Chapter 5: **Radiological Environmental Monitoring Program**

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

2024 Highlights

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

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

Wildlife Surveillance—All harvested animals SRS monitored during the annual onsite hunts were below the applicable standard. SRS monitored the deer, feral hogs, turkeys, and coyotes harvested during the hunts and released all 69 animals.

5.1 INTRODUCTION

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

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

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

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

SRS conducts environmental monitoring of the following:

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

Chapter 5—Key Terms

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

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

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

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

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

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

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

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

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

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

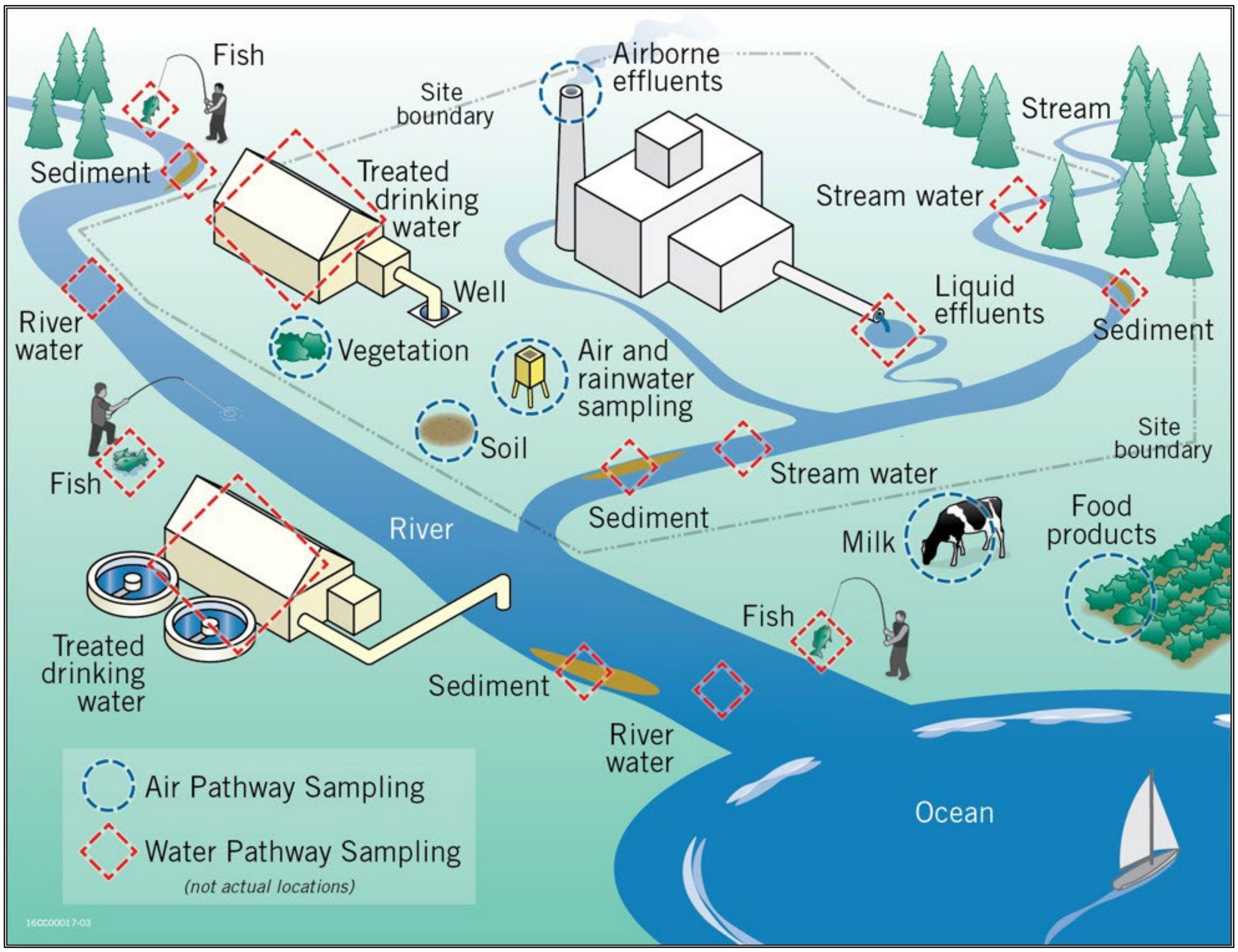


Figure 5-1 Types and Typical Locations of Radiological Sampling

5.2 SRS OFFSITE MONITORING

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

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

5.3 AIR PATHWAY

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

5.3.1 Air Monitoring

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

5.3.2 Air Effluents Monitoring Program

The EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) program establishes the limits for radionuclide emissions, detailing the methods for estimating and reporting radioactive emissions from DOE-owned or -operated sources. The South Carolina Department of Environmental Services 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 laboratories, disposal sites and storage tanks, and deactivation and decommissioning activities. The emissions calculated from unmonitored releases use the methods found 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 Air Effluents Results Summary

During the past 10 years, the total annual tritium release from SRS operations has ranged from about 7,000 to 40,000 Ci per year, with an annual average tritium release of 14,952 Ci (Figure 5-2). SRS tritium releases fluctuate from year to year due to deactivation of legacy process buildings, the amount of tritium released during routine operations, and natural decay of tritium (about 5% per year). The 2024 SRS tritium releases totaled 10,415 Ci, which is lower than the annual average tritium release. Table 5-1 summarizes radiologic atmospheric releases for the calendar year (CY). Appendix Table D-1 also presents SRS radioactive release totals from monitored and unmonitored (calculated) sources.

Tritium (68%) and krypton-85 (32%) accounted for most of the total radiation SRS operations released to the air in 2024. Tritium-processing facilities are responsible for most of the SRS tritium releases, and highly enriched uranium reprocessing at H Area separations facilities is responsible for all krypton-85 releases. Tritium releases from the separations areas are a combination of releases from the tritium-processing facilities and the dissolution in H Canyon. Figure 5-2 shows a 10-year history of tritium releases from separations areas, legacy reactor facilities, and unmonitored sources, with tritium from separations facilities historically comprising most of the releases. Tritium from separations facilities made up 99.57% of the total tritium releases in 2024, as Figure 5-3 illustrates. Appendix Table D-1 includes additional information on tritium releases.

Table 5-1 SRS Radiological Atmospheric Releases for CY 2024

Release Type	Total (curies)
Tritium	1.04E+04
Krypton-85 (^{85}Kr)	4.91E+03
Short-Lived Fission and Activation Products (T1/2 < 3 hr)[a,b]	5.03E-09
Fission and Activation Products (T1/2 > 3 hr)[a,b]	3.11E-02
Total Radio-iodine	4.77E-03
Total Radio-strontium[c]	6.15E-03
Total Uranium	1.27E-05
Plutonium[d]	1.75E-04
Other Actinides	2.64E-06
Other	2.30E-06

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

Appendix Table D-2 summarizes the 2024 air effluent-derived concentration standard (DCS) sum of fractions for continuous sources. The table contains calculated concentrations for tritium from the legacy reactor areas and the tritium-processing facilities and for krypton-85, carbon-14, and tritium released from the H Canyon facility during the dissolving process. SRS calculates these concentrations based on the annual releases in curies and the annual stack release volume.

