ESOP

Environmental Surveillance and Oversight Program

2023 DATA REPORT

SC DEPARTMENT *of* ENVIRONMENTAL SERVICES

Aiken Environmental Affairs Office
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Acknowledgements

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On July 1st, 2024, the South Carolina Department of Health and Environmental Control (SCDHEC) split into two new state agencies. These agencies are the South Carolina Department of Public Health (SCDPH)and the South Carolina Department of Environmental Services (SCDES). The Environmental Surveillance and Oversight Program transitioned to the SCDES and this report is published under this agency. However, for the 2023 monitoring year, the program was under SCDHEC. Therefore, for the remainder of this report, the monitoring and results from 2023 are considered from SCDHEC.

ESOP acknowledges the efforts of the following individuals that provided valuable support for publishing the 2023 ESOP Data Report:

Travis Fuss – Area Director

Tamala Mims-Herrera – Procurement Services

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Cover photo provided by Richard Burnett

Special Notes:

*Grace Anne Martin transitioned to the SCDHEC Bureau of Land & Waste Management in May 2023.
*Madeleine Kellett took over Environmental Report and Outreach Coordinator duties in June 2023.
*Anita Brown took over Team Lead duties in July 2023.

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Purpose

PURPOSE OF THIS REPORT

WHAT: South Carolina's Department of Health and Environmental Control (DHEC) monitors the Department of Energy's Savannah River Site (SRS) for potential contaminants and produces a report of all its annual findings.

WHY: Due to nuclear material testing and lack of environmental regulations during the Cold War era, radioactive and non-radioactive constituents are present on SRS property. SRS personnel have been sampling multiple media for many years. However, to verify the data being collected on and around SRS, DHEC conducts independent monitoring associated with the site to provide a second set of results for comparison.

HOW: In order to have a verification system for SRS's annual data, the Department of Energy-Savannah River (DOE-SR) partnered with DHEC as part of a 1995 Agreement in Principle (AIP) to create the Environmental Surveillance and Oversight Program (ESOP). ESOP is a division of DHEC specific to the Midlands Aiken Environmental Affairs Office. There are 10 team members with varying expertise working in ESOP that collect and analyze samples of air, water, soil, sediment, vegetation, milk, fish, and game for radiological and non-radiological constituents.

WHERE: Samples are collected on site property, around its perimeter, and in background locations. Depending upon the media, some DHEC sample locations coincide with those of DOE-SR. These locations are compared in our report.

WHEN: Samples are collected weekly, quarterly, biannually, and annually and are dependent upon the type of media and can be affected by availability of the resource, accessibility, and weather.

Basic Radiation Overview

RADIATION – Occurs when an unstable atom tries to become stable by releasing some of its energy in the form of an alpha or beta particle or gamma wave.

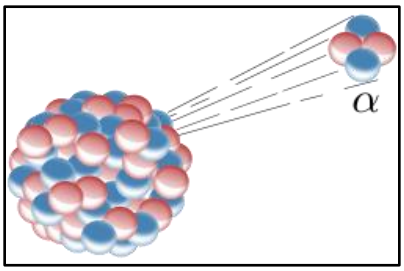
TYPES OF RADIATION

ALPHA – results when the nucleus of an atom releases two protons and two neutrons. Due to this particle being heavier in mass, it can be stopped by the air, skin, or paper. External exposure is not dangerous, but if swallowed, breathed in, or enters a person through a cut, it can harm the human body.

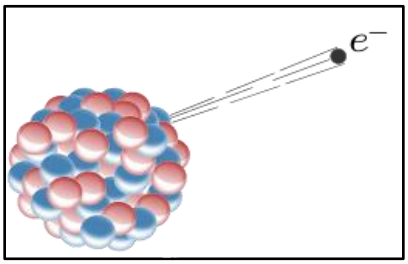
BETA – occurs when an atom releases an electron (negative charge). Since it is lighter in mass and faster moving, it can travel greater distances and can be stopped by a layer of wood or metal but can penetrate the outer layer of skin. It can cause skin burns.

GAMMA – is the release of pure energy that is fast moving and able to travel longer distances until it hits either concrete or lead. It will pass through the human body resulting in internal and external bodily damage.

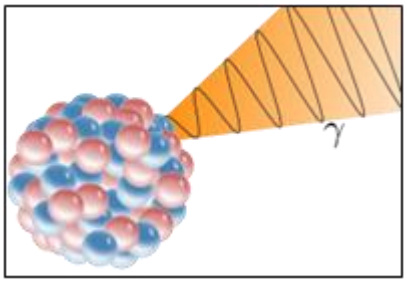
ALPHA RADIATION:



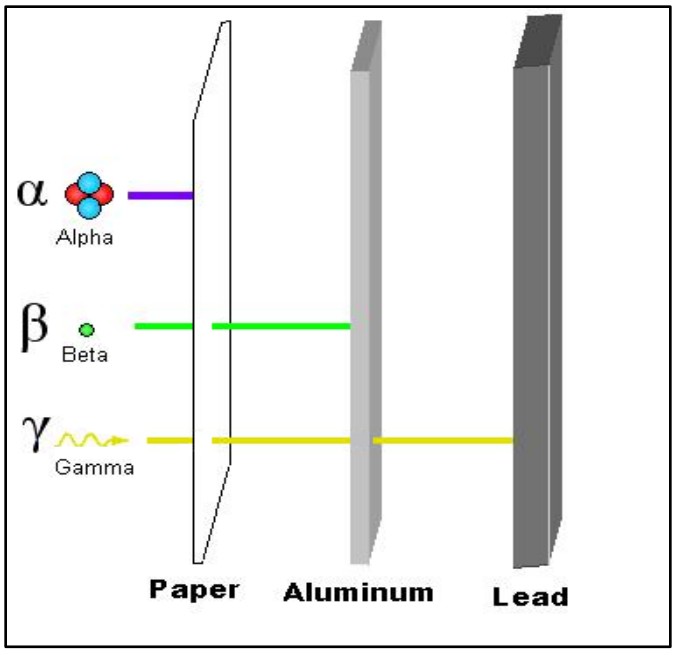
BETA RADIATION:



GAMMA RADIATION:



RADIATION:



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List of Analytes

Table 1. Gamma Analytes

Radioisotope	Abbreviation
Actinium-228	Ac-228
Americium-241	Am-241
Beryllium-7	Be-7
Cerium-144	Ce-144
Cobalt-58	Co-58
Cobalt-60	Co-60
Cesium-134	Cs-134
Cesium-137	Cs-137
Europium-152	Eu-152
Europium-154	Eu-154
Europium-155	Eu-155
Iodine-131	I-131
Potassium-40	K-40
Plutonium-238	Pu-238
Plutonium-239/240	Pu-239/240
Manganese-54	Mn-54
Sodium-22	Na-22
Lead-212	Pb-212
Lead-214	Pb-214
Radium-226	Ra-226
Ruthenium-103	Ru-103
Antimony-125	Sb-125
Thorium-234	Th-234
Yttrium-88	Y-88
Zinc-65	Zn-65
Zirconium-95	Zr-95

Table 2. Metal Analytes

Analyte	Abbreviation
Barium	Ba
Beryllium	Be
Cadmium	Cd
Chromium	Cr
Copper	Cu
Lead	Pb
Manganese	Mn
Mercury	Hg
Nickel	Ni
Zinc	Zn

LIST OF ACRONYMS

ABR	Allendale Barricade
AEI	Average Exposed Individual
AIK	Aiken
AIP	Agreement in Principle
AKN	Sample locations in Aiken County
ALD	Sample locations in Allendale County
ALN	Allendale
ARESD	Analytical and Radiological Environmental Services Division
ATSDR	Agency for Toxic Substances and Disease Registry
B/J	Beaufort-Jasper Water and Sewer Authority
BGN	Burial Grounds North
BOD	Biochemical Oxygen Demand
BWL	Sample locations in Barnwell County
CDC	Centers for Disease Control and Prevention
DIL	Derived Intervention Level
DKH	Dark Horse at the Williston Barricade
DHEC	South Carolina Department of Health and Environmental Control
DNR	South Carolina Department of Natural Resources
DO	Dissolved Oxygen
DOE	Department of Energy
DOE-SR	Department of Energy-Savannah River
DW	Drinking Water
ESOP	Environmental Surveillance and Oversight Program
EPA	United States Environmental Protection Agency
ESV	Ecological Screening Value
FDA	United States Food and Drug Administration
GW	Groundwater
HLW	High Level Waste
Hwy. 17	United States Highway 17
Hwy. 301	United States Highway 301
IAEA	International Atomic Energy Agency
JAK	Jackson
LLD	Lower Limit of Detection
LLW	Low Level Waste
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MDL	Minimum Detection Level
MEI	Maximum Exposed Individual
MPN	Most Probable Number
NA	Not Applicable
ND	Not Detected
NEL	New Ellenton
NORM	Naturally Occurring Radioactive Material
NRC	National Regulatory Commission
NS	No Sample
NSBLD	New Savannah Bluff Lock & Dam

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PCB	Polychlorinated Biphenyls
PRG	Preliminary Remediation Goals
RM	River Mile
RSL	Regional Screening Level
RSW	Radiological Surface Water
SCAT	South Carolina Advanced Technology
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions
SRS	Savannah River Site
SSL	Soil Screening Level
SW	Surface Water
TKN	Total Kjeldahl Nitrogen
TLD	Thermoluminescent Dosimeter
TSP	Total Suspended Particulates
TSS	Total Suspended Solid
USFS	United States Forestry Service
USGS	United States Geological Survey
VOC	Volatile Organic Compound

LIST OF ISOTOPES AND ABBREVIATIONS

I-129	Iodine-129
Sr-89/90	Strontium-89/90
Sr-90	Strontium-90

UNITS OF MEASURE

<	Less than
±	Plus or minus. Refers to one standard deviation unless otherwise stated
±2	Plus or minus 2 standard deviations.
°C	Temperature in Celsius
Ci	Curie
cnt	Counts
g/mL	Grams per milliliter
hrs/yr	Hours per year
kg/yr	Kilograms per year
L/yr	Liters per year
m^3/yr	Cubic meters per year
mg/day	Milligrams per day
mg/kg	Milligrams per kilogram
mg/L	Milligrams Per Liter
mL	Milliliter
mL/L	Milliliter per liter
MPN	Most Probable Number
mrem	Millirem or milliroentgen equivalent man
NTU	Nephelometric Turbidity Unit
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter
pCi/m^3	Picocuries per cubic meter

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pCi/mL	Picocuries per milliliter
SU	Standard units

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Introduction

In 1950, the U.S. Atomic Energy Commission established the Savannah River Site (SRS) (1954-1992) with the mission of producing nuclear materials, primarily tritium and plutonium. SRS is a Department of Energy (DOE) facility located approximately 20 miles from Aiken, South Carolina. SRS boundaries lie within Aiken, Allendale, and Barnwell counties and span approximately 310 square miles. During legacy operations, radionuclides were released into the surface water, groundwater, soils, and atmosphere. Although the reactors are no longer operating, work continues at SRS with the primary focus being on cleaning up legacy wastes and remediating areas associated with former operations.

Due to the large number of contaminants that could potentially be released from SRS, the Centers for Disease Control and Prevention (CDC) performed a site assessment to determine the potential health effects of any discharged radionuclides to the off-site public. Most of the radiological releases originated from processes associated with the reactor areas (R, K, P, L, and C) and the separations areas (F and H), but there are other areas of releases as a result of the varied processes at SRS.

P Reactor at SRS – No longer in operation
Photo by DOE-SR. CC BY 2.0

Tritium was one of the principle nuclear materials produced at SRS to multiply the firepower of plutonium in nuclear weapons (Till et al., 2001). Tritium releases originated from processes associated with the reactors, separations areas, D-Area, and tritium facilities. The two main types of tritium releases came from direct site facility releases and migration from seepage basins in the separation areas, the burial ground, and the K-Area containment basin. In the early operational years, nearly 100 percent of the discharges to streams were related to direct releases. Tritiated water's ability to react chemically like nonradioactive water in living cells lends itself to be more hazardous biologically than tritium gas (CDC SRSHES, 1997).

Alpha-emitting and beta-emitting radionuclides were also released to liquid effluent. Alpha-emitting radionuclide releases from M-Area primarily affected Tims Branch, which ultimately flows into Upper Three Runs Creek. Fourmile Branch is the stream most affected by alpha- and beta-emitting releases coming from the separation areas, and releases from the reactor areas affected all streams except for Upper Three Runs Creek (Till et al., 2001). Steel Creek, Pen Branch, and Lower Three Runs Creek were mainly affected by beta-emitting releases from the reactors. Strontium-90 (Sr-90) is a main contributor of beta activity and came primarily from the reactors (Till et al., 2001).

Plutonium was manufactured at SRS in H-Area from fuel rods and in F-Area from targets (Till et al., 2001). Releases at SRS occurred primarily through the discharge of liquid waste into streams. Iodine-129 (I-129) is a fission product of reactor fuel that has a very long half-life. Most occurred during fuel processing (Till et al., 2001). Technetium-99 (Tc-99) was produced in SRS production reactors as a fission by-product of uranium and plutonium. This radionuclide was released to the environment from the separations areas ventilation systems, the aqueous

environment from liquid waste in waste tanks, and the Solid Waste Disposal Facility (Westinghouse Savannah River Company [WSRC], 1993).

Strontium was a fission product in SRS reactors, subsequently released from F-area and H-area (WSRC, 1998). SRS operations have also released strontium into the environment through normal site operations and equipment failures.

H Canyon at SRS – Still in operation at the site
Photo by DOE-SR. CC BY 2.0

Routine operations at SRS have released cesium-137 (Cs-137) to the regional environment surrounding SRS. The most significant releases occurred during the early years of site operation when Cs-137 was released to seepage basins and site streams. The SRS facilities that have documented Cs-137 releases are the production reactors, separations areas, liquid waste facilities, solid waste disposal facility, central shops, heavy water rework facility, Saltstone Facility, and the Savannah River National Laboratory (SRNL).

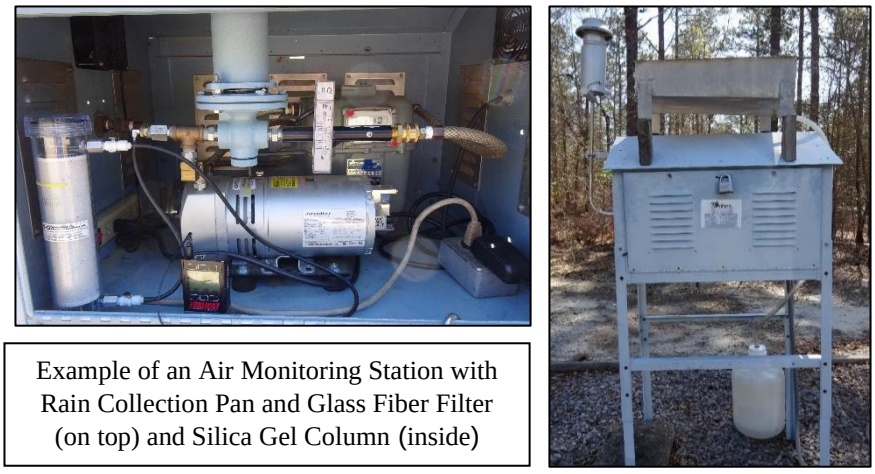
Historically, the Department of Energy-Savannah River (DOE-SR) has been self-regulating regarding environmental monitoring. Until 1995, the public had to rely solely on DOE-SR to ensure their health and the environment was protected. DOE-SR formed an Agreement in Principle (AIP) with the South Carolina Department of Health and Environmental Control (SCDHEC) to perform independent environmental surveillance and oversight of SRS. This partnership provides an extra source of information to the public regarding the effectiveness of the DOE-SR monitoring activities. From this agreement, the Environmental Surveillance and Oversight Program (ESOP) of DHEC was initiated to supplement and compliment monitoring functions of this unique facility. DHEC monitoring provides an added protection due to the potential for environmental releases that pose a threat to the state.

Program development at SRS is stable and evolves based on changing missions. The foremost focus is on legacy waste and materials that are stored or have been disposed of on-site and pose a current risk of release to the environment. Some of DOE-SR's primary activities are concerned with identifying concentrations and migration of radionuclides in the aquatic environment, detecting and verifying accidental releases, characterizing concentration trends, and determining associated impacts on human health and the environment. This report provides results of samples collected by DHEC related to SRS, trending data to document how contaminants are changing, and information on how these changes may impact the surrounding communities. The data reported by DHEC is based on detections only. DOE-SR provides raw data to DHEC to evaluate and compare results between the programs. DHEC's ESOP will continue its mission of monitoring and oversight around SRS to ensure the site's on-going activities continue to be safe for the public and the environment.

Chapter 1 Radiological Atmospheric Monitoring on and Adjacent to SRS

1.1.0 PROJECT SUMMARY

Atmospheric transport has the potential to impact the citizens of South Carolina from releases associated with activities at SRS. The Atmospheric Monitoring Project conducts routine, quantitative monitoring of atmospheric radionuclide releases associated with SRS, which it uses to identify concentration trends that could require further investigation. Air monitoring capabilities in 2023 included nineteen dosimeter monitoring locations and seven air monitoring stations that collected samples using glass fiber filters, rain collection pans, and silica gel columns. Glass fiber filters are used to collect total suspended particulates (TSP) in the air. Particulates are collected weekly and analyzed for gross alpha and beta-emitting activity. Precipitation, when present, and silica gel distillates of atmospheric moisture are sampled and analyzed monthly for tritium. Dosimeters are collected and analyzed every quarter for ambient beta/gamma levels. Radiological atmospheric monitoring sites were established to provide spatial coverage of the project area (Sections 1.4.0, Map and 1.5.0, Table 1). One air monitoring station is located at the center of the site, three are at the SRS perimeter, and three are found outside of the site boundary within public areas. The air monitoring stations in Jackson, S.C. (JAK) and New Ellenton, S.C. (NEL) are considered perimeter locations due to their proximity to the SRS boundary. The Aiken Elementary Water Tower (AIK) air monitoring station is within a 25-mile radius from SRS and is not considered a perimeter location. Thirteen of the dosimeters are on or near the site perimeter, one is in the center of the site, and five are within 25 miles of the site in surrounding population centers. DHEC emphasizes monitoring SRS perimeter locations for radionuclides in atmospheric media for potential public exposure. Section 1.5.0, Table 1 includes sample ID, location, and sampling station proximity to SRS for all DHEC air and dosimeter monitoring locations. Some DHEC monitoring locations are collocated with the Department of Energy-Savannah River (DOE-SR). Analytical comparisons made between DHEC and DOE-SR are from collocated monitoring locations except for yearly average dosimeter comparisons.



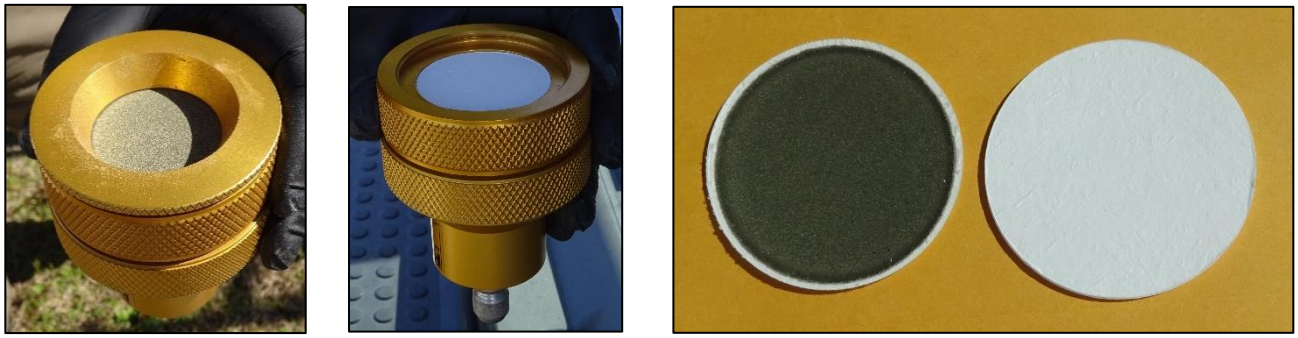
Example of an Air Monitoring Station with Rain Collection Pan and Glass Fiber Filter (on top) and Silica Gel Column (inside)

1.2.0 RESULTS AND DISCUSSION

Air Monitoring Summary Statistics can be found in Section 1.6.0 and all Air Monitoring Data can be found in the 2023 DHEC Data File.

1.2.1 Total Suspended Particulates

DHEC and DOE-SR had both gross alpha and gross beta detections in 2023. Small seasonal variations at each monitoring location have been consistent with historically reported DHEC values (DHEC, 2023). Section 1.5.0 illustrates trends for the last five years for average gross alpha activity (Figure 1) and average gross beta activity (Figure 2) at collocated SRS perimeter locations.



Glass fiber filter being collected for total suspended particulates: Used filter (left) vs. unused filter (right)

1.2.2 Ambient Beta/Gamma

DHEC conducts ambient beta/gamma monitoring through the deployment of dosimeters around the perimeter of SRS. In 2023, DHEC ambient beta/gamma average quarterly totals ranged from 19.25 (TLD-07) to 30.25 (TLD-02) mrem. Section 1.5.0, Figure 3 shows the yearly average data trends at the SRS perimeter for ambient beta/gamma values in dosimeters for DHEC and DOE-SR.

1.2.3 Tritium

Tritium continues to be the predominant radionuclide detected in the perimeter samples. Most of the tritium detected in DHEC perimeter samples may be attributed to the release of tritium from tritium facilities, separations areas, and from wide-spread and fleeting sources (SRNS, 2024).

Tritium in Air

Tritium in air values reported by DHEC are the result of using the historical method of calculating an air concentration of tritium based on the upper limit value of absolute humidity (11.5 grams of atmospheric moisture per cubic meter) in the geographic region (NCRP, 1984). This number is a dose equivalent concentration that would yield approximately 10 mrem to a member of the public at the site boundary (EPA, 1989).

The collocated perimeter average for DHEC tritium in air activity (4.37 pCi/m^3) was lower than the DOE-SR collocated perimeter average activity (13.39 pCi/m^3). These variations could be caused by different sample location frequencies and method of calculating air concentration. The overall perimeter average for DHEC tritium in air activity was 4.21 pCi/m^3.

Example of dosimeters present at 19 locations

Average tritium in air activity at the SRS perimeter reported by DHEC and DOE-SR for 2023 was higher than reported in 2022. These levels have fluctuated over the last five years. Section 1.5.0, Figure 4 illustrates data trends of atmospheric tritium activity for DHEC and DOE-SR as measured and calculated at the SRS perimeter.

Collecting atmospheric moisture from silica gel through distillation

Silica Gel Column

Tritium in Precipitation

In 2023, DHEC and DOE-SR averages for tritium activity in precipitation were well below the Environmental Protection Agency standard of 20,000 pCi/L for drinking water (EPA, 2020). Section 1.5.0, Figure 5 shows average tritium in precipitation activity for SRS perimeter collocations and illustrates trending tritium in precipitation values for DHEC and DOE-SR from the last five years.

During the 2023 sampling period, tritium detected in precipitation ranged from 355.00 pCi/L (Jackson, S.C. Air Station (JAK)) to 4,392.48 pCi/L (Burial Grounds North, SRS (BGN)). The maximum reported value for DHEC perimeter locations was collected at the Allendale Barricade (ABR) Air Station with 4,220.00 pCi/L. The DHEC average measured activity for collocated (and all) perimeter locations above the lower limit of detection for tritium in precipitation was 1646 pCi/L. DOE-SR did not detect tritium in precipitation above the lower limit of detection for any collocated perimeter locations (SRNS, 2024).

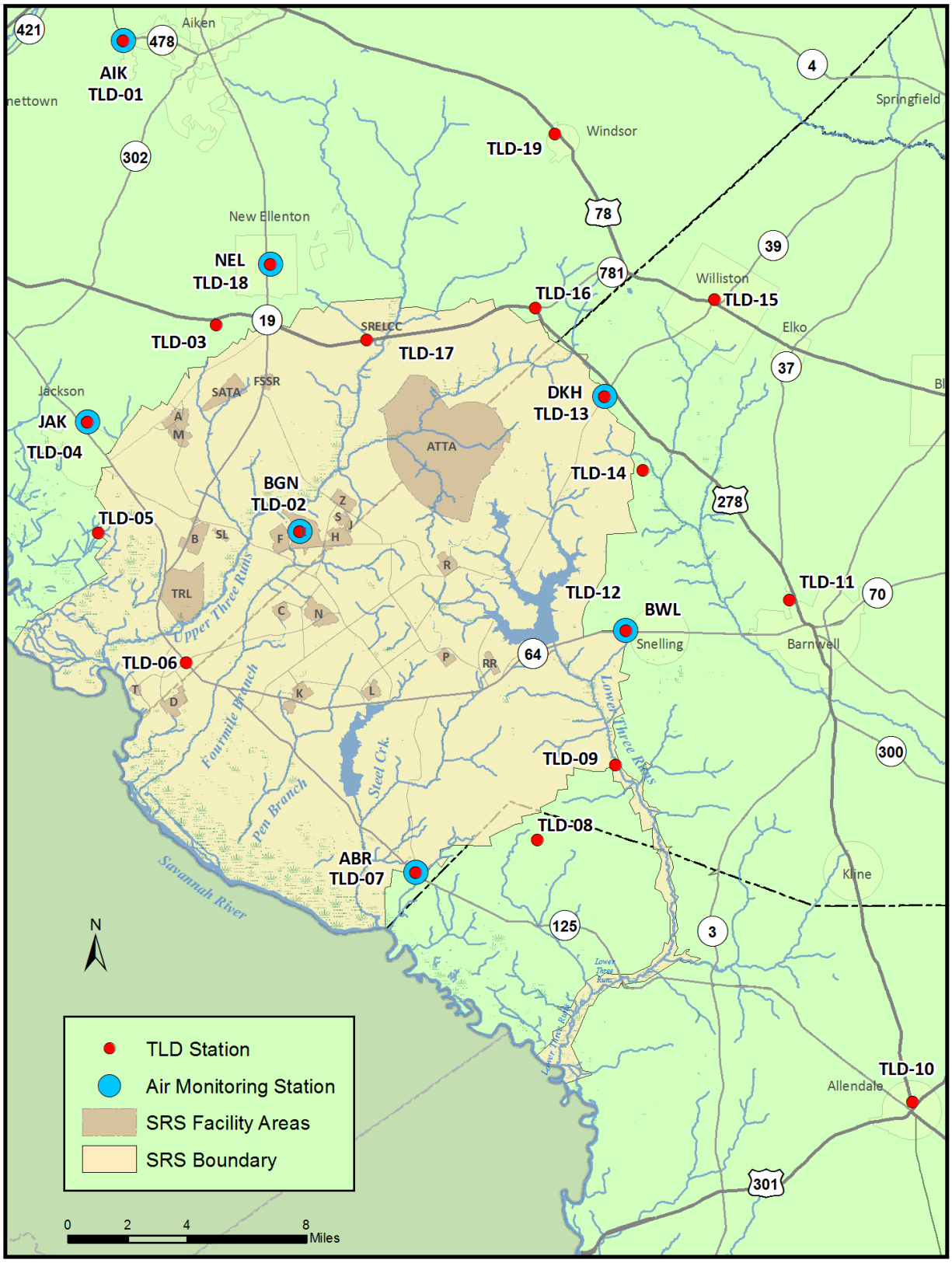
1.3.0 CONCLUSIONS AND RECOMMENDATIONS

All DHEC data collected in 2023 confirmed reported DOE-SR values for gross alpha/beta, ambient beta/gamma, and tritium in the environment at the SRS boundary with no anomalous data noted for any monitored parameters.

Due to continued potential releases from site facilities (tritium facilities, separations areas, etc.), DHEC will continue to collect weekly TSP for gross alpha/beta, monthly atmospheric and precipitation tritium samples, and quarterly ambient beta/gamma samples.

1.4.0 MAP

Radiological Atmospheric Monitoring Locations



2023 ESOP Radiological Air Monitoring Map www.scdhec.gov

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1.5.0 TABLES AND FIGURES

Table 1. 2023 DHEC Radiological Atmospheric Monitoring Locations

Dosimeter Monitoring Locations

Sample ID	Location	Proximity to SRS
TLD-01	Collocated with AIK Air Station	Within 25 miles of SRS
TLD-02	Collocated with BGN Air Station	Center of SRS
TLD-03*	Savannah River Research Park	SRS Perimeter
TLD-04*	Collocated with JAK Air Station	SRS Perimeter
TLD-05*	Crackerneck Gate	SRS Perimeter
TLD-06*	Ellenton Memorial at Hwy 125	SRS Perimeter
TLD-07*	Collocated with ABR Air Station	SRS Perimeter
TLD-08*	Junction of Millet Road and Round Tree Road	SRS Perimeter
TLD-09*	Patterson Mill Road at Lower Three Runs Creek	SRS Perimeter
TLD-10	Collocated with ALN Air Station	Within 25 miles of SRS
TLD-11	Barnwell Health Department	Within 25 miles of SRS
TLD-12*	Collocated with BWL Air Station	SRS Perimeter
TLD-13*	Collocated with DKH Air Station	SRS Perimeter
TLD-14*	Seven Pines Road Collocated with SRS Air Station	SRS Perimeter
TLD-15	Williston Police Department	Within 25 miles of SRS
TLD-16*	Junction of US-278 and SC-781	SRS Perimeter
TLD-17*	US-278 SREL Conference Center and Hwy 125	SRS Perimeter
TLD-18*	Collocated with NEL Air Station	SRS Perimeter
TLD-19	Windsor Post Office	Within 25 miles of SRS

* Denotes a perimeter location

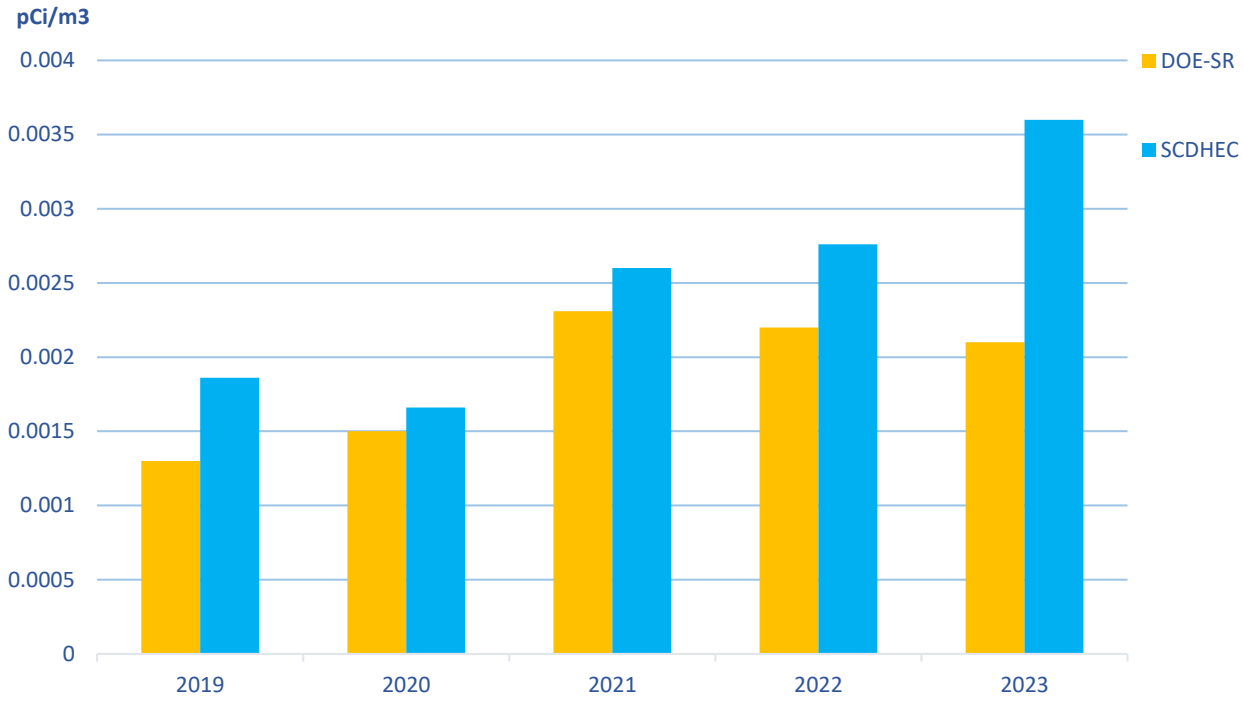
Air Monitoring Stations

Sample ID	Location	Proximity to SRS
BGN*	Burial Grounds North, SRS	Center of SRS
BWL*	Barnwell Barricade	SRS Perimeter
ABR*	Allendale Barricade	SRS Perimeter
DKH*	Dark Horse	SRS Perimeter
NEL	New Ellenton, S.C.	SRS Perimeter/ Population Area
JAK*	Jackson, S.C.	SRS Perimeter/ Population Area
AIK	Aiken Elementary Water Tower	Within 25 miles of SRS/ Population Area

* Indicates a location that is collocated with DOE-SR

1.5.0 TABLES AND FIGURES

Figure 1. Collocated DOE-SR and DHEC Comparison of Average Gross Alpha for Total Suspended Particulates at the SRS Perimeter (SRNS, 2020-2024; DHEC, 2020b-2023)



The DOE-SR 2019 average is based on all DOE-SR perimeter locations. All DOE-SR yearly averages after 2019 are based on collocated perimeter locations.

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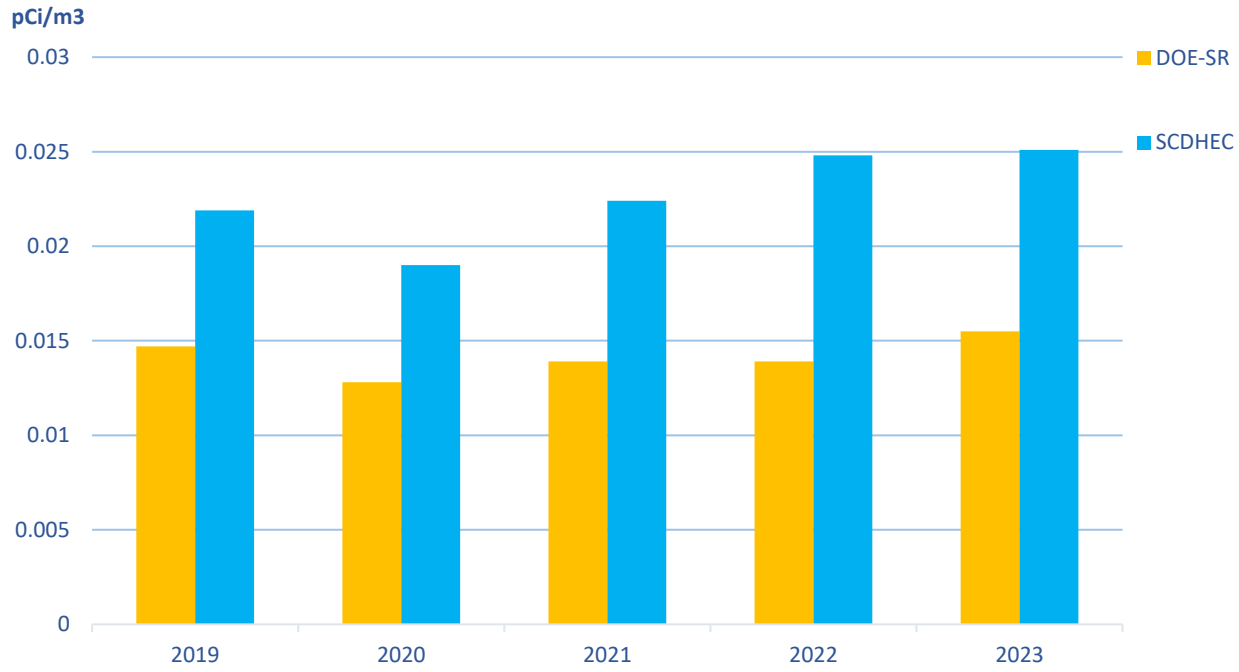
1.5.0 TABLES AND FIGURES

Figure 2. Collocated DOE-SR and DHEC Comparison of Average Gross Beta for Total Suspended Particulates at the SRS Perimeter (SRNS, 2020-2024; DHEC, 2020b-2023)



The DOE-SR 2019 average is based on all DOE-SR perimeter locations. All DOE-SR yearly averages after 2019 are based on collocated perimeter locations.

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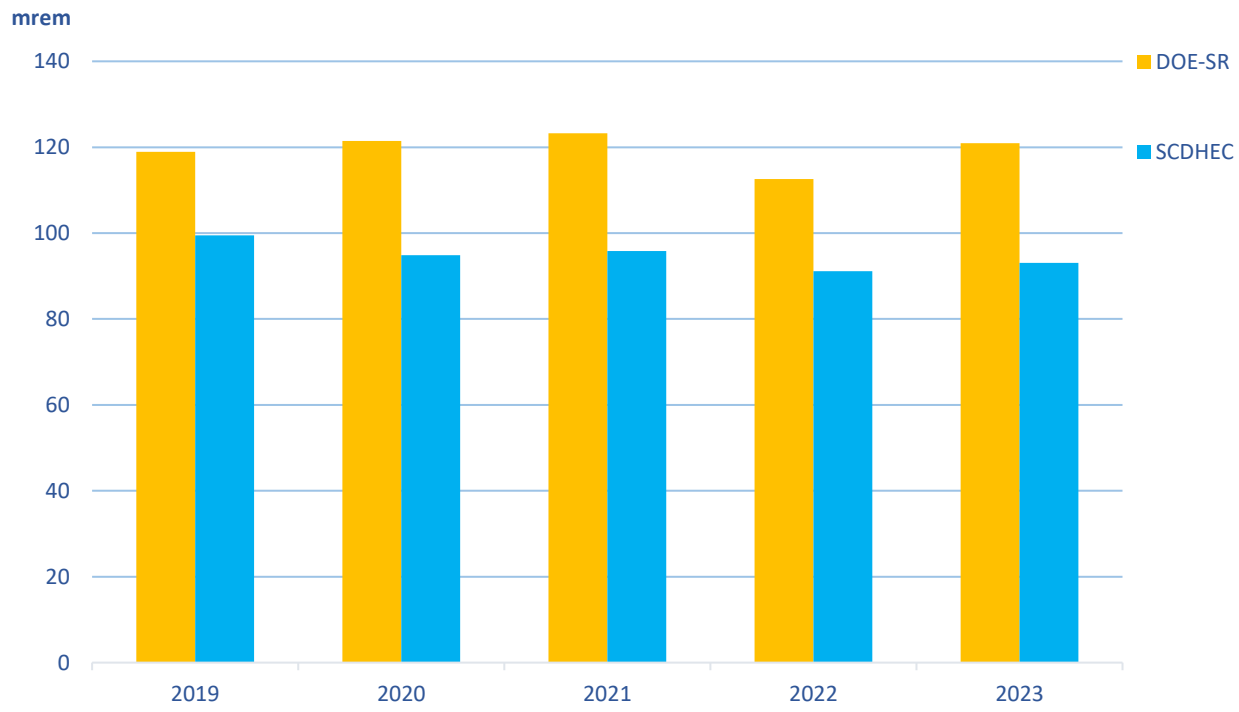
1.5.0 TABLES AND FIGURES

Figure 3. DOE-SR and DHEC Comparison of Yearly Average Ambient Beta/Gamma Dose for Dosimeters at the SRS Perimeter (SRNS, 2020-2024; DHEC, 2020b-2023)



The yearly average results for DOE-SR are based on population centers within proximity to SRS, site perimeter stations, and perimeter air surveillance stations. The yearly average results for DHEC are based on all perimeter locations (not limited to collocations).

