1	-6.54E-06	-1.58E-03	6.24E-04
782-3A	1	<b>2.24E-02</b>	<b>3.35E-02</b>	9.00E-03
905-113G Well	1	7.89E-03	<b>3.78E-02</b>	2.78E-03
905-125B	1	5.97E-03	3.24E-03	9.49E-03
905-67B	1	<b>9.57E-03</b>	4.03E-03	3.00E-03

## Onsite Location Summary—Annual Samples (continued)

Location	Number of Samples	Pu-238	Gross Beta	Gross Alpha
		Concentration (pCi/L)	Concentration (pCi/L)	Concentration (pCi/L)
617-8G	1	<b>2.33E-02</b>	<b>9.00E-01</b>	2.00E-01
681-3G	1	-4.14E-04	<b>3.43E+00</b>	<b>1.19E+00</b>
704-16G	1	1.53E-03	<b>1.65E+00</b>	<b>1.74E+00</b>
709-1G	1	2.09E-03	<b>1.49E+00</b>	9.89E-03
737-G	1	4.89E-03	<b>1.45E+00</b>	1.94E-01
782-3A	1	-1.05E-03	<b>1.65E+00</b>	<b>6.76E-01</b>
905-113G Well	1	1.14E-02	<b>1.16E+00</b>	<b>1.06E+00</b>
905-125B	1	<b>2.97E-02</b>	<b>1.62E+00</b>	<b>1.39E+00</b>
905-67B	1	4.41E-03	<b>1.16E+00</b>	<b>1.10E+00</b>

**Appendix Table D-15 Summary of Radionuclides in Freshwater Fish**

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. Sr-89/90 is the only analysis performed in both flesh (edible) and bone (nonedible) samples. All Co-60, I-129, and gross alpha results were not detected; therefore, they were not reported in this table.

The analyte mean is set to zero if all composite values per fish species at a single location are less than the MDL or the uncertainty is large. Three composite samples were analyzed for each fish type from each location, except flathead catfish and panfish from Upper Three Runs Creek River Mouth, respectively.

Cs-137 (Edible)												
Location	Bass			Catfish			Flathead			Panfish		
	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)
Augusta L&D	<b>2.89*E+0</b> <b>1</b>	<b>1.30E+01</b>	<b>5.26E+01</b>	1.45E+01	1.13E+01	<b>1.70E+01</b>	N/A	N/A	N/A	<b>6.52E+01</b>	<b>1.96E+01</b>	<b>9.08E+01</b>
Four Mile Creek River Mouth	<b>8.24E+01</b>	<b>5.45E+01</b>	<b>1.22E+02</b>	<b>4.33E+01</b>	<b>3.49E+01</b>	<b>5.67E+01</b>	3.12E+01	1.66E+01	<b>4.83E+01</b>	<b>7.75E+01</b>	<b>3.18E+01</b>	<b>1.27E+02</b>
Hwy 301 Bridge Area	<b>1.62E+01</b>	<b>1.38E+01</b>	<b>2.00E+01</b>	<b>1.77E+01</b>	<b>1.41E+01</b>	<b>2.15E+01</b>	<b>2.10E+01</b>	<b>1.90E+01</b>	<b>2.48E+01</b>	9.93E+00	6.83E+00	<b>1.40E+01</b>
Lower Three Runs Creek River Mouth	2.52E+01	1.62E+01	<b>3.12E+01</b>	<b>4.79E+02</b>	<b>2.79E+02</b>	<b>8.15E+02</b>	<b>6.12E+01</b>	<b>3.48E+01</b>	<b>1.03E+02</b>	<b>2.47E+02</b>	<b>1.02E+02</b>	<b>5.01E+02</b>
Steel Creek River Mouth	<b>1.35E+02</b>	<b>9.79E+01</b>	<b>1.68E+02</b>	<b>7.66E+01</b>	<b>6.19E+01</b>	<b>9.93E+01</b>	<b>7.62E+01</b>	<b>4.57E+01</b>	<b>1.36E+02</b>	<b>6.71E+01</b>	<b>5.19E+01</b>	<b>9.10E+01</b>
Upper Three Runs Creek River Mouth	<b>3.69E+01</b>	<b>1.64E+01</b>	<b>6.73E+01</b>	0.00E+00	1.09E+01	1.44E+01	<b>6.38E+01</b>	<b>3.45E+01</b>	<b>9.17+01</b>	0.00E+00	7.50E+00	9.91E+00