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

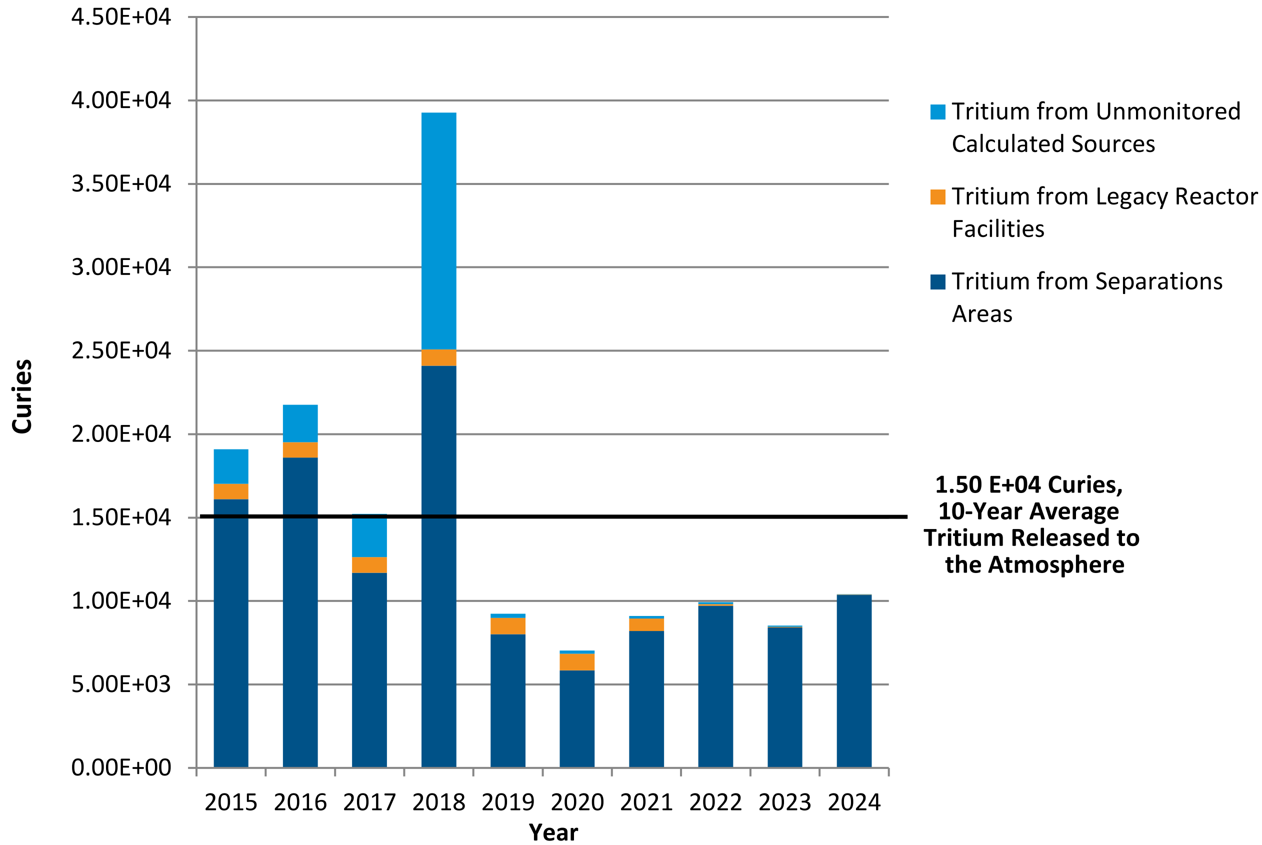


Figure 5-2 10-Year History of SRS Annual Tritium Releases to the Air

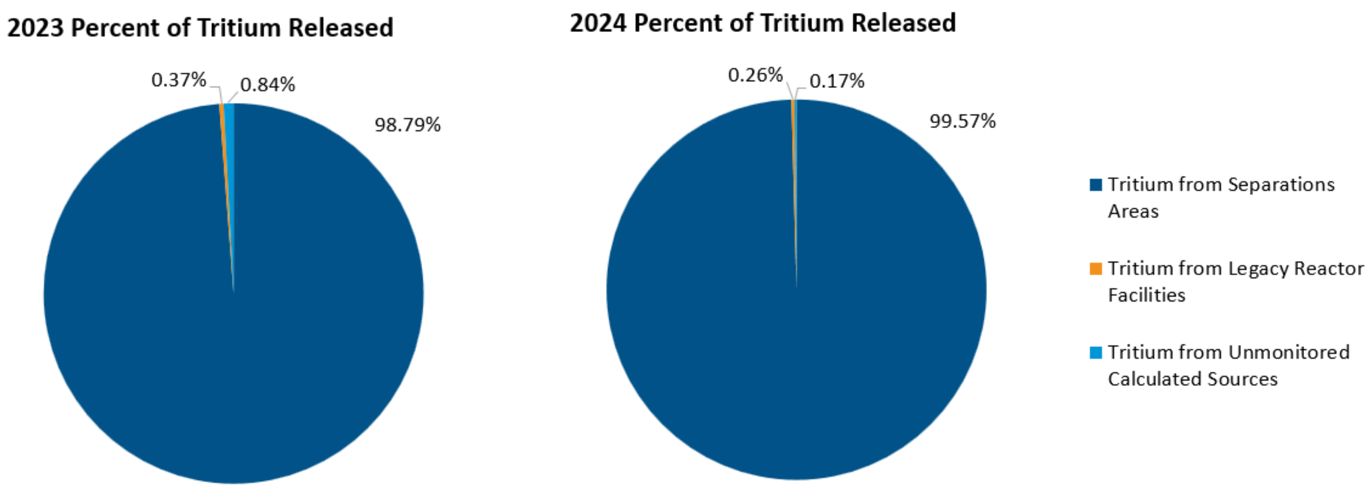


Figure 5-3 Percent of Tritium Released to the Air for 2023 and 2024

5.3.3 Air Surveillance

Beyond the operational facilities, SRS maintains a network of 18 air sampling stations (Figure 5-4 and Environmental Maps, *Radiological Air Surveillance Sampling Locations*) in and around SRS to monitor concentrations of radionuclides in the air and rainwater. The air contains radionuclides in various forms (gaseous, particulate matter, water vapor). Rainwater can redeposit radionuclides from the air onto the ground and vegetation, or soil can eventually absorb the radionuclides.

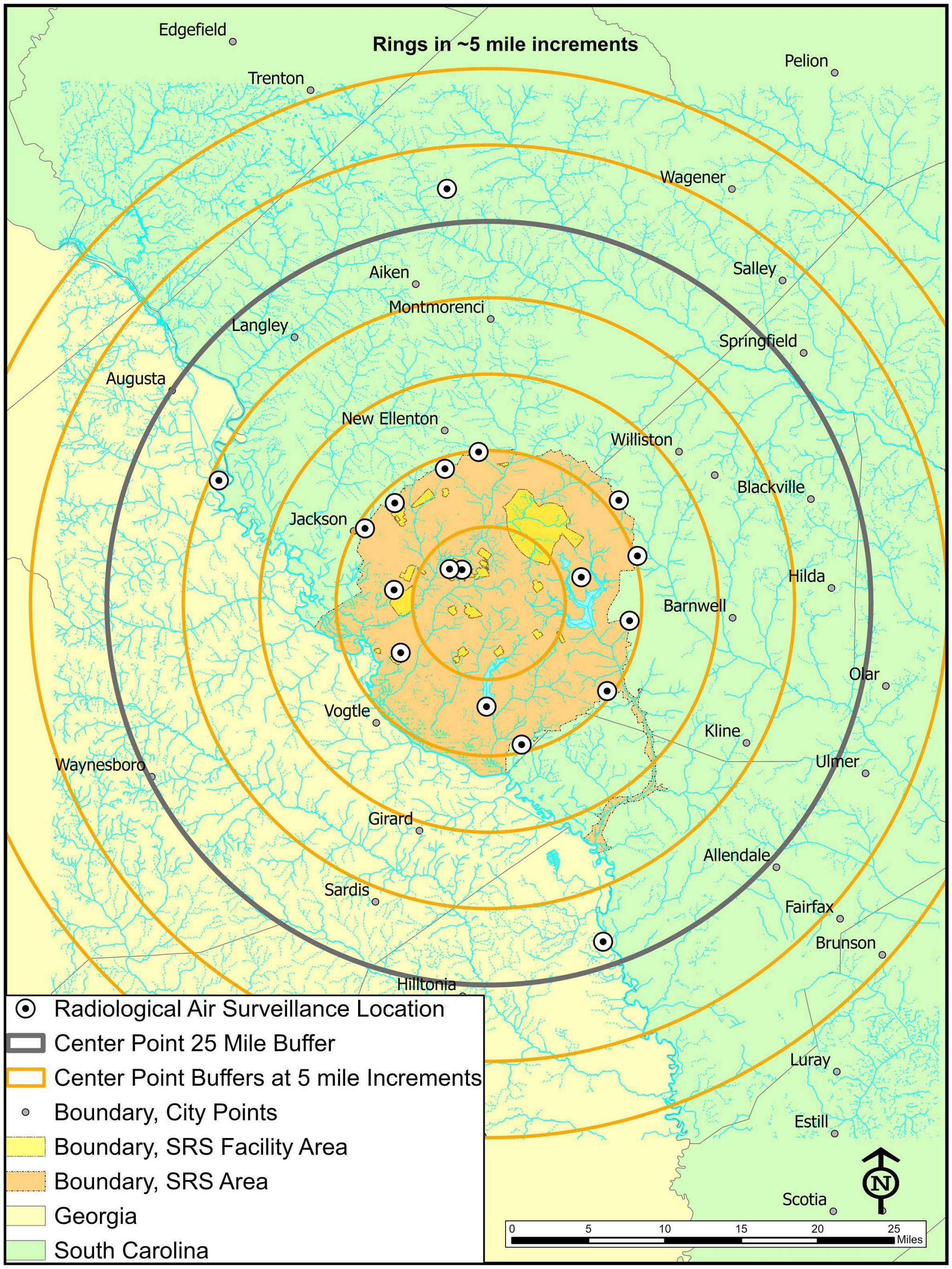


Figure 5-4 Air Sampling Locations Surrounding SRS Up to 25 Miles

The sampling stations are at locations on and off the Site. Onsite stations are at the center of the Site and around the perimeter. Offsite sampling stations are 25 miles from the Site in population centers and at a control location, the U.S. Highway 301 Bridge at the Georgia Welcome Center in Screven County. SRS operations are not likely to affect the control location. SRS has placed air sampling stations near the Site boundary and beyond to be representative of the atmospheric distribution of airborne releases to the environment. During CY 2024, SRS added an air station in F Area (F Area North) to collect baseline data for the Savannah River Plutonium Processing Facility (SRPPF) activities. SRS also replaced Hwy 21/167 air station with the Old Williston Barricade air station within the eastern wind sector, moving the location onsite making it more manageable.