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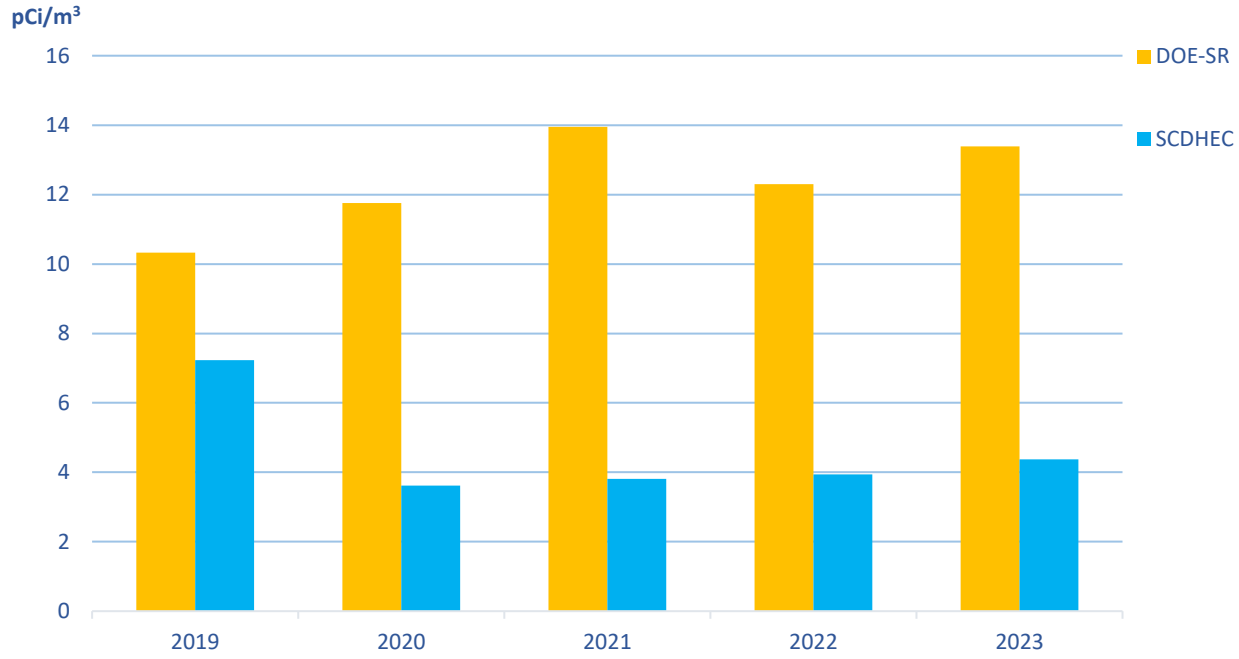
1.5.0 TABLES AND FIGURES

Figure 4. Collocated DOE-SR and DHEC Comparison of Average Tritium in Air at the SRS Perimeter (SRNS, 2020-2024; DHEC, 2020b-2023)



The DOE-SR 2019 average is based on all DOE-SR perimeter locations. All DOE-SR yearly averages after 2019 are based on collocated perimeter locations.

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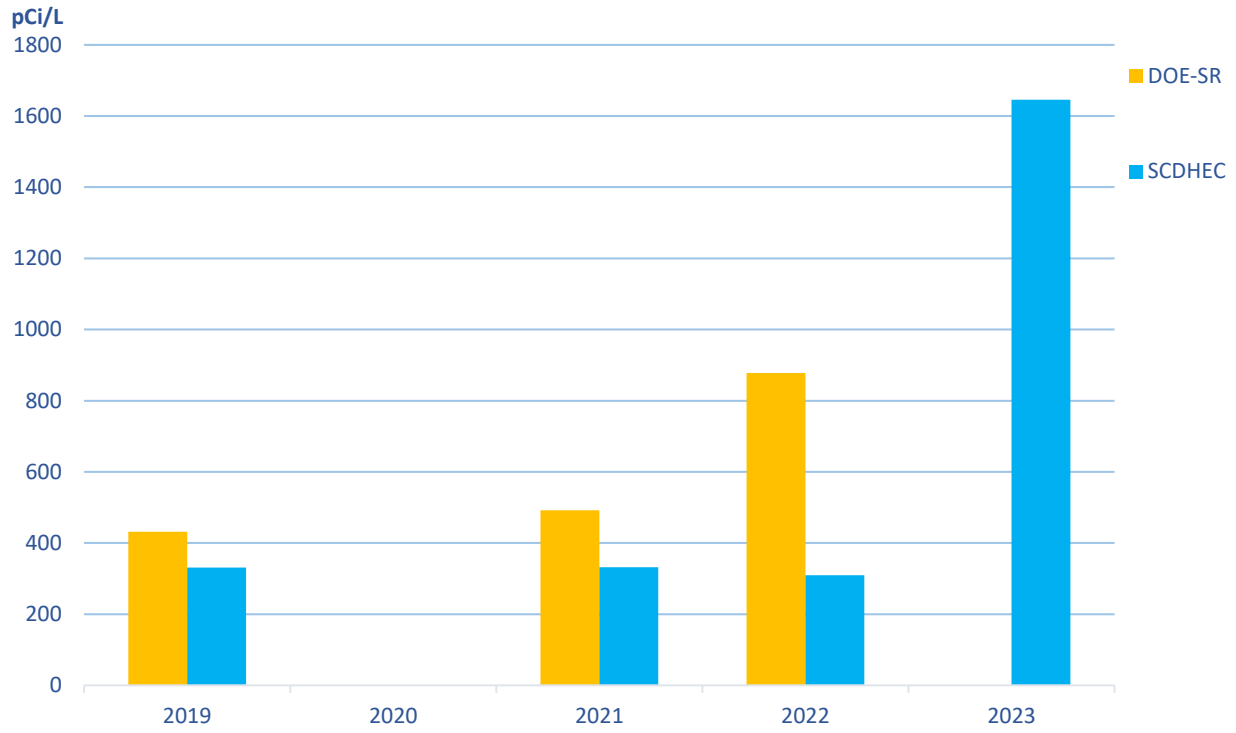
1.5.0 TABLES AND FIGURES

Figure 5. Collocated DOE-SR and DHEC Comparison of Average Tritium in Precipitation at the SRS Perimeter (SRNS, 2020-2024; DHEC, 2020b-2023)



Neither DHEC nor DOE-SR had detections above the LLD for tritium in 2020. DOE-SR had no detections above the LLD for tritium in 2023.
The DOE-SR 2019 average is based on all DOE-SR perimeter locations. All DOE-SR yearly averages after 2019 are based on collocated perimeter locations.

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1.6.0 SUMMARY STATISTICS

2023 DHEC Quarterly Averages of Ambient Dosimeter Beta/Gamma Data

Sample ID	Average (mrem)	Standard Deviation (mrem)	Median (mrem)	Minimum (mrem)	Maximum (mrem)
TLD-01	20.50	1.91	21.00	18.00	22.00
TLD-02	30.25	3.20	29.00	28.00	35.00
TLD-03*	23.00	1.63	23.00	21.00	25.00
TLD-04*	20.25	1.50	21.00	18.00	21.00
TLD-05*	25.75	2.36	25.00	24.00	29.00
TLD-06*	22.25	1.71	22.50	20.00	24.00
TLD-07*	19.25	1.71	19.50	17.00	21.00
TLD-08*	23.75	1.26	24.00	22.00	25.00
TLD-09*	26.25	1.89	25.50	25.00	29.00
TLD-10	22.25	2.06	22.50	20.00	24.00
TLD-11	25.75	1.50	26.00	24.00	27.00
TLD-12*	22.00	1.15	22.00	21.00	23.00
TLD-13*	21.50	1.29	21.50	20.00	23.00
TLD-14*	27.50	0.58	27.50	27.00	28.00
TLD-15	26.75	2.36	26.00	25.00	30.00
TLD-16*	23.25	1.89	22.50	22.00	26.00
TLD-17*	24.50	1.73	25.00	22.00	26.00
TLD-18*	23.25	0.50	23.00	23.00	24.00
TLD-19	24.00	1.41	23.50	23.00	26.00

* Denotes a perimeter location

1.6.0 SUMMARY STATISTICS

2023 DHEC and DOE-SR Collocated Air Station Gross Alpha Data in pCi/m^3 (SRNS, 2024)

Location	Average	Standard Deviation	Median	Minimum	Maximum	Number of Detects	Number of Samples
Allendale Barricade (ABR)*	0.0039	0.0019	0.0036	0.0008	0.0085	52	52
	0.0018	0.0008	0.0018	0.0007	0.0033	26	26
Dark Horse (DKH)*	0.0028	0.0013	0.0027	0.0009	0.0055	52	52
	0.0023	0.0014	0.0022	0.0006	0.0065	25	26
Jackson, S.C. (JAK)*	0.0037	0.0017	0.0033	0.0010	0.0080	52	52
	0.0020	0.0009	0.0019	0.0005	0.0036	26	26
Barnwell Barricade (BWL)*	0.0040	0.0019	0.0035	0.0007	0.0089	51	51
	0.0021	0.0012	0.0019	0.0005	0.0050	25	26
Burial Ground North (BGN)	0.0035	0.0013	0.0033	0.0008	0.0066	51	51
	0.0021	0.0010	0.0019	0.0006	0.0044	26	26

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
* Denotes a perimeter location
DHEC collects glass fiber filter weekly while DOE-SR collects them biweekly which may cause variations in data.

1.6.0 SUMMARY STATISTICS

2023 DHEC and DOE-SR Collocated Air Station Gross Beta Data in pCi/m^3 (SRNS, 2024)

Location	Average	Standard Deviation	Median	Minimum	Maximum	Number of Detects	Number of Samples
Allendale Barricade (ABR)*	0.0267	0.0079	0.0241	0.0140	0.0487	52	52
	0.0145	0.0039	0.0153	0.0072	0.0205	26	26
Dark Horse (DKH)*	0.0198	0.0055	0.0189	0.0110	0.0346	52	52
	0.0157	0.0047	0.0149	0.0058	0.0304	26	26
Jackson, S.C. (JAK)*	0.0256	0.0085	0.0235	0.0140	0.0501	52	52
	0.0160	0.0035	0.0161	0.0098	0.0239	26	26
Barnwell Barricade (BWL)*	0.0284	0.0092	0.0253	0.0155	0.0528	51	51
	0.0157	0.0046	0.0151	0.0082	0.0282	26	26
Burial Ground North (BGN)	0.0271	0.0085	0.0257	0.0154	0.0536	51	51
	0.0165	0.0048	0.0157	0.0094	0.0282	26	26

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
* Denotes a perimeter location
DHEC collects glass fiber filter weekly while DOE-SR collects them biweekly which may cause variations in data.

1.6.0 SUMMARY STATISTICS

2023 DHEC and DOE-SR Collocated Air Station Tritium in Air Data in pCi/m^3 (SRNS, 2024)

Location	Average	Standard Deviation	Median	Minimum	Maximum	Number of Detects	Number of Samples
Allendale Barricade (ABR)*	4.19	NA	4.19	4.19	4.19	1	12
	15.16	3.02	15.16	13.02	17.29	2	27
Dark Horse (DKH)*	4.25	0.80	4.60	3.13	5.15	5	12
	12.49	4.28	10.04	9.99	17.44	3	26
Jackson, S.C. (JAK)*	4.97	2.79	3.36	3.36	8.19	3	12
	13.10	4.52	11.21	9.84	18.26	3	26
Barnwell Barricade (BWL)*	3.86	0.89	3.86	3.23	4.49	2	12
	ND	ND	ND	ND	ND	0	26
Burial Ground North (BGN)	261.27	151.52	212.09	91.40	566.26	12	12
	351.56	189.84	320.44	98.37	742.47	27	27

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
* Denotes a perimeter location
DHEC collects silica gel columns monthly while DOE-SR collects them biweekly which may cause variations in data.
ND is Not Detected
NA is Not Applicable

1.6.0 SUMMARY STATISTICS

2023 DHEC and DOE-SR Collocated Air Station Tritium in Precipitation Data in pCi/L (SRNS, 2024)

Location	Average	Standard Deviation	Median	Minimum	Maximum	Number of Detects	Number of Samples
Allendale Barricade (ABR)*	4220	NA	4220	4220	4220	1	12
	ND	ND	ND	ND	ND	0	13
Dark Horse (DKH)*	364	NA	364	364	364	1	12
	ND	ND	ND	ND	ND	0	13
Jackson, S.C. (JAK)*	355	NA	355	355	355	1	12
	ND	ND	ND	ND	ND	0	13
Barnwell Barricade (BWL)*	ND	ND	ND	ND	ND	0	12
	ND	ND	ND	ND	ND	0	13
Burial Ground North (BGN)	1936.72	1224.54	2034	361	4392.48	12	12
	1728.00	888.34	1795	443	3340	12	13

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
* Denotes a perimeter location
Both DHEC and DOE-SR collect precipitation samples monthly. In 2023, DOE-SR collected 2 samples in August.
ND is Not Detected
NA is Not Applicable

1.6.0 SUMMARY STATISTICS

2023 DHEC Air Station Gross Alpha Data in pCi/m^3

Location	Average	Standard Deviation	Median	Minimum	Maximum	Number of Detects	Number of Samples
Allendale Barricade (ABR)*	0.0039	0.0019	0.0036	0.0008	0.0085	52	52
Dark Horse (DKH)*	0.0028	0.0013	0.0027	0.0009	0.0055	52	52
Aiken Elementary Water Tower (AIK)	0.0029	0.0014	0.0028	0.0010	0.0060	52	52
New Ellenton, S.C. (NEL)*	0.0036	0.0017	0.0033	0.0011	0.0075	52	52
Jackson, S.C. (JAK)*	0.0037	0.0017	0.0033	0.0010	0.0080	52	52
Burial Ground North (BGN)	0.0035	0.0013	0.0033	0.0008	0.0066	51	51
Barnwell Barricade (BWL)*	0.0040	0.0019	0.0035	0.0007	0.0089	51	51

* Denotes a perimeter location. Aiken Elementary Water Tower (AIK) is within a 25-mile radius and is not considered a perimeter location.

2023 DHEC Air Station Gross Beta Data in pCi/m^3

Location	Average	Standard Deviation	Median	Minimum	Maximum	Number of Detects	Number of Samples
Allendale Barricade (ABR)*	0.0267	0.0079	0.0241	0.0140	0.0487	52	52
Dark Horse (DKH)*	0.0198	0.0055	0.0189	0.0110	0.0346	52	52
Aiken Elementary Water Tower (AIK)	0.0203	0.0061	0.0197	0.0107	0.0370	52	52
New Ellenton, S.C. (NEL)*	0.0247	0.0070	0.0234	0.0140	0.0444	52	52
Jackson, S.C. (JAK)*	0.0256	0.0085	0.0235	0.0140	0.0501	52	52
Burial Ground North (BGN)	0.0271	0.0085	0.0257	0.0154	0.0536	51	51
Barnwell Barricade (BWL)*	0.0284	0.0092	0.0253	0.0155	0.0528	51	51

* Denotes a perimeter location. Aiken Elementary Water Tower (AIK) is within a 25-mile radius and is not considered a perimeter location.

1.6.0 SUMMARY STATISTICS

2023 DHEC Air Station Tritium in Air Data in pCi/m^3

Location	Average	Standard Deviation	Median	Minimum	Maximum	Number of Detects	Number of Samples
Allendale Barricade (ABR)*	4.19	NA	4.19	4.19	4.19	1	12
Dark Horse (DKH)*	4.25	0.80	4.60	3.13	5.15	5	12
Aiken Elementary Water Tower (AIK)	ND	ND	ND	ND	ND	0	12
New Ellenton, S.C. (NEL)*	3.78	0.51	3.75	3.32	4.30	4	12
Jackson, S.C. (JAK)*	4.97	2.79	3.36	3.36	8.19	3	12
Burial Ground North (BGN)	261.27	151.52	212.09	91.40	566.26	12	12
Barnwell Barricade (BWL)*	3.86	0.89	3.86	3.23	4.49	2	12

* Denotes a perimeter location. Aiken Elementary Water Tower (AIK) is within a 25-mile radius and is not considered a perimeter location.
ND is Not Detected
NA is Not Applicable

1.6.0 SUMMARY STATISTICS

2023 DHEC Air Station Tritium in Precipitation Data in pCi/L

Location	Average	Standard Deviation	Median	Minimum	Maximum	Number of Detects	Number of Samples
Allendale Barricade (ABR)*	4220	NA	4220	4220	4220	1	12
Dark Horse (DKH)*	364	NA	364	364	364	1	12
Aiken Elementary Water Tower (AIK)	ND	ND	ND	ND	ND	0	12
New Ellenton, S.C. (NEL)*	ND	ND	ND	ND	ND	0	12
Jackson, S.C. (JAK)*	355	NA	355	355	355	1	12
Burial Ground North (BGN)	1936.72	1224.54	2034	361	4392.48	12	12
Barnwell Barricade (BWL)*	ND	ND	ND	ND	ND	0	12

* Denotes a perimeter location. Aiken Elementary Water Tower (AIK) is within a 25-mile radius and is not considered a perimeter location.
ND is Not Detected
NA is Not Applicable

Chapter 2 Monitoring of Ambient Groundwater Adjacent to SRS

2.1.0 PROJECT SUMMARY

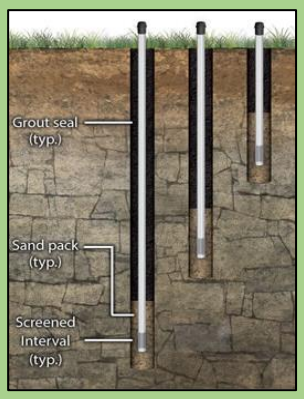
DHEC currently utilizes a regional groundwater monitoring well network consisting of cluster wells (C-wells) and network wells (private wells and public water systems). This groundwater well network consists of approximately 114 wells that are cyclically sampled every five years by DHEC. The C-wells are owned and maintained by the South Carolina Department of Natural Resources (DNR). These cluster wells are screened from shallow surficial aquifers to deeper aquifers up to depths exceeding 1,400 feet below ground surface. The C-well clusters are situated around the perimeter of SRS.

Groundwater samples are collected from wells within a 20-mile site boundary. A 20-mile sampling perimeter was selected based on regional well availability and comparative review of known or suspected sources of groundwater contamination and local groundwater flow patterns. The project map in Section 2.4.0 depicts the network groundwater well locations, the extent of the study area, and the wells sampled in 2023. DHEC evaluates five aquifer zones (Upper Three Runs, Gordon, Crouch Branch, Steel Pond, and McQueen Branch).

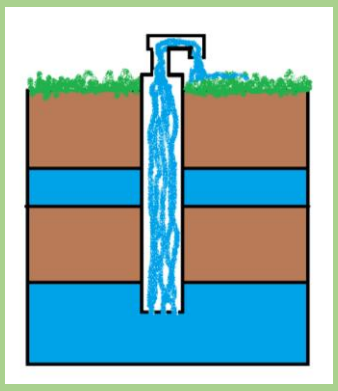
An **AQUIFER** is soil and/or rock containing water below the ground surface.

CLUSTER WELLS vs. NETWORK WELLS

CLUSTER WELLS are multiple wells that are at the same location but are drilled to varying depths to screen different aquifers.



NETWORK WELLS are single wells at a specific location screened in a specific aquifer.



2.2.0 RESULTS AND DISCUSSION

Groundwater Monitoring Data can be found in Section 2.6.0 and in the 2023 DHEC Data File.

DHEC collected groundwater from 10 wells. Based on a review of the tritium, gross alpha, non-volatile beta, and gamma-emitting radioisotope analytical data provided by the DHEC Analytical and Radiological Environmental Services Division (ARESD) laboratories, the only gamma-emitting radioisotope detected was Lead-214 (Pb-214). Pb-214 is a naturally occurring radioactive or NORM contaminant and was detected in 3 out of the 10 groundwater wells sampled. See Section 2.5.0, Table 1 for a list of the network of sampling wells with their assigned aquifer.

Groundwater investigations performed by state and federal agencies such as DHEC, DNR, and the United States Geological Survey (USGS) have confirmed the presence of naturally occurring radionuclides in groundwater across South Carolina (ATSDR, 2007). If known contaminants are found in wells located within the DHEC sampling network, the affected wells would be investigated further to help determine the source.

Residential Well

The United States Environmental Protection Agency (EPA) has a drinking water Maximum Contaminant Level (MCL) of 20,000 pCi/L for tritium, 15 pCi/L for gross alpha, and 50 pCi/L minus natural potassium-40 (K-40) for non-volatile beta (EPA, 2020). In 2023, DHEC did not detect tritium in any wells. Five wells in two different aquifers (McQueen Branch and Crouch Branch) had gross alpha detects below the EPA MCL. One well (M02305) had gross alpha detects slightly above the EPA MCL but there is a decreasing trend in the gross alpha detects from this well between 2018 and 2023. Two wells in the same aquifer (McQueen Branch) had non-volatile beta detects well below the EPA MCL.

With groundwater locations having a five-year collection cycle, the wells sampled in 2023 were last sampled in 2018. Wells that were sampled in both 2018 and 2023 were found to have comparable data which can be found in the tables in Section 2.6.0. Wells that were not sampled in 2023 were due to groundwater pump failures.

2.3.0 CONCLUSIONS AND RECOMMENDATIONS

DOE-SR collects groundwater samples from a separate on-site monitoring well network; therefore, direct DHEC off-site groundwater comparisons could not be made. However, the 2023 SRS report identifies various contaminants such as volatile organic compounds (VOCs), tritium, and gross alpha/beta radionuclides in numerous areas of groundwater throughout the SRS property (SRNS, 2024).

Collecting well water for analysis

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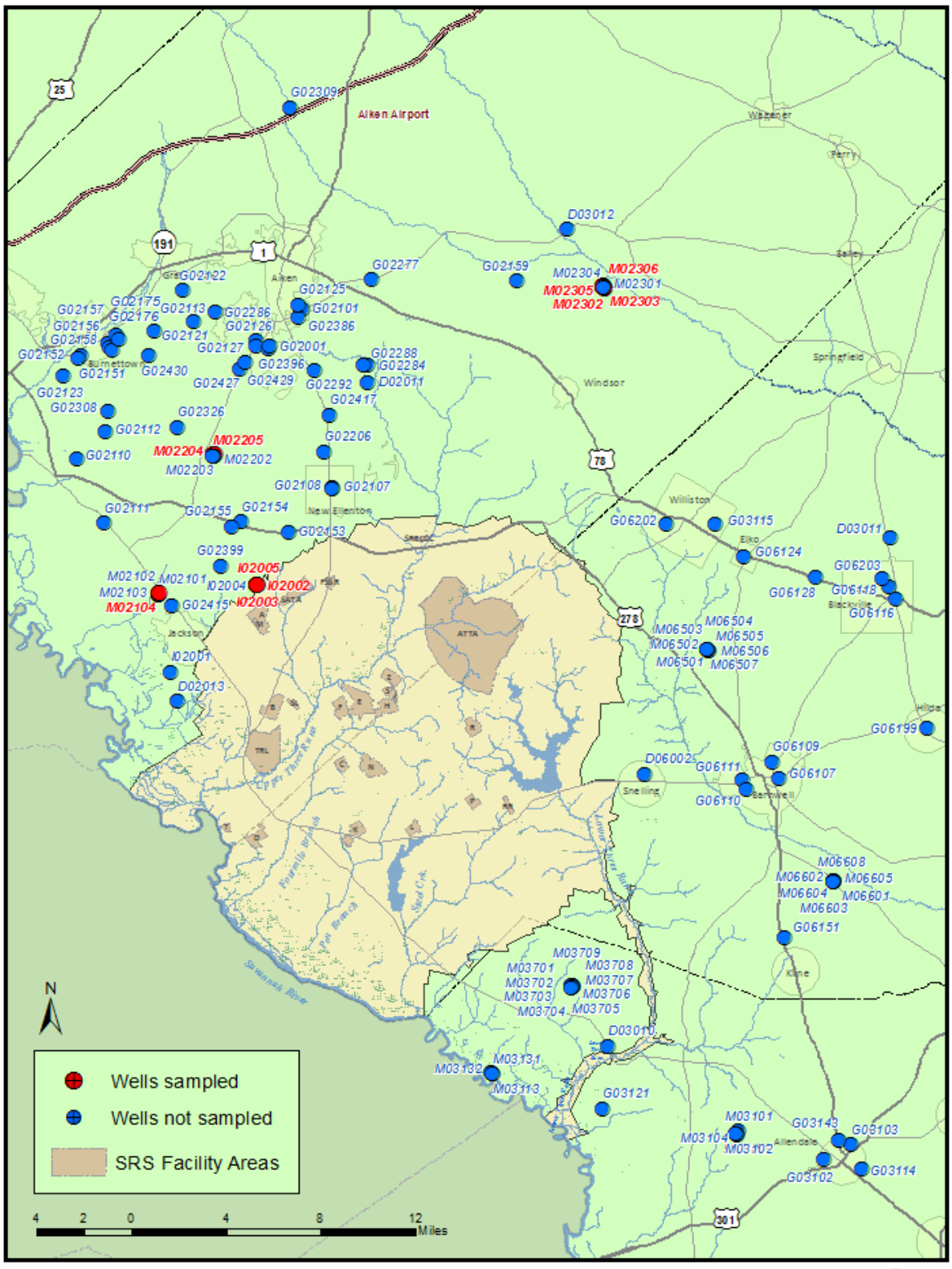
2.4.0 MAP

Groundwater Monitoring Locations



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2.5.0 TABLES AND FIGURES

Table 1. DHEC Ambient Groundwater Monitoring Locations

Well No.	Well Name	Sample Year	Top of Casing Elevation (ft amsl)	Total Depth (ft bgs)	Aquifer
I02002	Greene Irrigation 1	**2023**	381	278	SP
I02003	Greene Irrigation 2	**2023**	381	280	SP
I02004**	Greene Irrigation 3	**2023**	373	276	SP
I02005	Greene Irrigation 4	**2023**	373	236	SP
M02101**	SCDNR Cluster C-01, AIK-2378	**2023**	220.3	185	CB
M02102**	SCDNR Cluster C-01, AIK-2379	**2023**	224.2	266	CB
M02103**	SCDNR Cluster C-01, AIK-2380	**2023**	228.9	385	MB
M02104	SCDNR Cluster C-01, AIK-902	**2023**	231.9	511	MB
M02202**	SCDNR Cluster C-02, AIK-825	**2023**	418.8	231	CB
M02203**	SCDNR Cluster C-02, AIK-824	**2023**	418.6	365	CB
M02204	SCDNR Cluster C-02, AIK-818	**2023**	418.3	425	MB
M02205	SCDNR Cluster C-02, AIK-817	**2023**	418.9	535	MB
M02301**	SCDNR Cluster C-03, AIK-849	**2023**	301.6	97	SP
M02302	SCDNR Cluster C-03, AIK-848	**2023**	299.7	131	CB
M02303	SCDNR Cluster C-03, AIK-847	**2023**	299	193	CB
M02304**	SCDNR Cluster C-03, AIK-846	**2023**	297.8	255	CB
M02305	SCDNR Cluster C-03, AIK-845	**2023**	296.9	356	MB
M02306	SCDNR Cluster C-03, AIK-826	**2023**	294.9	500	MB
M06501**	SCDNR Cluster C-05, BRN-360	**2023**	264.3	140	UTR
M06502**	SCDNR Cluster C-05, BRN-359	**2023**	265.5	214	GOR
M06503**	SCDNR Cluster C-05, BRN-367	**2023**	263.8	285	GOR
M06504	SCDNR Cluster C-05, BRN-368	2024	265.1	443	CB
M06505	SCDNR Cluster C-05, BRN-365	2024	263.5	539	CB
M06506	SCDNR Cluster C-05, BRN-366	2024	266.7	715	MB
M06507	SCDNR Cluster C-05, BRN-358	2024	265.6	847	MB
M03706	SCDNR Cluster C-07, ALL-368	2024	246.6	691	CB
M03707	SCDNR Cluster C-07, ALL-369	2024	242.1	800	CB
M03708	SCDNR Cluster C-07, ALL-370	2024	245.1	975	MB
M03709	SCDNR Cluster C-07, ALL-358	2024	243.1	1123	MB
M03701	SCDNR Cluster C-07, ALL-363	2024	246.1	105	UTR
M03702	SCDNR Cluster C-07, ALL-364	2024	245.2	225	UTR
M03703	SCDNR Cluster C-07, ALL-365	2024	244.3	333	GOR
M03704	SCDNR Cluster C-07, ALL-366	2024	243.5	400	GOR
M03705	SCDNR Cluster C-07, ALL-367	2024	245.7	566	CB
M06601	SCDNR Cluster C-06, BRN-351	2024	207.3	95	UTR
M06602	SCDNR Cluster C-06, BRN-350	2024	207.4	170	UTR
M06603	SCDNR Cluster C-06, BRN-352	2024	207.1	293	GOR
M06604	SCDNR Cluster C-06, BRN-354	2024	207.6	411	GOR
M06605	SCDNR Cluster C-06, BRN-353	2024	207.7	588	CB
M06608	SCDNR Cluster C-06, BRN-349	2024	208.6	1045	MB
M03101	SCDNR Cluster C-10, ALL-347	2024	281.6	1423	MB
M03102	SCDNR Cluster C-10 ALL-372	2024	282	155	UTR
M03103	SCDNR Cluster C-10 ALL-371	2024	282.2	217	UTR
M03113	SCDNR Cluster C-13 Artesian	2024	73	*	GOR
M03132	SCDNR Cluster C-13 ALL-378	2024	90	1060	MB
M03131	SCDNR Cluster C-13, Artesian	2024	80	*****	GOR
M03104	SCDNR Cluster C-10, ALL-374	2024	280.9	580	GOR

G02206	Oak Hill Subdivision	2025	445	240	SP
G06124	Elko	2025	351	353	UTR
G06116	Blackville Lartique St.	2025	295	380	UTR
G06118	Blackville Greene Well	2025	292	620	GOR
G06203	Blackville Industrial Park	2025	273	425	UTR
G06199	Hilda	2025	271	345	UTR
G02309	Aiken Shiloh Springs	2025	362	50	SP
G02101	Aiken Pine Log Road	2025	483	407	MB
G02126	Aiken Town Creek	2025	508	400	MB
G02427	Aiken Silver Bluff	2025	467	*	MB
G02121	Vally PSA Gloverville	2025	413	242	CB
G02286	Vally PSA Walker	2025	471	400	MB
G02122	Vally PSA Howlandville	2025	483	323	CB
G02123	Valley PSA Johnstown	2025	259	150	CB
G02259	Aiken State Park	2025	262	*	SP
G02153	Talatha well #1	2025	420	280	SP
G02154	Talatha Well #2	2025	250	185	CB
G02155	Talatha Well #3	2025	343	240	SP
G02399	Jackson Well #3`	2025	405	450	CB
G02415	Jackson Well #4	2025	339	400	CB
G02110	Beech Island Well #2	2025	417	468	CB
G02111	Beech Island Well #3	2025	369	460	MB
G02112	Beech Island Well #4	2025	380	600	MB
G02113	Beech Island Well #5	2025	508	438	CB
G02308	Beech Island Well #6	2025	448	400	CB
G02430	Beech Island Well Piney Heights	2025	453	490	CB
G02326	Boyd Pond (Former ORA)	2025	300	397	MB
D02013	Cowden Plantation, Well 2	2025	124	*	SP
I02001	Cowden Plantation, Well 1	2025	132	*	CB
D02011	Mettlen Well	2025	400	180	SP
G02108	New Elenton Well #1	2025	422	427	CB
G02107	New Elenton Well #2	2025	422	425	CB
G02417	New Ellenton Well #4	2025	488	565	MB
G02277	Montmorenci WD Office Well	2025	504	363	CB
G02159	Montmorenci Well 1	2025	504	330	CB
G06110	Barnwell #10 Shuron	2025	190	276	UTR
G06109	Barnwell, Hwy. 3	2026	230	146	UTR
G06111	Barnwell, Rose St.	2026	220	166	UTR
G06107	Barnwell Shop Well	2026	224	314	GOR
D03011	Healing Springs	2026	240	*	CB
D03012	Cedar Creek Spring	2026	271	*	CB
G06128	Edisto Station	2026	322	360	GOR
G06202	Williston, Schuler St.	2026	352	220	GOR
D06002	Moore Well	2026	240	*	UTR
G02001	Hidden Haven 2	2027	471	484	MB
G02125	Aiken Douglas Dr	2027	483	480	MB
G02127	Aiken Woodside	2027	491	407	MB
G02429	Aiken Silver Bluff 2	2027	451	*	MB
G02386	Aiken Robin Rd	2027	492	430	MB
G0396	Aiken Hidden Haven 1	2027	494	504	MB
G02284	Aiken Vale 2	2027	435	300	CB
G02288	Aiken Vale/Tank	2027	439	363	CB
D03010	Martin Post Office	2027	108	105	UTR

G02292	Hunter's Glen	2027	487	210	SP
G03102	Allendale, Water St.	2027	201	343	UTR
G03103	Allendale, Googe St.	2027	180	347	UTR
G03114	Allendale Patterson Street	2027	172	308	UTR
G03143	Allendale Spruce Street	2027	185	335	UTR
G06151	Chappels Labor Camp	2027	250	260	UTR
G02151	Bath Well One - Tank Well	2027	194	150	SP
G02152	Bath Well Two -Hill Well	2027	217	100	SP
G02157	Burnettown Well Two	2027	272	173	SP
G02156	Burnettown Well One	2027	306	245	SP
G02158	Burnettown Well Three	2027	312	180	SP
G02175	Langley Well One	2027	206	100	SP
G02176	Langley Well Two	2027	249	105	SP
G03115	Martin District Fire Department	2027	95	*	*

Notes:
ft amsl is feet above mean sea level
ft bgs is feet below ground surface
CB is Crouch Branch
MB is McQueen Branch
SP is Steeds Pond
UTR is Upper Three Runs
GOR is Gordon
* is total depth/top of casing information unknown.
** Well was unable to be sampled during the sampling cycle; however, it will remain in the network

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2.6.0 SUMMARY STATISTICS

2023 DHEC Alpha Detects in Groundwater Data in pCi/L

Location Description	2023 Result	2018 Result	Aquifer
I02002	<LLD	2.18	SP
I02003	<LLD	2.40	SP
I02004	NS	<LLD	SP
I02005	<LLD	<LLD	SP
M02101	NS	<LLD	CB
M02102	NS	<LLD	CB
M02103	NS	<LLD	MB
M02104	1.30	1.54	MB
M02202	NS	1.77	CB
M02203	NS	NS	CB
M02204	1.18	<LLD	MB
M02205	3.93	<LLD	MB
M02301	NS	NS	SP
M02302	<LLD	NS	CB
M02303	3.13	1.56	CB
M02304	NS	NS	CB
M02305	15.4	19.5	MB
M02306	5.84	10.8	MB
M06501	NS	NS	UTR
M06502	NS	NS	GOR
M06503	NS	NS	GOR

NS means Not Sampled
<LLD means Less than the Lower Limit of Detection
2018 results are found in the *2018 ESOP Data Report* (DHEC, 2020a)

2.6.0 SUMMARY STATISTICS

2023 DHEC Beta Detects in Groundwater Data in pCi/L

Location Description	2023 Result	2018 Result	Aquifer
I02002	<LLD	<LLD	SP
I02003	<LLD	<LLD	SP
I02004	NS	<LLD	SP
I02005	<LLD	<LLD	SP
M02101	NS	<LLD	CB
M02102	NS	<LLD	CB
M02103	NS	<LLD	MB
M02104	<LLD	<LLD	MB
M02202	NS	<LLD	CB
M02203	NS	NS	CB
M02204	<LLD	<LLD	MB
M02205	<LLD	<LLD	MB
M02301	NS	NS	SP
M02302	<LLD	NS	CB
M02303	<LLD	<LLD	CB
M02304	NS	NS	CB
M02305	13.2	12.5	MB
M02306	8.63	10.7	MB
M06501	NS	NS	UTR
M06502	NS	NS	GOR
M06503	NS	NS	GOR

NS means Not Sampled
<LLD means Less than the Lower Limit of Detection
2018 results are found in the *2018 ESOP Data Report* (DHEC, 2020a)

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Chapter 3 Radiological Monitoring of Drinking Water Adjacent to SRS

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3.1.0 PROJECT SUMMARY

DHEC evaluates drinking water quality to provide information on the radiological impact of SRS to community drinking water systems adjacent to and downstream of the site. DHEC samples five drinking water systems. Monthly composite samples are taken from three Savannah River-fed systems: one upstream location (North Augusta) and two downstream of SRS (Purrysburg Beaufort/Jasper (B/J) and Chelsea B/J). Additionally, two public drinking water systems that are not primarily served by the Savannah River but draw from surface water sources were sampled each month (Aiken Public Shaw Creek Water Works Treatment Plant and Breezy Hill Water Treatment Plant). These systems are located outside of the SRS perimeter and are up to 30 miles from the center of the site (Map, Section 3.4.0).

SURFACE WATER – water that collects on the surface of the ground in the form of streams, ponds, lakes, rivers, or the ocean.

GROUNDWATER– water stored underground in sediment pores or crevices in rock. It may eventually be used by plants, taken up through wells by humans, or discharge into another body of water.

DRINKING WATER – surface water or groundwater that has been treated through a cleaning process to be available for healthy consumption by humans.

In 2023, DOE-SR collected drinking water from two surface water-fed systems (North Augusta and Purrysburg B/J) that are collocated with the DHEC Savannah River-fed systems. Currently, DOE-SR does not conduct drinking water sampling from other public systems off SRS property. DHEC and DOE-SR analyze and compare all samples for gross alpha, non-volatile beta, gamma-emitting radionuclides, and tritium.