Appendix Table D-15 Summary of Radionuclides in Freshwater Fish (continued)

Sr-89/90 (Edible)												
Location	Bass			Catfish			Flathead			Panfish		
	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)
Augusta L&D	0.00E+00	5.17E-01	2.93E+00	0.00E+00	-1.86E+00	4.18E+00	N/A	N/A	N/A	0.00E+00	1.24E+00	2.55E+00
Four Mile Creek River Mouth	2.44E+00	2.20E+00	2.57E+00	2.49E+00	5.91E-01	<b>5.75E+00</b>	1.72E+00	2.16E-02	<b>4.31E+00</b>	0.00E+00	1.17E+00	1.82E+00
Hwy 301 Bridge Area	0.00E+00	6.07E-01	1.36E+00	0.00E+00	1.95E+00	2.32E+00	0.00E+00	-2.81E-01	2.13E+00	0.00E+00	-3.50E+00	4.93E+00
Lower Three Runs Creek River Mouth	0.00E+00	-5.71E-01	3.02E+00	0.00E+00	1.22E+00	2.13E+00	0.00E+00	-2.89E-01	1.90E+00	0.00E+00	-5.82E-01	4.22E+00
Steel Creek River Mouth	0.00E+00	-5.28E-01	1.62E+00	0.00E+00	-6.92E-01	1.95E+00	0.00E+00	-1.86E-01	1.74E+00	0.00E+00	-6.38E-01	4.87E+00
Upper Three Runs Creek River Mouth	2.29E+00	1.16E+00	<b>3.78E+00</b>	0.00E+00	5.90E-02	1.22E+00	0.00E+00	7.37E-01	1.70E-00	1.88E+00	1.51E-01	<b>3.61E+00</b>

Sr-89/90 (Nonedible)												
Location	Bass			Catfish			Flathead			Panfish		
	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)
Augusta L&D	1.02E+02	9.22E+01	1.18E+02	8.04E+01	6.22E+01	1.03E+02	N/A	N/A	N/A	1.16E+02	8.51E+01	1.37E+02
Four Mile Creek River Mouth	5.07E+02	1.76E+02	1.11E+03	1.15E+02	7.65E+01	1.50E+02	8.31E+01	5.67E+01	1.02E+02	3.73E+02	1.63E+02	5.58E+02
Hwy 301 Bridge Area	7.40E+01	4.99E+01	1.01E+02	9.39E+01	7.16E+01	1.05E+02	8.00E+01	5.32E+01	9.54E+01	9.49E+01	8.08E+01	1.21E+02
Lower Three Runs Creek River Mouth	9.36E+01	8.37E+01	1.02E+02	8.53E+01	5.98E+01	1.02E+02	9.54E+01	6.59E+01	1.25E+02	1.13E+02	9.28E+01	1.34E+02
Steel Creek River Mouth	1.54E+02	1.06E+02	2.12E+02	9.38E+01	7.49E+01	1.15E+02	9.20E+01	6.53E+01	1.15E+02	9.53E+01	9.13E+01	9.75E+01
Upper Three Runs Creek River Mouth	1.02E+02	7.35E+01	1.40E+02	5.82E+01	5.65E+01	5.97E+01	7.34E+01	1.05E-02	1.07E+02	1.24E+02	8.98E+01	1.48E+02

Appendix Table D-15 Summary of Radionuclides in Freshwater Fish (continued)