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

Table 5-2 Air Sampling Media

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

5.3.3.1 Air Surveillance Results Summary

The 2024 results for tritium in air showed detectable levels in 77 of the 445 samples, or 17%, which is slightly higher than 2023 detection levels. The reason for this is the installation of air station F Area North, which is located at the center of the site in F Area. 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 2024 results for tritium in rainwater showed detectable levels in 22 of the 237 rainwater samples, or 9%, as compared to 2023 results, with detectable levels in 7% of the samples. 13 of the 22 results were detected at Burial Ground North and 6 of the 22 results were detected at F Area North, which are both located at the center of the separations area at SRS. Barricade 8, East Talatha, and D Area each had 1 of 22 results detected. Concentrations from all locations were below the EPA drinking water standard of 20,000 pCi/L. While there are no regulatory standards for tritium in rainwater, SRS uses the EPA drinking water standard as a benchmark. As in previous years, the 2024 values were highest near the center of SRS and decreased with distance from the Site.

The 2024 results for glass fiber filter paper showed detectable results for gross alpha and nonvolatile beta emitting radionuclides, but all cesium-137 and cobalt-60 analyses were non-detect. SRS also selected glass fiber filter samples from all air stations to analyze for actinides and strontium-90 on a quarterly basis. Samples chosen were dependent on periods of elevated concentrations at F Area stacks and the wind direction during the corresponding time period. Appendix Table D-5 summarizes all glass fiber filter results, which are all comparable to historical trends.

5.3.4 Ambient Gamma Surveillance

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

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

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

5.3.4.1 Ambient Gamma Results Summary

Ambient gamma exposure rates at all OSLD monitoring locations show some variation based on location and natural levels of background radiation in the environment. In 2024, ambient gamma exposure rates onsite varied between 115 mR/yr at the PP_75D location and 183 mR/yr at A-14. Rates at population centers ranged from 140 mR/yr at the McBean, Georgia, location to 184 mR/yr at the Girard, Georgia, location. Appendix Table D-6 summarizes the gamma results.

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

5.3.5 Soil Surveillance

SRS conducts soil surveillance to provide the following:

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

In 2024, SRS collected soil samples from 10 onsite locations, 12 locations at the Site perimeter, and 7 offsite locations (Environmental Maps, *Soil Sampling Locations*). Five soil sites were added this year around F Area to collect baseline information prior to SRPPF operations. Radionuclide concentrations in soil vary greatly among locations because of differences in the patterns, retention, and transport of rainfall. Therefore, a direct comparison of year-to-year data could be misleading. However, SRS evaluates the data for long-term trends.

5.3.5.1 Soil Results Summary

In 2024, SRS detected radionuclides in soil samples from all 29 sampling locations. Analyses detect uranium isotopes (uranium-233/234, uranium-235, and uranium-238) in the soil samples each year. Uranium is naturally occurring in soil and is expected to be present in the environment. The concentration range for naturally occurring uranium in soil is typically about 1–5 picocuries/gram (pCi/g), with an average concentration of 2 pCi/g in soils in the United States. Many factors affect the uranium concentration in soil over time, including the pH of the soil, the type of soil, and deposits from the air transferred through rainfall. Organic matter and clay minerals provide exchange sites in soil, which can increase the uranium sorption. Uranium results both onsite and at the Site perimeter are consistent with naturally occurring uranium levels.

The concentrations of radionuclides at these locations are consistent with historical results. Cesium-137 typically produces the highest concentrations due to 1) global fallout from atmospheric weapons testing and 2) discharges and legacy processes from SRS operations. For 2024, SRS had a maximum cesium-137 concentration of 28.3 pCi/g at the Creek Plantation Trail 1 1600’ location and 0.0499 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*). One vegetation site was added this year around F Area to collect baseline information prior to SRPPF operations. This information complements the soil sample results that the Site uses to evaluate radionuclide accumulation in the environment and to validate SRS dose models. Vegetation can receive radioactive contamination either externally, when radioactive particles from the air settle on a plant, or internally, when a plant absorbs contaminants in soil and water through its roots. The Site prefers Bermuda grass for surveillance because of its importance as a pasture grass for dairy herds. SRS collects vegetation samples from the following:

- All air surveillance sampling station locations
- When applicable, locations where SRS expects soil radionuclide concentrations to be higher than normal background levels
- When applicable, locations receiving potentially contaminated water

SRS Collects Vegetation Samples to Test for Radionuclides.

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

5.3.6.1 Grassy Vegetation Results Summary

SRS collected 17 annual samples for 2024. SRS detected various radionuclides in the grassy vegetation samples at all air sampling locations (2 onsite, 12 at the perimeter, and 3 offsite). All radionuclides are within the trends of the previous 10 years for all locations. Appendix Table D-8 summarizes the results.

5.3.7 Terrestrial Food Surveillance

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

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

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

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

5.3.7.1 Terrestrial Food Results Summary

In 2024, SRS sampled milk and the following terrestrial foodstuffs: greens, watermelons, beef, pecans, and corn. The analytical results of the routine terrestrial foodstuffs and milk are consistent with 10-year trends. Results for most foodstuffs (82% for terrestrial foodstuffs and nearly 93% for dairy) did not detect radionuclides. Thirty-two percent of the detected terrestrial foodstuff results were associated with natural uranium. Appendix Tables D-9 and D-10 summarize the foodstuffs and dairy results.

5.4 LIQUID PATHWAY

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

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

5.4.1 Liquid Effluents Monitoring Program

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

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

5.4.1.1 Liquid Effluents Results Summary

Table 5-3 summarizes the liquid effluent releases of radioactive materials and shows tritium as the largest contributor. During the past 10 years, the total annual tritium release has ranged from 348 to 737 Ci per year, with an annual average tritium release of 503 Ci. The direct releases (including migration) of tritium increased by 19% (from 378 Ci in 2023 to 451 Ci in 2024). Appendix Table D-11 provides SRS liquid radionuclide releases for 2024. 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).