3.2.0 RESULTS AND DISCUSSION

Three locations' samples waiting to be analyzed

Gross alpha, tritium, and non-volatile beta sample results are presented in the following tables in Section 3.5.0 and can be found in the 2023 DHEC Data File. All results are below their respective EPA MCLs.

In 2023, DHEC and DOE-SR detected tritium above the lower limit of detection (LLD) in the Savannah River-fed systems downstream of SRS. These activities are well below the EPA established 20,000 pCi/L drinking water limit (EPA, 2020).

Gamma-emitting radionuclides in the List of Analytes, Table 1, page ix, were not detected above the MDA for the drinking water samples collected by DHEC or in DOE-SR's collocated samples in 2023 except for Pb-214 and K-40, which are NORM decay products.

3.3.0 CONCLUSIONS AND RECOMMENDATIONS

Tritium continues to be the most abundant radionuclide detected in public drinking water supplies potentially affected by SRS. Observed tritium activities were low when compared to the EPA MCL for tritium in drinking water, which is 20,000 pCi/L. Detections of gross alpha and

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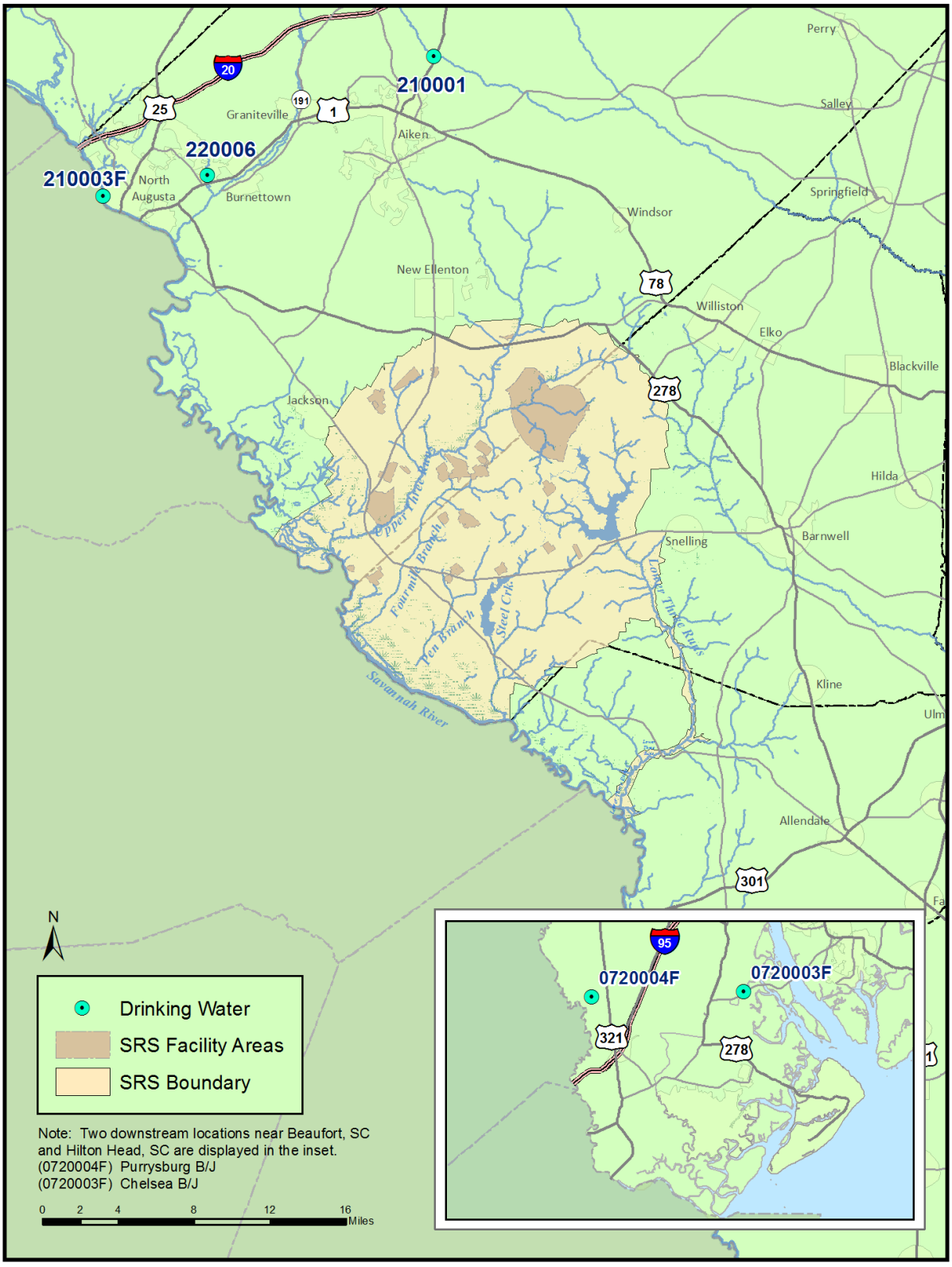
non-volatile beta were all below their respective MCLs. DOE-SR does not sample systems not served by the Savannah River; therefore, DHEC will continue to monitor these off-site public water systems in the event these wells are affected by contaminated groundwater from SRS.

The DHEC Drinking Water Monitoring Project continues to be an important source of essential data for assessing human health exposure pathways. DHEC will continue to monitor drinking water quality due to the potential of elevated radionuclide concentrations in surface water on SRS and its potential to migrate, and potentially affect, drinking water systems downstream from SRS. Continued sampling will also provide the public with an independent source of radiological data for drinking water systems within the SRS study area.

DHEC continues to reevaluate the drinking water systems monitored by the drinking water project. Primary and background drinking water systems will be added and removed from the list of sampled drinking water systems as deemed necessary to maintain monitoring coverage.

3.4.0 MAP

Drinking Water Monitoring Locations



2023 ESOP Drinking Water Monitoring www.scdhec.gov

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3.5.0 TABLES AND FIGURES

Table 1. 2023 DHEC Drinking Water System Monitoring Locations

System Number	System Name	Number of Taps	Population
210001	Aiken	20,292	45,090
220006	Breezy Hill Water District	8,378	20,526
0210003F	North Augusta	13,659	33,185
0720004F	Chelsea B/J	61,769	196,061
0720003F	Purrysburg B/J	96	280
	Total		
	Savannah River-fed systems downstream from SRS	61,865	196,341
	Systems not fed from the Savannah River downstream of SRS	41,367	93,022

Data was obtained from DHEC's Environmental Facility Information System database.

Note for Tables 2-6: Summary statistics are not shown for locations whose analytes had either no detections or only one detection. If a location did have multiple detections for a specific analyte, the summary statistics are written as a note below its table. AE is Analytical Error and ND is No Detect.

Table 2: 2023 DHEC and DOE-SR Drinking Water Data for North Augusta (DW0210003F) in pCi/L (SRNS, 2024)

Month	DHEC Total Alpha	DHEC Nonvolatile Beta	DHEC Tritium	DOE-SR Total Alpha	DOE-SR Nonvolatile Beta	DOE-SR Tritium
JAN	ND	ND	ND	ND	2.20	ND
FEB	ND	ND	ND	ND	1.12	ND
MAR	ND	ND	ND	ND	1.66	ND
APR	ND	ND	ND	ND	1.79	ND
MAY	ND	ND	ND	ND	1.71	ND
JUN	ND	ND	ND	ND	1.48	ND
JUL	ND	ND	ND	ND	1.58	193
AUG	AE	AE	275	ND	2.76	ND
SEP	ND	ND	ND	ND	1.71	ND
OCT	ND	ND	ND	ND	1.63	ND
NOV	ND	ND	ND	ND	1.96	ND
DEC	ND	ND	ND	ND	1.82	ND

Note: 1) In pCi/L, DOE-SR Nonvolatile Beta summary statistics: Average = 1.79, Standard Deviation = 0.40, Median = 1.71, Minimum = 1.12, Maximum = 2.76, Number of Detections = 12, Number of Samples = 12.

3.5.0 TABLES AND FIGURES

Table 3: 2023 DHEC and DOE-SR Drinking Water Data for Purrysburg B/J Water Treatment Plant (DW0720004F) in pCi/L (SRNS, 2024)

Month	DHEC Total Alpha	DHEC Nonvolatile Beta	DHEC Tritium	DOE-SR Total Alpha	DOE-SR Nonvolatile Beta	DOE-SR Tritium
JAN	ND	ND	366	ND	1.07	337
FEB	ND	ND	ND	ND	1.47	289
MAR	ND	ND	465	ND	1.20	505
APR	ND	ND	ND	ND	1.17	275
MAY	ND	ND	346	ND	1.76	296
JUN	ND	ND	283	ND	1.87	284
JUL	ND	ND	374	ND	1.12	330
AUG	AE	AE	536	ND	1.34	539
SEP	ND	ND	644	ND	1.67	547
OCT	ND	ND	431	ND	1.83	456
NOV	ND	ND	473	ND	2.04	341
DEC	ND	ND	568	ND	2.10	296

Note: 1). In pCi/L, DHEC Tritium summary statistics: Average = 448.62, Standard Deviation = 111.34, Median = 447.88, Minimum = 283.00, Maximum = 644.00, Number of Detections = 10, Number of Samples = 12.
2). In pCi/L, DOE-SR Nonvolatile Beta summary statistics: Average = 1.55, Standard Deviation = 0.37, Median = 1.57, Minimum = 1.07, Maximum = 2.10, Number of Detections = 12, Number of Samples = 12.
3). In pCi/L, DOE-SR Tritium summary statistics: Average = 374.58, Standard Deviation = 105.62, Median = 333.50, Minimum = 275.00, Maximum = 547.00, Number of Detections = 12, Number of Samples = 12.

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3.5.0 TABLES AND FIGURES

Table 4: 2023 DHEC Drinking Water Data for Chelsea B/J Water Treatment Plant (DW0720003F) in pCi/L

Month	Total Alpha	Nonvolatile Beta	Tritium
JAN	ND	ND	ND
FEB	ND	ND	ND
MAR	ND	ND	346
APR	ND	ND	278
MAY	ND	ND	ND
JUN	ND	ND	363
JUL	ND	ND	351
AUG	AE	AE	616
SEP	ND	ND	428
OCT	ND	ND	555
NOV	ND	ND	456
DEC	ND	ND	352

Note: 1) In pCi/L, DHEC Tritium summary statistics: Average = 416.14, Standard Deviation = 109.63, Median = 363.00, Minimum = 278.00, Maximum = 615.73, Number of Detections = 9, Number of Samples = 12.

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3.5.0 TABLES AND FIGURES

Table 5: 2023 DHEC Drinking Water Data for Aiken Public Shaw Creek Water Works Treatment Plant (DW210001) in pCi/L

Month	Total Alpha	Nonvolatile Beta	Tritium
JAN	2.17	ND	ND
FEB	ND	ND	ND
MAR	ND	ND	ND
APR	3.09	ND	ND
MAY	ND	ND	ND
JUN	ND	ND	ND
JUL	ND	ND	ND
AUG	AE	AE	ND
SEP	ND	ND	ND
OCT	2.04	ND	ND
NOV	4.75	ND	ND
DEC	3.87	ND	ND

Note: 1). In pCi/L, DHEC Total Alpha summary statistics: Average = 3.28, Standard Deviation = 1.05, Median = 3.42, Minimum = 2.04, Maximum = 4.75, Number of Detections = 6, Number of Samples = 12.

Table 6: 2023 DHEC Drinking Water Data for Breezy Hill Water Treatment Plant (DW220006) in pCi/L

Month	Total Alpha	Nonvolatile Beta	Tritium
JAN	ND	ND	ND
FEB	ND	ND	ND
MAR	ND	ND	ND
APR	ND	ND	ND
MAY	ND	ND	ND
JUN	ND	ND	ND
JUL	ND	ND	ND
AUG	AE	AE	270
SEP	ND	ND	ND
OCT	1.31	ND	ND
NOV	ND	ND	ND
DEC	ND	ND	ND

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Chapter 4 Radiological Monitoring of Surface Water on and Adjacent to SRS

4.1.0 PROJECT SUMMARY

The focus of the Radiological Monitoring of Surface Water (RSW) Project is to surveil the streams and creeks on SRS as well as the Savannah River. Since the Savannah River is the primary drinking water source for some downstream communities, it is important to monitor radionuclide concentrations in the river. Surface water samples are collected and analyzed for radionuclides, and the results are compared to DOE-SR data. DHEC supports DOE-SR's objectives to ensure that the primary goal of drinking water safety is established and met.

Collecting a composite sample

DHEC collects surface water samples from 12 specific locations within and outside of the SRS boundary as part of an ambient sampling network along with 4 supplemental locations that are monitored separately to determine their potential to be added to the ambient sampling network based on SRS activities (Section 4.4.0, Map). Section 4.5.0, Table 1, identifies sample ID, location, rationale, and frequency. Some locations were chosen because they are considered public access locations. All but one of the public access locations are downstream of SRS, which provide a potential means for exposure to radionuclides. Jackson Boat Landing (SV-2010) is upstream from SRS activities and is a public access location.

Monthly samples are collected for tritium analysis from the 4 creek mouths that flow from SRS directly into the Savannah River (Upper Three Runs Creek, SV-2011; Fourmile Branch, SV-2015; Steel Creek, SV-2017; and Lower Three Runs Creek, SV-2020). Prior to 2023, creek mouth tritium samples were collected quarterly. Pen Branch is not sampled because the Savannah River Swamp interrupts the flow of this creek and there is no creek mouth access.

Example of a Grab Sample

An enhanced surface water monitoring component was implemented to provide downstream drinking water systems with advance notice of the potential for increased tritium levels in the Savannah River. This early detection facet is possible because of the continuous monitoring of the five SRS streams that flow to the Savannah River. Samples for tritium analysis are collected from six locations with automatic water samplers. Additionally, a grab sample is collected from Johnson's Boat Landing (SV-2080) and U.S. Highway 301 at the Savannah River (SV-118). The results for these samples are considered nonreportable results for this report.

In 2019, the Supplemental Surface Water Monitoring Program was modified from serving as an early detection system for unplanned releases from SRS operations areas to a monthly composite. In 2023, the Supplemental Surface Water Monitoring Program was modified to determine the need for

routine sampling at select locations based on ongoing SRS activity. In 2023, locations along Upper Three Runs (SV-2075), Fourmile Branch (SV-2044), and Steel Creek (SV-2052) were transitioned from Supplemental Monitoring locations to Ambient Monitoring locations. Locations along Mill Creek (SV-2032), Beaver Dam Creek (SV-2040), Steel Creek (SV-2064), and Mary's Branch (SV-2081) were added as Supplemental Monitoring locations. SV-2040 (tritium only), SV-2064, and SV-2081 are collocated and compared with DOE-SR.

Quarterly sampling for I-129 and Tc-99 is conducted at the SV-2044 ambient location due to concerns that these are possible constituents related to effluent from the burial grounds, which could enter the surface water.

4.2.0 RESULTS AND DISCUSSION

Radiological Monitoring of Surface Water Summary Statistics can be found in Section 4.6.0 and all Radiological Monitoring of Surface Water Data can be found in the 2023 DHEC Data File. The data presented in this section concerns the DHEC ambient sampling network including the Savannah River and on-site streams. The enhanced surface water monitoring program data is not displayed in the annual report and data file due to its sole purpose of serving as an early detection system for downstream drinking water users.

DHEC data from 2023 was compared to DOE-SR reported results (Section 4.6.0, Summary Statistics). The DHEC and DOE-SR collocated ambient sampling locations were Tims Branch at SRS Road C (SV-324), Upper Three Runs Creek at S.C. 125/SRS Road A (SV-325), Fourmile Branch at SRS Road A-12.2 (SV-2039), Pen Branch at SRS Road A-13.2 (SV-2047), Steel Creek at S.C. 125/SRS Road A (SV-327), Savannah River at U.S. Highway 301 Bridge (SV-118), and Lower Three Runs Creek at SRS Road B (SV-2053). DHEC and DOE-SR also have one collocated creek mouth sampling location at Steel Creek (SV-2017). DOE-SR sampled at several other locations along the Savannah River and on-site streams. However, the data comparisons are only for the collocated sampling locations.

Collecting composite and grab samples.

Tritium

In 2023, DHEC and DOE-SR detected tritium at all collocated sample locations with the exception of SV-2053 where DOE-SR did not have any detections (Section 4.6.0, Summary Statistics). DHEC average tritium activities at SV-2010 are not directly affected by SRS operations. This location is upstream from SRS impacts and is considered a background location. Samples were not collected in 2023 at Upper Three Runs Creek at United States Forestry Service (USFS) Road 2-1 (SV-2027) due to safety concerns. DHEC and DOE-SR samples indicate that SV-2039 had the highest average tritium activity of all SRS streams in the ambient sampling network with an average of 15,416 pCi/L for DHEC and 13,777 pCi/L for DOE-SR (SRNS, 2024). For

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supplemental locations, SV-2064 had the highest average tritium activity for both DHEC and DOE-SR with an average of 25,658 pCi/L for DHEC and 22,275 pCi/L for DOE-SR. The 2023 DHEC and DOE-SR tritium results appear to be consistent with historically reported data values (Section 4.5.0, Figures 2-9). Section 4.5.0, Figure 1 shows trending data for DHEC tritium averages for the past five years. Tritium activity in the Savannah River at the creek mouths of the four SRS streams are monitored monthly. Samples collected at SV-2015 had the highest average tritium activity of 9,555 pCi/L of all DHEC creek mouth locations. The average tritium activity at SV-2017 for DHEC was 1,129 pCi/L while DOE-SR detected an average of 410 pCi/L. Variations in results may be attributed to DHEC and DOE-SR collecting creek mouth tritium samples at varying times. Section 4.5.0, Figure 9 shows comparisons between DHEC and DOE-SR tritium averages for SV-2017 from the last five years.

Collecting grab samples during a boat run

Gamma

As part of a gamma spectroscopy analysis, samples were analyzed monthly for gamma-emitting radionuclides (List of Analytes, Table 1, page ix). Cesium-137 was the only gamma-emitting radionuclide that DHEC and DOE-SR shared in analytical results. DHEC had detections of Cs-137 at SV-2044 with an average of 5.86 pCi/L and SV-2064 with an average of 4.89 pCi/L while DOE-SR only had detects at SV-2044 with an average of 11.25 pCi/L. DHEC also had detects of Pb-212 and Pb-214, which are considered NORM decay products.

Iodine-129 and Technetium-99

SV-2044 is a collocated sampling location between DHEC and DOE-SR for I-129 and Tc-99. DHEC collects I-129 and Tc-99 samples on a quarterly basis while DOE-SR collects samples monthly. DHEC detected 1 quarterly I-129 sample above the MDA (single detect of 0.64 pCi/L) while DOE-SR detected 1 monthly I-129 sample above the MDA (single detect of 1.49 pCi/L). DOE-SR had 2 monthly detects of Tc-99 with an average of 3.64 pCi/L while DHEC did not have any quarterly detects of Tc-99.

I-129 and Tc-99 are included under the EPA established MCL of 4 millirem per year. The average concentration of I-129, which is assumed to yield 4 millirem per year, is 1 pCi/L. If other radionuclides emitting beta particles and photon radioactivity are present in addition to I-129 and Tc-99, the sum of the annual dose from all the radionuclides shall not exceed 4 millirem/year (EPA, 2020).

Preparing for tritium analysis in a Liquid Scintillation Counter

Alpha

Samples collected from SV-325 for both DHEC and DOE-SR exhibited the highest alpha activity of the collocated ambient sampling locations with an average of 4.66 pCi/L for DHEC and 16.40 pCi/L for DOE-SR (Section 4.6.0, Summary Statistics; SRNS, 2024). The location that exhibited the highest alpha activity from collocated supplemental locations for DHEC was SV-2064 with an average of 6.19 pCi/L. SV-2064 also had the highest alpha activity for all DHEC supplemental locations. DOE-SR's highest alpha activity from supplemental collocations was SV-2081 with an average of 19.06 pCi/L. Historically, SV-325 yields detections for alpha activity (DHEC, 2020b-2023). Isotopic analysis performed by DOE-SR revealed the source to be natural uranium (SRNS, 2013). This may contribute to the common occurrence of alpha detections at this location. The 2023 average alpha activity was below the EPA MCL for drinking water of 15 pCi/L (EPA, 2020) at all locations except for DOE-SR's average alpha activity at SV-325 and SV-2081. Beginning in 2009, samples collected at SV-325 exhibited particles of sediment and detritus. This increase in turbidity seems to be related to storm events. Samples with high turbidity can have potential interferences during alpha/beta analysis. Alpha particles, and to a lesser extent, beta particles, are reduced by salts and solids dried onto a sampling planchet (Floeckher, 2000). Pump tubing is evaluated during each sample collection at all locations to ensure no blockage of sediment has occurred.

Beta

The location exhibiting the highest average gross beta activity for ambient sampling locations for DHEC was SV-2039 with an average of 6.33 pCi/L while the highest average gross beta activity for DOE-SR ambient locations was from SV-325 with an average of 8.76 pCi/L (SRNS, 2024). SV-2064 had the highest gross beta activity for supplemental sampling locations for DHEC with an average of 5.53 pCi/L while the highest average gross beta activity for DOE-SR was from SV-2081 with an average of 7.58 pCi/L. The location with the highest gross beta activity for all DHEC supplemental locations was SV- 2032 with an average of 6.52 pCi/L. EPA has established a Maximum Contaminant Level (MCL) of 4 millirem per year for beta particle and photon radioactivity from man-made radionuclides in drinking water (EPA, 2020). The EPA screening

Pipetting samples in preparation for tritium analysis

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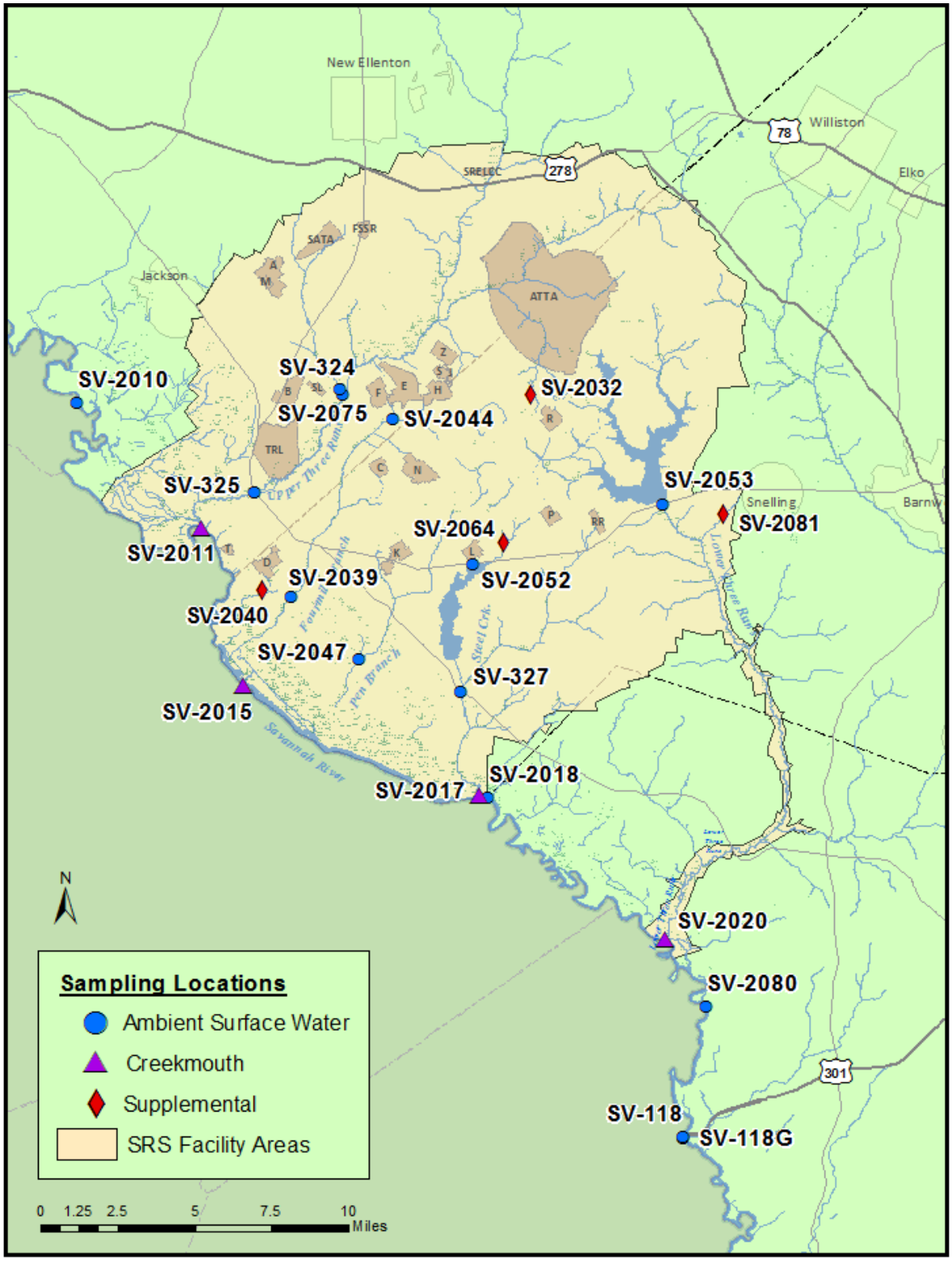
MCL for gross beta-emitting particles for drinking water systems is 50 pCi/L minus natural potassium-40 (K-40). All averages were below this limit.

4.3.0 CONCLUSIONS AND RECOMMENDATIONS

Differences in average values between DHEC and DOE-SR could be attributed, in part, to the nature of the medium and the specific point and time of when the sample was collected. DHEC will continue independent collection and analysis of surface water on and adjacent to SRS. This monitoring effort will provide an improved understanding of radionuclide levels in SRS surface waters. DHEC will periodically evaluate modifying the monitoring activities to better accomplish the project's goals and objectives. Further refinement of the RSW project may result in additional sampling locations being incorporated into the ambient or enhanced monitoring regimes. Monitoring will continue for as long as there are activities at SRS that create the potential for contamination to enter the environment, as well as past radioactive contamination that still exists due to unexpired half-lives.

4.4.0 MAP

Radiological Surface Water Monitoring Locations



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4.5.0 TABLES AND FIGURES

Table 1. 2023 DHEC Surface Water Monitoring Locations and Frequency

Ambient Monitoring Locations

ID	Location	Rationale	Frequency
SV-2010	Savannah River at RM 170.5 (Jackson Boat Landing)	Accessible to public; upstream all SRS operations; Near Jackson population center; Up-river control; River monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-324*	Tims Branch at SRS Road C	Within SRS perimeter; Downstream of SRS operations areas; Tributary monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-325*	Upper Three Runs Creek at S.C. 125/SRS Road A	Within SRS perimeter; Downstream of SRS operations areas; Tributary monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-2039*	Fourmile Branch at SRS Road A-12.2	Within SRS perimeter; Downstream of SRS operations areas; Tributary monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-2047*	Pen Branch at SRS Road A-13.2	Within SRS perimeter; Downstream of SRS operations areas; Tributary monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-327*	Steel Creek at S.C. 125/SRS Road A	Within SRS perimeter; Downstream of SRS operations areas; Tributary monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-2018	Savannah River at RM 141 (Steel Creek Boat Landing)	Accessible to the public; Adjacent to SRS perimeter; Downstream of SRS operations; River monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-2080	Savannah River at RM 125 (Johnson's Boat Landing)	Accessible to the public; Downstream of SRS operations and tributaries; River monitoring	Tri-weekly tritium grab
SV-118*	Savannah River at RM 118.8 (Hwy 301 Bridge)	Accessible to the public; Downstream of SRS operations and tributaries; River monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-328*	Lower Three Runs Creek at Patterson Mill Road	Within SRS perimeter; Downstream of SRS operations and Par Pond; Tributary monitoring	Weekly tritium grab
SV-2053*	Lower Three Runs Creek at SRS Road B	Within SRS perimeter; Downstream of SRS operations and Par Pond; Tributary monitoring	Weekly tritium; Monthly Alpha, Beta, and Gamma composite
SV-2027*	Upper Three Runs Creek at SRS Road 2-1	Within SRS perimeter; Upstream from SRS operations; Upstream control; Tributary monitoring	Weekly tritium grab
SV-2075*	Upper Three Runs Creek at SRS Road C	Downstream from F-and H-Areas HLW Tanks	Monthly gamma composite

SV-2044*	Fourmile Branch at SRS Road C	Downstream from F-and H-Areas HLW I Tanks	Monthly gamma composite
SV-2052	Steel Creek at the top of L-Lake	Downstream from P- and L- Areas	Weekly tritium, Monthly gamma composite

Creek Mouth Monitoring Locations

ID	Location	Rationale	Frequency
SV-2011	Upper Three Runs Creek at RM 157.4	Accessible to public; Adjacent to SRS; Downstream of SRS operation areas; Tributary monitoring	Monthly tritium
SV-2015	Fourmile Branch at RM 150.6	Accessible to public; Adjacent to SRS; Downstream of SRS operation areas; Tributary monitoring	Monthly tritium
SV-2017*	Steel Creek at RM 141.5	Accessible to public; Adjacent to SRS; Downstream of SRS operation areas; Tributary monitoring	Monthly tritium
SV-2020	Lower Three Runs Creek at RM 129.1	Accessible to public; Adjacent to SRS; Downstream of SRS operation areas; Tributary monitoring	Monthly tritium

Supplemental Monitoring Locations

ID	Location	Rationale	Frequency
SV-2032	Mill Creek at Woodward Road, SRS Road E - ATTA	Downstream of past operations R area	Monthly Tritium, Alpha, Beta, and Gamma composite
SV-2040*	Beaver Dam Creek	Downstream of past operations in D Area	Monthly Tritium, Alpha, Beta, and Gamma composite
SV-2064*	Steel Creek off SRS Road C	Downstream of past operations in P area	Monthly Tritium, Alpha, Beta, and Gamma composite
SV-2081*	Mary's Branch near Barnwell Barricade, SRS Road B	Tributary monitoring related to potential impacts from adjacent offsite facility	Monthly Tritium, Alpha, Beta, and Gamma composite

Notes:
1). ID is Sampling Location Identification Code Number
2). RM is River Mile
3). HLW is High-Level Waste
4). LLW is Low-Level Waste
5). Tri-Weekly Enhanced sample data is used for detection purposes only.
6). * Indicates a location that is collocated with DOE-SR sampling
7). SV-2027 and SV-328 were not sampled in 2023 due to safety concerns at the sampling location.

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4.5.0 TABLES AND FIGURES

Figure 1. DHEC Average Tritium Data Trends for 2019-2023 Ambient Locations (DHEC, 2020b-2023)

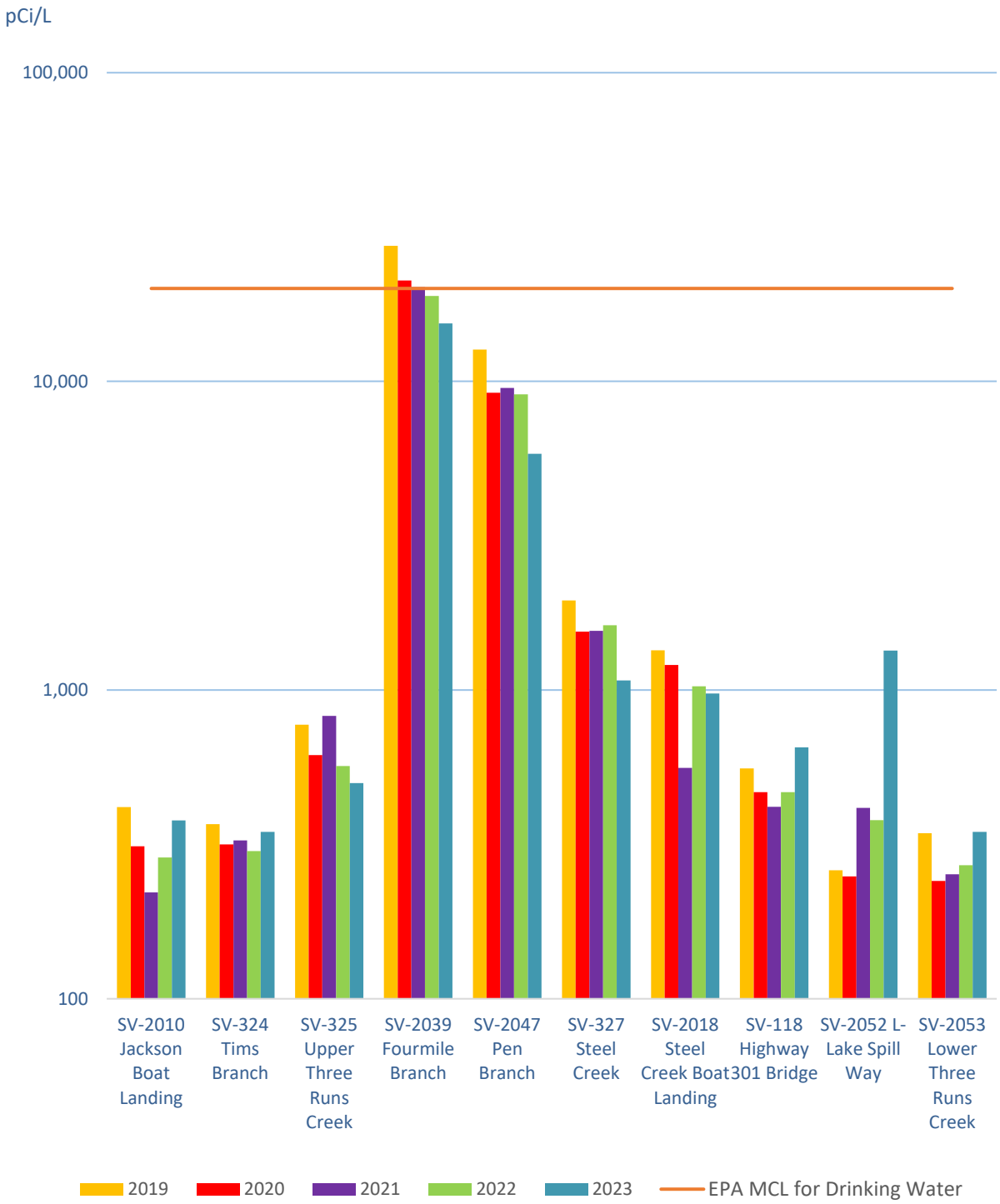

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Figure 2. 2019-2023 Average Tritium Data Trends for DHEC and DOE-SR for Tims Branch at SRS Road C (SV-324 – Ambient Location) (SRNS, 2020-2024; DHEC, 2020b-2023)

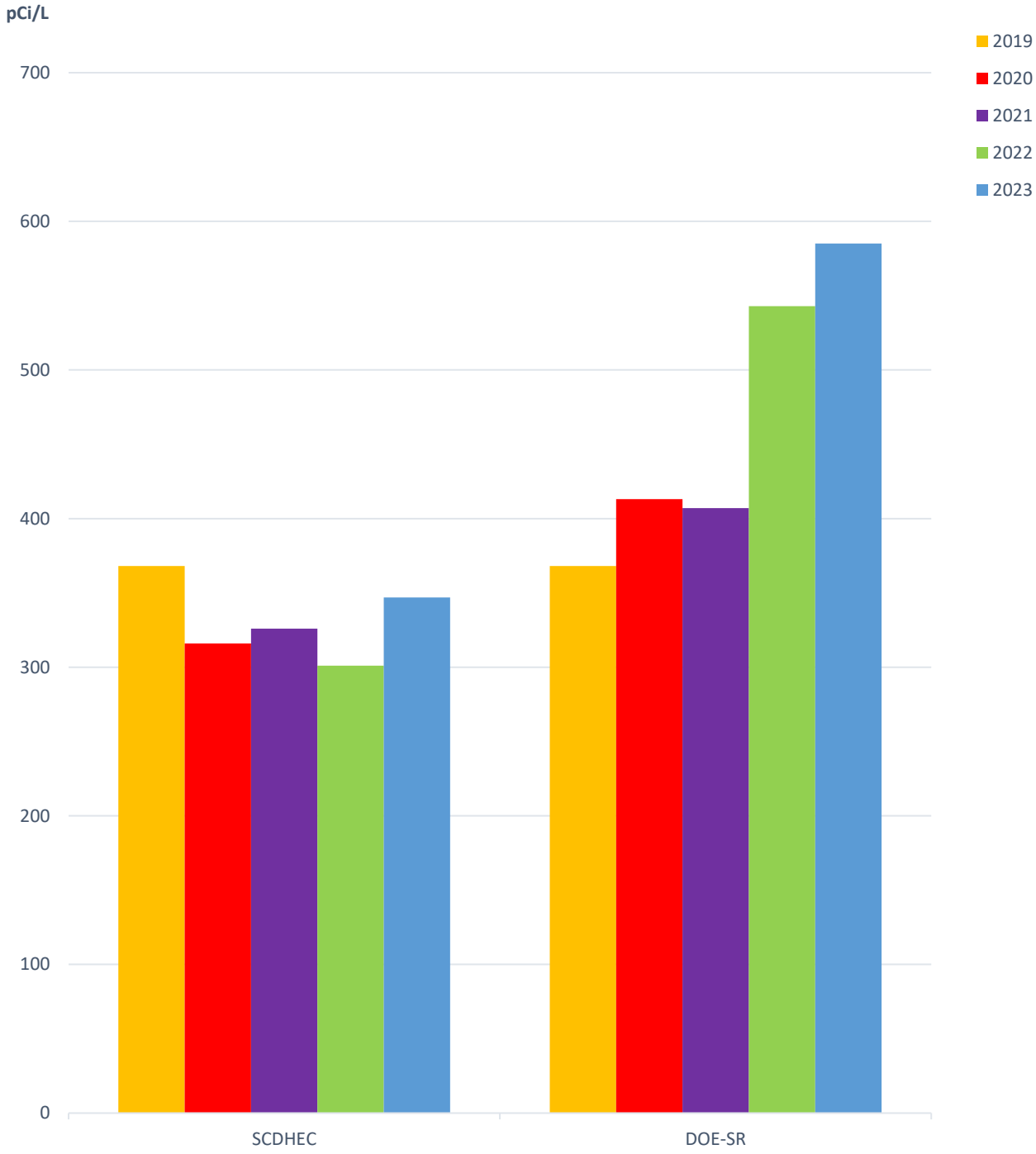

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Figure 3. 2019-2023 Average Tritium Data Trends for DHEC and DOE-SR for Upper Three Runs Creek at S.C. 125/SRS Road A (SV-325 – Ambient Location) (SRNS, 2020-2024; DHEC, 2020b-2023)