Tc-99 (Edible)												
Location	Bass			Catfish			Flathead			Panfish		
	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)
Augusta L&D	0.00E+00	2.22E+01	3.22E+01	0.00E+00	-8.87E+00	2.42E+01	N/A	N/A	N/A	0.00E+00	6.04E+00	3.75E+01
Four Mile Creek River Mouth	0.00E+00	-2.76E+01	3.02E+01	0.00E+00	-1.24E+01	1.74E+01	0.00E+00	2.88E+00	6.20E+00	0.00E+00	1.50E-04	1.78E+01
Hwy 301 Bridge Area	0.00E+00	-2.55E+01	1.90E+01	0.00E+00	2.40E+01	3.23E+01	0.00E+00	-1.90E+00	1.64E+01	0.00E+00	-5.33E+00	1.56E+01
Lower Three Runs Creek River Mouth	5.20E+01	3.03E+01	<b>6.81E+01</b>	0.00E+00	2.27E+01	4.29E+01	0.00E+00	1.64E+01	3.24E+01	0.00E+00	1.05E+01	5.67E+01
Steel Creek River Mouth	0.00E+00	3.29E+01	5.16E+01	0.00E+00	2.25E+01	5.39E+01	0.00E+00	2.16E+01	3.51E+01	0.00E+00	3.75E+01	5.06E+01
Upper Three Runs Creek River Mouth	0.00E+00	-1.43E+01	1.64E+00	0.00E+00	-2.28E+01	2.61E+01	0.00E+00	-2.89E-01	7.85E+00	0.00E+00	-8.57E+00	8.14E+00
Gross Beta (Edible)												
Location	Bass			Catfish			Flathead			Panfish		
	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)	Mean (pCi/kg)	Minimum (pCi/kg)	Maximum (pCi/kg)
Augusta L&D	<b>1.31E+03</b>	<b>1.15E+03</b>	<b>1.51E+03</b>	<b>1.23E+03</b>	<b>1.03E+03</b>	<b>1.39E+03</b>	N/A	N/A	N/A	<b>1.25E+03</b>	<b>1.12E+03</b>	<b>1.42E+03</b>
Four Mile Creek River Mouth	<b>1.32E+03</b>	<b>1.21E+03</b>	<b>1.51E+03</b>	<b>1.31E+03</b>	<b>1.19E+03</b>	<b>1.37E+03</b>	<b>1.35E+03</b>	<b>1.12E+03</b>	<b>1.53E+03</b>	<b>1.21E+03</b>	<b>1.08E+03</b>	<b>1.28E+03</b>
Hwy 301 Bridge Area	<b>8.59E+02</b>	<b>7.85E+02</b>	<b>9.39E+02</b>	<b>7.92E+02</b>	<b>6.40E+02</b>	<b>9.56E+02</b>	<b>8.96E+02</b>	<b>7.28E+02</b>	<b>9.86E+02</b>	<b>1.01E+03</b>	<b>9.46E+02</b>	<b>1.06E+03</b>
Lower Three Runs Creek River Mouth	<b>9.84E+02</b>	<b>7.86E+02</b>	<b>1.28E+03</b>	<b>8.31E+02</b>	<b>7.81E+02</b>	<b>9.11E+02</b>	<b>8.12E+02</b>	<b>7.32E+02</b>	<b>9.08E+02</b>	<b>8.94E+02</b>	<b>7.76E+02</b>	<b>1.11E+03</b>
Steel Creek River Mouth	<b>7.68E+02</b>	<b>6.58E+02</b>	<b>8.35E+02</b>	<b>7.91E+02</b>	<b>5.78E+02</b>	<b>9.27E+02</b>	<b>9.09E+02</b>	<b>8.79E+02</b>	<b>9.32E+02</b>	<b>7.78E+02</b>	<b>6.20E+02</b>	<b>8.73E+02</b>
Upper Three Runs Creek River Mouth	<b>1.08E+03</b>	<b>9.77E+02</b>	<b>1.21E+03</b>	<b>1.22E+03</b>	<b>1.16E+03</b>	<b>1.35E+03</b>	<b>1.30E+03</b>	<b>1.20E+03</b>	<b>1.46E+03</b>	<b>9.82E+02</b>	<b>8.14E+02</b>	<b>1.15E+03</b>

**Appendix Table D-16 Summary of Radionuclides in Saltwater Fish**

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. Sr-89/90 is the only analysis performed in both flesh (edible) and bone (nonedible) samples. Results of all samples for Cs-137, Co-60, gross alpha, I-129, and Tc-99 were below method detection limits.

All saltwater fish are collected at the location designated as RM 0–8 (mouth of Savannah River).