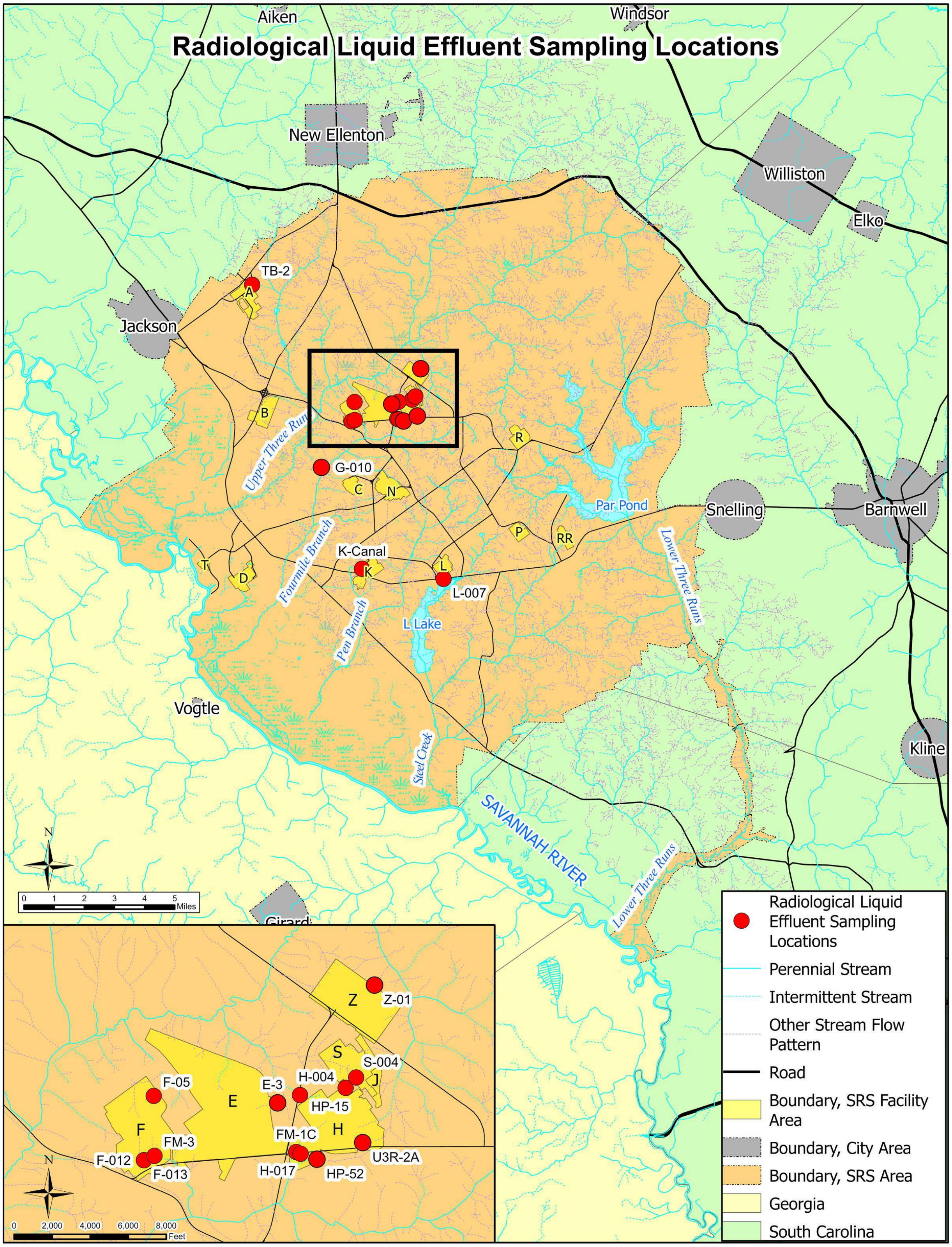


Figure 5-5 Radiological Liquid Effluent Sampling Locations

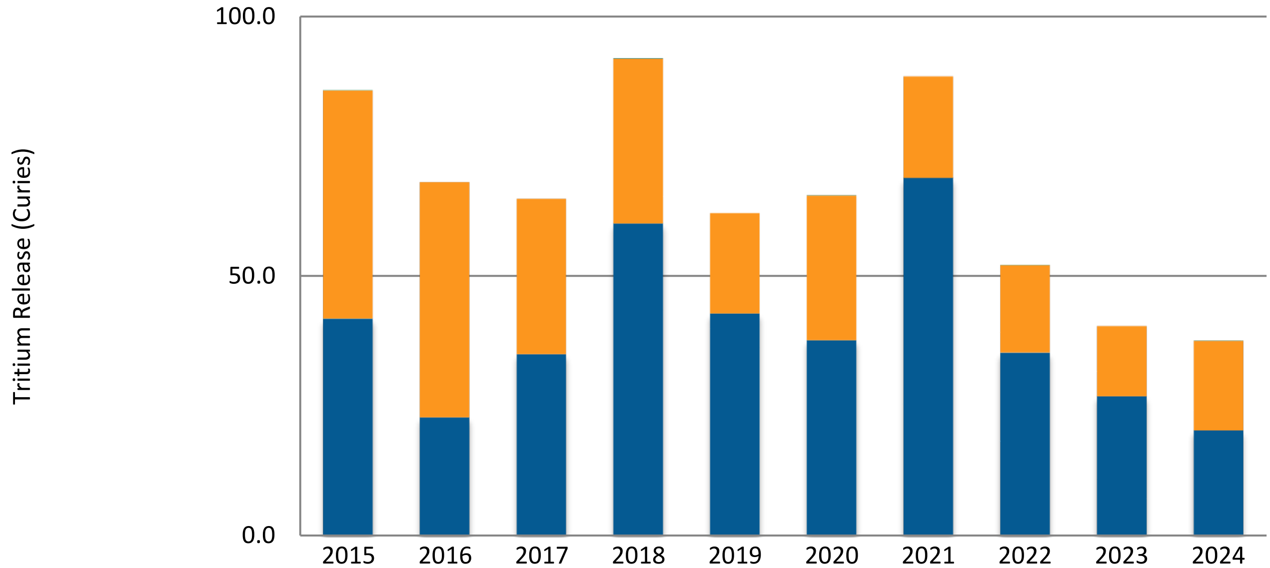
Table 5-3 SRS Radiological Liquid Effluent Releases[a] of Radioactive Material for CY 2024

Release Type	Totals (curies)
Tritium	4.51E+02
Fission and Activation Products (half-life > 3 hr)[b,c]	5.99E-01
Total Radio-iodine	1.04E-02
Total Radio-strontium[d]	8.47E-02
Total Uranium	1.14E-01
Plutonium[e]	1.54E-02
Other Actinides	1.32E-04
Other	0.00E+00

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

The total amount of tritium released directly from process areas to SRS streams (not including shallow groundwater migration) during 2024 was 37.6 Ci, compared to 40.4 Ci released in 2023. Figure 5-6 presents the tritium released by source area and shows that while oftentimes variable, the total direct releases of tritium in 2024 is consistent with the 10-year historical measurements.

As the introduction to this chapter mentions, compliance with the derived concentration standard (DCS) is when the sum of the ratios of each radionuclide’s observed concentration to its corresponding DCS does not exceed 1.00. The DCS sum of fractions for all liquid effluent locations was less than 1.00. Appendix Table D-12 summarizes the 2024 liquid effluent sum of fractions and radionuclides detected at each outfall or facility.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
SRNL	0.01	0	0.0	0.05	0	0.02	0	0.01	0	0.03
Legacy Reactor Areas	43.8	45.2	29.9	31.7	19.3	27.8	19.5	16.8	13.5	17.2
Separations Areas	41.8	22.9	35	60.1	42.8	37.7	68.9	35.33	26.9	20.4

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

5.4.2 Stormwater Basin Surveillance

The Site stream and stormwater basin surveillance network consists of 27 locations. These include onsite control locations and stations on each onsite watershed downstream of process effluents. SRS monitors the accumulated stormwater in the Site's stormwater basins for gross alpha, gross beta, tritium, strontium-90, technetium-99, gamma-emitting radionuclides, and carbon-14. Additional analytes may include actinides (including neptunium-237) however no additional analytes were sampled for the 2024 reporting year. With no active processes discharging to SRS's stormwater basins, the accumulations in these basins are mainly stormwater runoff. SRS selects the specific radionuclides for monitoring based on the operational history of each basin. The E Area basins receive stormwater from SWDF, the E Area Vault, and stormwater from the controlled clean-soil pit on the east side of E Area. F Area Pond 400 receives stormwater from F Area and the Savannah River Plutonium Processing Facility. The Z Area Stormwater Basin receives stormwater from Z Area (Saltstone processing and disposal facilities). Stormwater basins may release to monitored outfalls during heavy rainfall. Figure 5-7 identifies all the Site's stormwater basin locations, along with the Site's stream surveillance locations that are part of the surface water surveillance program. This is discussed later in this chapter in Section 5.4.3, *SRS Stream Sampling and Monitoring.*