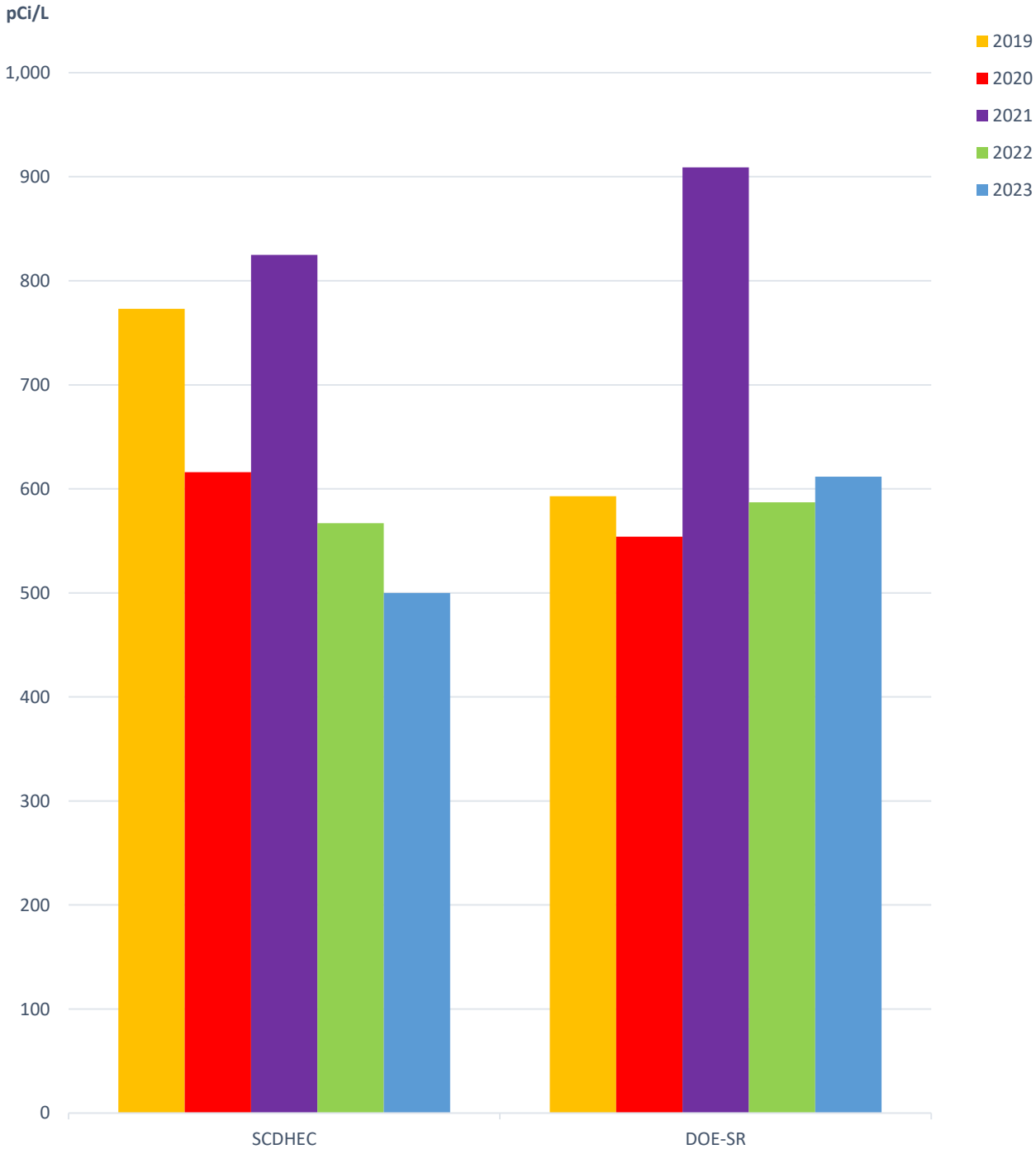

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Figure 4. 2019-2023 Average Tritium Data Trends for DHEC and DOE-SR for Fourmile Branch at SRS Road A-12.2 (SV-2039 – Ambient Location) (SRNS, 2020-2024; DHEC, 2020b-2023)

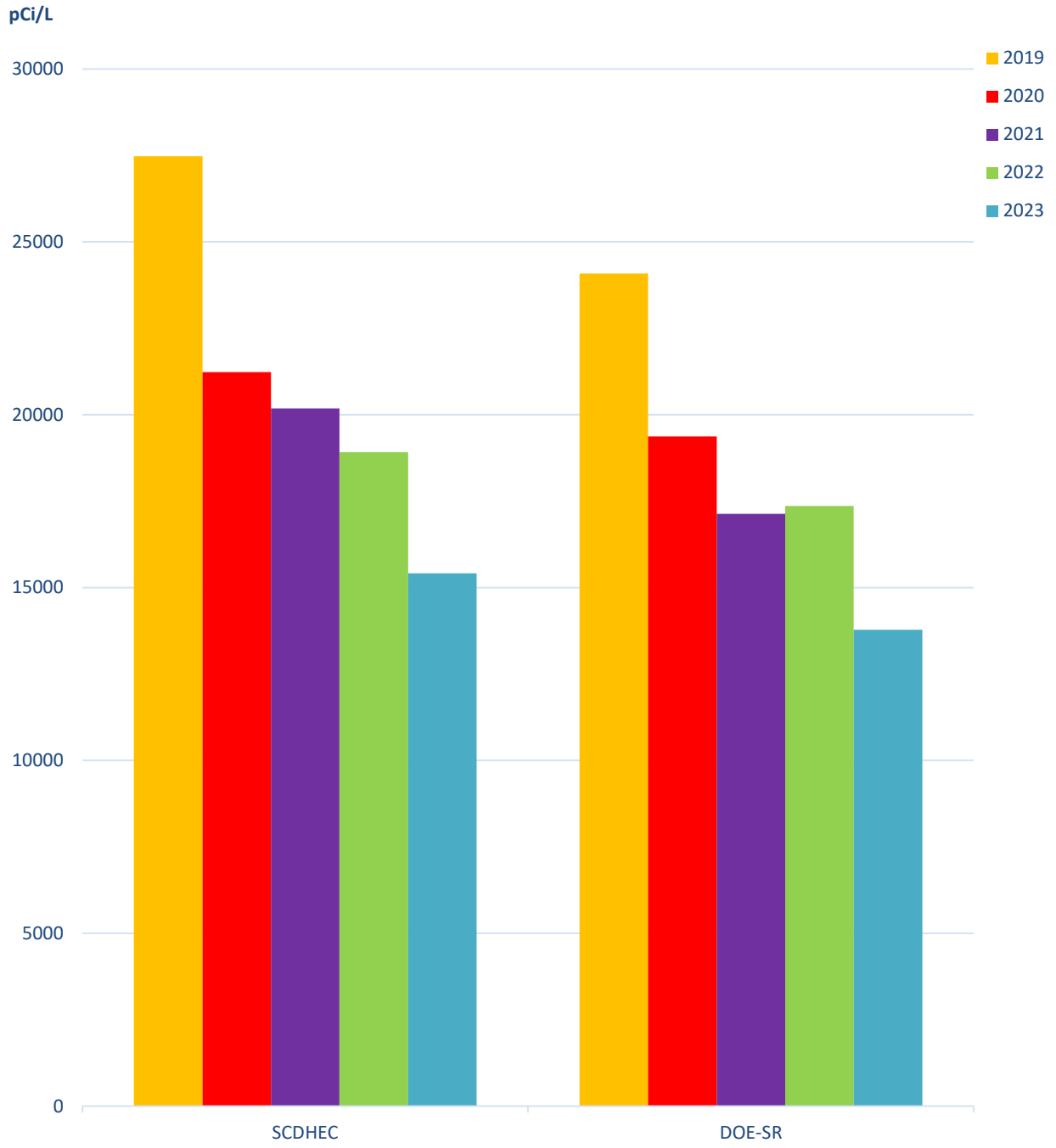

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Figure 5. 2019-2023 Average Tritium Data Trends for DHEC and DOE-SR for Pen Branch at SRS Road A-13.2 (SV-2047 – Ambient Location) (SRNS, 2020-2024; DHEC, 2020b-2023)

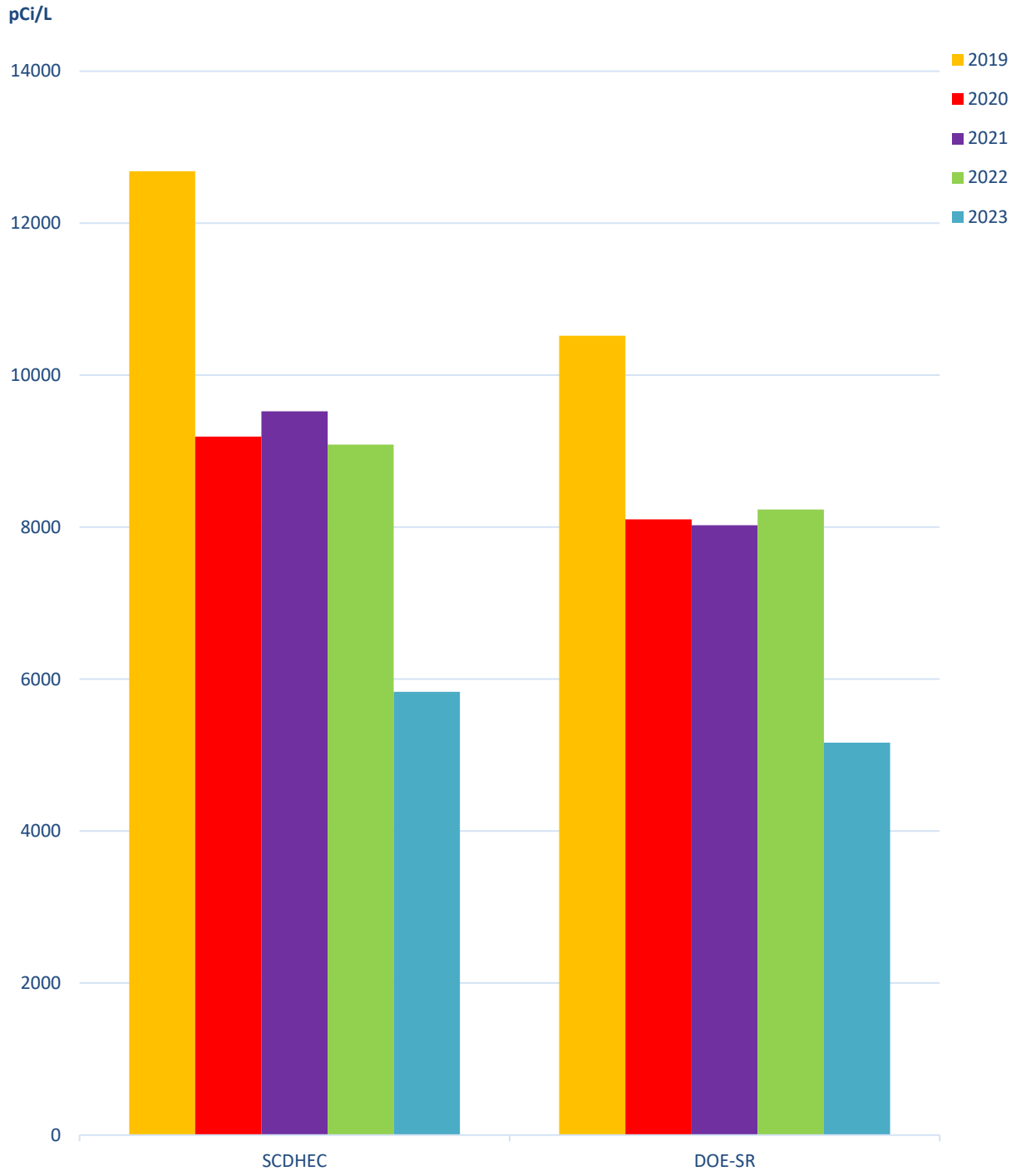

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Figure 6. 2019-2023 Average Tritium Data Trends for DHEC and DOE-SR for Steel Creek at S.C. 125/SRS Road A (SV-327 – Ambient Location) (SRNS, 2020-2024; DHEC, 2020b-2023)

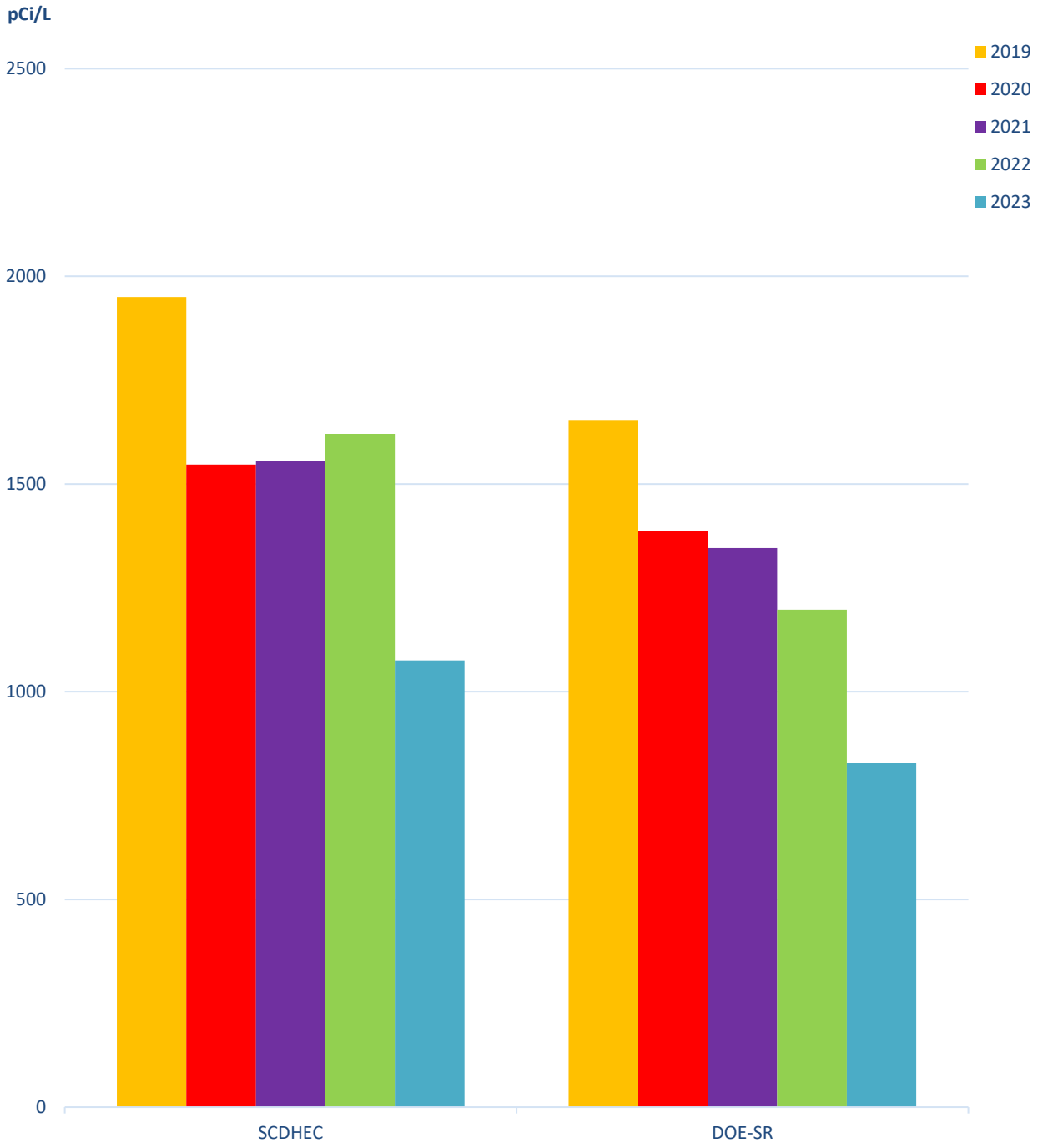

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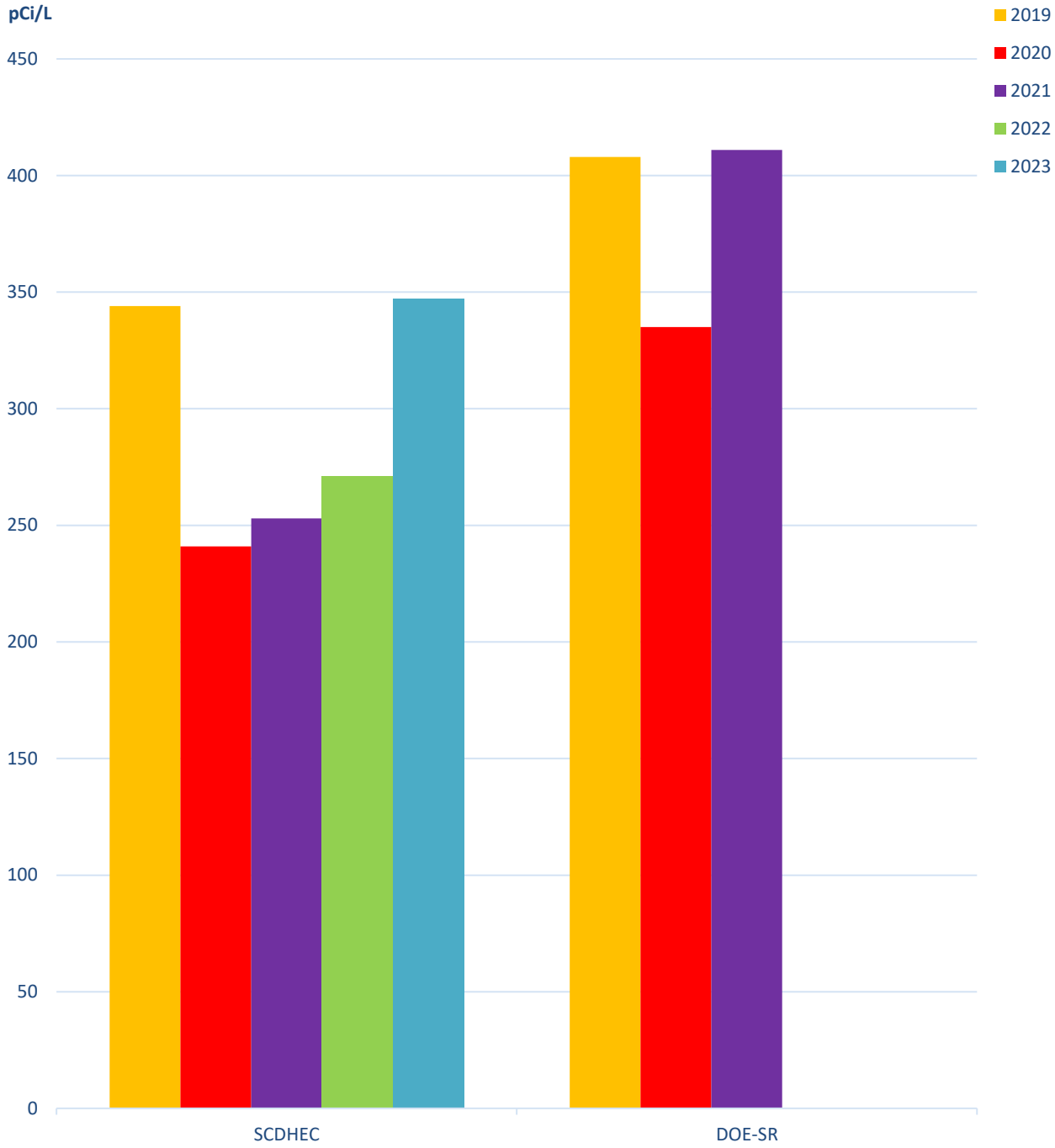
Figure 7. 2019-2023 Average Tritium Data Trends for DHEC and DOE-SR for Lower Three Runs Creek at SRS Road B (SV-2053 – Ambient Location) (SRNS, 2020-2024; DHEC, 2020b-2023)



In 2020, DOE-SR's data is not an average due to there only being one detection during the year with a reading of 335 pCi/L**.**
In 2022 & 2023, DOE-SR had no detections of tritium at Lower Three Runs Creek at SRS Road B (SV-2053).

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Figure 8. 2019-2023 Average Tritium Data Trends for DHEC and DOE-SR for the Savannah River at US Highway 301 Bridge (SV-118 – Ambient Location) (SRNS, 2020-2024; DHEC, 2020b-2023)

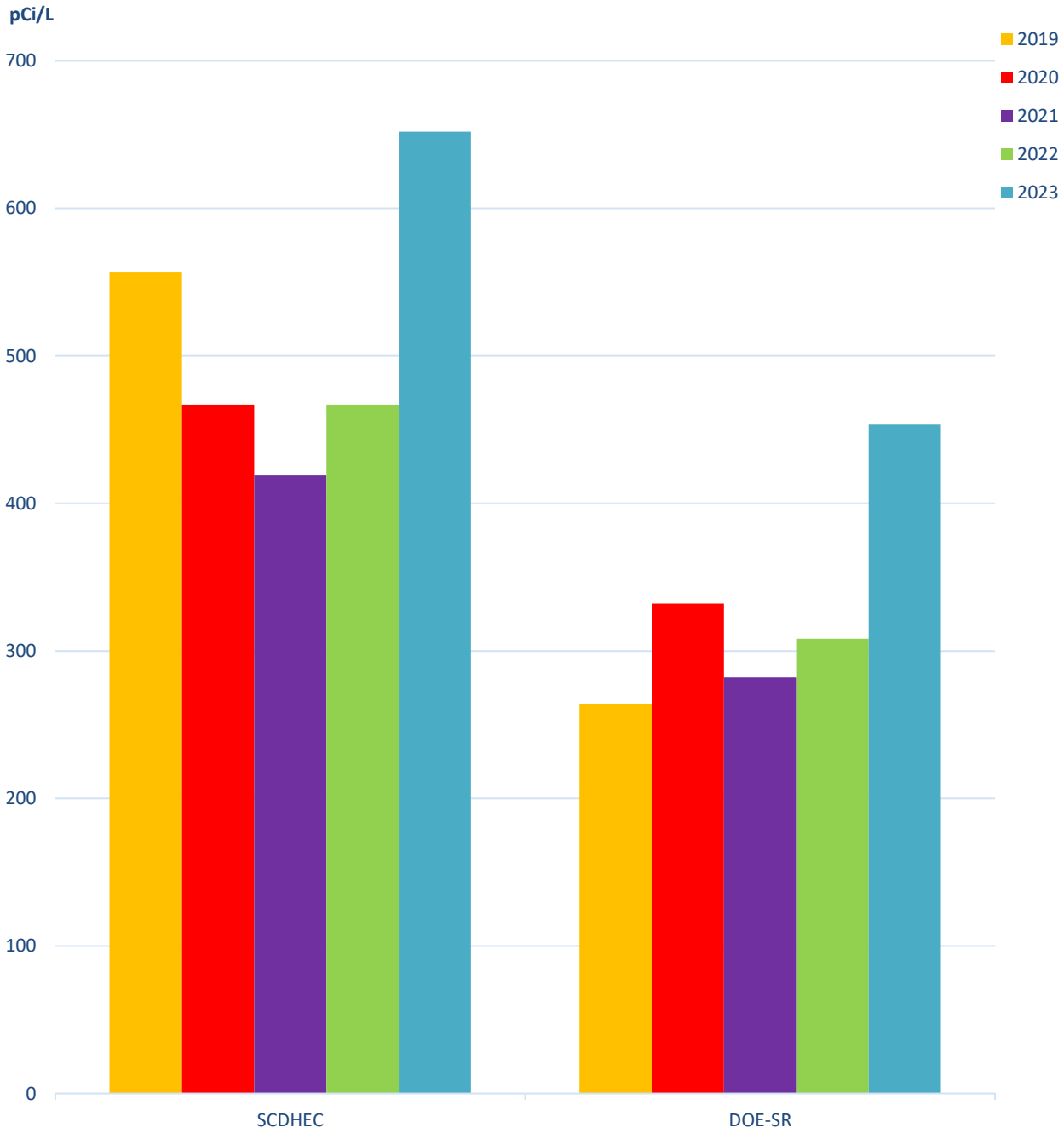

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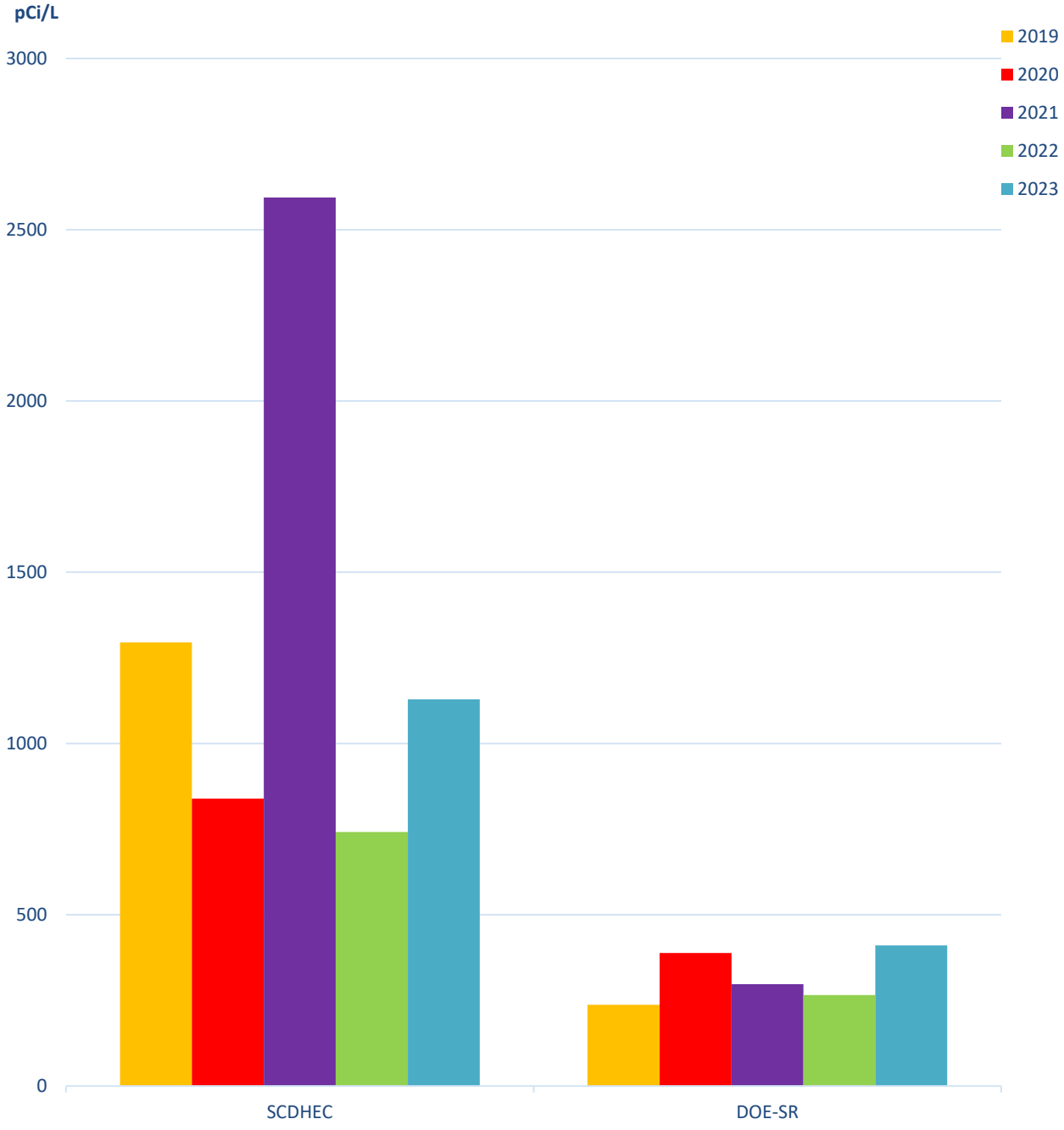
Figure 9. 2019-2023 Average Tritium Data Trends for DHEC and DOE-SR for Steel Creek Mouth at RM 141.5 (SV-2017 – Creek Mouth Location) (SRNS, 2020-2024; DHEC, 2020b-2023)



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4.6.0 SUMMARY STATISTICS

2023 Tritium Data Comparison for DHEC and DOE-SR Collocated Ambient & Creek Mouth Sampling Locations (SRNS, 2024)

Sample Location	Sample ID	Average Concentration (pCi/L)	Standard Deviation (pCi/L)	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detects	Number of Samples
Tims Branch at SRS Road C	SV-324	347	84	310	271	556	11	53
	TB-5	585	NA	585	585	585	1	12
Upper Three Runs Creek at S.C. 125/ SRS Road A	SV-325	500	151	475	291	1032	50	53
	U3R-4	612	49	597	572	666	3	13
Fourmile Branch at SRS Road A-12.2	SV-2039	15416	2628	15454	7864	20011	53	53
	FM-6	13777	1656	13900	10300	17100	13	13
Pen Branch at SRS Road A-13.2	SV-2047	5832	1709	5839	2770	9847	53	53
	PB-3	5163	1010	5070	3690	7280	13	13
Steel Creek at S.C. 125/SRS Road A	SV-327	1075	546	1077	342	4288	53	53
	SC-4	828	250	831	512	1380	13	13
Highway 301 Bridge at RM 118.8	SV-118	652	407	519	288	2527	37	53
	RM-118	453	217	426	175	1060	39	52
Lower Three Runs Creek at SRS Road B	SV-2053	347	63	339	279	430	4	53
	L3R-1A	ND	ND	ND	ND	ND	0	12
Steel Creek at RM 141.5	SV-2017	1129	570	1301	291	1844	10	10
	RM-141.5	410	462	285	24	3190	50	52

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
ND is Not Detected
NA is Not Applicable

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4.6.0 SUMMARY STATISTICS

2023 Alpha Data Comparison for DHEC and DOE-SR Collocated Ambient Sampling Locations (SRNS, 2024)

Sample Location	Sample ID	Average Concentration (pCi/L)	Standard Deviation (pCi/L)	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detects	Number of Samples
Tims Branch at SRS Road C	SV-324	2.57	0.65	2.64	1.64	3.34	6	12
	TB-5	3.37	1.16	3.32	1.67	5.20	12	12
Upper Three Runs Creek at S.C. 125/SRS Road A	SV-325	4.66	2.42	4.34	1.67	8.58	11	12
	U3R-4	16.40	11.48	11.49	4.80	45.00	12	12
Fourmile Branch at SRS Road A-12.2	SV-2039	ND	ND	ND	ND	ND	0	12
	FM-6	1.18	0.55	1.28	0.42	1.95	11	12
Pen Branch at SRS Road A-13.2	SV-2047	ND	ND	ND	ND	ND	0	11
	PB-3	1.21	1.30	0.59	0.36	4.40	9	12
Steel Creek at S.C. 125/ SRS Road A	SV-327	ND	ND	ND	ND	ND	0	12
	SC-4	2.93	4.18	0.96	0.31	11.50	11	12
Highway 301 Bridge at RM 118.8	SV-118	ND	ND	ND	ND	ND	0	11
	RM 118	0.44	0.14	0.40	0.29	0.75	13	52
Lower Three Runs Creek at SRS Road B	SV-2053	ND	ND	ND	ND	ND	0	11
	L3R-1A	1.40	1.82	0.59	0.38	4.62	5	12

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
ND is Not Detected

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4.6.0 SUMMARY STATISTICS

2023 Beta Data Comparison for DHEC and DOE-SR Collocated Ambient Sampling Locations (SRNS, 2024)

Sample Location	Sample ID	Average Concentration (pCi/L)	Standard Deviation (pCi/L)	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detects	Number of Samples
Tims Branch at SRS Road C	SV-324	4.42	NA	4.42	4.42	4.42	1	12
	TB-5	1.98	0.53	1.84	1.27	3.10	12	12
Upper Three Runs Creek at S.C. 125/SRS Road A	SV-325	5.71	NA	5.71	5.71	5.71	1	12
	U3R-4	8.76	6.48	5.89	2.82	25.10	12	12
Fourmile Branch at SRS Road A-12.2	SV-2039	6.33	NA	6.33	6.33	6.33	1	12
	FM-6	4.33	0.67	4.09	3.48	5.34	12	12
Pen Branch at SRS Road A-13.2	SV-2047	ND	ND	ND	ND	ND	0	11
	PB-3	1.31	0.87	0.95	0.66	3.63	12	12
Steel Creek at S.C. 125/ SRS Road A	SV-327	ND	ND	ND	ND	ND	0	12
	SC-4	2.77	2.80	1.64	0.65	9.25	12	12
Highway 301 Bridge at RM 118.8	SV-118	ND	ND	ND	ND	ND	0	11
	RM 118	2.16	0.33	2.15	1.40	3.05	52	52
Lower Three Runs Creek at SRS Road B	SV-2053	ND	ND	ND	ND	ND	0	11
	L3R-1A	1.09	0.49	1.04	0.62	2.36	12	12

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
ND is Not Detected
NA is Not Applicable

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4.6.0 SUMMARY STATISTICS

2023 Tritium Data Comparison for DHEC and DOE-SR Collocated Supplemental Sampling Locations (SRNS, 2024)

Sample Location	Sample ID	Average Concentration (pCi/L)	Standard Deviation (pCi/L)	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detects	Number of Samples
Beaver Dam Creek	SV-2040	334	38	339	271	383	6	12
	BDC	ND	ND	ND	ND	ND	0	12
Steel Creek off SRS Road C	SV-2064	25658	3786	25510	15909	30097	12	12
	SC-2A	22275	2218	21950	18200	26700	12	12
Mary's Branch near Barnwell Barricade, SRS Road B	SV-2081	8355	670	8712	6961	8955	12	670
	Mary's Branch	7065	1251	7350	3910	8480	12	12

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
ND is Not Detected

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4.6.0 SUMMARY STATISTICS

2023 Alpha Data Comparison for DHEC and DOE-SR Collocated Supplemental Sampling Locations (SRNS, 2024)

Sample Location	Sample ID	Average Concentration (pCi/L)	Standard Deviation (pCi/L)	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detects	Number of Samples
Steel Creek off SRS Road C	SV-2064	6.19	NA	6.19	6.19	6.19	1	12
	SC-2A	1.29	0.54	1.16	0.56	2.45	11	12
Mary's Branch near Barnwell Barricade, SRS Road B	SV-2081	5.09	3.09	3.76	2.88	13.20	10	670
	Mary's Branch	19.06	10.72	17.55	5.31	43.40	12	12

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
NA is Not Applicable

2023 Beta Data Comparison for DHEC and DOE-SR Collocated Supplemental Sampling Locations (SRNS, 2024)

Sample Location	Sample ID	Average Concentration (pCi/L)	Standard Deviation (pCi/L)	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detects	Number of Samples
Steel Creek off SRS Road C	SV-2064	5.53	1.52	5.10	4.27	7.21	3	12
	SC-2A	2.78	0.82	2.59	1.67	4.81	12	12
Mary's Branch near Barnwell Barricade, SRS Road B	SV-2081	5.36	NA	5.36	5.36	5.36	1	12
	Mary's Branch	7.58	5.38	6.56	2.16	21.60	12	12

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
NA is Not Applicable

4.6.0 SUMMARY STATISTICS

2023 DHEC Monitoring Data-Tritium in pCi/L

Ambient Sample Location	Average Concentration	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detections	Number of Samples
Jackson Boat Landing (SV-2010)	378	96	332	313	488	3	53
Tims Branch at SRS Road C (SV-324)	347	84	310	271	556	11	53
Upper Three Runs Creek at S.C. 125/SRS Road A (SV-325)	500	151	475	291	1032	50	53
Fourmile Branch at SRS Road A-12.2 (SV-2039)	15416	2628	15454	7864	20011	53	53
Pen Branch at SRS Road A-13.2 (SV-2047)	5832	1709	5839	2770	9847	53	53
Steel Creek at S.C. 125/SRS Road A (SV-327)	1075	546	1077	342	4288	53	53
Steel Creek Boat Landing at RM 141 (SV-2018)	975	1383	466	282	7151	31	53
Highway 301 Bridge at RM 118.8 (SV-118)	652	407	519	288	2527	37	53
L-Lake Spill Way (SV-2052)	1343	2527	339	277	10526	22	53
Lower Three Runs Creek at SRS Road B (SV-2053)	347	63	339	279	430	4	53
Creek Mouth Sample Location	**Average Concentration**	**Standard Deviation**	**Median**	**Minimum Detect**	**Maximum Detect**	**Number of Detects**	**Number of Samples**
Upper Three Runs Creek at RM 157.4 (SV-2011)	366	38	378	279	406	9	10
Fourmile Branch at RM 150.6 (SV-2015)	9555	8433	11589	291	16785	3	10
Steel Creek at RM 141.5 (SV-2017)	1129	570	1301	291	1844	10	10
Lower Three Runs Creek at RM 129.1 (SV-2020)	478	127	496	288	652	7	10

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4.6.0 SUMMARY STATISTICS

2023 DHEC Monitoring Data-Tritium in pCi/L continued

Supplemental Sample Location	Average Concentration	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects	Number of Samples
Mary's Branch near Barnwell Barricade, SRS Road B (SV-2081)	8355	670	8712	6961	8955	12	12
Steel Creek off SRS Road C (SV-2064)	25658	3786	25510	15909	30097	12	12
Mill Creek at Woodward Road, Road E – ATTA (SV-2032)	497	115	487	332	688	10	12
Beaver Dam Creek (SV-2040)	334	38	339	271	383	6	12

4.6.0 SUMMARY STATISTICS

2023 DHEC Monitoring Data-Alpha

Ambient Sample Location	Average Concentration (pCi/L)	Standard Deviation	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detections	Number of Samples
Jackson Boat Landing (SV-2010)	ND	ND	ND	ND	ND	0	12
Tims Branch at SRS Road C (SV-324)	2.57	0.65	2.64	1.64	3.34	6	12
Upper Three Runs Creek at S.C. 125/SRS Road A (SV-325)	4.66	2.42	4.34	1.67	8.58	11	12
Fourmile Branch at SRS Road A-12.2 (SV-2039)	ND	ND	ND	ND	ND	0	12
Pen Branch at SRS Road A-13.2 (SV-2047)	ND	ND	ND	ND	ND	0	11
Steel Creek at S.C. 125/SRS Road A (SV-327)	ND	ND	ND	ND	ND	0	12
Steel Creek Boat Landing at RM 141 (SV-2018)	1.75	NA	1.75	1.75	1.75	1	12
Highway 301 Bridge at RM 118.8 (SV-118)	ND	ND	ND	ND	ND	0	11
Lower Three Runs Creek at SRS Road B (SV-2053)	ND	ND	ND	ND	ND	0	11
Supplemental Sample Location	**Average Concentration (pCi/L)**	**Standard Deviation**	**Median (pCi/L)**	**Minimum Detect (pCi/L)**	**Maximum Detect (pCi/L)**	**Number of Detections**	**Number of Samples**
Mary's Branch near Barnwell Barricade, SRS Road B (SV-2081)	5.09	3.09	3.76	2.88	13.20	10	12
Steel Creek off SRS Road C (SV-2064)	6.19	NA	6.19	6.19	6.19	1	12
Mill Creek at Woodward Road, Road E – ATTA (SV-2032)	2.44	NA	2.44	2.44	2.44	1	12
Beaver Dam Creek (SV-2040)	0.76	NA	0.76	0.76	0.76	1	12

ND is Not Detected
NA is Not Applicable

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4.6.0 SUMMARY STATISTICS

2023 DHEC Monitoring Data-Beta

Ambient Sample Location	Average Concentration (pCi/L)	Standard Deviation	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detections	Number of Samples
Jackson Boat Landing (SV-2010)	ND	ND	ND	ND	ND	0	12
Tims Branch at SRS Road C (SV-324)	4.42	NA	4.42	4.42	4.42	1	12
Upper Three Runs Creek at S.C. 125/SRS Road A (SV-325)	5.71	NA	5.71	5.71	5.71	1	12
Fourmile Branch at SRS Road A-12.2 (SV-2039)	6.33	NA	6.33	6.33	6.33	1	12
Pen Branch at SRS Road A-13.2 (SV-2047)	ND	ND	ND	ND	ND	0	11
Steel Creek at S.C. 125/SRS Road A (SV-327)	ND	ND	ND	ND	ND	0	12
Steel Creek Boat Landing at RM 141 (SV-2018)	ND	ND	ND	ND	ND	0	12
Highway 301 Bridge at RM 118.8 (SV-118)	ND	ND	ND	ND	ND	0	11
Lower Three Runs Creek at SRS Road B (SV-2053)	ND	ND	ND	ND	ND	0	11
Supplemental Sample Location	**Average Concentration (pCi/L)**	**Standard Deviation**	**Median (pCi/L)**	**Minimum Detect (pCi/L)**	**Maximum Detect (pCi/L)**	**Number of Detections**	**Number of Samples**
Mary's Branch near Barnwell Barricade, SRS Road B (SV-2081)	5.36	NA	5.36	5.36	5.36	1	12
Steel Creek off SRS Road C (SV-2064)	5.53	1.52	5.10	4.27	7.21	3	12
Mill Creek at Woodward Road, Road E – ATTA (SV-2032)	6.52	3.17	6.52	4.28	8.76	2	12
Beaver Dam Creek (SV-2040)	3.73	NA	3.73	3.73	3.73	1	12

ND is Not Detected
NA is Not Applicable

Chapter 5 Non-radiological Monitoring of Surface Water on SRS

5.1.0 PROJECT SUMMARY

Using a Horiba Water Quality Meter to determine field parameters

DHEC assessed the surface water quality for non-radiological parameters in 2023 at SRS by sampling the on-site streams for inorganic and organic constituents. As an indication of possible water quality issues, DHEC data is compared to the freshwater standard guidelines in DHEC's Water Classifications and Standards, Regulation 61-68 (DHEC, 2020c). These guidelines give numeric criteria for specific parameters and narrative criteria that indicate conditions of biological integrity and water quality for aquatic life and human health. The fact that a stream does not meet the specified numeric standards for a particular parameter does not mean the stream is polluted or of poor quality. Natural conditions can cause streams to exceed the standards.