<b>Marine Mullet</b>					
<b>Analyte</b>	<b>Number of Samples</b>	<b>Number of Results &gt; Detection Limit</b>	<b>Mean (pCi/kg)</b>	<b>Minimum (pCi/kg)</b>	<b>Maximum (pCi/kg)</b>
<b>Gross Beta</b>	3	3	<b>7.94E+02</b>	<b>6.34E+02</b>	<b>9.67E+02</b>
<b>Sr-89/90 (Edible)</b>	3	1	3.06E+00	5.62E-01	<b>4.78E+00</b>
<b>Sr-89/90 (Nonedible)</b>	3	1	2.72E+01	7.68E+00	<b>5.55E+01</b>

**Appendix Table D-17 Summary of Radionuclides in Shellfish**

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 Cs-137, Co-60, Gross Alpha, I-129, Sr-89/90, and Tc-99 results were not detected; therefore, they were not reported in this table.

All shellfish are collected at the location designated as RM 0-8 (at the mouth of Savannah River).

The species of shellfish collected in 2022 were crab and shrimp

Specie	Nuclide	Number of Samples	Number of Results > Detection Limit	Mean Concentration (pCi/kg)	Minimum Concentration (pCi/kg)	Maximum Concentration (pCi/kg)
<b>Crab</b>	Gross Beta	1	1	<b>8.11E+02</b>	<b>8.11E+02</b>	<b>8.11E+02</b>
<b>Shrimp</b>	Gross Beta	1	1	<b>8.42E+02</b>	<b>8.42E+02</b>	<b>8.42E+02</b>

**Appendix Table D-18 Summary of Radionuclides in Wildlife**

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 Co-60 results were below detection limits; therefore, they are not reported in this table.

Sample Type	Nuclide	Number of Samples	Number of Results > Detection Limit	Mean Sample Concentration (pCi/g)	Minimum Sample Concentration (pCi/g)	Maximum Sample Concentration (pCi/g)
Deer Flesh	Cs-137	34	34	1.02E+00	<b>2.58E-01</b>	<b>2.90E+00</b>
Hog Flesh	Cs-137	6	6	1.39E+00	<b>6.80E-01</b>	<b>3.05E+00</b>
Deer Flesh	Sr-89/90	34	1	2.14E-03	-2.52E-03	<b>9.44E-03</b>
Hog Flesh	Sr-89/90	6	0	1.09E-03	-9.27E-04	5.57E-03
Deer Bone	Sr-89/90	34	34	2.41E+00	<b>5.48E-01</b>	<b>5.83E+00</b>
Hog Bone	Sr-89/90	6	6	4.36E+00	<b>1.77E+00</b>	<b>1.11E+01</b>

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# 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)**

<b>Document Title</b>	<b>Submittal Frequency</b>
<b>Effectiveness Monitoring Report (EMR) for the Monitored Natural Attenuation (MNA) at the Chemicals, Metals, and Pesticides (CMP) Pits Operable Unit</b>	Annual
<b>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</b>	Biennial
<b>Scoping Summary for the General Separations Area Eastern Groundwater Operable Unit</b>	Annual
<b>Scoping Summary for the General Separations Area Western Groundwater Operable Unit</b>	Annual
<b>Sanitary Landfill Groundwater Monitoring and Corrective Action Report</b>	Annual
<b>Annual Groundwater Monitoring Report for the F- and H-Area Radioactive Liquid Waste Tank Farms</b>	Annual
<b>Effectiveness Monitoring Report (EMR) for the P-Area Groundwater (PAGW) Operable Unit Zero Valent Iron Permeable Reactive Barrier Removal Action</b>	Annual
<b>Groundwater Report for the P-Area Groundwater (PAGW) Operable Unit</b>	Annual
<b>Treatability Study Data Report for Groundwater Injection and Discharge Canal Neutralization at the D-Area Groundwater Operable Unit</b>	Annual
<b>Five-Year Monitoring Report (Data Summary Letter) for K-Area Groundwater Operable Unit</b>	Quinquennial
<b>Groundwater Mixing Zone Report for the R-Reactor Seepage Basin, 108-4R Overflow Basin (Full Report)</b>	Quadrennial
<b>Groundwater Mixing Zone Sampling Summary Report for the Report for the R-Reactor Seepage Basin, 108-4R Overflow Basin</b>	Quadrennial (2 years after full report)
<b>SRS Environmental Report</b>	Not applicable <sup>a</sup>

<sup>a</sup> 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

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## 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**<sup>®</sup> —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  $3.7 \times 10^{10}$  (37 billion) disintegrations per second. Several fractions and multiples of the curie are commonly used:

- **kilocurie (kCi)**— $10^3$  Ci, one thousand curies;  $3.7 \times 10^{13}$  disintegrations per second.
- **millicurie (mCi)**— $10^{-3}$  Ci, one-thousandth of a curie;  $3.7 \times 10^7$  disintegrations per second.
- **microcurie ( $\mu$ Ci)**— $10^{-6}$  Ci, one-millionth of a curie;  $3.7 \times 10^4$  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 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.