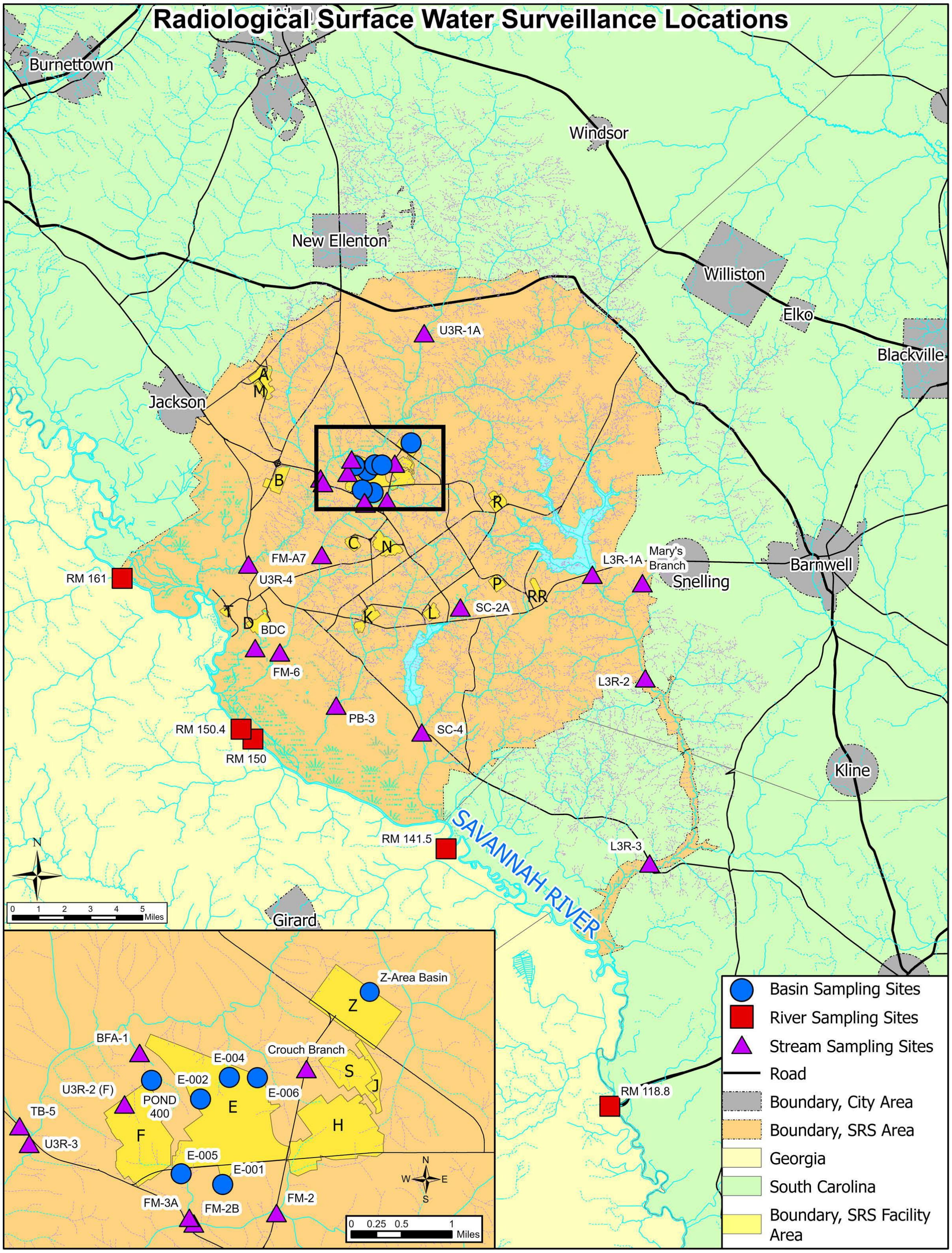


Figure 5-7 Radiological Surface Water Sampling Locations

5.4.2.1 Stormwater Basin Results Summary

In 2024, SRS sampled at six E Area Basins (E-001, E-002, E-003, E-004, E-005, and E-006), as well as at the Z Area Stormwater Basin and F-Area Pond 400. Table 5-4 summarizes gross alpha, gross beta, and tritium results for all E-Area stormwater basins (excluding E-003), Z Area Stormwater Basin and F-Area Pond 400. E-003 basin has had an increase in its source category in previous years and as a Best Management Practice, in the case of a potential flooding event causing migration, a monthly composite sample is obtained, and flow equipment has been installed to measure volume. As a result, the E-003 basin results are not included in Table 5-4 and are instead reported in section 5.4.1.1. For 2024, E-004 Basin had the highest tritium concentration (34,400 picocuries/liter [pCi/L]). Tritium results for all basin locations are consistent with the 10-year historical measurements.

Table 5-4 Radionuclide Concentrations Summary for Stormwater Basins for CY 2024

Basin Location	Average Gross Alpha (pCi/L)	Average Nonvolatile Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
E-001	All < DL	3.05	3,003	4,700
E-002	All < DL	3.44	11,402	16,600
E-004	All < DL	2.14	13,934	34,400
E-005	0.63	2.40	3,806	6,970
E-006	All < DL	4.22	1,695	1,850
Pond 400	0.54	4.04	780	2,950
Z Basin	0.60	540	1,045	3,180

5.4.3 SRS Stream Sampling and Monitoring

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

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

5.4.3.1 SRS Stream Results Summary

SRS found concentrations of tritium above the detection limits at all major stream locations. Table 5-5 presents the average 2024 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.

Table 5-5 Radionuclide Concentrations in the Primary SRS Streams by Location for CY 2024

	Average Gross Alpha (pCi/L)	Average Nonvolatile Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
Onsite Stream Locations				
Lower Three Runs (L3R-3)	0.62	1.08	403	585
Steel Creek (SC-4)	0.30	0.94	987	1,430
Pen Branch (PB-3)	0.86	1.23	6,046	8,560
Fourmile Branch (FM-6)	0.52	3.72	12,642	14,700
Upper Three Runs (U3R-4)	14.02	8.25	424	711
Onsite Control Locations (for comparison)				
Upper Three Runs (U3R-1A)	5.78	3.36	All < DL	All < DL

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

During 2024, the total quantity of tritium migrating from SRS seepage basins and SWDF into SRS streams was 414 Ci, compared to 337 Ci in 2023, which represents a 23% increase. This increase was likely influenced by two major weather systems which affected the Savannah River Site in 2024. Each of these events produced very large amounts of rain, amplifying groundwater migration. In August of 2024, Tropical Storm Debby brought more than 6 inches of rain to Site over the course of 3 days and in September, Hurricane Helene brought more than 5 inches of rain over the course of 2 days. As Figure 5-9 shows, migration releases of tritium generally have declined over the past 10 years, with year-to-year variability caused mainly by the amount of annual rainfall.

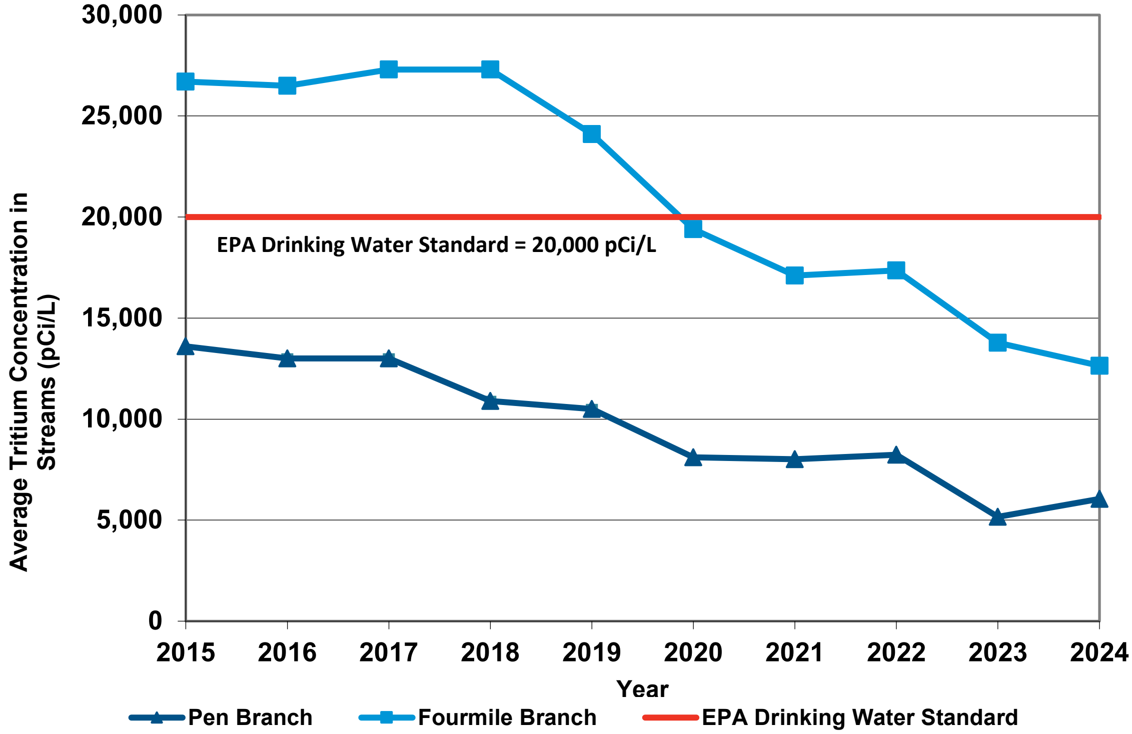


Figure 5-8 10-Year Trend of Tritium in Pen Branch and Fourmile Branch

SRS calculated 326 Ci (78.7%) of the 414 Ci of tritium migrated into SRS streams in Fourmile Branch. Sampling in Pen Branch measures the tritium migration from the K Area Seepage Basin and the percolation field below the K Area Retention Basin. An estimated 88 Ci migrated in 2024, compared to 96 Ci in 2023. Stream transport includes tritium migration releases from C Area, L Area, and P Area Seepage Basins. (See Section 5.4.5, Tritium Transport in Streams and Savannah River Surveillance, in this chapter.) Migration releases of other radionuclides vary from year to year but have remained below 1 Ci the past 10 years.