Seven DHEC sample locations were strategically chosen to monitor ambient surface water conditions and to determine the potential impacts from non-radiological constituents related to DOE-SR operations. A map of DHEC sample locations can be found in Section 5.4.0. Five of the DHEC sample locations are collocated with DOE-SR sample locations to provide data comparisons (Section 5.5.0, Table 1). DHEC also sampled 4 supplemental locations that are monitored separately to determine their potential to be added to the ambient sampling network based on SRS activities (Section 5.5.0, Table 2). Supplemental locations are only sampled for mercury, metals, and field parameters. After monitoring McQueen Branch at SRS Road F (NWSV-2037 Supplemental) during the first quarter of 2023, the location was removed as a sampling location due to accessibility concerns and lack of adequate stream flow. DHEC supplemental locations are not collocated with DOE-SR. For all DHEC ambient and supplemental sample location ID, descriptions, and rationales, refer to Section 5.5.0, Tables 1 & 2. The stream sample locations were selected based on accessibility and their proximity upstream and downstream of DOE-SR operations before flowing into the publicly accessible Savannah River. A list of water quality parameter analyses and sample frequency can be found in Section 5.5.0, Table 3.

5.2.0 RESULTS AND DISCUSSION

Non-radiological Monitoring of Surface Water Summary Statistics can be found in Section 5.6.0 and all Non-radiological Monitoring of Surface Water Data can be found in the 2023 DHEC Data File.

Many chemical and biological processes in surface waters can be affected by pH, a measurement that indicates the alkalinity or acidity of a substance (EPA, 1997). The streams encountered at SRS are typical of southeastern streams characterized as blackwater. A blackwater stream is one that has a deep, slow-moving channel that flows through forested swamps and wetlands. Decaying vegetation in the water results in the leaching of tannins from the vegetation which

results in transparent, acidic water that is darkly stained, resembling tea or coffee. Low pH is typical for blackwater streams such as those sampled at SRS (Hughes et al., 2000).

Water sample to be analyzed by the lab in DHEC's Columbia office

The pH standard for all South Carolina freshwater streams is between 6.0 and 8.5 standard units (SU) (DHEC, 2020c). All ambient DHEC locations had yearly averages within the standard. NWSV-2039 with a yearly pH average of 6.46 and NWSV-2047 with a yearly pH average of 6.44 were the only locations with individual pH detections under the standard. NWSV-2040 with a yearly pH average of 4.45 and NWSV-2032 with a yearly pH average of 5.44 were the only 2 supplemental locations that had yearly pH averages under the standard. All of the supplemental locations had some individual pH detections under the standard. These streams are blackwater streams, which could contribute to them having a pH lower than 6. All DOE-SR locations had some individual pH detections under the standard, but all of the locations had yearly averages within the standard. See Section 5.5.0, Figure 1 for a comparison of DHEC and DOE-SR data for collocated samples (SRNS, 2024).

Oxygen is cycled through the environment and is both produced and consumed in streams. The amount of oxygen in its dissolved form in water is the Dissolved Oxygen (DO). The Biochemical Oxygen Demand (BOD) is the amount of oxygen consumed by microorganisms in stream water. Water quality is diminished when the BOD is high, which depletes the oxygen in the water. Low DO means less oxygen to support higher forms of aquatic life (EPA, 1997). The South Carolina freshwater standard for DO is a daily average of no less than 5.0 mg/L with no individual sample to be below 4.0 mg/L (DHEC, 2020c). All DHEC individual samples and daily averages met the DO standard except for NWSV-324 with a yearly average DO of 8.38 mg/L and NWSV-2032 (Supplemental) with a yearly average DO of 6.47 mg/L in 2023. All DOE-SR locations had individual samples and daily averages that met the DO standard. A DO comparison of DHEC and DOE-SR data for collocated samples can be found in Section 5.5.0, Figure 2 (SRNS, 2024). There are no numeric criteria in the South Carolina freshwater standards for a maximum BOD level; however, in 2023, DHEC samples had no detections above the LLD of 2.0 mg/L except for NWSV-325 which had a single detect of 2.00 mg/L, and NWSV-2039 with a single detect of 2.10 mg/L. DHEC Supplemental locations are not sampled for BOD. DOE-SR did not collect BOD samples in 2023, therefore, no comparison can be made for BOD.

Recording field parameters: DO, pH, temperature, conductivity, and total dissolved solids

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Water samples collected in a composite grab

Temperature can affect biological and chemical processes in a stream. All aquatic organisms can be negatively affected by temperatures that vary from the naturally occurring range (EPA, 1997). The South Carolina freshwater standards state that the temperature of free-flowing freshwater shall not exceed a maximum of 32.2°C (DHEC, 2020c). All DHEC and DOE-SR data showed that the stream temperatures during each sampling event were comparable to each other and did not exceed the maximum of 32.2°C.

The South Carolina freshwater *E. coli* standard is a daily maximum of 349 Most Probable Number per 100mL (MPN/100mL). All streams sampled had individual samples that exceeded 349 MPN/100mL except for NWSV-327, NWSV-2039, and NWSV-2053, but all locations had yearly averages below the standard. DHEC Supplemental locations are not sampled for E. coli. DOE-SR did not collect samples for *E. coli* in 2023, therefore, no comparison can be made.

Phosphorous and nitrogen are essential nutrients for the plants and animals that make up the aquatic food web. However, in excess they can cause significant water quality problems. Phosphorous and nitrogen cycle through the environment in a variety of forms and can indirectly impact DO and other water quality indicators (EPA, 1997). In 2023, DHEC sampled for total phosphorous and various forms of nitrogen, including nitrate/nitrite, total Kjeldahl nitrogen (TKN), and ammonia. There are no numeric criteria in the South Carolina freshwater standard for total phosphorus, TKN, or ammonia.

DHEC uses the most conservative of the federally established drinking water standards for nitrate/nitrite levels to indicate ambient water quality in freshwater streams for nutrients. The EPA drinking water standards for nitrate/nitrite levels are 10 mg/L and 1 mg/L, respectively, and are designed to protect the public from consumption of high levels of these nutrients (DHEC, 2020c). As a conservative measure, DHEC uses a maximum of 1 mg/L as an indication of possible water quality issues. Overall, the nutrient levels on SRS are comparable to the levels found throughout the Savannah River Basin. DOE-SR did not sample for TKN or ammonia in 2023; therefore, no comparison can be made. A comparison of DHEC and DOE-SR data from collocated samples for total phosphorous and nitrate/nitrite, respectively, can be found in Section 5.5.0, Figures 3 and 4.

Most metals are considered pollutants, including some that are toxic or known carcinogens. In 2023, DHEC personnel collected samples for the following metals: aluminum, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, thallium, and zinc.

Water sample to be analyzed

Due to the potential health effects of some metals, a yearly average, even if based on a single detection that exceeds the freshwater standards, may indicate a water quality issue. These metals, with the exceptions of aluminum, calcium, iron, magnesium, and manganese, have numeric criteria for the protection of human health and aquatic life in the South Carolina freshwater quality standards.

The freshwater quality standard for cadmium in South Carolina streams is not to exceed 0.00025 mg/L (DHEC, 2020c). DHEC found 2 individual samples above the limit at NWSV-2040 (Supplemental), but the averages from all locations (ambient and supplemental) were below the standard of cadmium. DOE-SR had no detections above the standard of cadmium (SRNS, 2024).

The freshwater quality standards for chromium, copper, and nickel in South Carolina streams are not to exceed 0.011 mg/L, 0.0029 mg/L and 0.016 mg/L, respectively (DHEC, 2020c). DHEC detected copper above the standard in 1 sample at NWSV-324 (0.081 mg/L), 1 sample at NWSV-2053 (0.21 mg/L), and 1 sample at NWSV-2081 (Supplemental) (0.017 mg/L) but did not detect chromium or nickel above their respective standards in any other samples in 2023. Due to copper's standard of 0.0029 mg/L being lower than the DHEC laboratory's limit of detection of <0.010 mg/L, samples that were found to be <0.010 mg/L were considered non-detects. DOE-SR detected chromium, copper, and nickel below the standard in their collocated sample locations with the exception of copper at NWSV-325 (single detect of 0.01 mg/L) and NWSV-328 (single detect of 0.00363 mg/L). NWSV-325 was the only location that did not have detects of chromium for DOE-SR (SRNS, 2024).

Samples are individually bottled and transported on ice

The freshwater quality standard for lead in South Carolina streams is not to exceed 0.00054 mg/L (DHEC, 2020c). Due to laboratory limitations, DHEC has a lower limit of detection (LLD) higher than the standard. Therefore, any detection of lead would be over the standard. DHEC did not detect lead in any samples above the standard except for NWSV-2064 (Supplemental) (single detect of 0.0043 mg/L) and NWSV-2032 (Supplemental) (single detect of 0.0027 mg/L). Beginning in August 2018, DOE-SR changed their laboratory analysis for lead to achieve a lower detection limit. DOE-SR had no locations with average lead detections above the standard in 2023. (SRNS, 2024).

The freshwater quality standard for mercury in South Carolina streams is not to exceed 0.00005 mg/L (DHEC, 2020c). Mercury was not detected in any of the DHEC samples but was detected below the standard in a DOE-SR individual sample at NWSV-324 (SRNS, 2024).

The freshwater quality standard for zinc in South Carolina streams is not to exceed 0.037 mg/L (DHEC, 2020c). DHEC had 3 individual samples at NWSV-2040 (Supplemental) (yearly

average – 0.031 mg/L) and 1 individual sample at NWSV-2032 (Supplemental) (single detect of 0.040 mg/L) that exceeded the zinc standard while all other samples were below the standard. DOE-SR had all locations' averages below the standard for zinc (SRNS, 2024). A zinc comparison of DHEC and DOE-SR yearly averages for collocated samples can be found in Section 5.5.0, Figure 5.

Samples were also analyzed for beryllium and thallium whose freshwater quality standards are <0.004 mg/L and <0.00024 mg/L, respectively. DHEC had 1 individual sample at NSWV-2040 (Supplemental) (0.0040 mg/L) that exceeded the beryllium standard while the rest of the samples were below both beryllium and thallium standards. DOE-SR had no beryllium or thallium detects that exceeded their respective standards (SRNS, 2024).

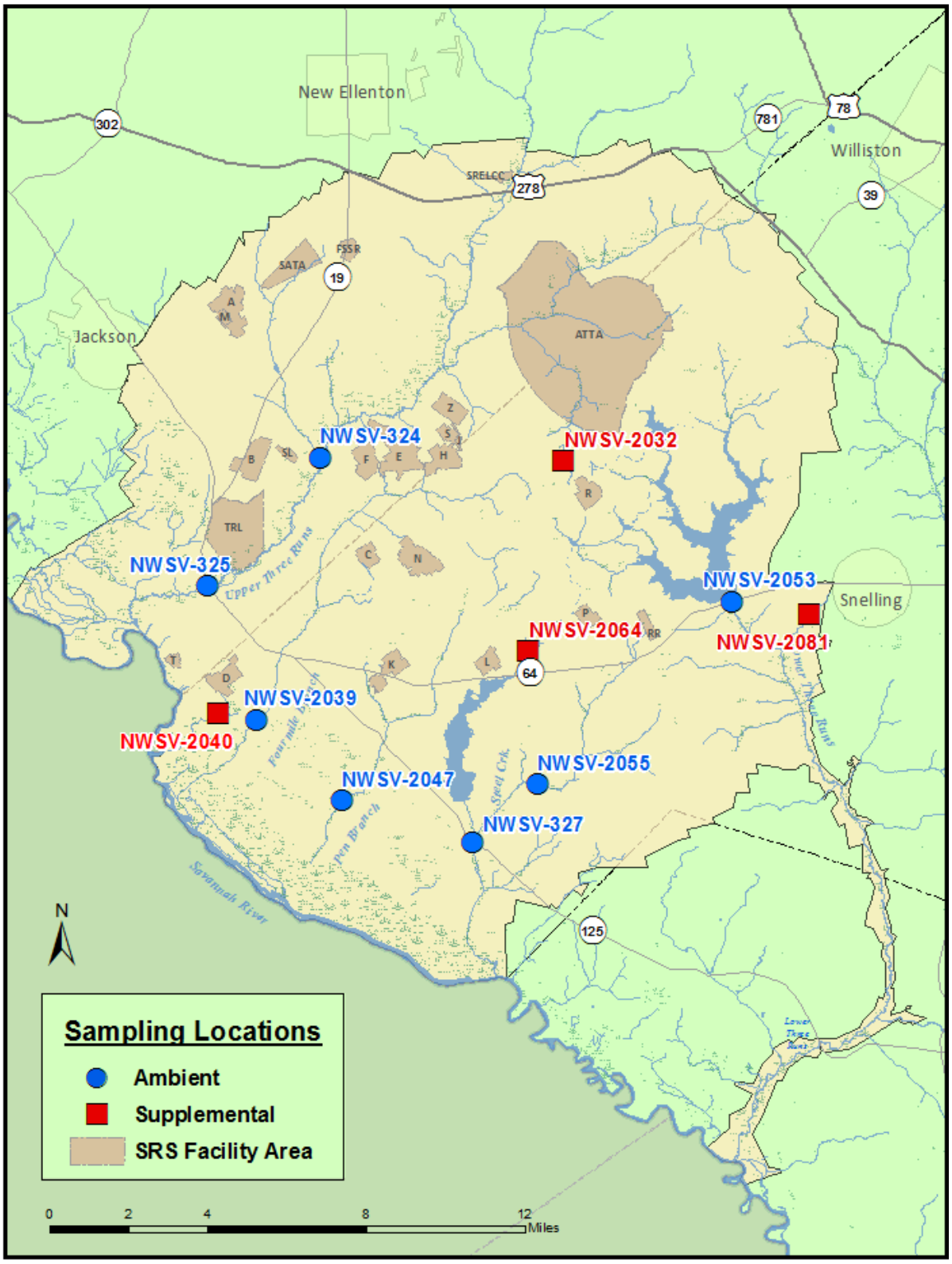
Small discrepancies in data between DOE-SR and DHEC may be attributed to differences in sample collection date and time, sample preservation, and lab analysis. Variances in statistical calculations, such as the yearly averages, may also attribute to dissimilarities. All data less than the LLD were left out of DHEC summary statistics due to lack of numeric information.

5.3.0 CONCLUSIONS AND RECOMMENDATIONS

The current parameters will continue to be monitored to establish trends that may warrant further investigation based on EPA or DHEC standards or recommended levels. Overall, the non-radiological water quality on SRS in 2023 compared favorably with the South Carolina Freshwaters Standard or other recommendations for the parameters and monitored locations. The 2023 DHEC results for most parameters were comparable to the DHEC's Bureau of Water data for the Savannah River watershed (DHEC, 2022b). DHEC will continue to evaluate water quality based on the independent, non-radiological testing and surveillance of SRS surface water. Monitoring is required due to continued land disturbance from clean-up activities, new facility construction, logging, and new missions. The locations, number and frequencies of samples, and monitoring parameters are reviewed annually and modified as needed to maximize available resources and address SRS mission changes.

5.4.0 MAP

Non-radiological Surface Water Monitoring Locations



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5.5.0 TABLES AND FIGURES

Table 1. 2023 DHEC Ambient Non-radiological Surface Water Monitoring Locations

Sample ID	Location Description	Location Rationale
NWSV-2027	Upper Three Runs Creek at SRS Road 2-1	Upstream of most SRS Operations
NWSV-2061	Tinker Creek at SRS Road 2-1	Downstream of ATTA
NWSV-324*	Tims Branch at SRS Road C	Downstream from M- & A-Areas
NWSV-325*	Upper Three Runs Creek at S.C. 125/SRS Road A	Downstream from F-Area
NWSV-2055	Meyers Branch at SRS Road 9	Downstream from P-Area
NWSV-2039*	Fourmile Branch at SRS Road A-12.2	Downstream from F- and H-Areas
NWSV-2047*	Pen Branch at SRS Road A-13.2	Downstream from K-Area
NWSV-327*	Steel Creek at S.C. 125/SRS Road A	Downstream from L-Lake
NWSV-328*	Lower Three Runs Creek at Patterson Mill Road	Downstream from Par Pond
NWSV-2053	Lower Three Runs Creek at SRS Road B	Downstream of SRS operations and Par Pond

* Indicates collocation with DOE-SR sample locations.
NWSV-2027, NWSV-2061, and NWSV-328 were not sampled by DHEC in 2023 due to safety concerns at the sampling location.

5.5.0 TABLES AND FIGURES

Table 2. 2023 DHEC Supplemental Non-radiological Surface Water Monitoring Locations

Sample Location	Location Description	Location Rationale
NWSV-2032	Mill Creek at Woodward Road, SRS Road E - ATTA	Downstream of past operations R area
NWSV-2040	Beaver Dam Creek	Downstream of past operations in D Area
NWSV-2064	Steel Creek off SRS Road C	Downstream of past operations in P area
NWSV-2081	Mary's Branch near Barnwell Barricade, SRS Road B	Tributary monitoring related to potential impacts from adjacent offsite facility

Table 3. 2023 DHEC Water Quality Parameter Analyses

Laboratory	Frequency	Parameter
Field	Monthly	Temperature, pH, Specific Conductivity, Dissolved Oxygen, and Total Dissolved Solids (TDS)
DHEC Lab Aiken, S.C.	Monthly	Turbidity, BOD, E. Coli, and TSS
DHEC Lab Columbia, S.C.	Monthly	Alkalinity, Ammonia, Nutrients, Mercury, and Metals,

5.5.0 TABLES AND FIGURES

Figure 1. pH 2023 Yearly Average DHEC and DOE-SR Comparison (SRNS, 2024)

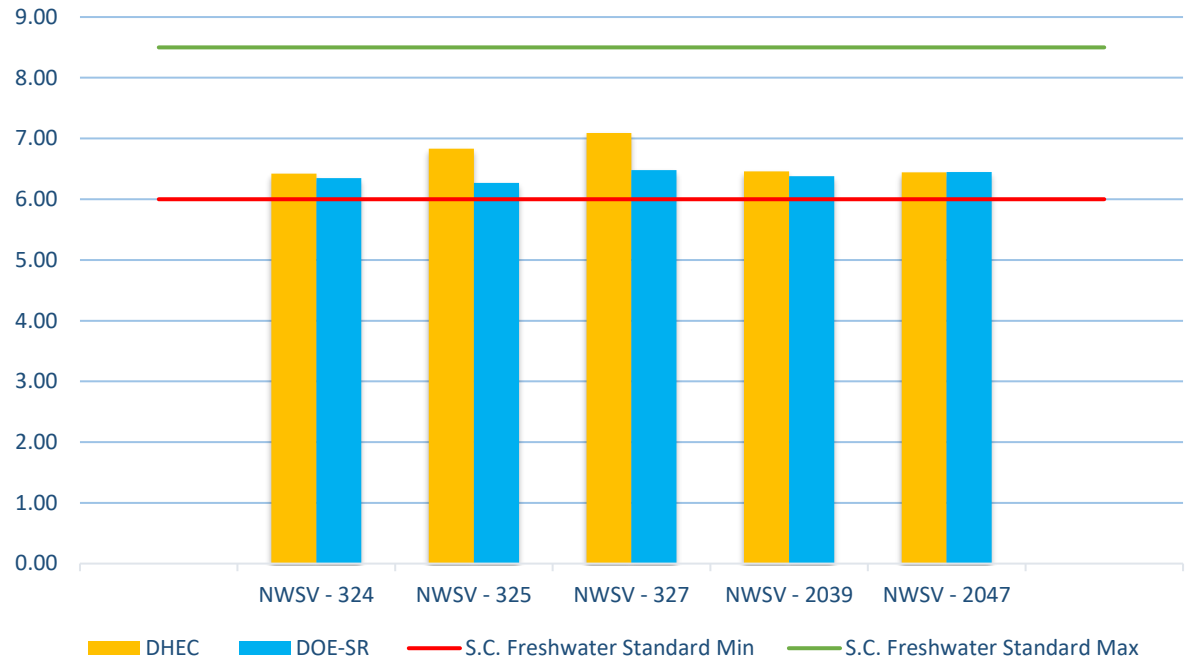

Figure 2. DO 2023 Yearly Average DHEC and DOE-SR Comparison (SRNS, 2024)

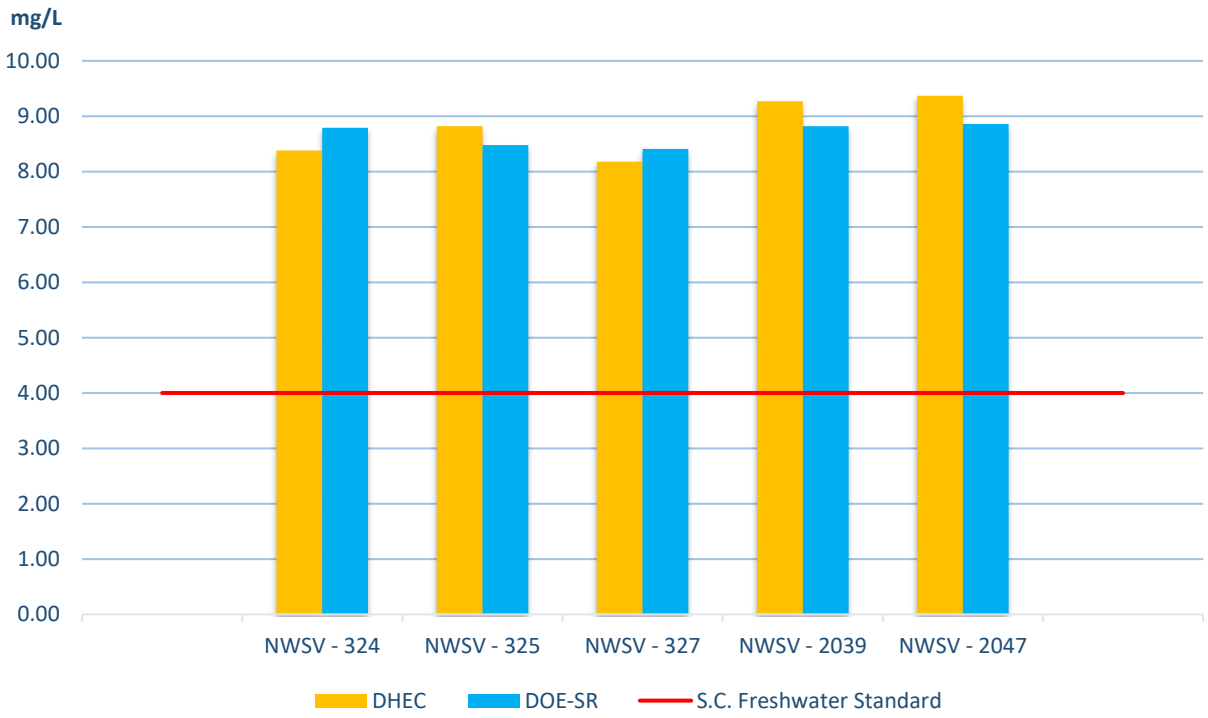

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Figure 3. Total Phosphorous 2023 Yearly Average DHEC and DOE-SR Comparison (SRNS, 2024)

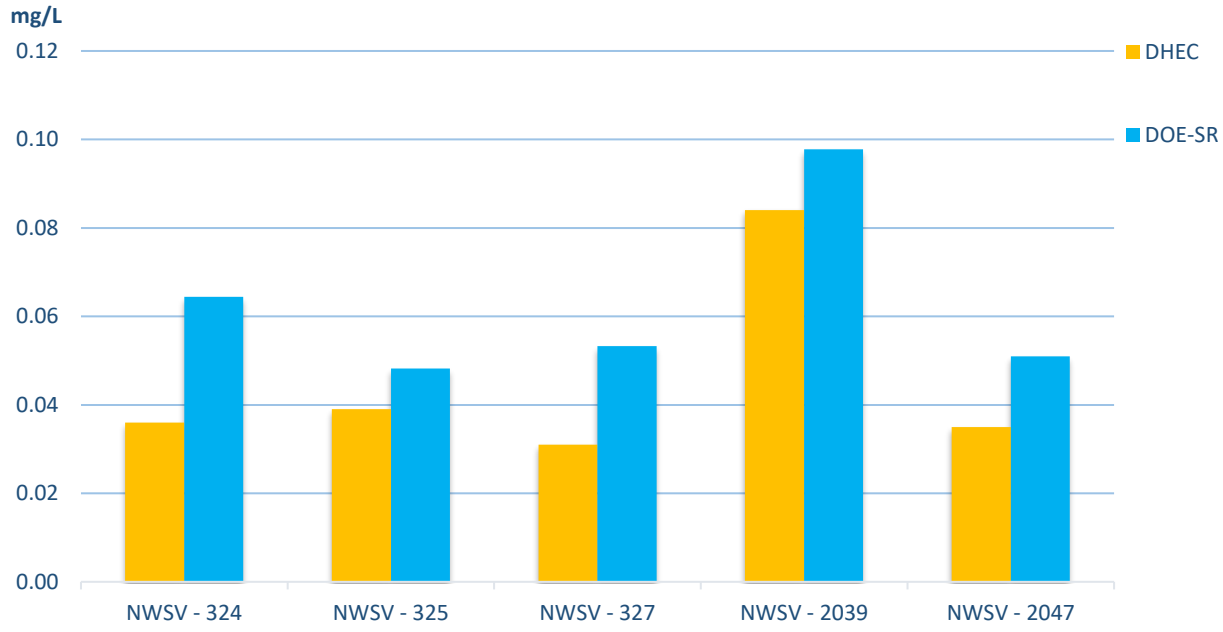
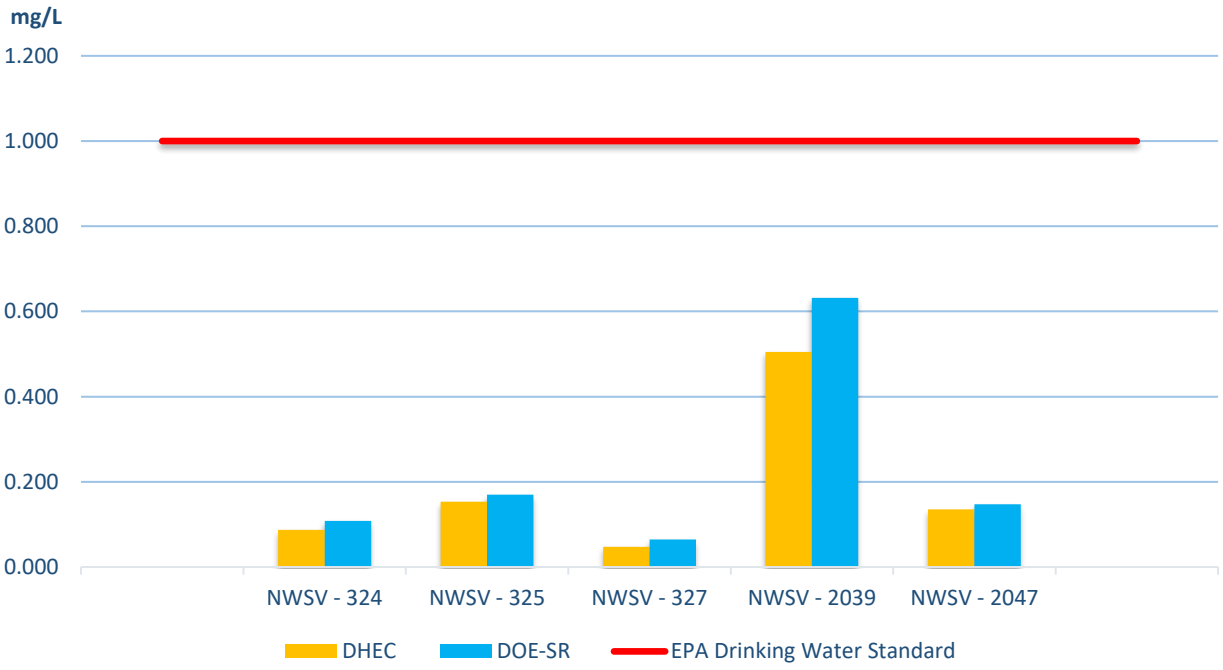


Figure 4. Nitrate/Nitrite 2023 Yearly Average DHEC and DOE-SR Comparison (SRNS, 2024)



DOE-SR collects nitrate and nitrite as separate parameters. In this graph, DOE-SR's nitrate and nitrite were added together and then an average of the sum was taken to produce one number representing both nitrate and nitrite at each location in order to have comparable data to DHEC.

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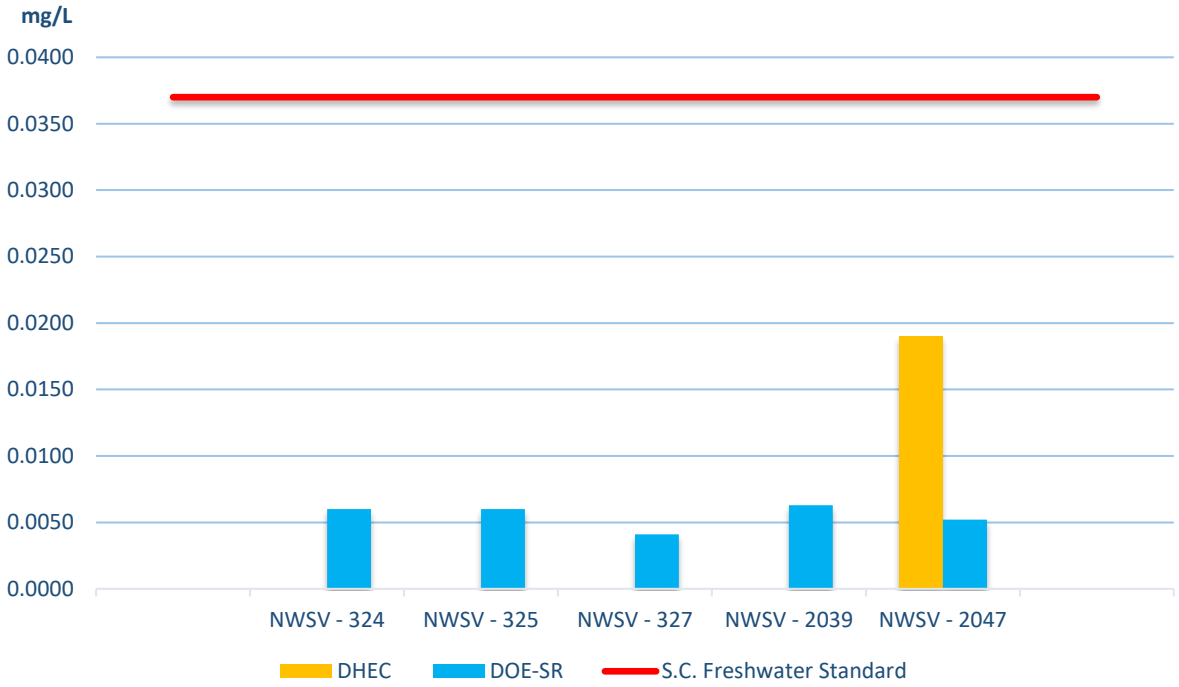
5.5.0 TABLES AND FIGURES

Figure 5. Zinc 2023 Yearly Average DHEC and DOE-SR Comparison (SRNS, 2024)



DHEC had no detects of zinc in all locations except for NWSV-2047. DOE-SR has a lower detection limit than DHEC for zinc.

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5.6.0 SUMMARY STATISTICS

Notes for the 5.6.0 Summary Statistic Tables on pages 78-88:
NA is Not Applicable
ND is Not Detected
NS is Not Sampled
Chromium, Mercury, Nickel, and Thallium are not included in the table due to no detections in 2023 across all locations.
Total Alkalinity, Turbidity, BOD, TSS, E. Coli, TKN, Ammonia, Nitrate/Nitrite, Total Phosphorous, and Total Organic Carbon samples are not collected at Supplemental locations.
The number of samples per parameter is 12 unless otherwise stated below each location table. Variations in the number of samples per parameter is due to analytical errors.

NWSV–324 Tims Branch at SRS Road C

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	6.42	0.35	6.30	6.09	7.32	12
	DO (mg/L)	8.38	2.43	8.64	1.59	10.95	12
	Water Temp (°C)	17.62	4.60	17.87	10.22	24.01	12
	Conductivity (mS/cm)	0.02	0.001	0.02	0.02	0.02	12
	TDS (mg/L)	0.013	0.001	0.013	0.012	0.014	12
Laboratory	Total Alkalinity (mg/L)	5.86	7.95	3.75	2.40	31.00	12
	Turbidity (NTU)	5.62	3.51	4.70	2.60	15.00	12
	BOD (mg/L)	ND	ND	ND	ND	ND	0
	TSS (mg/L)	10.84	16.35	6.00	4.00	60.00	11
	E. Coli (MPN/100mL)	207.76	126.50	175.60	30.90	488.40	12
	TKN (mg/L)	0.24	0.10	0.25	0.12	0.39	9
	Ammonia (mg/L)	ND	ND	ND	ND	ND	0
	Nitrate/Nitrite (mg/L)	0.087	0.034	0.093	0.029	0.140	12
	Total Phosphorus (mg/L)	0.036	0.009	0.037	0.024	0.051	12
	Cadmium (mg/L)	ND	ND	ND	ND	ND	0
	Calcium (mg/L)	0.85	0.15	0.83	0.66	1.20	12
	Copper (mg/L	0.081	NA	0.081	0.081	0.081	1
	Iron (mg/L)	1.79	0.73	1.55	1.10	3.20	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	0.41	0.04	0.40	0.35	0.52	12
	Manganese (mg/L)	0.06	0.02	0.05	0.03	0.10	12
	Zinc (mg/L)	ND	ND	ND	ND	ND	0
	Hardness (mg/L)	3.78	0.53	3.65	3.10	5.10	12
	Aluminum (mg/L)	0.20	0.22	0.14	0.07	0.90	12
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	3.23	1.20	3.15	1.60	4.90	12

Only 11 samples were collected for TSS from NWSV-324 throughout 2023.

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5.6.0 SUMMARY STATISTICS

NWSV-325 Upper Three Runs Creek at S.C. 125/SRS Road A

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	6.83	0.44	6.72	6.1	7.56	12
	DO (mg/L)	8.82	1.33	9.32	6.96	10.97	12
	Water Temp (°C)	17.81	4.74	17.59	10.89	24.68	12
	Conductivity (mS/cm)	0.02	0.004	0.02	0.02	0.03	12
	TDS (mg/L)	0.016	0.003	0.015	0.012	0.022	12
Laboratory	Total Alkalinity (mg/L)	3.48	0.41	3.55	2.70	4.00	12
	Turbidity (NTU)	3.34	1.13	3.30	1.40	5.70	12
	BOD (mg/L)	2.00	NA	2.00	2.00	2.00	1
	TSS (mg/L)	5.81	6.22	4.70	1.20	24.00	11
	E. Coli (MPN/100mL)	209.86	195.10	156.10	108.10	816.40	12
	TKN (mg/L)	0.32	0.27	0.18	0.11	0.92	10
	Ammonia (mg/L)	0.06	NA	0.06	0.06	0.06	1
	Nitrate/Nitrite (mg/L)	0.153	0.048	0.150	0.084	0.270	12
	Total Phosphorus (mg/L)	0.039	0.017	0.037	0.020	0.086	12
	Cadmium (mg/L)	ND	ND	ND	ND	ND	0
	Calcium (mg/L)	2.04	0.12	2.00	1.80	2.20	12
	Copper (mg/L)	ND	ND	ND	ND	ND	0
	Iron (mg/L)	0.55	0.18	0.52	0.31	0.91	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	0.44	0.02	0.44	0.41	0.49	12
	Manganese (mg/L)	0.02	0.01	0.02	0.01	0.03	12
	Zinc (mg/L)	ND	ND	ND	ND	ND	0
	Hardness (mg/L)	6.93	0.38	6.85	6.20	7.50	12
	Aluminum (mg/L)	0.22	0.15	0.17	0.09	0.64	12
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	4.15	2.09	3.50	2.30	10.00	12

Only 11 samples were collected for TSS from NWSV-325 throughout 2023.