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## 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, as of nuclear waste.

**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,  $\text{pH} < 7$ ; basic solutions,  $\text{pH} > 7$ ; and neutral solutions,  $\text{pH} = 7$ ).

**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**<sup>®</sup>—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

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# Appendix H: Units of Measure

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<b>Symbol</b>	<b>Name</b>	<b>Symbol</b>	<b>Name</b>
<b>Temperature</b>		<b>Concentration</b>	
°C	degrees Celsius	ppb	parts per billion
°F	degrees Fahrenheit	ppm	parts per million
<b>Time</b>		<b>Rate</b>	
d	day	cfs	cubic feet per second
h	hour	gpm	gallons per minute
y	year	<b>Conductivity</b>	
<b>Length</b>		µmho	micromho
cm	centimeter	<b>Radioactivity</b>	
ft	foot	Ci	curie
in	inch	Ci/mL	curie per milliliter
km	kilometer	cpm	counts per minute
m	meter	mCi	millicurie
mm	millimeter	µCi	microcurie
µm	micrometer	pCi	picocurie
<b>Mass</b>		pci/L	picocurie per liter
g	gram	Bq	becquerel
kg	kilogram	<b>Radiation Dose</b>	
mg	milligram	mrad	millirad
µg	microgram	mrem	millirem
<b>Area</b>		Sv	sievert
mi <sup>2</sup>	square mile	mSv	millisievert
ft <sup>2</sup>	square foot	µSv	microsievert
<b>Volume</b>		R	roentgen
gal	gallon	mR	milliroentgen
L	liter	µR	microroentgen
mL	milliliter	Gy	gray

Fractions and Multiples of Units				
Multiple	Decimal Equivalent	Prefix	Symbol	Report Format
10 <sup>6</sup>	1,000,000	mega-	M	E+06
10 <sup>3</sup>	1,000	kilo-	k	E+03
10 <sup>2</sup>	100	hecto-	h	E+02
10	10	deka-	da	E+01
10 <sup>-1</sup>	0.1	deci-	d	E-01
10 <sup>-2</sup>	0.01	centi-	c	E-02
10 <sup>-3</sup>	0.001	milli-	m	E-03
10 <sup>-6</sup>	0.000001	micro-	μ	E-06
10 <sup>-9</sup>	0.000000001	nano-	n	E-09
10 <sup>-12</sup>	0.000000000001	pico-	p	E-12
10 <sup>-15</sup>	0.000000000000001	femto-	f	E-15
10 <sup>-18</sup>	0.000000000000000001	atto-	a	E-18

Conversion Table (Units of Radiation Measure)		
Current System	<i>Systeme International</i>	Conversion
curie (Ci)	becquerel (Bq)	1 Ci = 3.7x10 <sup>10</sup> Bq
rad (radiation absorbed dose)	gray (Gy)	1 rad = 0.01 Gy
rem (roentgen equivalent man)	sievert (Sv)	1 rem = 0.01 Sv

Conversion Table					
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 <sup>2</sup>	0.093	m <sup>2</sup>	m <sup>2</sup>	10.764	ft <sup>2</sup>
mi <sup>2</sup>	2.59	km <sup>2</sup>	km <sup>2</sup>	0.386	mi <sup>2</sup>
ft <sup>3</sup>	0.028	m <sup>3</sup>	m <sup>3</sup>	35.31	ft <sup>3</sup>
d/m	0.450	pCi	pCi	2.22	d/m
pCi	10 <sup>-6</sup>	μCi	μCi	10 <sup>6</sup>	pCi
pCi/L (water)	10 <sup>-9</sup>	μCi/mL (water)	μCi/mL (water)	10 <sup>9</sup>	pCi/L (water)
pCi/m <sup>3</sup> (air)	10 <sup>-12</sup>	μCi/mL (air)	μCi/mL (air)	10 <sup>12</sup>	pCi/m <sup>3</sup> (air)





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