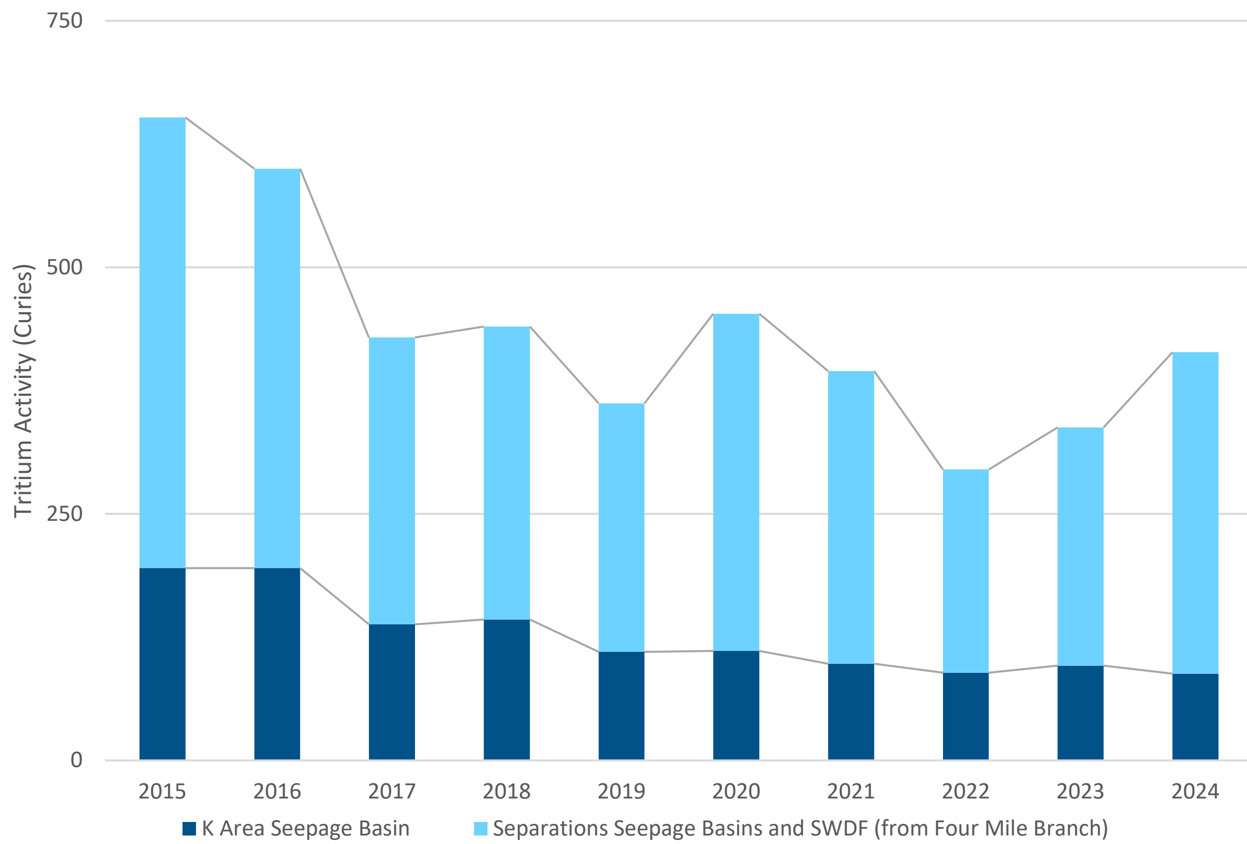


Figure 5-9 10-Year History of Tritium Migration from SRS Seepage Basins and SWDF to SRS Streams

5.4.4 Savannah River Sampling and Monitoring

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

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

5.4.4.1 <u>Savannah River Results Summary</u>

Tritium is frequently detected above background levels in the Savannah River in the downriver vicinity of SRS. The tritium concentration levels are well below the EPA drinking water standard of 20,000 pCi/L (20,000 pCi/L). Table 5-6 lists the average 2024 concentrations of gross alpha, gross beta, and tritium and the maximum 2024 concentrations of tritium at river locations. The combined SRS, VEGP, and Barnwell Low-Level Disposal Facility (BLLDF) tritium estimates based on concentration results at Savannah River RM 141.5 and average flow rates at RM 141.5 were 2,372 Ci in 2024, compared to 2,779 Ci in 2023. Annual variation in tritium concentration estimates, may result from a combination of increased or decreased releases from SRS, seepage basins, BLLDF or VEGP. (See section 5.4.5.1.) As a comparison, the estimated total of SRS's tritium releases to the river was 451 Ci in 2024, while the release total was 378 Ci in 2023. The total of the estimated releases from BLLDF was 23 Ci in 2024 and 16 Ci in 2023.

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

Table 5-6 Radionuclide Concentrations in the Savannah River for CY 2024

Location	Average Gross Alpha (pCi/L)	Average Nonvolatile Beta (pCi/L)	Average Tritium (pCi/L)	Maximum Tritium (pCi/L)
RM 161.0 (Control)	0.15	2.05	117	592
RM 150.4 (VEGP)	0.21	2.31	867	9,610
RM 150	0.28	2.28	191	549
RM 141.5	0.24	2.21	329	1,440
RM 118.8	0.21	2.25	314	1,380

Note: VEGP = Vogtle Electric Generating Plant

5.4.5 Tritium Transport in Streams and Savannah River Surveillance

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

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

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

SRS has detected a measurable amount of tritium migrating from a non-SRS source. In 2014, SRS started monitoring at Mary's Branch, which is near the Barnwell Low-Level Disposal Facility (BLLDF), which EnergySolutions, LLC operates. Monitoring at Mary's Branch, which discharges into Lower Three Runs, allows for accounting of the tritium contributions of BLLDF. The tritium currently in groundwater will continue to decay and dilute as it moves from the source toward Lower Three Runs. SRS estimated the amount of tritium from BLLDF during 2024 to be 23 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 2024, tritium levels in stream transport and river transport showed a decrease, specifically as described below:

- The stream transport of tritium decreased by 0.3% (from 315 Ci in 2023 to 314 Ci).
- The river transport of tritium decreased by 14.6% (from 2,779 Ci in 2023 to 2,372 Ci). VEGP, BLLDF, and SRS contributed to these values.

Tritium transport in the Savannah River includes the 23 Ci migration value attributed to BLLDF and the 1,628 Ci release value attributed to VEGP.

SRS tritium transport data from 1960 to 2024 (Figure 5-10), shows the history of direct releases plus migration, stream transport, and river transport, while Table 5-7 shows an increase from 2023 to 2024 for direct releases plus migration and a decrease in the stream transport and river transport value. The general downward trend over the past 60 years is attributed to the following:

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

Chapter 6, *Radiological Dose Assessment*, discusses that the direct plus migration releases value was higher than the tritium stream transport value. Therefore, the compliance dose calculations for 2024 use the direct releases and migration value of 451 Ci.

Table 5-7 Liquid Tritium Releases and Transport

Releases/Transport (curies)	CY 2023	CY 2024
Liquid Effluent Releases		
Direct releases	40	38
Shallow groundwater migration from Separations Areas Basins, K-Area Seepage Basins, and Percolation Field below K-Area Retention Basin	337	414
Total Liquid Effluent Releases (direct releases and migration)	**378**	**451**
Total Stream Transport		
Stream transport and shallow groundwater migration from C-Area, L-Area, and P-Area Seepage Basins	315	314
River Transport		
SRS contribution	378	451
VEGP contribution	2,450	1,628
BLLDF contribution	16	23
Total River Transport (SRS, VEGP, and BLLDF)	**2,779**	**2,372**