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5.6.0 SUMMARY STATISTICS

NWSV-327 Steel Creek at S.C. 125/SRS Road A

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	7.09	0.42	7.13	6.4	7.78	12
	DO (mg/L)	8.18	1.26	8.22	6.14	10.33	12
	Water Temp (°C)	18.39	5.85	17.99	10.51	26.01	12
	Conductivity (mS/cm)	0.06	0.017	0.05	0.05	0.11	12
	TDS (mg/L)	0.036	0.011	0.032	0.030	0.071	12
Laboratory	Total Alkalinity (mg/L)	17.58	1.93	17.50	15.00	21.00	12
	Turbidity (NTU)	4.38	2.84	3.50	1.60	11.00	12
	BOD (mg/L)	ND	ND	ND	ND	ND	0
	TSS (mg/L)	7.83	8.96	4.00	1.30	30.00	11
	E. Coli (MPN/100mL)	98.39	30.58	110.90	44.10	145.00	12
	TKN (mg/L)	0.27	0.09	0.26	0.16	0.43	10
	Ammonia (mg/L)	0.065	NA	0.065	0.065	0.065	1
	Nitrate/Nitrite (mg/L)	0.047	0.015	0.051	0.020	0.063	12
	Total Phosphorus (mg/L)	0.031	0.010	0.027	0.025	0.050	6
	Cadmium (mg/L)	ND	ND	ND	ND	ND	0
	Calcium (mg/L)	6.28	0.70	6.30	4.50	7.30	12
	Copper (mg/L)	ND	ND	ND	ND	ND	0
	Iron (mg/L)	0.63	0.45	0.46	0.27	1.70	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	0.70	0.11	0.73	0.48	0.86	12
	Manganese (mg/L)	0.05	0.04	0.04	0.02	0.14	12
	Zinc (mg/L)	ND	ND	ND	ND	ND	0
	Hardness (mg/L)	18.58	1.31	19.00	15.00	20.00	12
	Aluminum (mg/L)	0.25	0.25	0.13	0.06	0.76	12
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	4.31	1.01	4.35	3.00	6.10	12

Only 11 samples were collected for TSS from NWSV-327 throughout 2023.

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5.6.0 SUMMARY STATISTICS

NWSV-2039 Fourmile Branch at SRS Road A-12.2

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	6.46	0.49	6.35	5.82	7.52	12
	DO (mg/L)	9.27	1.22	9.33	7.52	10.94	12
	Water Temp (°C)	17.21	4.86	17.27	9.38	24.29	12
	Conductivity (mS/cm)	0.05	0.012	0.04	0.04	0.08	12
	TDS (mg/L)	0.028	0.002	0.029	0.024	0.031	12
Laboratory	Total Alkalinity (mg/L)	11.46	1.72	11.50	9.30	15.00	12
	Turbidity (NTU)	3.25	0.71	3.35	1.90	4.80	12
	BOD (mg/L)	2.10	NA	2.10	2.10	2.10	1
	TSS (mg/L)	3.07	1.60	2.70	1.10	6.80	11
	E. Coli (MPN/100mL)	116.84	66.72	113.25	54.60	290.90	12
	TKN (mg/L)	0.34	0.15	0.36	0.10	0.51	11
	Ammonia (mg/L)	ND	ND	ND	ND	ND	0
	Nitrate/Nitrite (mg/L)	0.505	0.213	0.570	0.220	0.790	12
	Total Phosphorus (mg/L)	0.084	0.028	0.083	0.030	0.140	12
	Cadmium (mg/L)	0.00022	NA	0.00022	0.00022	0.00022	1
	Calcium (mg/L)	3.68	0.26	3.65	3.30	4.10	12
	Copper (mg/L)	ND	ND	ND	ND	ND	0
	Iron (mg/L)	0.88	0.24	0.80	0.55	1.40	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	0.57	0.04	0.56	0.51	0.63	12
	Manganese (mg/L)	0.04	0.01	0.04	0.02	0.06	12
	Zinc (mg/L)	ND	ND	ND	ND	ND	0
	Hardness (mg/L)	11.58	0.79	12.00	10.00	13.00	12
	Aluminum (mg/L)	0.12	0.04	0.11	0.06	0.17	12
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	4.54	1.16	4.60	3.00	7.00	12

Only 11 samples were collected for TSS from NWSV-2039 throughout 2023.

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5.6.0 SUMMARY STATISTICS

NWSV-2047 Pen Branch at SRS Road A-13.2

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	6.44	0.40	6.45	5.83	7.34	12
	DO (mg/L)	9.37	1.45	9.28	7.35	11.83	12
	Water Temp (°C)	16.95	5.18	17.05	9.38	24.38	12
	Conductivity (mS/cm)	0.05	0.005	0.05	0.05	0.06	12
	TDS (mg/L)	0.035	0.003	0.034	0.030	0.040	12
Laboratory	Total Alkalinity (mg/L)	18.75	3.25	19.00	13.00	24.00	12
	Turbidity (NTU)	4.82	1.23	4.95	2.60	6.80	12
	BOD (mg/L)	ND	ND	ND	ND	ND	0
	TSS (mg/L)	4.98	2.53	4.10	2.00	11.00	11
	E. Coli (MPN/100mL)	193.12	135.93	134.40	86.50	579.40	12
	TKN (mg/L)	0.28	0.13	0.29	0.12	0.43	10
	Ammonia (mg/L)	ND	ND	ND	ND	ND	0
	Nitrate/Nitrite (mg/L)	0.135	0.038	0.120	0.089	0.200	12
	Total Phosphorus (mg/L)	0.035	0.006	0.037	0.025	0.044	12
	Cadmium (mg/L)	ND	ND	ND	ND	ND	0
	Calcium (mg/L)	7.53	0.89	7.60	6.10	9.20	12
	Copper (mg/L)	ND	ND	ND	ND	ND	0
	Iron (mg/L)	0.85	0.18	0.91	0.55	1.10	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	0.65	0.07	0.64	0.56	0.75	12
	Manganese (mg/L)	0.05	0.01	0.05	0.03	0.07	12
	Zinc (mg/L)	0.0190	0.0014	0.0190	0.0180	0.0200	2
	Hardness (mg/L)	21.50	2.15	21.50	18.00	25.00	12
	Aluminum (mg/L)	0.23	0.10	0.27	0.09	0.41	12
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	5.97	1.85	6.10	3.20	8.40	12

Only 11 samples were collected for TSS from NWSV-2047 throughout 2023.

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5.6.0 SUMMARY STATISTICS

NWSV-2053 Lower Three Runs Creek at SRS Road B

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	6.86	0.25	6.83	6.49	7.33	12
	DO (mg/L)	7.97	1.48	8.08	5.73	10.22	12
	Water Temp (°C)	21.50	6.34	19.84	12.61	30.34	12
	Conductivity (mS/cm)	0.03	0.002	0.03	0.03	0.04	12
	TDS (mg/L)	0.022	0.001	0.021	0.019	0.024	12
Laboratory	Total Alkalinity (mg/L)	11.17	0.83	11.00	10.00	13.00	12
	Turbidity (NTU)	1.75	0.73	1.50	1.10	3.50	11
	BOD (mg/L)	ND	ND	ND	ND	ND	0
	TSS (mg/L)	1.89	0.89	1.45	1.00	3.20	8
	E. Coli (MPN/100mL)	19.50	34.89	3.10	1.00	81.60	5
	TKN (mg/L)	0.28	0.11	0.23	0.16	0.50	10
	Ammonia (mg/L)	ND	ND	ND	ND	ND	0
	Nitrate/Nitrite (mg/L)	ND	ND	ND	ND	ND	0
	Total Phosphorus (mg/L)	ND	ND	ND	ND	ND	0
	Cadmium (mg/L)	ND	ND	ND	ND	ND	0
	Calcium (mg/L)	4.41	0.18	4.35	4.20	4.80	12
	Copper (mg/L)	0.21	NA	0.21	0.21	0.21	1
	Iron (mg/L)	0.46	0.28	0.39	0.23	1.30	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	0.44	0.02	0.44	0.41	0.46	12
	Manganese (mg/L)	0.05	0.02	0.05	0.03	0.12	12
	Zinc (mg/L)	ND	ND	ND	ND	ND	0
	Hardness (mg/L)	12.75	0.62	13.00	12.00	14.00	12
	Aluminum (mg/L)	0.05	0.00	0.05	0.05	0.06	2
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	3.08	0.43	3.05	2.50	4.20	12

Only 10 samples were collected for TSS and 11 samples collected for Turbidity and BOD from NWSV-2053 throughout 2023.

5.6.0 SUMMARY STATISTICS

NWSV-2055 Meyers Branch at SRS Road 9

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	6.83	0.18	6.85	6.56	7.15	12
	DO (mg/L)	9.54	1.15	9.44	8.07	11.28	12
	Water Temp (°C)	17.19	4.63	17.78	10.09	23.70	12
	Conductivity (mS/cm)	0.04	0.004	0.04	0.03	0.04	12
	TDS (mg/L)	0.024	0.002	0.025	0.021	0.029	12
Laboratory	Total Alkalinity (mg/L)	15.28	9.58	13.50	9.00	45.00	12
	Turbidity (NTU)	3.24	1.18	3.30	1.30	5.30	12
	BOD (mg/L)	ND	ND	ND	ND	ND	0
	TSS (mg/L)	4.72	2.34	4.30	1.10	8.10	11
	E. Coli (MPN/100mL)	245.24	102.99	212.00	141.40	461.10	12
	TKN (mg/L)	0.25	0.11	0.26	0.12	0.42	9
	Ammonia (mg/L)	ND	ND	ND	ND	ND	0
	Nitrate/Nitrite (mg/L)	0.11	0.02	0.11	0.08	0.15	12
	Total Phosphorus (mg/L)	0.02	0.00	0.02	0.02	0.03	3
	Cadmium (mg/L)	ND	ND	ND	ND	ND	0
	Calcium (mg/L)	5.68	0.59	5.65	4.60	6.70	12
	Copper (mg/L)	ND	ND	ND	ND	ND	0
	Iron (mg/L)	0.50	0.13	0.49	0.31	0.70	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	0.44	0.04	0.44	0.38	0.54	12
	Manganese (mg/L)	0.03	0.01	0.03	0.02	0.04	12
	Zinc (mg/L)	ND	ND	ND	ND	ND	0
	Hardness (mg/L)	15.92	1.56	15.50	13.00	19.00	12
	Aluminum (mg/L)	0.19	0.08	0.21	0.06	0.33	12
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	4.70	1.49	5.30	2.60	6.50	12

Only 11 samples were collected for TSS from NWSV-2055 throughout 2023.

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5.6.0 SUMMARY STATISTICS

NWSV-2032 Mill Creek at Woodward Road, SRS Road E – ATTA (Supplemental)

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	5.44	0.49	5.22	4.83	6.16	12
	DO (mg/L)	6.47	2.47	6.16	2.78	10.37	12
	Water Temp (°C)	18.80	6.48	19.36	9.11	27.35	12
	Conductivity (mS/cm)	0.02	0.003	0.02	0.02	0.03	12
	TDS (mg/L)	0.014	0.004	0.013	0.011	0.023	12
Laboratory	Total Alkalinity (mg/L)	NS	NS	NS	NS	NS	NS
	Turbidity (NTU)	NS	NS	NS	NS	NS	NS
	BOD (mg/L)	NS	NS	NS	NS	NS	NS
	TSS (mg/L)	NS	NS	NS	NS	NS	NS
	E. Coli (MPN/100mL)	NS	NS	NS	NS	NS	NS
	TKN (mg/L)	NS	NS	NS	NS	NS	NS
	Ammonia (mg/L)	NS	NS	NS	NS	NS	NS
	Nitrate/Nitrite (mg/L)	NS	NS	NS	NS	NS	NS
	Total Phosphorus (mg/L)	NS	NS	NS	NS	NS	NS
	Cadmium (mg/L)	ND	ND	ND	ND	ND	0
	Calcium (mg/L)	0.67	0.39	0.58	0.43	1.90	12
	Copper (mg/L)	ND	ND	ND	ND	ND	0
	Iron (mg/L)	3.06	2.79	2.35	0.50	9.90	12
	Lead (mg/L)	0.0027	NA	0.0027	0.0027	0.0027	1
	Magnesium (mg/L)	0.63	0.62	0.46	0.38	2.60	12
	Manganese (mg/L)	0.08	0.08	0.06	0.03	0.32	12
	Zinc (mg/L)	0.04	NA	0.04	0.04	0.04	1
	Hardness (mg/L)	7.23	6.73	3.40	3.30	15.00	3
	Aluminum (mg/L)	0.66	1.37	0.30	0.14	5.00	12
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	NS	NS	NS	NS	NS	NS

Only 3 samples were collected for Hardness from NWSV-2032 throughout 2023.

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5.6.0 SUMMARY STATISTICS

NWSV-2040 Beaver Dam Creek (Supplemental)

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	4.45	0.72	4.28	3.81	6.5	12
	DO (mg/L)	7.24	1.87	7.08	5.06	11.05	12
	Water Temp (°C)	18.18	5.55	18.70	10.30	26.05	12
	Conductivity (mS/cm)	0.14	0.027	0.13	0.10	0.18	12
	TDS (mg/L)	0.089	0.017	0.088	0.064	0.115	12
Laboratory	Total Alkalinity (mg/L)	NS	NS	NS	NS	NS	NS
	Turbidity (NTU)	NS	NS	NS	NS	NS	NS
	BOD (mg/L)	NS	NS	NS	NS	NS	NS
	TSS (mg/L)	NS	NS	NS	NS	NS	NS
	E. Coli (MPN/100mL)	NS	NS	NS	NS	NS	NS
	TKN (mg/L)	NS	NS	NS	NS	NS	NS
	Ammonia (mg/L)	NS	NS	NS	NS	NS	NS
	Nitrate/Nitrite (mg/L)	NS	NS	NS	NS	NS	NS
	Total Phosphorus (mg/L)	NS	NS	NS	NS	NS	NS
	Cadmium	0.00017	0.00009	0.00014	0.00011	0.00034	9
	Calcium (mg/L)	12.58	2.91	12.00	9.00	20.00	12
	Copper (mg/L)	ND	ND	ND	ND	ND	0
	Iron (mg/L)	2.58	2.44	1.70	0.45	8.50	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	2.58	0.40	2.65	1.90	3.10	12
	Manganese (mg/L)	0.37	0.07	0.39	0.23	0.44	12
	Zinc (mg/L)	0.031	0.008	0.029	0.020	0.049	12
	Hardness (mg/L)	39.33	8.62	41.00	30.00	47.00	3
	Aluminum (mg/L)	1.57	0.63	1.40	0.63	2.80	12
	Beryllium (mg/L)	0.0026	0.0008	0.0025	0.0014	0.0040	12
	Total Organic Carbon (mg/L)	NS	NS	NS	NS	NS	NS

Only 3 samples were collected for Hardness from NWSV-2040 throughout 2023.

5.6.0 SUMMARY STATISTICS

NWSV-2064 Steel Creek off SRS Road C (Supplemental)

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	6.00	0.28	6.03	5.54	6.58	12
	DO (mg/L)	8.69	0.97	8.60	7.19	10.80	12
	Water Temp (°C)	17.77	3.73	18.65	12.21	22.68	12
	Conductivity (mS/cm)	0.03	0.002	0.04	0.03	0.04	12
	TDS (mg/L)	0.02	0.001	0.02	0.02	0.02	12
Laboratory	Total Alkalinity (mg/L)	NS	NS	NS	NS	NS	NS
	Turbidity (NTU)	NS	NS	NS	NS	NS	NS
	BOD (mg/L)	NS	NS	NS	NS	NS	NS
	TSS (mg/L)	NS	NS	NS	NS	NS	NS
	E. Coli (MPN/100mL)	NS	NS	NS	NS	NS	NS
	TKN (mg/L)	NS	NS	NS	NS	NS	NS
	Ammonia (mg/L)	NS	NS	NS	NS	NS	NS
	Nitrate/Nitrite (mg/L)	NS	NS	NS	NS	NS	NS
	Total Phosphorus (mg/L)	NS	NS	NS	NS	NS	NS
	Cadmium (mg/L)	0.00024	NA	0.00024	0.00024	0.00024	1
	Calcium (mg/L)	4.21	0.41	4.25	3.10	4.60	12.00
	Copper (mg/L)	ND	ND	ND	ND	ND	0
	Iron (mg/L)	1.21	2.09	0.53	0.30	7.80	12
	Lead (mg/L)	0.0043	NA	0.0043	0.0043	0.0043	1
	Magnesium (mg/L)	0.51	0.03	0.51	0.47	0.55	12
	Manganese (mg/L)	0.08	0.11	0.05	0.03	0.41	12
	Zinc (mg/L)	0.015	NA	0.015	0.015	0.015	1
	Hardness (mg/L)	11.57	1.69	12.00	9.70	13.00	3
	Aluminum (mg/L)	0.36	0.53	0.16	0.07	1.90	11
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	NS	NS	NS	NS	NS	NS

Only 3 samples were collected for Hardness from NWSV-2064 throughout 2023.

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5.6.0 SUMMARY STATISTICS

NWSV-2081 Mary's Branch near Barnwell Barricade, SRS Road B (Supplemental)

Parameters		Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects
Field	pH (SU)	6.03	0.42	5.95	5.55	7.18	12
	DO (mg/L)	9.18	1.49	8.67	7.52	12.16	12
	Water Temp (°C)	17.81	4.51	19.13	10.45	23.50	12
	Conductivity (mS/cm)	0.02	0.002	0.02	0.02	0.03	12
	TDS (mg/L)	0.01	0.001	0.01	0.01	0.02	12
Laboratory	Total Alkalinity (mg/L)	NS	NS	NS	NS	NS	NS
	Turbidity (NTU)	NS	NS	NS	NS	NS	NS
	BOD (mg/L)	NS	NS	NS	NS	NS	NS
	TSS (mg/L)	NS	NS	NS	NS	NS	NS
	E. Coli (MPN/100mL)	NS	NS	NS	NS	NS	NS
	TKN (mg/L)	NS	NS	NS	NS	NS	NS
	Ammonia (mg/L)	NS	NS	NS	NS	NS	NS
	Nitrate/Nitrite (mg/L)	NS	NS	NS	NS	NS	NS
	Total Phosphorus (mg/L)	NS	NS	NS	NS	NS	NS
	Cadmium (mg/L)	ND	ND	ND	ND	ND	0
	Calcium (mg/L)	1.98	0.17	1.90	1.80	2.40	12
	Copper (mg/L)	0.017	NA	0.017	0.017	0.017	1
	Iron (mg/L)	0.53	0.32	0.44	0.20	1.40	12
	Lead (mg/L)	ND	ND	ND	ND	ND	0
	Magnesium (mg/L)	0.52	0.02	0.52	0.48	0.56	12
	Manganese (mg/L)	0.02	0.01	0.01	0.01	0.04	9
	Zinc (mg/L)	ND	ND	ND	ND	ND	0
	Hardness (mg/L)	6.83	0.49	6.60	6.50	7.40	3
	Aluminum (mg/L)	0.32	0.25	0.26	0.10	1.00	12
	Beryllium (mg/L)	ND	ND	ND	ND	ND	0
	Total Organic Carbon (mg/L)	NS	NS	NS	NS	NS	NS

Only 3 samples were collected for Hardness from NWSV-2081 throughout 2023.

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Chapter 6 Monitoring of Sediments on and Adjacent to SRS

6.1.0 PROJECT SUMMARY

The accumulation of radiological and non-radiological contaminants in sediment can directly affect aquatic organisms which can lead to human exposure. Impacts to water bodies come through direct discharge, atmospheric fallout, and runoff. These accumulated contaminants may re-suspend in streams and rivers or disperse downstream, potentially affecting drinking water supplies and fish consumed by the public. The transportation of sediments is a dynamic process. Stream flow changes can redistribute contaminants or bury them as part of the natural sedimentation process. Patterns of sediment contamination are strongly affected by hydrologic factors and the physical and chemical characterization of the sediment (EPA, 1987).

Collecting sediment sample from the Savannah River

SRS streams receive surface water runoff and water from permitted discharges (DOE, 1995). SRS is within the Savannah River watershed with five major streams feeding into the Savannah River. Dispersal of any contaminants from these streams has the potential to impact the Savannah River.

DHEC personnel evaluate sediment samples for radionuclide and non-radionuclide contaminant concentrations in SRS streams, SRS storm-water basins, creek mouths along the boundary of SRS, the Savannah River, and publicly accessible boat landings in the SRS vicinity. Radionuclide detections in sediment are typically the result of accumulation over many years and do not represent yearly depositions. Sediment samples on SRS are routinely split with DOE-SR to compare results.

A complete list of all radiological and non-radiological analytes can be found in List of Analytes, Table 1 and Table 2 on page ix. DHEC sediment sampling locations are illustrated in Section 6.4.0, Map. DHEC and DOE-SR split samples were collected from eight stream locations on SRS, three SRS storm-water basins, five creek mouths along SRS, and two public boat landings. All locations are sampled once. In 2023, DHEC sampled two boat landings (SMJBL23 and SMBFL23) twice with one sample from each location collected as a split sample with DOE-SR and the other as an independent sample. DHEC and DOE-SR also sample other locations independently, thus any comparisons between DHEC and DOE-SR are based only on collocated samples. Though DHEC and DOE-SR did not collect split samples at SMLHL23, independent samples were collected and compared due to the collocation of this monitoring location. Comparisons made from SMLHL23 are only for radiological parameters. A complete list of sample locations is listed in Section 6.5.0, Table 1.

6.2.0 RESULTS AND DISCUSSION

DHEC sediment monitoring summary statistics can be found in Section 6.6.0 and sediment monitoring data can be found in the 2023 DHEC Data File.

6.2.1 Radiological Results

Cesium-137 (Cs-137) releases from Z-Area have the potential to contaminate tributaries of McQueen Branch, which flows into Upper Three Runs. The impact from possible contamination warrants long-term monitoring by DHEC along SRS streams and the publicly accessible Savannah River.

The creek mouths of SRS are a potential conduit for the dispersal of radionuclides into publicly accessible water. Cs-137 activity was found by DHEC in the sediment within several creek mouths along the Savannah River. Actinium-228, beryllium-7, potassium-40, lead-212, lead-214, radium-226, and thorium-234 are NORM decay products that account for the remaining gamma detections. All other gamma-emitting radionuclides had no detections above their respective MDA except for a single detect of Europium-152 with a concentration of 0.203 pCi/g in 2023.

Sediment is collected and then dried before radiological analysis

DHEC had gross alpha and gross beta activity detections in 2023. The summary statistics can be found in Section 6.6.0.

Cs-137 is the most abundant anthropogenic radionuclide found in the sediment samples. Cs-137 levels in 2023 data from samples collected outside SRS boundaries are all within the expected range and consistent with previous DHEC background data. Cs-137 in sediment may be attributed, in part, to fallout from past nuclear events in the 1950s and 1960s. The highest level of Cs-137 from the 2023 DHEC and DOE-SR collocated on-site stream sediment samples occurred at SMSV-327 (4.92 pCi/g for DHEC and 3.88 pCi/g for DOE-SR). The highest level of Cs-137 from the 2023 DHEC and DOE-SR collocated creek mouth sediment samples occurred at SMSV-2017 (0.54 pCi/g) for DHEC and SMSV-2020 (0.42 pCi/g) for DOE-SR. DHEC had detections of Cs-137 at one stormwater basin (SME-004 – 0.055 pCi/g) while DOE-SR had no detections of Cs-137 at any of the stormwater basins. The highest level of Cs-137 from the 2023 DHEC and DOE-SR collocated boat landing sediment samples occurred at SMBFL23 (0.085 pCi/g) for DHEC and SMLHL23 (0.166 pCi/g) for DOE-SR. Cs-137 contamination in Steel Creek Mouth is well documented and not unexpected. All sample results were well below the Preliminary Remediation Goal (PRG) of 27.9 pCi/g for Cs-137 (Section 6.5.0, Table 2) (EPA, 2022).

All creek mouth locations are sampled annually, whereas other locations (on-site streams, stormwater basins, and boat landings) are sampled on varying schedules. Therefore, creek mouth locations are the only location type suitable for comparison of annual trends. Figure 1 in Section 6.5.0 illustrates the average Cs-137 activity in sediment samples from all the DHEC locations.

DHEC Cs-137 data from the SRS creek mouths were trended for 2019-2023 (Section 6.5.0, Figure 2) and were compared to DOE-SR data (Section 6.5.0, Figure 3).

Preparing sample for non-radionuclide lab analysis

6.2.2 Non-radiological Results

Metals in sediment can be naturally occurring or a result of man-made processes such as those used in SRS operations. Re-distribution of sediment from flooding can carry contaminants to downstream locations. Geological factors in the Savannah River basin contribute to the levels of metals through erosion and sedimentation. All 2023 DHEC and DOE-SR samples had averages below the Ecological Screening Values (ESVs) for beryllium (for which DOE-SR does not test), copper, lead, mercury, nickel, and zinc (EPA, 2018). DHEC had no chemicals with detection concentrations above the ESV for the background location in 2023.

Comparisons were made to the ESVs for sediment, which do not represent remediation goals or cleanup levels but are used to identify constituents of potential concern (EPA, 2018).

Barium was detected above the ESV of 20 mg/kg by DHEC in all collocated creek mouths, all collocated stormwater basins, 7 collocated on-site streams (SMSV-2073, SMSV-175, SMSV-327, SMSV-2048, SMSV-2049, SMSV-328, and SMSV-2069), and both collocated boat landings (SMJBL23 & SMBFL23). DHEC also detected Barium above the ESV in 5 other boat landings (SMSC23, SMJL23, SMRVP23, SMSVC23, and SMJBL23 (independent)). DOE-SR detected barium above the ESV in all collocated creek mouths except for SMSV-2020, all collocated on-site streams except for SMSV-324, 2 collocated stormwater basins (E-004 and E-005), and both collocated boat landings.

Beryllium does not have an established ESV for sediment, so in lieu of a sediment value, the ESV for soil was used. DHEC had no detects above the ESV of 2.5 mg/kg. DOE-SR did not analyze for beryllium in 2023.

Prepped samples being sent to the lab for radionuclide analysis

Cadmium was detected above the ESV of 1 mg/kg by DHEC in all collocated creek mouths except for SMSV-2013, all collocated stormwater basins, 5 collocated on-site streams (SV-2073, SV-327, SV-2048, SV-2049, and SV-2069), and both collocated public boat landings (SMJBL23 & SMBFL23). DHEC also detected cadmium above the EVS of 1mg/kg in 2 other public boat landings (SMSC23 and SMSVC23). DOE-SR did not detect cadmium above the ESV in any location in 2023.

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Chromium was detected above the ESV of 43.4 mg/kg in 1 of the collocated stormwater basins (SME-004) for DHEC. DOE-SR had detections of chromium in 1 collocated creek mouth (SMSV-2011) and 1 collocated stormwater basin (E-004).

DHEC and DOE-SR did not detect copper above the ESV of 31.6 mg/kg in any collocated samples. DHEC also did not detect copper above the ESV at any other locations.

Pieces of rockier sediment are sieved before samples are sent to the Columbia lab for radionuclide analysis

Lead was not detected above the ESV of 35.8 mg/kg at any DHEC or DOE collocations. DHEC also did not detect lead above the ESV at any other locations.

DHEC detected manganese above the ESV of 460 mg/kg in all collocated creek mouths, 2 collocated on-site streams (SMSV-2048 and SMSV-327), and both collocated boat landings (SMJBL23 and SMBFL23). 3 other DHEC boat landings also had manganese detections above the ESV of 460 mg/kg (SMSC23, SMSVC23, and SMJBL23 (independent)). DOE-SR had detections in 4 collocated creek mouths (SMSV-2011, SMSV-2013, SMSV-2015, SMSV-2017), 2 collocated on-site stream (SMSV-327 and SMSV-2048), and both collocated boat landings with results above the ESV.

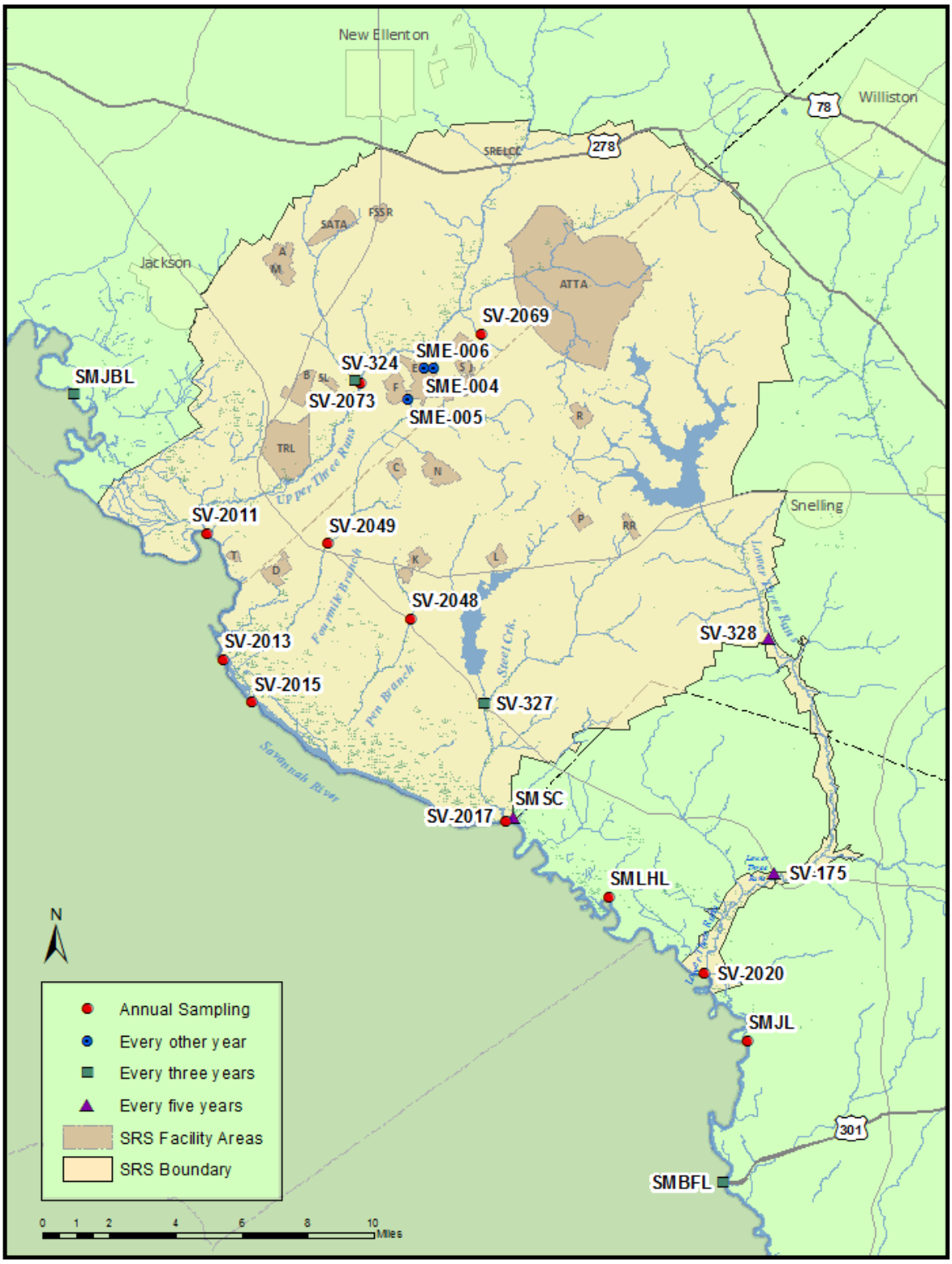
Mercury, nickel, and zinc were not detected above their respective ESVs at DHEC and DOE-SR collocations. DHEC also did not detect mercury, nickel, or zinc above their respective ESVs at any other location.

6.3.0 CONCLUSIONS AND RECOMMENDATIONS

SRS sediments will continue to be monitored due to current releases of contaminants and the potential for future discharges from SRS operations, legacy wastes, and clean-up activities. Year-to-year data comparisons are difficult to interpret due to the nature of sediment accumulation. Differences among samples may be due to the fraction of clays that most effectively retain radionuclides. Monitoring of on-site sediments is of great importance since over-land precipitation and streams transport contaminated sediment with radionuclides outside the SRS boundary. DHEC will continue independent monitoring of sediment around SRS and split sampling with DOE-SR on site and in the Savannah River to catalogue the presence of radionuclide and non-radionuclide analytes. DHEC will also periodically evaluate and modify the sampling methodology to better accomplish project objectives.
Trending of data over multiple years demonstrates whether radionuclide concentrations in the SRS area are declining through radioactive decay or possibly increasing due to disturbances on SRS. Cooperation between DOE-SR and DHEC provides credibility and confidence in the information being provided to the public.

6.4.0 MAP

Sediment Monitoring Locations



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6.5.0 TABLES AND FIGURES

Table 1. 2023 DHEC Sediment Monitoring Locations

DHEC Sample Location ID	DOE Sample Location ID	Location Description
Storm-water Basins		
SME-004	E-004	E-004 E Area Stormwater Basin
SME-005	E-005	E-005 E Area Stormwater Basin
SME-006	E-006	E-006 E Area Stormwater Basin
Creek Mouths		
SMSV-2011	RM 157.2 U3R	Upper Three Runs Mouth at RM 157.4
SMSV-2013	BDC at RM 152.3	Beaver Dam Creek Mouth at RM 152.3
SMSV-2015	RM 150.2	Fourmile Branch Creek Mouth at RM 150.6
SMSV-2017	SC at RM 141.5	Steel Creek Mouth at RM 141.5
SMSV-2020	RM-129 L3R	Lower Three Runs Mouth at RM 129.1
On-site Streams		
SMSV-2073	U3R-3	Upper Three Runs off SRS Road C
SMSV-2069	McQB at MO Rd.	McQueen Branch at Monroe Owens Road
SMSV- 327	SC-4 at Rd. A	Steel Creek at S.C. 125/SRS Road A
SMSV-2048	Pen Branch at Rd. A	Pen Branch at S.C. 125/SRS Road A
SMSV-2049	FMC at Rd. A	Four Mile Creek S.C. 125/SRS Road A
SMSV-324	TB-5 near Rd. C	Tim's Branch at SRS Road C
SMSV-175	L3R-3	Lower Three Runs at S.C. 125
SMSV-328	L3R-2 at PMR	Lower Three Runs at Patterson Mill Road
Upstream of SRS		
SMRVP23	NA	North Augusta Riverview Park Boat Landing
SMSVC23	NA	Steven’s Creek Boat Landing
SMJBL23	RM 170.5	Jackson Boat Landing
Downstream of SRS		
SMLHL23	RM 134	Little Hell Boat Landing
SMJL23	NA	Johnson’s Boat Landing
SMBFL23	RM 118.7	Burton's Ferry Boat Landing
SMSC23	NA	Steel Creek Boat Landing
Background		
SMPKY23	NA	Pinckney Island National Wildlife Refuge

RM is River Mile

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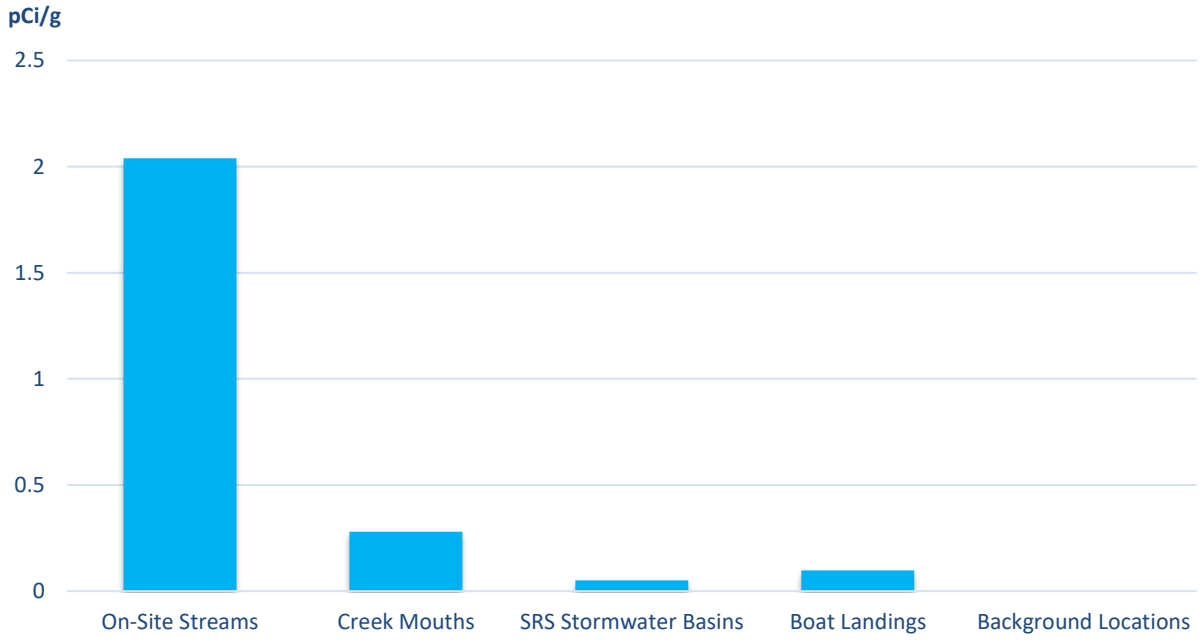
6.5.0 TABLES AND FIGURES

Table 2. Soil Ingestion Preliminary Remediation Goals (PRGs) of Select Anthropogenic Radionuclides (EPA, 2022)

Radionuclide	Peak PRG for Exposure through Ingestion (pCi/g)
Americium-241	4.95
Cesium-137	27.9
Cobalt – 60	82.8
Iodine-131	5980
Plutonium-238	4.40
Plutonium-239/240	3.92

Note: The PRG standards are produced through the EPA's "PRGs for Radionuclides Calculator" which are based on scenarios, select target risk, and media type and are calculated in real time and are not from an established table.