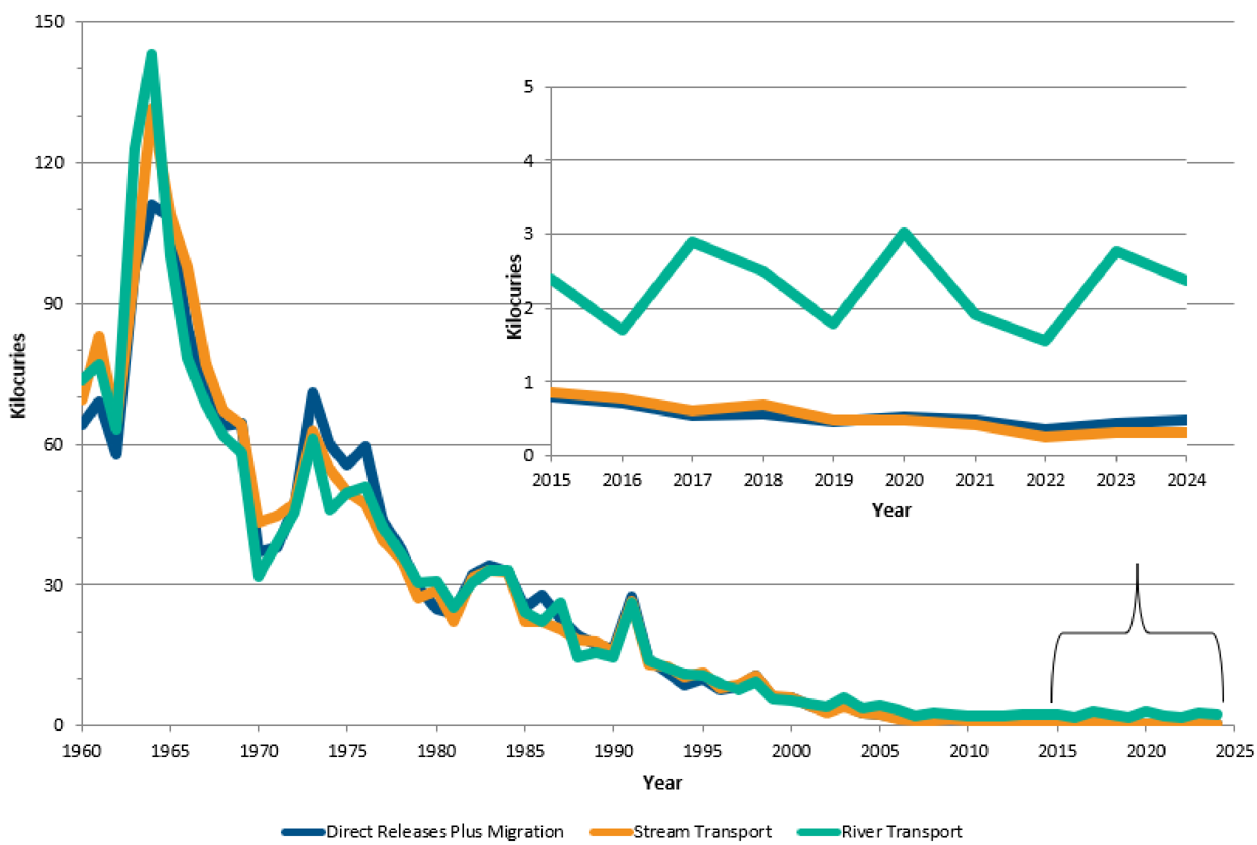


Figure 5-10 History of SRS Tritium Transport (1960–2024)

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 or National Pollutant Discharge Elimination System outfalls that are co-located with radiological liquid effluent locations. If TSS results are regularly greater than 40 parts per million, SRS will investigate the cause and take additional water or sediment samples, or both, if necessary, to ensure compliance.

5.4.6.1 Settleable Solids Results Summary

In 2024, 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 2024, SRS collected annual sediment samples at 10 Savannah River locations, 8 basin or pond locations, and 21 onsite streams or swamp discharge locations (Environmental Maps, *Radiological Sediment Sampling Locations*). To complement the air surveillance Savannah River Plutonium Processing Facility pre-operational sampling, BFA-1 was added to sediment sampling in 2024. The locations vary from year to year, depending on the rotation schedule agreed upon with the South Carolina Department of Environmental Services, 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.

Sediment Sampling Locations Vary Year to Year.

5.4.7.1 Sediment Results Summary

Soil contamination areas at SRS are locations where the contamination levels exceed 150 pCi/g for beta and gamma radionuclides. Table 5-8 shows the maximum cesium-137 concentrations found in river, stream, and basin sediment, by sampling location. The Z Area Stormwater Basin, a posted soil contamination area, had the maximum cesium-137 concentration of 3,070 pCi/g. Appendix Table D-13 shows the maximum of each radionuclide compared to the applicable SRS control location.

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

Table 5-8 Maximum Cesium-137 Concentration in Sediments Collected in 2024

Location	Maximum Concentration (pCi/g)	Maximum Location
Savannah River Sediment	4.02E+00	SC RM
SRS Stream Sediment	1.25E+01	SC-4
SRS Basin Sediment	3.07E+03	Z Basin

5.4.8 Drinking Water Monitoring

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

Onsite drinking water sampling consists of samples from the large treatment plant in A Area, from five small systems, and from groundwater samples from four wells. However, 704-16G, one of the small systems, was inoperable in 2024. Onsite sample analyses consist of tritium, gross alpha, gross beta, gamma-emitting radionuclides, strontium-90, and actinides.

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

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

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

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 2024, SRS performed gross alpha and gross beta analyses on all onsite and offsite drinking water samples. All results were well below the EPA's 15 pCi/L alpha concentration limit and 50 pCi/L beta concentration limit. In addition, no onsite or offsite drinking water samples exceeded the 20,000 pCi/L EPA standard for tritium, and no onsite drinking water samples exceeded the 8 pCi/L strontium-90 maximum contaminant level (MCL).

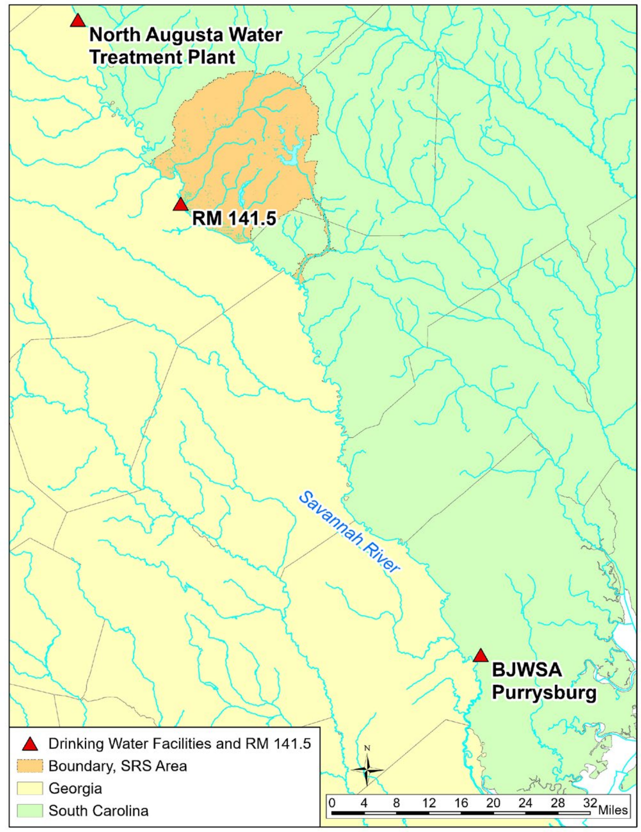


Figure 5-11 Offsite Drinking Water Sampling Locations

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

Sample results did not detect americium-241, cesium-137, cobalt-60, curium-234/244, plutonium-238, plutonium-239/240, strontium-90, tritium, and uranium-235 in onsite drinking water test locations. Appendix Table D-14 summarizes on and offsite results. All analytical results are well below the EPA standard.

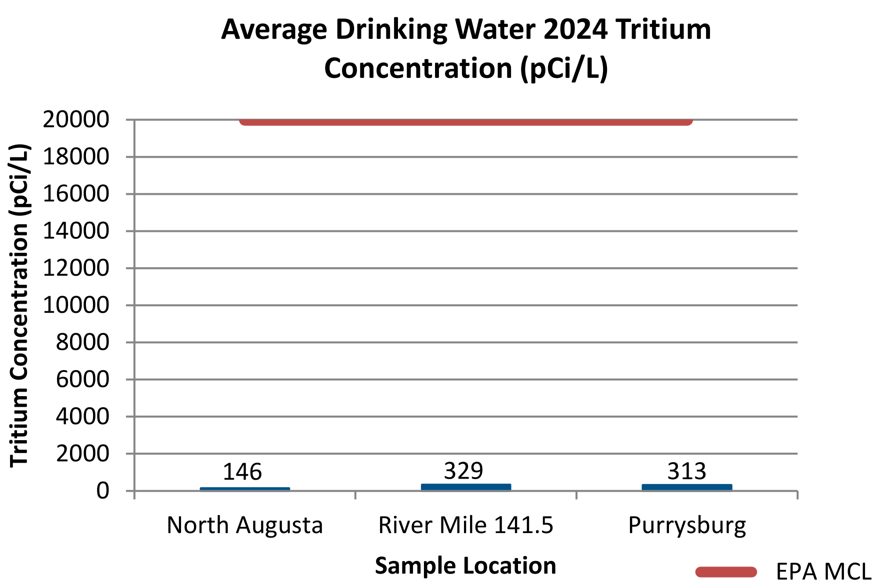


Figure 5-12 Tritium in Offsite Drinking Water and River Mile 141.5

5.5 AQUATIC FOOD PRODUCTS

5.5.1 Fish Collection in the Savannah River

SRS collects aquatic food from the Savannah River, including freshwater fish, saltwater fish, and shellfish. Freshwater fish come from six locations on the Savannah River from above SRS at Augusta, Georgia, to the Highway 301 bridge (Environmental Maps*, Fish Sampling Locations*). Onsite, SRS collects freshwater fish at the mouth of the streams that traverse the Site. Saltwater fish come from the Savannah River mouth near Savannah, Georgia. Additionally, shellfish come from the Savannah River mouth near Savannah, or SRS purchases them from Savannah-area vendors that harvest from local saltwater that waters of the Savannah River potentially influence. Table 5-9 identifies the aquatic products collected in 2024. SRS analyzes both edible (meat and skin only) and nonedible (bone) samples of freshwater and saltwater fish. SRS analyzes only the edible portion of shellfish. Analyses of edible samples of all aquatic species collected include gross alpha, gross beta, gamma-emitting radionuclides (specifically, cesium-137 and cobalt-60), strontium-90, technetium 99, and iodine-129. Strontium-90 is the only analysis SRS conducts on the nonedible samples.

Table 5-9 Aquatic Products Collected by SRS in 2024 for the Radiological Environmental Monitoring Program

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

5.5.1.1 <u>Fish in Savannah River Results Summary</u>

In 2024, SRS collected freshwater fish from the six locations along the Savannah River in the vicinity of SRS, saltwater fish from the Savannah River mouth, and obtained crabs and shrimp from a Savannah-area supplier that harvests from saltwater potentially influenced by Savannah River water. SRS analyzed 72 freshwater fish composites, 3 saltwater fish composites, and 2 shellfish composites. The freshwater and saltwater composites consisted of three to eight fish each. The shellfish composites comprised separate composites: one from a bushel of crab and another from one bushel of shrimp. The analytical results of the freshwater and saltwater fish as well as shellfish collected are consistent with results for the previous 10 years. Most of the results for the specific radionuclides associated with SRS operations (including cesium-137, cobalt-60, iodine-129, strontium-90, and technetium-99) were nondetectable (69% for freshwater fish, 87% for saltwater fish, and 79% for shellfish). Table 5-10 lists the maximum concentration for those radionuclides detected in the flesh of all fish types sampled. The table also identifies the fish type and the collection location associated with the maximum concentration for each detected radionuclide. SRS did not detect cobalt-60, iodine 129, and technetium-99 in any fish flesh samples. Appendix Tables D-15, D-16, and D-17 for freshwater fish, saltwater fish, and shellfish, respectively, summarize results for all fish and shellfish.

Gross alpha results were below the minimum detectable concentration for freshwater fish and saltwater fish but were above the minimum detectable concentration in one sample from crabs at the Savannah River mouth location. However, the gross alpha result was below the threshold to analyze for actinides (0.961 pCi/g). Gross beta activity was detectable in all freshwater and saltwater fish, as well as shellfish.

The concentrations are consistent with results from the previous 10 years and are likely due to the naturally occurring radionuclide potassium-40.

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

Table 5-10 Location and Fish Type for the Maximum Detected Concentration of Specific Radionuclides Measured in Flesh Samples Collected in 2024

Radionuclide	Maximum Detected Concentration (pCi/g)	Location	Fish Type
Cesium-137	0.339	Lower Three Runs Creek Mouth	Bass
Strontium-90	0.00829	Upper Three Runs Creek River Mouth	Panfish

5.6 WILDLIFE SURVEILLANCE

5.6.1 Wildlife Monitoring of Game

The wildlife surveillance program monitors wildlife harvested from SRS and subsequently released to the public. Monitoring assesses any impact of Site operations on the wildlife populations and ensures that no individual exceeds the SRS Annual Administrative Game Animal Release Limit of 22 millirem (mrem)/year (yr). Annual game animal hunts for deer, coyote, and feral hogs are open to the public. During 2024, SRS held 2 turkey hunts for Wounded Warriors and residents with mobility impairments in the spring and 10 game animal hunts in the fall. The Site holds the annual hunts to reduce vehicle collisions with animals and control the Site's turkey, deer, coyote, and feral hog populations.

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

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

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

5.6.1.1 Wildlife Results Summary

During the hunts in 2024, SRS monitored a total of 38 deer, 20 feral hogs, 2 coyotes, and 9 turkeys. SRS did not assign a dose to any hunter during the two turkey hunts. This indicates that the cesium-137 activity in the turkeys was below the field equipment's detection limits (~0.6 pCi/g). All animals harvested during the 2024 hunts were released to the hunters based on administrative dose limits (22 mrem/yr, 100 mrem/hunter lifetime).

SRS sampled flesh and bone from an alligator hit by a vehicle on Highway 125. Flesh and bone samples were analyzed for gamma and strontium-90. The concentration of cesium-137 in the alligator flesh was comparable to the maximum flesh concentration harvested from the hogs but below that of the deer.

Appendix Table D-18 summarizes the muscle and bone laboratory sample results of monitored deer, hogs, and the alligator collected in 2024. As seen in previous years, laboratory analysis detected cesium-137 in muscle tissue. Laboratory analysis detected strontium-90, a beta-emitting radionuclide, in bone and in one hog flesh sample.

Because its chemistry is similar to calcium, strontium is found more frequently in bone than in muscle tissue. In 2024, all seven deer bone, both hog bone, and the alligator bone samples had detectable levels of strontium-90. Strontium-90 was detected in deer bone with an average of 1.96 pCi/g and a maximum of 5.65 pCi/g. Strontium-90 was detected in hog bone with an average of 1.49 pCi/g and a maximum of 1.66 pCi/g. The average of bone strontium-90 results for the alligator was 0.69 pCi/g with a maximum of 0.905 pCi/g, from the tail bone sample.

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

Table 5-11 Cesium-137 Results for Laboratory and Field Measurements in Wildlife for CY 2024

Animal	Number of Animals Field Monitored	Field Gross Average Cesium-137 Conc. (pCi/g)	Field Maximum Cesium-137 Conc. (pCi/g)	Number of Samples Collected for Laboratory Analysis	Number of Detected Results	Lab Average Cesium-137 Conc. (pCi/g)	Lab Maximum Cesium-137 Conc. (pCi/g)
Deer	38	1.23	4.63	7	7	0.97	1.97
Hog	20	1.85	3.63	2	2	0.30	0.35
Coyote	2	1.61	1.88	-----	-----	-----	-----
Turkey	9	0.63	0.69	-----	-----	-----	-----
Alligator	1	-----	-----	1	1	0.38	0.38

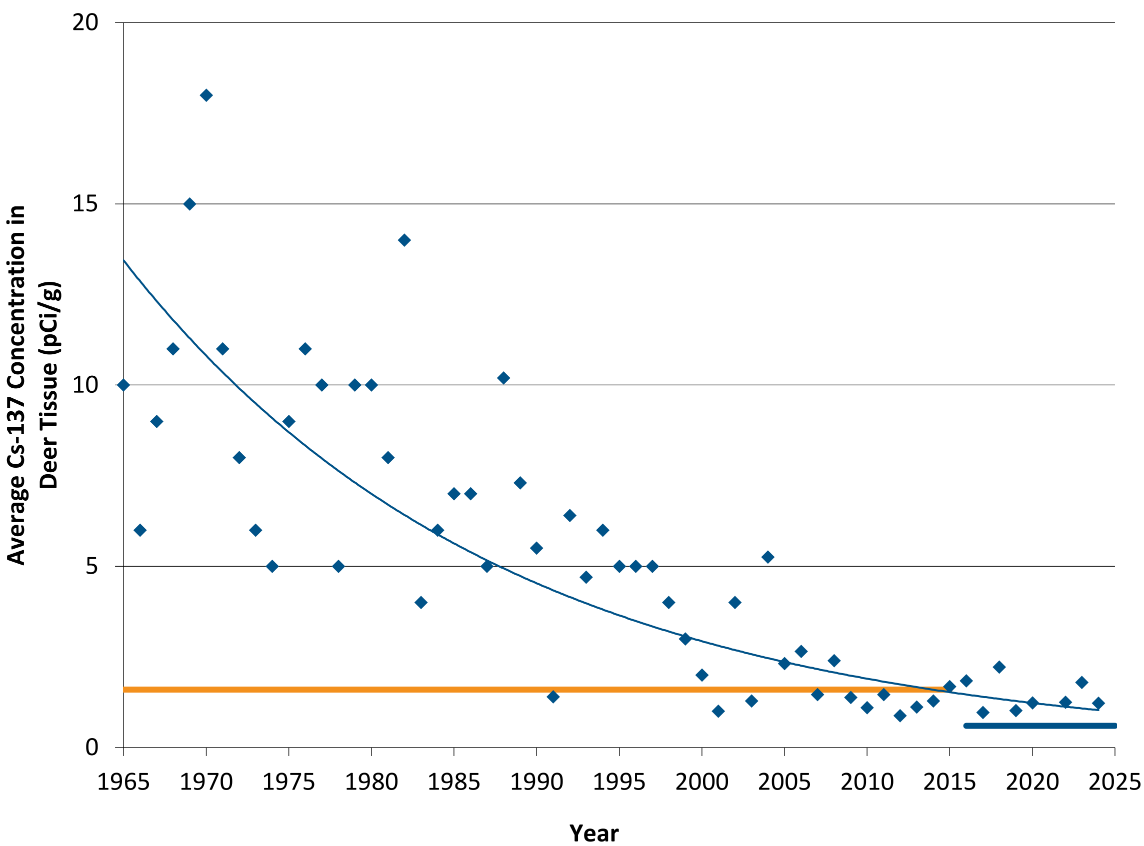


Figure 5-13 Yearly Average Cesium-137 Concentration in Wildlife, 1965–2024

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