Figure 1. 2023 Comparisons of Cs-137 Average Activity Among DHEC Sample Location Types



No bar denotes no detection.
The average for boat landings includes the collocated and individual samples from SMJBL23 and SMBFL23.

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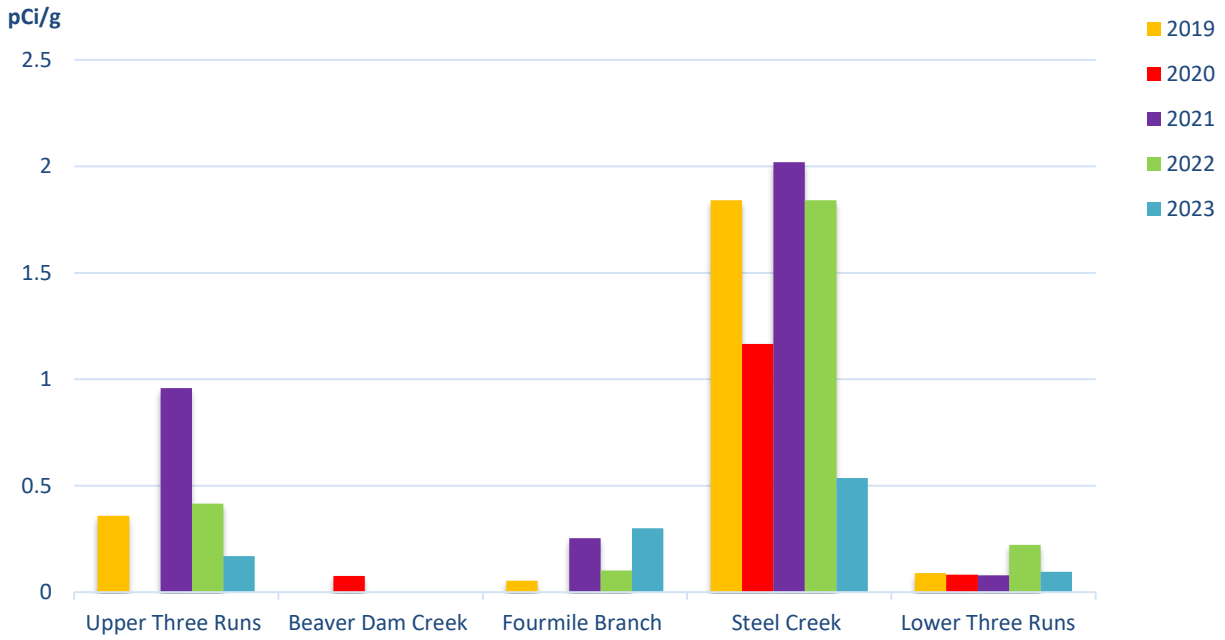
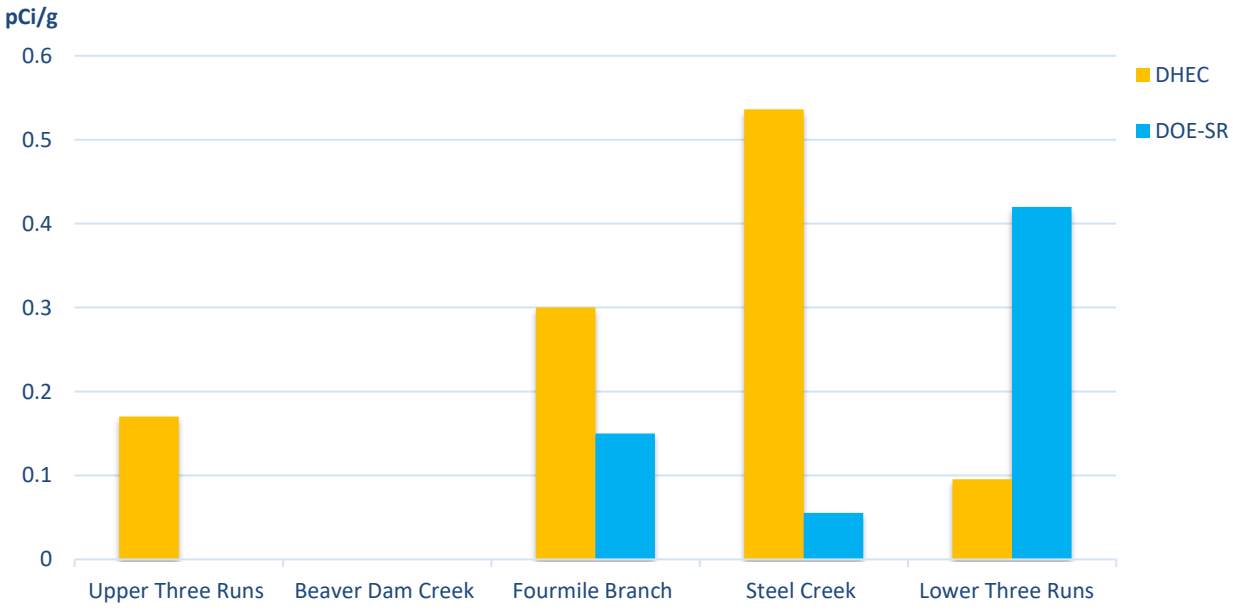
6.5.0 TABLES AND FIGURES

Figure 2. 2019-2023 Trending Data for Cs-137 in SRS Creek Mouth Samples (DHEC, 2020b-2023)



No bar denotes no detection for that year.

Figure 3. 2023 Cesium-137 in Collocated Savannah River Creek Mouths–DHEC Comparison to DOE-SR Data (SRNS, 2024)



Beaver Dam Creek is a man-made stream that was used for past operations at D-Area.

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6.6.0 SUMMARY STATISTICS

2023 Alpha, Beta, & Cesium-137 Data Comparison for DHEC and DOE-SR Collocated On-Site Streams Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	22.09	18.34	17.05	9.32	58.40	6	8
	16.91	10.30	12.90	11.50	41.80	8	8
Gross Beta	17.72	11.17	13.75	7.90	41.30	8	8
	13.73	5.27	11.75	7.95	21.30	8	8
Cs-137	2.04	1.96	1.93	0.14	4.92	7	8
	2.28	1.39	2.74	0.15	3.88	5	8

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.

2023 Alpha, Beta, & Cesium-137 Data Comparison for DHEC and DOE-SR Collocated Creek Mouth Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	16.34	2.07	17.30	13.60	18.40	5	5
	22.89	14.27	20.60	7.66	43.00	5	5
Gross Beta	31.44	6.46	32.90	23.30	40.40	5	5
	24.34	5.99	22.00	18.60	34.20	5	5
Cs-137	0.28	0.19	0.24	0.10	0.54	4	5
	0.21	0.19	0.15	0.06	0.42	3	5

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.

2023 Alpha, Beta, & Cesium-137 Data Comparison for DHEC and DOE-SR Collocated Stormwater Basin Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	16.60	NA	16.60	16.60	16.60	1	3
	15.70	4.83	14.20	11.80	21.10	3	3
Gross Beta	14.93	5.08	14.30	10.20	20.30	3	3
	10.00	5.24	7.64	6.36	16.00	3	3
Cs-137	0.05	NA	0.05	0.05	0.05	1	3
	ND	ND	ND	ND	ND	0	3

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
ND is Not Detected
NA is Not Applicable

6.6.0 SUMMARY STATISTICS

2023 Alpha, Beta, & Cesium-137 Data Comparison for DHEC and DOE-SR Collocated Boat Landing Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	13.69	5.91	11.40	9.27	20.40	3	3
	16.43	3.11	15.50	13.90	19.90	3	3
Gross Beta	22.73	11.31	25.50	10.30	32.40	3	3
	22.53	6.40	24.10	15.50	28.00	3	3
Cs-137	0.06	0.04	0.06	0.03	0.08	2	3
	0.12	0.06	0.12	0.08	0.17	2	3

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
NA is Not Applicable

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6.6.0 SUMMARY STATISTICS

2023 Non-radiological (Metals) Data Comparison for DHEC and DOE-SR Collocated On-Site Streams Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples	ESV
Barium	77.38	52.16	59.50	17.00	170.00	8	8	20
	61.03	47.10	42.10	17.00	160.00	8	8	
Cadmium	1.86	0.38	1.90	1.40	2.40	5	8	1
	ND	ND	ND	ND	ND	0	8	
Chromium	15.04	6.96	15.00	3.40	24.00	8	8	43.4
	11.09	5.57	9.32	3.80	19.00	8	8	
Copper	4.88	2.03	4.30	3.40	8.80	6	8	31.6
	4.52	2.50	4.33	1.40	7.80	8	8	
Lead	11.07	3.45	10.50	6.50	16.00	6	8	35.8
	7.83	4.08	7.95	2.70	14.00	8	8	
Manganese	345.88	294.56	270.00	47.00	1000.00	8	8	460
	326.75	211.07	299.00	51.00	740.00	8	8	
Mercury	0.10	NA	0.10	0.10	0.10	1	8	0.18
	0.08	0.04	0.06	0.05	0.14	5	8	
Nickel	6.86	4.76	6.00	2.00	17.00	8	8	22.7
	6.11	5.83	3.84	1.73	18.00	8	8	
Zinc	34.50	14.73	39.50	6.00	48.00	8	8	121
	26.58	13.07	26.85	5.50	49.00	8	8	

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
DOE-SR did not sample for Beryllium in 2023.
ND is Not Detected
NA is Not Applicable

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6.6.0 SUMMARY STATISTICS

2023 Non-radiological (Metals) Data Comparison for DHEC and DOE-SR Collocated Creek Mouth Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples	ESV
Barium	121.00	40.68	110.00	65.00	170.00	5	5	20
	98.00	73.51	87.00	16.00	200.00	5	5	
Cadmium	2.95	0.81	2.75	2.20	4.10	4	5	1
	ND	ND	ND	ND	ND	0	5	
Chromium	22.26	11.35	22.00	6.30	38.00	5	5	43.4
	24.42	16.49	20.00	7.10	51.00	5	5	
Copper	9.00	4.26	7.95	5.10	15.00	4	5	31.6
	10.72	9.76	10.00	2.00	26.00	5	5	
Lead	13.98	5.63	12.50	8.90	22.00	4	5	35.8
	12.36	9.27	9.30	3.50	28.00	5	5	
Manganese	1160.00	353.27	1200.00	740.00	1500.00	5	5	460
	1173.86	941.53	1000.00	9.30	2400.00	5	5	
Mercury	AE	AE	AE	AE	AE	AE	AE	0.18
	ND	ND	ND	ND	ND	0	5	
Nickel	8.68	4.24	8.40	3.10	15.00	5	5	22.7
	9.08	7.03	8.40	2.80	20.00	5	5	
Zinc	47.60	23.90	45.00	15.00	82.00	5	5	121
	37.54	32.65	34.00	5.70	88.00	5	5	

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
DOE-SR did not sample for Beryllium in 2023.
No Mercury data is reported for Creek Mouths due to an Analytical Error (AE).
ND is Not Detected

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6.6.0 SUMMARY STATISTICS

2023 Non-radiological (Metals) Data Comparison for DHEC and DOE-SR Collocated Stormwater Basin Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples	ESV
Barium	43.00	12.77	46.00	29.00	54.00	3	3	20
	28.00	13.11	30.00	14.00	40.00	3	3	
Cadmium	2.77	0.84	3.20	1.80	3.30	3	3	1
	ND	ND	ND	ND	ND	0	3	
Chromium	37.33	10.07	36.00	28.00	48.00	3	3	43.4
	31.67	11.72	27.00	23.00	45.00	3	3	
Copper	6.00	3.47	4.20	3.80	10.00	3	3	31.6
	11.27	5.19	9.90	6.90	17.00	3	3	
Lead	19.60	10.80	22.00	7.80	29.00	3	3	35.8
	16.73	7.66	19.00	8.20	23.00	3	3	
Manganese	86.67	48.68	96.00	34.00	130.00	3	3	460
	76.33	46.76	82.00	27.00	120.00	3	3	
Mercury	ND	ND	ND	ND	ND	0	3	0.18
	ND	ND	ND	ND	ND	0	3	
Nickel	8.43	1.93	9.50	6.20	9.60	3	3	22.7
	6.40	2.99	7.60	3.00	8.60	3	3	
Zinc	37.33	36.25	20.00	13.00	79.00	3	3	121
	26.43	29.16	12.00	7.30	60.00	3	3	

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
DOE-SR did not sample for Beryllium in 2023.
ND is Not Detected

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6.6.0 SUMMARY STATISTICS

2023 Non-radiological (Metals) Data Comparison for DHEC and DOE-SR Collocated Boat Landing Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples	ESV
Barium	102.00	67.88	102.00	54.00	150.00	2	2	20
	90.00	56.57	90.00	50.00	130.00	2	2	
Cadmium	2.30	1.56	2.30	1.20	3.40	2	2	1
	ND	ND	ND	ND	ND	0	2	
Chromium	21.50	14.85	21.50	11.00	32.00	2	2	43.4
	24.50	16.26	24.50	13.00	36.00	2	2	
Copper	6.90	5.80	6.90	2.80	11.00	2	2	31.6
	11.55	9.12	11.55	5.10	18.00	2	2	
Lead	9.90	5.80	9.90	5.80	14.00	2	2	35.8
	10.95	7.14	10.95	5.90	16.00	2	2	
Manganese	805.00	417.19	805.00	510.00	1100.00	2	2	460
	1130.00	664.68	1130.00	660.00	1600.00	2	2	
Mercury	AE	AE	AE	AE	AE	AE	AE	0.18
	ND	ND	ND	ND	ND	0	2	
Nickel	9.05	7.00	9.05	4.10	14.00	2	2	22.7
	10.05	7.00	10.05	5.10	15.00	2	2	
Zinc	43.00	28.28	43.00	23.00	63.00	2	2	121
	38.00	21.21	38.00	23.00	53.00	2	2	

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.
DOE-SR did not sample for Beryllium in 2023.
No mercury data is reported for collocated DHEC boat landing samples due to an Analytical Error (AE).
ND is Not Detected

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6.6.0 SUMMARY STATISTICS

2023 DHEC Radiological Data

On-Site Streams

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	22.09	18.34	17.05	9.32	58.40	6	8
Gross Beta	17.72	11.17	13.75	7.90	41.30	8	8
Cs-137	2.04	1.96	1.93	0.14	4.92	7	8

Creek Mouths

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	16.34	2.07	17.30	13.60	18.40	5	5
Gross Beta	31.44	6.46	32.90	23.30	40.40	5	5
Cs-137	0.28	0.19	0.24	0.10	0.54	4	5

Stormwater Basins

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	16.60	NA	16.60	16.60	16.60	1	3
Gross Beta	14.93	5.08	14.30	10.20	20.30	3	3
Cs-137	0.05	NA	0.05	0.05	0.05	1	3

NA is Not Applicable

Boat Landings

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	12.52	4.42	10.50	7.98	20.40	9	9
Gross Beta	24.86	7.28	25.50	10.30	32.40	9	9
Cs-137	0.10	0.10	0.06	0.03	0.24	4	9

Boat Landing results include the split and independent samples from SMJBL23 and SMBFL23.

6.6.0 SUMMARY STATISTICS

2023 DHEC Radiological Data

Background Samples

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	ND	ND	ND	ND	ND	0	1
Gross Beta	17.80	NA	17.80	17.80	17.80	1	1
Cs-137	ND	ND	ND	ND	ND	0	1

ND is Not Detected
NA is Not Applicable

2023 DHEC Non-radiological (Metals) Data

On-Site Streams

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples	ESV
Barium	77.38	52.16	59.50	17.00	170.00	8	8	20
Beryllium	1.17	0.63	1.10	0.54	2.20	6	8	*
Cadmium	1.86	0.38	1.90	1.40	2.40	5	8	1
Chromium	15.04	6.96	15.00	3.40	24.00	8	8	43.4
Copper	4.88	2.03	4.30	3.40	8.80	6	8	31.6
Lead	11.07	3.45	10.50	6.50	16.00	6	8	35.8
Manganese	345.88	294.56	270.00	47.00	1000.00	8	8	460
Mercury	0.10	NA	0.10	0.10	0.10	1	8	0.18
Nickel	6.86	4.76	6.00	2.00	17.00	8	8	22.7
Zinc	34.50	14.73	39.50	6.00	48.00	8	8	121

NA is Not Applicable

6.6.0 SUMMARY STATISTICS

2023 DHEC Non-radiological (Metals) Data

Creek Mouth Locations

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples	ESV
Barium	121.00	40.68	110.00	65.00	170.00	5	5	20
Beryllium	0.93	0.49	0.85	0.34	1.70	5	5	*
Cadmium	2.95	0.81	2.75	2.20	4.10	4	5	1
Chromium	22.26	11.35	22.00	6.30	38.00	5	5	43.4
Copper	9.00	4.26	7.95	5.10	15.00	4	5	31.6
Lead	13.98	5.63	12.50	8.90	22.00	4	5	35.8
Manganese	1160.00	353.27	1200.00	740.00	1500.00	5	5	460
Mercury	AE	AE	AE	AE	AE	AE	AE	0.18
Nickel	8.68	4.24	8.40	3.10	15.00	5	5	22.7
Zinc	47.60	23.90	45.00	15.00	82.00	5	5	121

No Mercury data is reported for Creek Mouths due to an Analytical Error (AE).

6.6.0 SUMMARY STATISTICS

2023 DHEC Non-radiological (Metals) Data

Stormwater Basins

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples	ESV
Barium	43.00	12.77	46.00	29.00	54.00	3	3	20
Beryllium	1.05	0.07	1.05	1.00	1.10	2	3	*
Cadmium	2.77	0.84	3.20	1.80	3.30	3	3	1
Chromium	37.33	10.07	36.00	28.00	48.00	3	3	43.4
Copper	6.00	3.47	4.20	3.80	10.00	3	3	31.6
Lead	19.60	10.80	22.00	7.80	29.00	3	3	35.8
Manganese	86.67	48.68	96.00	34.00	130.00	3	3	460
Mercury	ND	ND	ND	ND	ND	0	3	0.18
Nickel	8.43	1.93	9.50	6.20	9.60	3	3	22.7
Zinc	37.33	36.25	20.00	13.00	79.00	3	3	121

ND is Not Detected

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6.6.0 SUMMARY STATISTICS

2023 DHEC Non-radiological (Metals) Data

Boat Landings

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples	ESV
Barium	59.69	46.06	54.00	7.20	150.00	9	9	20
Beryllium	0.71	0.47	0.52	0.34	1.60	6	9	*
Cadmium	1.68	0.98	1.30	1.00	3.40	5	9	1
Chromium	12.26	8.39	11.00	4.90	32.00	9	9	43.4
Copper	7.43	6.18	5.40	1.40	18.00	9	9	31.6
Lead	12.56	10.34	7.60	5.40	30.00	5	9	35.8
Manganese	507.56	351.00	510.00	38.00	1100.00	9	9	460
Mercury	ND	ND	ND	ND	ND	0	7	0.18
Nickel	6.00	3.83	4.40	2.50	14.00	7	9	22.7
Zinc	33.44	22.77	24.00	10.00	76.00	9	9	121

Boat Landing calculations include the split and independent samples from SMJBL23 and SMBFL23.
Split samples from SMJBL23 and SMBFL23 were not sampled for mercury due to an Analytical Error.
ND is Not Detected

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Chapter 7 Monitoring of Surface Soil on and Adjacent to SRS

7.1.0 PROJECT SUMMARY

DHEC independently evaluates surface soil on and adjacent to SRS from the ground surface to a 12-inch depth for gross alpha, gross non-volatile beta, and select gamma-emitting radionuclides, as well as specific metals of concern. Soil samples are collected to determine if SRS activities have had an impact on areas inside and outside the site boundary. Radionuclide detections in soil are the result of accumulation over many years.

A 50-mile area from the center of SRS was chosen for the comparison of DHEC and DOE-SR radiological data averages. DOE-SR does not collect metals for surface soil; therefore, no direct data comparisons can be made.

DHEC collected samples from 13 sample locations on and around SRS along with 1 background location in 2023 (Section 7.5.0, Table 1). Soil samples are collected as split samples, which are samples taken and split between DHEC and DOE-SR to allow for direct sample data comparisons. DHEC's background location is the only location not collocated with DOE-SR. In 2023, DHEC added A-14 as a sample location to maintain direct data comparisons from collocations between DHEC and DOE-SR. DHEC and DOE-SR collocated sample locations are depicted on the Map in Section 7.4.0.

Collecting soil samples which will be analyzed for radiological material and metals

7.2.0 RESULTS AND DISCUSSION

Soil Monitoring Summary Statistics for radionuclides and metals can be found in Section 7.6.0, and all Soil Monitoring Data can be found in the 2023 DHEC Data File.

7.2.1 Radiological Parameter Results

Most samples had detectable amounts of Cesium-137 (Cs-137), an anthropogenic radionuclide that may be present due to a legacy of releases by SRS and atmospheric fallout from past nuclear weapons testing (SRNS, 2024). Cs-137 activity in 2023 is comparable to levels detected by DHEC in the past. No surface soil samples collected in 2023 were above the EPA Preliminary Remediation Goals (PRGs), which can be found in Section 7.5.0, Table 2 (EPA, 2022).

DHEC and DOE-SR had gross alpha and gross non-volatile beta detections in 2023. The summary statistics can be found in Section 7.6.0.

Cs-137 and Potassium-40 (K-40) were the only gamma-emitting radionuclides that DHEC and DOE-SR shared in analytical results. K-40 is a NORM decay product that will not be discussed further. Both DHEC and DOE-SR samples resulted in similar findings. DHEC had a sample location average of 0.12 pCi/g for Cs-137, which was slightly higher than DOE-SR's findings of

0.09 pCi/g. The PRG for C-137 is 28 pCi/g and all sample results were well below that level. Trending data for Cs-137 in sample locations is in Section 7.5.0, Figures 1 and 2.

The results found by both DHEC and DOE-SR are influenced by the number of samples used to determine the average and by collecting samples from different locations. The average level of Cs-137 in surface soil can vary due to the highly variable nature of soils. Radiocesium bioavailability in soil is influenced by soil properties such as clay content, pH, organic matter, and soil microflora (Absalom et al., 2001).

The only other gamma-emitting radionuclides detected in DHEC surface soil samples were lead-212, lead-214, radium-226, actinium-228, and thallium-234. These are NORM decay products.

7.2.2 Non-radiological Parameter Results

DOE-SR did not analyze for metals; therefore, no comparisons could be made. DHEC saw no exceedances of the EPA Regional Screening Levels (RSLs) in any of the surface soil samples in 2023 (EPA, 2021). A complete list of all DHEC non-radiological analytes and RSLs can be found in Section 7.5.0, Table 3.

Clearing away debris to expose soil

Barium has been a constituent of the H-Area Hazardous Waste Management Facility (WSRC, 1993). Barium was detected in 13 sample locations and the background location.

Beryllium is a strong, lightweight metal used in nuclear weapons that works as a shield for radiation and as a neutron source (Till et al., 2001). Beryllium was detected in 1 sample location.

Cadmium enters the atmosphere through fuel and coal combustion (Till et al. 2001). None of the surface soil sample locations yielded detections.

Chromium solutions were used at SRS as corrosive inhibitors. Chromium was a part of wastewater solutions resulting from dissolving stainless steel. It was also used in cleaning solutions in the separation's areas (Till et al., 2001). The legal disposal of fly ash on land as a result of burning coal is a contributor of both chromium and nickel to soils. Chromium was detected in 13 sample locations and the background location.

D-Area and the other coal combustion powerhouses emitted copper and other heavy metals (Till et al., 2001). These mechanisms are possible sources of elevated copper levels in surface soils. Copper was detected in 13 sample locations and the background location.
Atmospheric emissions of lead from SRS occurred through coal and fuel combustion (Till et al., 2001). Lead can accumulate in soils where its bioavailability can persist long-term (Alloway, 1995). Lead was detected in 8 sample locations.

Manganese has been released in the separation's areas processes and discharged to liquid waste tanks (Till et al., 2001). It is also a byproduct of coal burning. Manganese was detected in 13 sample locations and the background location.

Samples being prepared for lab

The largest anthropogenic source of nickel globally is the burning of fuels and coal combustion (Alloway, 1995). At SRS, nickel was directly released through M-Area effluent from the plating rinse tanks and through site use of diesel generators (Till et al., 2001). Nickel was detected in 4 sample locations.

Zinc was released in relatively small amounts to the separation's areas seepage basins as well as the M-Area seepage basin (Till et al., 2001). Zinc was detected in 13 sample locations and the background location.

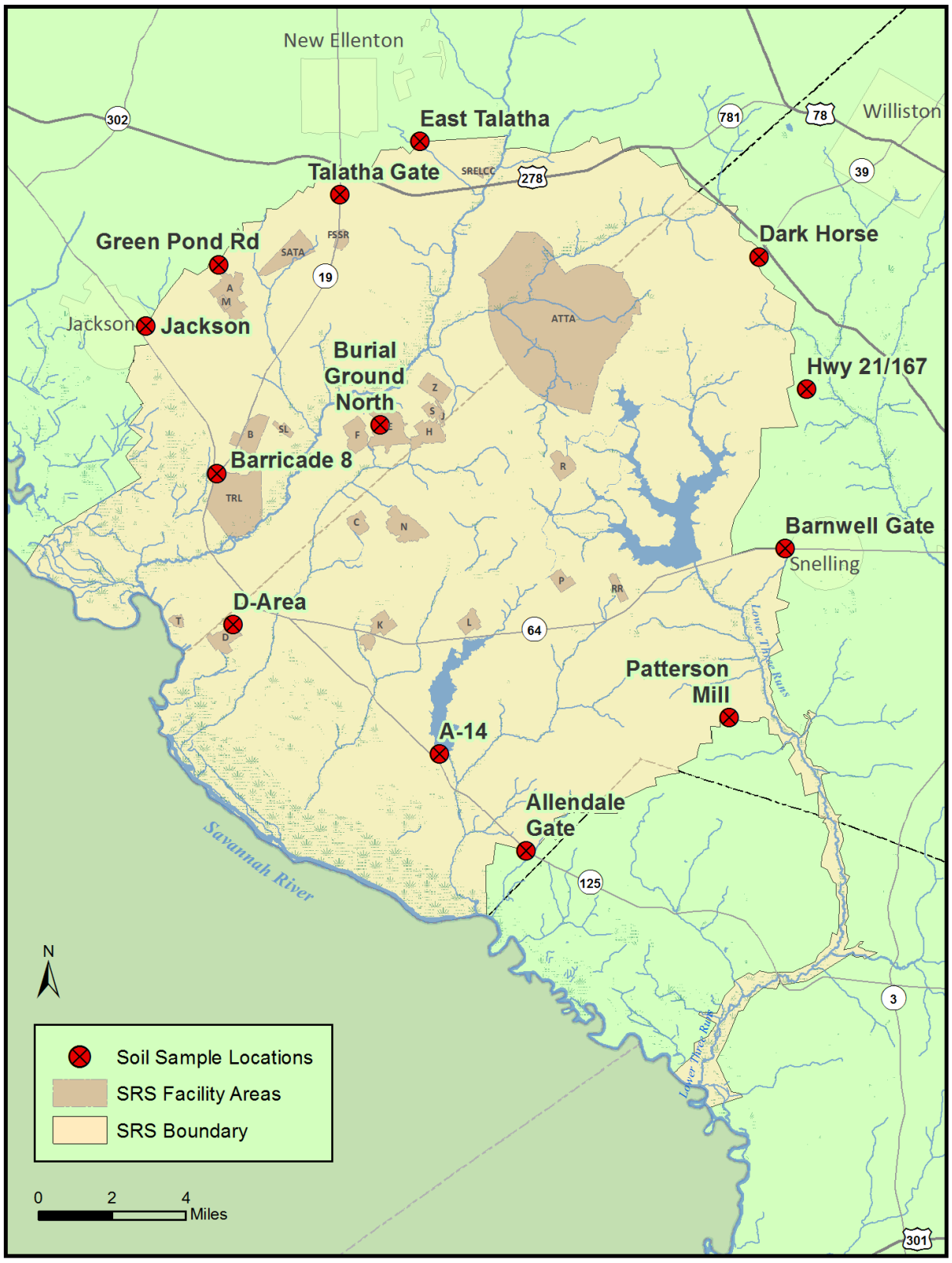
SRS facilities, such as F- and H-Area, tritium facilities, waste tanks, and the coal-fired power plants have emitted mercury to the atmosphere (Till et al., 2001). Atmospheric fallout contributes to mercury findings in surface soil. There were no mercury detections in surface soil samples collected in 2023.

7.3.0 CONCLUSIONS AND RECOMMENDATIONS

DHEC will continue to monitor the surface soil on and adjacent to SRS and will periodically evaluate modifications of the monitoring activities to better accomplish project goals and objectives. Monitoring will continue as long as there are activities at SRS that create the potential for contamination to enter the environment. Continued monitoring will provide an improved understanding of radionuclide and non-radionuclide activity in SRS perimeter surface soils and the surrounding areas. Additional monitoring will impart valuable information to human health exposure pathways. Trending of data over multiple years will give a more definitive answer as to whether radionuclide concentrations in the SRS area are declining due to radioactive decay or possibly increasing due to flooding, soil disturbances, and prescribed burns on SRS. The comparison of data allows for independent data verification of DOE-SR monitoring activities. Cooperation between DOE-SR and DHEC provides credibility and confidence in the information being provided to the public.

7.4.0 MAP

Surface Soil Monitoring Locations



2023 ESOP Soil Monitoring Map www.scdhec.gov

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7.5.0 TABLES AND FIGURES

Table 1. 2023 DHEC Surface Soil Monitoring Locations

On-Site and Perimeter Soil Samples		
Sample ID	**Location**	**County**
East Talatha	New Ellenton	Aiken
Talatha Gate	New Ellenton	Aiken
Burial Ground North	SRS	Aiken
Barricade 8	S.C. Hwy 125	Aiken
Jackson	Jackson	Aiken
Green Pond Rd	Near SRS Air Station at Green Pond	Aiken
A-14	SRS	Aiken
D-Area	SRS	Aiken
Allendale Gate	Air Station	Allendale
Barnwell Gate	Snelling	Barnwell
Hwy 21/167	Seven Pines Air Station	Barnwell
Dark Horse	U.S. Hwy 278	Barnwell
Patterson Mill	Patterson Mill Air Station	Barnwell
Background Soil Samples		
Sample ID	**Location**	**County**
Pinckney	Pinckney Island National Refuge	Beaufort

Table 2. Soil Ingestion Preliminary Remediation Goals of Select Anthropogenic Radionuclides (EPA, 2022)

Radionuclide	Peak PRG for Exposure through Ingestion (pCi/g)
Americium-241	4.95
Cesium-137	27.9
Cobalt – 60	82.8
Iodine-131	5,980
Plutonium-238	4.40
Plutonium-239/240	3.92

See note for Table 2 in Section 6.5.0

Table 3. Regional Screening Levels of Metals (EPA, 2021)

Analyte	RSL (mg/kg)
Barium	15,000
Beryllium	160
Cadmium	71
Total Chromium	23**
Copper	3,100
Lead	400
Manganese	1,800
Mercury	11
Nickel	1,500
Zinc	23,000

**The DHEC lab analyzes soil samples for total chromium; however, a RSL is not established for total chromium. The value provided in the table above is the ecological screening value for total chromium in soil.

7.5.0 TABLES AND FIGURES

Figure 1. 2019-2023 DHEC and DOE-SR Trending Averages for Cesium-137 (SRNS, 2020-2024; DHEC, 2020b-2023)

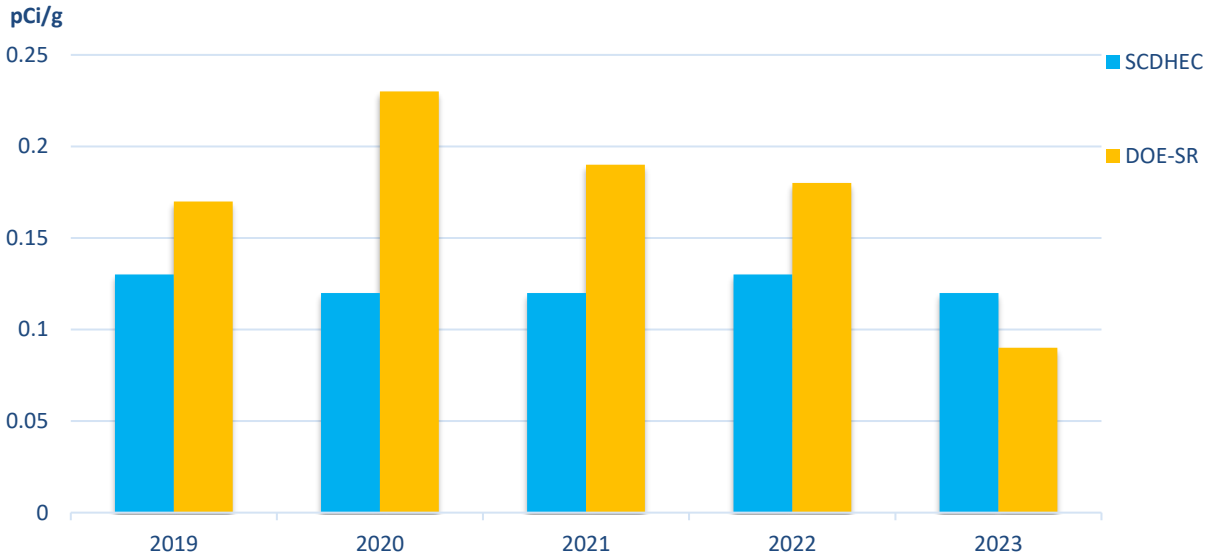
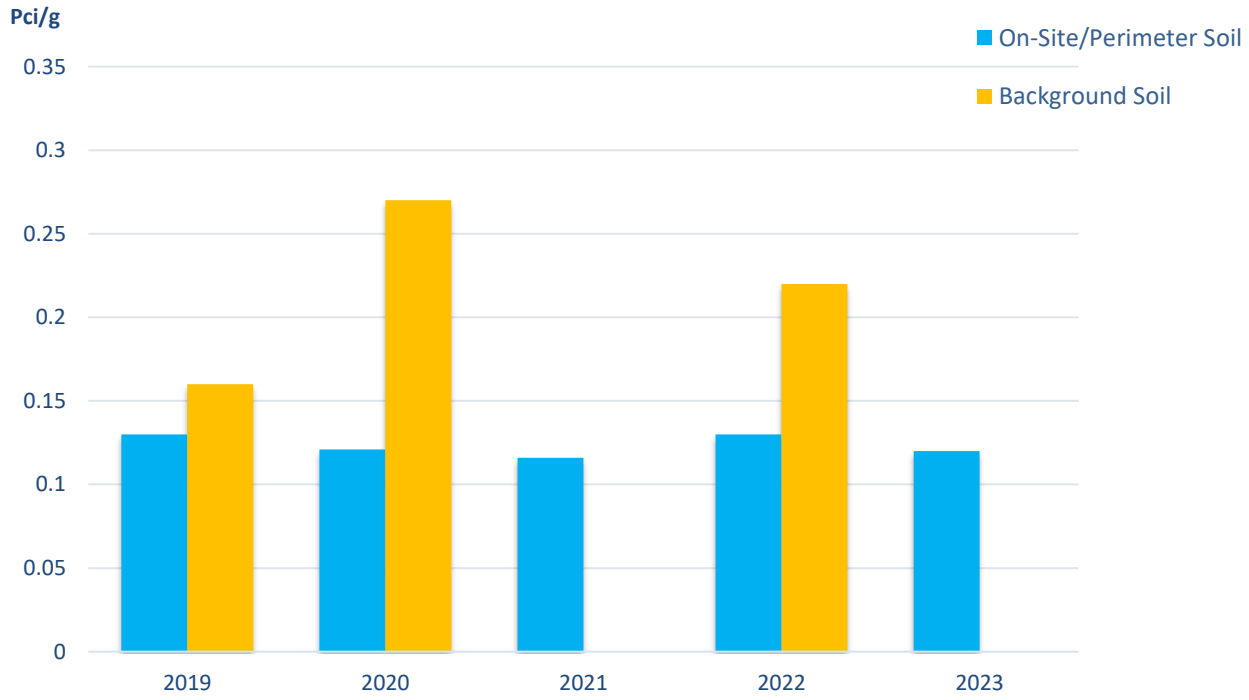


Figure 2. 2019-2023 On-Site/Perimeter and Background Trending Averages for Cesium-137 (DHEC 2020b – 2023)



Background samples were not collected in 2021 and had no detects in 2023.

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7.6.0 SUMMARY STATISTICS

2023 Alpha, Beta, & Cesium-137 Data Comparison for DHEC and DOE-SR Collocated Sampling Locations (SRNS, 2024)

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	11	NA	11	11	11	1	13
	6.95	4.73	5.61	2.33	21.00	13	13
Gross Beta	9.84	4.21	7.63	6.75	21.50	11	13
	7.85	4.82	6.51	4.22	18.20	7	13
Cs-137	0.12	0.05	0.10	0.04	0.22	12	13
	0.09	0.06	0.06	0.03	0.20	11	13

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.

2023 DHEC Radiological Statistics – Background Sample

Analyte	Average Concentration (pCi/g)	Standard Deviation	Median (pCi/g)	Minimum Detect (pCi/g)	Maximum Detect (pCi/g)	Number of Detections	Number of Samples
Gross Alpha	ND	ND	ND	ND	ND	0	1
Gross Beta	15.7	NA	15.7	15.7	15.7	1	1
Cs-137	ND	ND	ND	ND	ND	0	1

DOE-SR does not collect a background sample that is collocated with DHEC.

2023 DHEC Non-radiological (Metals) Statistics -- On-Site and Perimeter Samples

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples
Barium	17.17	7.56	16	8.40	32	13	13
Beryllium	0.42	NA	0.42	0.42	0.42	1	13
Cadmium	ND	ND	ND	ND	ND	0	13
Chromium	5.26	3.18	4	1.90	11	13	13
Copper	3.53	3.25	2.2	1	11	13	13
Lead	6.49	0.73	6.6	5.40	7.8	8	13
Manganese	87.15	69.35	59	15	230	13	13
Mercury	ND	ND	ND	ND	ND	0	13
Nickel	2.75	0.85	2.45	2.10	4	4	13
Zinc	26.55	37.16	7.1	4.50	140	13	13

7.6.0 SUMMARY STATISTICS

2023 DHEC Non-radiological (Metals) Statistics – Background Samples

Analyte	Average Concentration (mg/kg)	Standard Deviation	Median (mg/kg)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Number of Detections	Number of Samples
Barium	16	NA	16	16	16	1	1
Beryllium	ND	ND	ND	ND	ND	0	1
Cadmium	ND	ND	ND	ND	ND	0	1
Chromium	5.90	NA	5.90	5.90	5.90	1	1
Copper	1.80	NA	1.80	1.80	1.80	1	1
Lead	ND	ND	ND	ND	ND	0	1
Manganese	54	NA	54	54	54	1	1
Mercury	ND	ND	ND	ND	ND	0	1
Nickel	ND	ND	ND	ND	ND	0	1
Zinc	9	NA	9	9	9	1	1

NA is Not Applicable and ND is Not Detected

Chapter 8 Radiological Monitoring of Terrestrial Vegetation on and Adjacent to SRS

8.1.0 PROJECT SUMMARY

DOE-SR collects and analyzes terrestrial vegetation, primarily Bermuda grass, to determine concentrations of radionuclides (SRNS, 2024). In 2019, DHEC began sampling Bermuda grass (*cynodon dactylon*) to align with DOE-SR's methodology. If grass is unavailable, DHEC and DOE-SR will revert to collecting leaves from broad-leafed evergreen trees and shrubs. DHEC and DOE-SR locations are collocated with samples being obtained from 12 locations on and around SRS and 1 on-site center location at the burial grounds. DHEC joins DOE-SR personnel in the field to collect and split grass samples. DHEC also has a background location at Pinckney Island National Wildlife Refuge that is not collocated with DOE-SR. DHEC and DOE-SR 2023 sample locations are shown in Section 8.4.0, Map.

Preparing vegetation samples for analysis

8.2.0 RESULTS AND DISCUSSION

Terrestrial Vegetation Data

Terrestrial Vegetation Monitoring Data can be found in the 2023 DHEC Data File.

In 2023, DHEC detected tritium at its on-site center sample location (Burial Ground North – 0.420 pCi/g) and 2 perimeter sample locations (Green Pond Road – 0.250 pCi/g and D-Area – 0.370 pCi/g) (Section 8.6.0, Summary Statistics). DOE-SR had tritium detects in 1 perimeter sample location (Dark Horse – 0.055 pCi/g) (SRNS, 2024).

Bermuda grass samples

Tritium analysis results from DHEC and DOE-SR sampling are presented in Section 8.6.0, Summary Statistics.

Gamma

Cesium-137 (Cs-137) and potassium-40 were the only gamma-emitting radionuclides that DHEC and DOE-SR shared in analytical results. DHEC also detected beryllium-7. Potassium-40 and beryllium-7 are NORM; therefore, the results will not be discussed further but are presented in the 2023 DHEC Data File. A list of radionuclides in the gamma spectroscopy analysis are in the List of Analytes, Table 1, page ix.

Gamma analysis results for Cs-137 from DHEC and DOE-SR sampling in 2023 are presented in Section 8.6.0, Summary Statistics. The man-made isotopes Co-60 and Am-241 were not detected in the DHEC 2023 samples.

Prepared vegetation samples ready for analysis

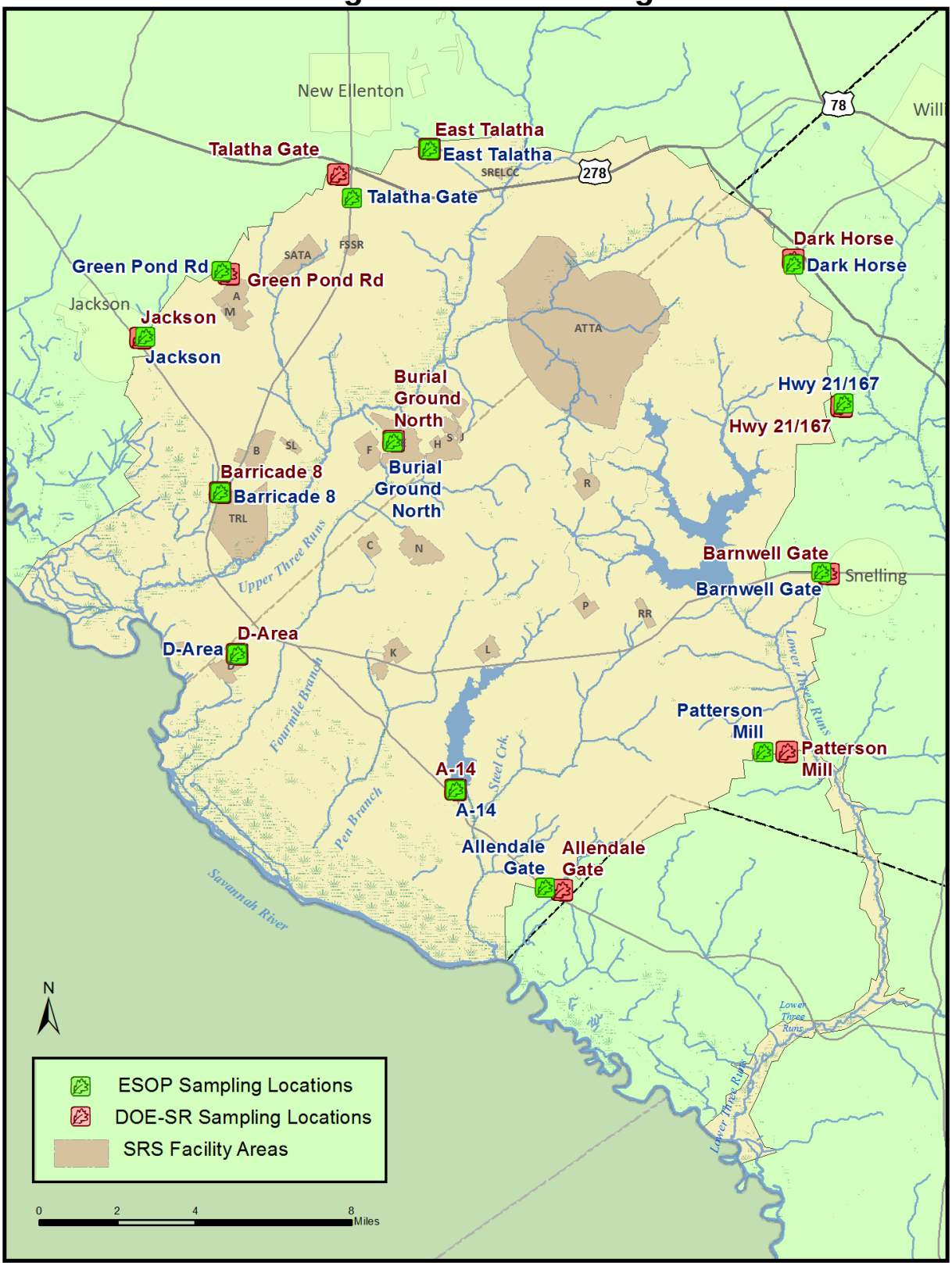
8.3.0 CONCLUSIONS AND RECOMMENDATIONS

In 2020, DHEC discontinued sampling at the three 25-mile radius locations (Hwy 301 Welcome Center, Augusta Loc and Dam, and the Aiken Airport). Two of these locations are located in Georgia, whereas DHEC's background sample is collected from Pinckney Island National Wildlife Refuge in Beaufort County, SC. In 2023, DHEC added A-14 as a sampling location to maintain direct data comparisons from collocations between DHEC and DOE-SR.

DHEC's revision of beginning to sample Bermuda grass on an annual basis in 2019 allows for a more direct comparison with the data collected by DOE-SR. By having parallel sampling techniques with DOE-SR, DHEC will potentially observe less differences in the data.

8.4.0 MAP

Terrestrial Vegetation Monitoring Locations



2023 ESOP Terestrial Vegetation Monitoring Map www.scdhec.gov

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8.5.0 TABLES AND FIGURES

Table 1. 2023 DHEC Terrestrial Vegetation Monitoring Locations

On-Site and Perimeter Terrestrial Vegetation Samples		
Sample ID	**Location**	**County**
East Talatha	New Ellenton	Aiken
Talatha Gate	New Ellenton	Aiken
Burial Ground North	SRS	Aiken
Barricade 8	S.C.Hwy 125	Aiken
Jackson	Jackson	Aiken
Green Pond Rd	Near SRS Air Station at Green Pond	Aiken
A-14	SRS	Aiken
D-Area	SRS	Aiken
Allendale Gate	Air Station	Allendale
Barnwell Gate	Snelling	Barnwell
Hwy 21/167	Seven Pines Air Station	Barnwell
Dark Horse	U.S. Hwy 278	Barnwell
Patterson Mill	Patterson Mill Air Station	Barnwell
Background Terrestrial Vegetation Samples		
Sample ID	**Location**	**County**
Pinckney	Pinckney Island National Refuge	Beaufort

8.6.0 SUMMARY STATISTICS

2023 Tritium Data Comparison for DHEC and DOE-SR Sampling Locations (SRNS, 2024)

Stations	DHEC Result (pCi/g)	DOE-SR Result (pCi/g)
On-Site Center Sample Location		
Burial Ground North	0.420	ND
On-Site/Perimeter Sample Locations		
Talatha Gate	ND	ND
Green Pond Rd	0.250	ND
Jackson	ND	ND
East Talatha	ND	ND
Dark Horse	ND	0.055
A-14	ND	ND
Patterson Mill	ND	ND
Barnwell Gate	ND	ND
Barricade 8	ND	ND
Highway 21/167	ND	ND
Allendale Gate	ND	ND
D-Area	0.370	ND
On-Site/Perimeter Locations' Summary Statistics – Tritium		
Average	0.310	0.055
Standard Deviation	0.085	NA
Median	0.310	0.055

NA is Not Applicable
ND is Not Detected
DHEC's background location at Pinckney did not detect tritium in 2023. No background sample was collected at Pinckney for DOE-SR.
No summary statistics for each location were shown due to only one sample being taken per location.

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8.6.0 SUMMARY STATISTICS

2023 Cesium-137 Data Comparison for DHEC and DOE-SR Sampling Locations (SRNS, 2024)

Stations	DHEC Result (pCi/g)	DOE-SR Result (pCi/g)
On-Site Center Sample Location		
Burial Ground North	ND	ND
On-Site/Perimeter Sample Locations		
Talatha Gate	ND	ND
Green Pond Rd	0.017	ND
Jackson	ND	ND
East Talatha	0.045	0.172
Dark Horse	0.020	ND
A-14	ND	ND
Patterson Mill	0.099	0.202
Barnwell Gate	ND	0.245
Barricade 8	ND	ND
Highway 21/167	0.083	ND
Allendale Gate	0.070	0.537
D-Area	ND	ND
On-Site/Perimeter Locations' Summary Statistics – Cs-137		
Average	0.056	0.289
Standard Deviation	0.034	0.168
Median	0.058	0.224

ND is Not Detected
DHEC's background location at Pinckney had no detection of Cs-137. No background sample was collected at Pinckney for DOE-SR.
No summary statistics for each location were shown due to only one sample being taken per location.

Chapter 9 Radiological Monitoring of Edible Vegetation Adjacent to SRS

9.1.0 PROJECT SUMMARY

The Radiological Monitoring of Edible Vegetation Project is a component of the DHEC's ESOP that monitors edible vegetation from the SRS perimeter and background locations.

Foraging for wild plums

DHEC defined a study area comprised of grids radiating out to 25 miles from the SRS center point, 25 miles to 50 miles, and background locations greater than 50 miles from the SRS center point (Map in Section 9.4.0). DOE-SR, as compared to DHEC, has 5 defined quadrants where samples are collected annually: 4 quadrants are within 10 miles of SRS in each direction (NE, NW, SE, SW), along with 1 quadrant located within 25 miles SE. Direct comparisons between DOE-SR and DHEC could not be made due to variation in sampling and analysis methodologies.

Edible vegetation is collected based solely on availability and is directly dependent upon the growing season. Certain farmers, gardeners, and/or businesses surrounding the perimeter of SRS contribute domestically grown crops. Wild, edible vegetation, such as muscadines and plums, are also collected. References to vegetation in this section pertain to the edible parts of plants.

DHEC background sampling helps to separate atomic test fallout contamination levels and other sources (e.g., ongoing permitted releases at other nuclear facilities) from SRS source potential contamination. However, fallout dispersion patterns and concentrations are weather related and not uniform, and no assignment of a specific source can be made. DHEC did not collect a background sample in 2023.

9.2.0 RESULTS AND DISCUSSION

Edible Vegetation Monitoring Data can be found in the 2023 DHEC Data File.

Blended samples to be sent to the Columbia lab for analysis

The U.S. Food and Drug Administration (FDA) has guidance levels for specific radionuclides called Derived Intervention Levels (DILs). The FDA adopted DILs to help determine whether domestic food in interstate commerce or food offered for import into the United States presents a safety concern (FDA, 2020).

Blending squash for analysis

DHEC detected tritium in 2 samples of fruit from the NE-1 quadrant with an average detection of 0.243 pCi/L in 2023. DOE-SR had no detections of tritium in any of their edible vegetation samples in 2023 (SRNS, 2024).

In 2023, DOE-SR edible vegetation exhibited radiological detections of nonvolatile beta, cesium-137, potassium-40, plutonium-238, plutonium-239/40, strontium-90, neptunium-237, americium-241, curium-243/244, uranium-233/234, uranium-235, and uranium-238 (SRNS, 2024). Cesium-137, Potassium-40, and lead-214 were the only gamma analytes detected in 2023 in DHEC samples. All the detected gamma radionuclides, except Cs-137, are NORM and are the source of most detections in edible vegetation; therefore, they are not discussed further.

The FDA-derived Guidance Level for Cs-137 is 32.4 pCi/g (FDA, 2020). DHEC detected Cs-137 in 1 sample of fungi from W-1 quadrant at 0.21 pCi/g and in 1 sample of fungi from E-1 quadrant at 0.25 pCi/g. DOE-SR had a detection of Cs-137 in 1 of the 20 samples collected in 2023 at 0.023 pCi/g in the NE quadrant 10 Miles (SRNS, 2024).

9.3.0 CONCLUSIONS AND RECOMMENDATIONS

DHEC and DOE-SR have different edible vegetation sampling schemes. DOE-SR samples primarily domestic plants collected from annual contributors in quadrants at zero to 10 miles from the perimeter of the SRS border and one quadrant at 25 miles. DHEC accepts domestic plants as donations from citizens and collects perennial, wild, edible vegetation and fungi found within 50 miles of the SRS center and background locations (Section 9.4.0).

In the future, DHEC will explore opportunities to split samples with DOE-SR and attempt to establish collocated sampling locations for better comparisons between the two. In addition, DHEC will continue to collect wild fungi due to its inherent ability to bioconcentrate Cs-137.

Collecting zucchini in a garden

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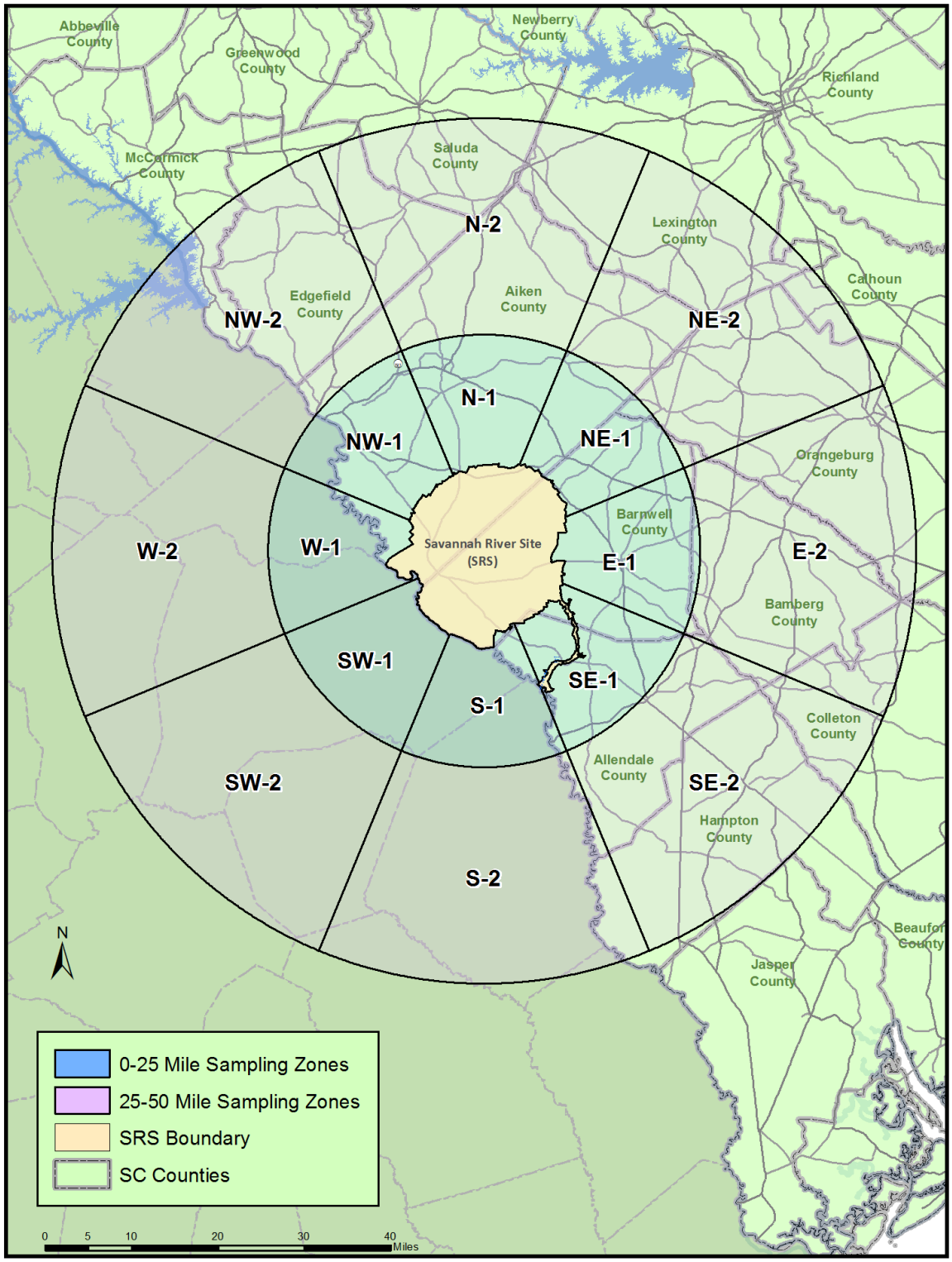
9.4.0 MAP

Edible Vegetation Monitoring Locations



Note: Though zones are highlighted in Georgia, samples are only collected in South Carolina.

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Chapter 10 Radiological Monitoring of Dairy Milk

10.1.0 PROJECT SUMMARY

Operations at SRS have resulted in the potential for radiological constituents to be released to the surrounding environment (Till et al., 2001). Consumption of milk products containing radioactive materials can be a human exposure pathway. When an atmospheric release occurs, radionuclides can be deposited on pastures and ingested by grazing dairy animals. The animals may release a portion of the radionuclides into their milk that could be consumed by humans (CDC, 2001). Radionuclides could also enter milk through the irrigation of a pasture using groundwater containing radioactive materials and through uptake by plants from soil containing radioactive materials.

In 2023, DHEC collected milk from four dairies within South Carolina (Section 10.4.0, Map). All four of these locations are within a 50-mile radius to the center of SRS. This project provides analytical data for trending and comparison to published DOE-SR data. DHEC and DOE-SR have varying sampling locations. Comparisons are based on each program's respective results.

Milk samples collected for analysis

DHEC personnel collected unpasteurized milk samples on a quarterly basis in 2023. All milk samples from each quarter were analyzed for tritium, Sr-89/90, and gamma-emitting radionuclides. While a select group of gamma-emitting radionuclides (iodine-131 (I-131), cesium-137 (Cs-137), and cobalt-60 (Co-60)) are analytes of concern in dairy milk for this project, all other detections such as potassium-40 (K-40) are considered NORM and will not be discussed further. DHEC analyzes samples for total strontium (Sr-89/90) instead of only Sr-90. This is done to provide a more conservative result, and it is assumed the total strontium detected is in the form of Sr-90.

10.2.0 RESULTS AND DISCUSSION

None of the 16 DHEC milk samples collected in 2023 exhibited tritium activity above the LLD (2023 DHEC Data File). DOE-SR did not detect tritium above the LLD in any of the samples collected in 2023 from the South Carolina dairies as well (SRNS, 2024).

DHEC analyzed for gamma-emitting radionuclides (K-40, I-131, Cs-137, and Co-60) in 16 milk samples collected in 2023. All analytical results for these radionuclides were below the sample MDA, except for naturally occurring K-40 at all locations and 2 detects of Cesium-137 at MK-25 with an average concentration of 4.98 pCi/L. These results can be found in the 2023 DHEC Data File. DOE-SR had no detections of Cs-137 in their 15 cow milk samples from South Carolina dairies (SRNS, 2024). Variations in data may be attributed to differences between sampling locations and frequency for DHEC and DOE-SR.

8 of the 16 DHEC milk samples collected in 2023 exhibited strontium activity above the MDA with an average of 0.775 pCi/L. Section 10.5.0, Figure 1 shows the trend for DHEC strontium detections for the last five years. All strontium averages have been below the EPA established

MCL of 8 pCi/L for Sr-90 in drinking water (EPA, 2020) since testing initiated in 1998. DOE-SR had 2 detections of Sr-89/90 in their 15 cow milk samples with an average of 1.790 pCi/L collected in 2023 in South Carolina (SRNS, 2024).

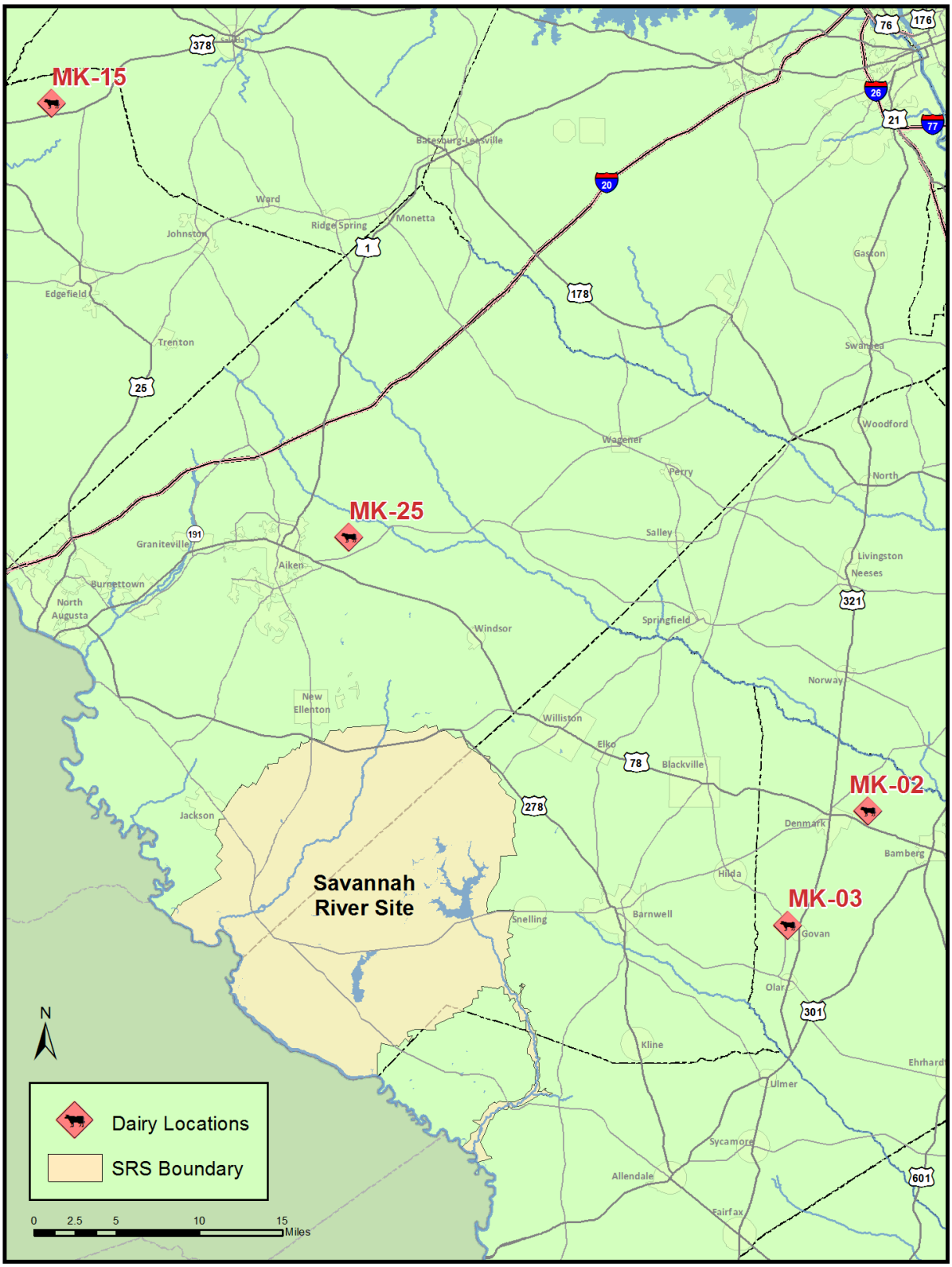
10.3.0 CONCLUSIONS AND RECOMMENDATIONS

A large portion of the radiological activity observed in milk samples can be attributed to fallout from past nuclear testing (Kathren, 1984). Also, radionuclides within soil and plants can potentially be redistributed because of farming practices and fires. Due to strontium's ability to be stored in bones and cesium building up in muscles, DHEC will continue to monitor tritium, gamma-emitting radionuclides, and strontium in milk to ensure the safety of milk consumption by the public.

The remaining dairies in DHEC's study area appear to be stable with no indication of closing in the foreseeable future. DHEC will continue to seek opportunities to add additional dairies to the sampling program for better coverage of the study area.

10.4.0 MAP

Radiological Dairy Milk Monitoring Locations



2023 ESOP Dairy Milk Monitoring Map www.scdhec.gov

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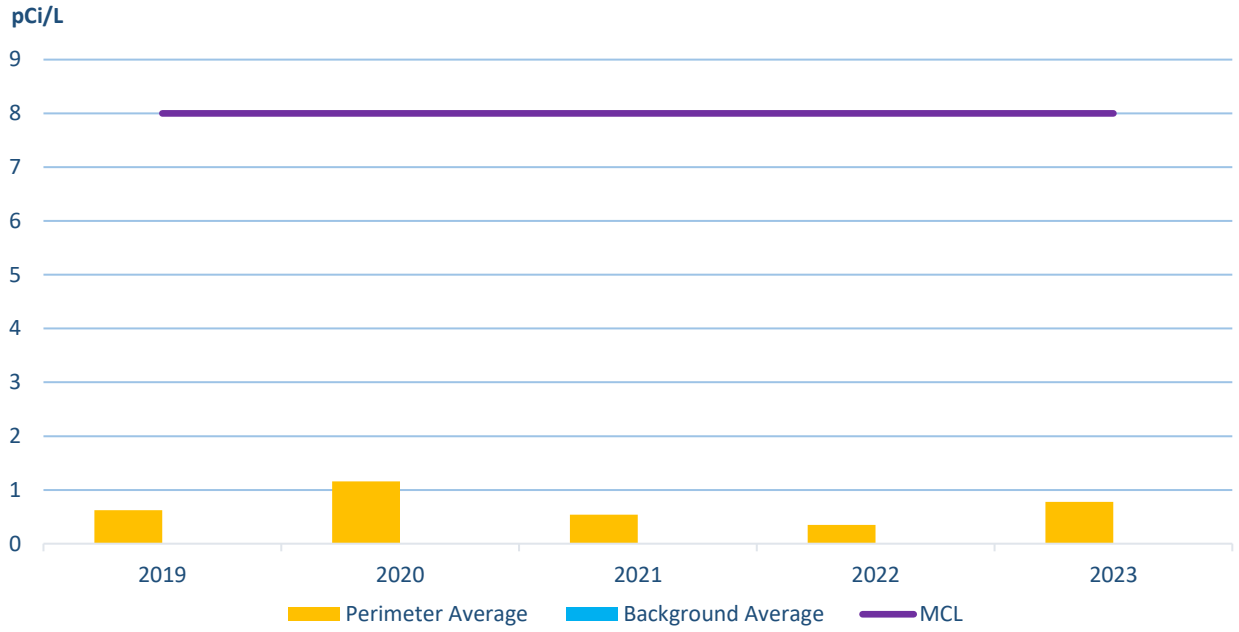
10.5.0 TABLES AND FIGURES

Figure 1. DHEC Average Strontium-89/90 Data Trends for 2019-2023 (DHEC, 2020b-2023)



No bar indicates <MDA

10.6.0 SUMMARY STATISTICS

2023 Strontium-89/90 All Sample Detections

Sample Location	Average (pCi/L)	Standard Deviation	Median (pCi/L)	Minimum Detect (pCi/L)	Maximum Detect (pCi/L)	Number of Detections	Number of Samples
MK-02	1.35	NA	1.35	1.35	1.35	1	4
MK-03	0.71	0.16	0.77	0.53	0.84	3	4
MK-15	0.60	NA	0.60	0.60	0.60	1	4
MK-25	0.71	0.37	0.89	0.28	0.96	3	4

NA is Not Applicable
ND is Not Detected
MK-25 was added for sampling in 2023.

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Chapter 11 Monitoring of Fish Adjacent to SRS

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11.1.0 PROJECT SUMMARY

DHEC conducts non-regulatory, independent monitoring and surveillance of fish to determine the magnitude, extent, and trend levels for radionuclides and select metals.

Electroshocking boat on the Savannah River

In 2023, DHEC collected largemouth bass (*Micropterus salmoides)*, channel catfish (*Ictalurus punctatus*), and flathead catfish (*Pylodictis olivaris*) from four stations where creeks from SRS meet the Savannah River: Upper Three Runs Creek (SV-2011), Fourmile Branch (SV-2015), Steel Creek (SV-2017), and Lower Three Runs Creek (SV-2020). Samples of largemouth bass and channel catfish were also collected from the background station on the Combahee River between Beaufort and Colleton counties (MD-119), one Savannah River station upstream of SRS (New Savannah Bluff Lock and Dam, NSBLD SV-2028), and two stations downstream of SRS (Highway 301, SV-118 and Highway 17 (saltwater), SV-2091). SV-2091 is the only area where striped mullet (*Mugil cephalus*) and red drum (*Sciaenopsocellatus*) are caught. Flathead catfish were also collected at SV-118 and SV-2028. Stations sampled in 2023 are shown in Section 11.4.0, Map. These stations are accessible to the public.

A total of 5 largemouth bass and 5 channel catfish were collected and composited from all Savannah River stations. 5 red drum and 5 striped mullet were collected and composited from the saltwater station (SV-2091) along with 5 largemouth bass and 5 channel catfish collected and composited from the Combahee River background sampling location. Non-edible portions (bone) were tested for Sr-89/90. DOE-SR only analyzes Sr-90 while DHEC analyzes Sr-89/90. Edible portions (muscle tissue) were analyzed for mercury and other select metals and gamma-emitting isotopes. 5 flathead catfish were also composited and tested for gamma-emitting radionuclides in muscle tissue and strontium in bone tissue. In 2023, DOE-SR discontinued the sampling process for individual, large flathead catfish. Due to this, DHEC will no longer be collecting individual, large flathead catfish starting in 2024 as there will be no direct comparison with DOE-SR data. DHEC did collect 6 individual, large flathead catfish in 2023. Tritium has been found to contribute to “less than 1% of the estimated total fisherman dose” (SRNS, 2016). This is due to tritium’s ability to reach concentration equilibrium (the ability of a chemical to balance out) in both water and fish flesh resulting in no bioaccumulation (build up) in fish muscle

Catching a largemouth bass

(SRNS, 2016). With this discovery, DOE-SR and DHEC have at this time discontinued their testing of tritium in fish flesh.

11.2.0 RESULTS AND DISCUSSION

Fish Monitoring Summary Statistics can be found in Section 11.6.0 and all Fish Monitoring Data can be found in the 2023 DHEC Data File.

Prepared fish samples ready for laboratory analysis

11.2.1 Radiological Data Comparison

DHEC bass and catfish data collected in 2023 were compared to DOE-SR data (Section 11.5.0) (SRNS, 2024). One difference between the two programs is that DHEC analyzes one composite from each species for each station, whereas the DOE-SR program analyzes three composites per station for Cs-137. Therefore, a single composite for a DHEC station was compared to the average of the three DOE-SR composites reported. For Sr-90, DOE-SR reports composite sample results. To compare Sr-89/90 data, the average of 3 composite Sr-90 DOE-SR samples for each location are compared to the one Sr-89/90 composite sample of DHEC.

Blending fish samples for sample preparation

Trending graphs for 2023 activity levels of Cs-137 and Sr-89/90 are reported in Section 11.5.0, Figures 1 and 2.

11.2.2 Non-radiological Data Comparison

DHEC and DOE-SR analyzed fish for antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc. DHEC did have detections of chromium, copper, manganese, mercury, nickel, and zinc in some of its edible fish samples. Due to differences in sampling methodology, direct comparisons were not made between DHEC and DOE-SR for these non-radiological constituents; however, since mercury tends to be a public health focus with fish consumption, a comparison was made for bass and both catfish species (Section 11.5.0, Table 9, 10, 11, and 12). In 2023, DHEC had 1 composite sample per species tested for mercury while DOE-SR had 7 individual samples per species tested for mercury per location. Therefore, the 1 composite of DHEC species were compared to the averages of 7 samples of DOE-SR species for mercury. Mercury trends for 2023 are reported in Section 11.5.0, Figure 3.

11.3.0 CONCLUSIONS AND RECOMMENDATIONS

Higher levels of radionuclides are found in Savannah River fish collected adjacent to and downstream of SRS compared to upstream. Therefore, independent monitoring of radionuclide levels in Savannah River fish will continue along with evaluating the DOE-SR Radiological Fish Monitoring Program. Continued monitoring will provide a better understanding of actual radionuclides, their extent, and trends. This data will allow DHEC to advise and inform the public. Data comparison will also be part of the further evaluation of the DOE-SR program. This independent evaluation will provide credibility and confidence in the DOE-SR data and its uses. Future analyses of the target species will continue to include mercury and select metals. This will augment the existing data on Savannah River fish, provide information for human health assessment, and provide another basis for comparison of results with DOE-SR data.

Flathead Catfish

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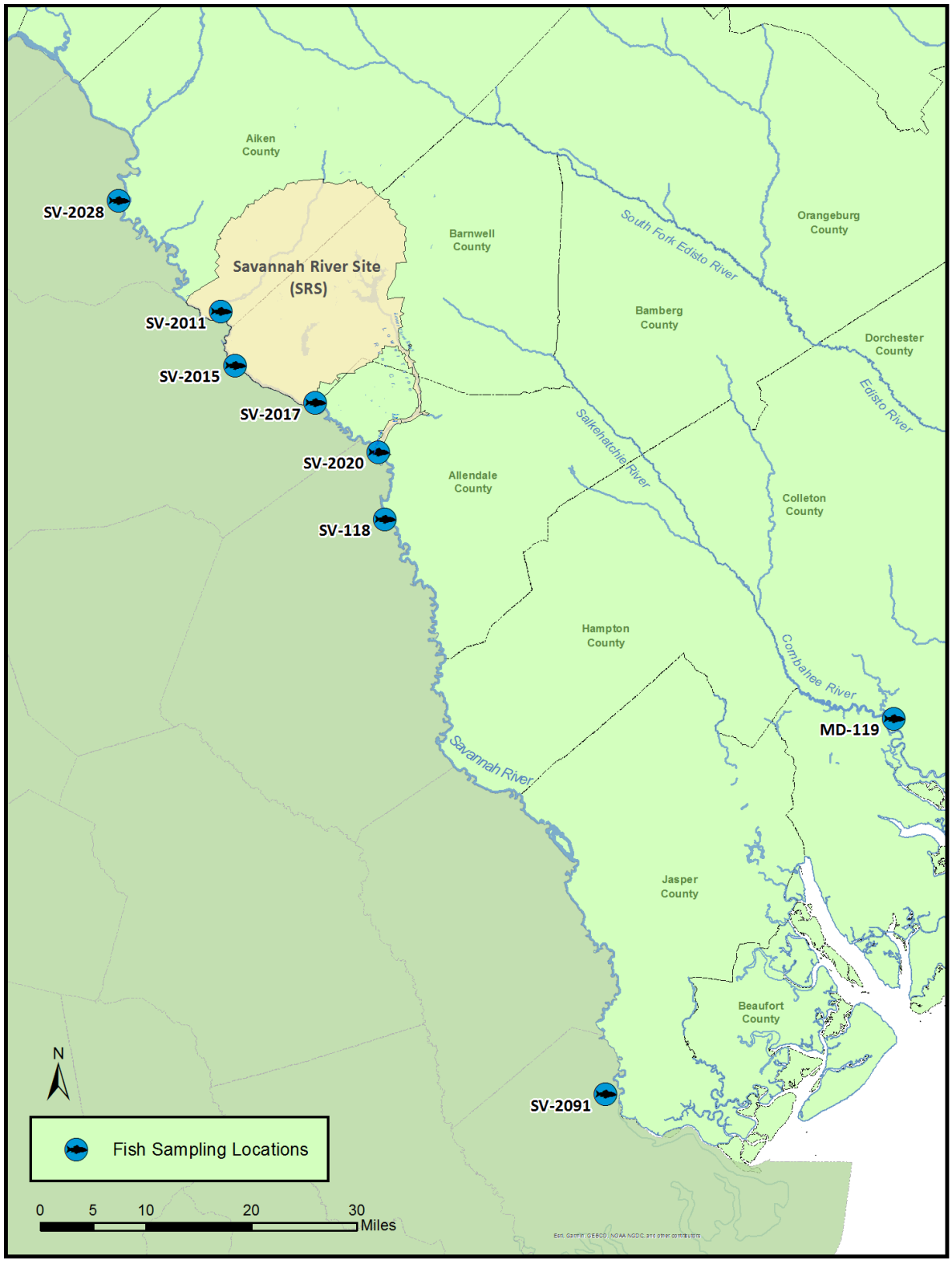
11.4.0 MAP

Fish Monitoring Locations



2023 ESOP Fish Monitoring Map www.scdhec.gov

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11.5.0 TABLES AND FIGURES

2023 DHEC and DOE-SR Data Comparison (SRNS, 2024)

Notes for Table 1-12:
ND is Not Detected
NS is Not Sampled
DOE-SR data are averages.
DHEC submits one composite sample per species for each location, whereas DOE-SR typically submits three composite samples per species for Cs-137, three composite samples per species for Sr-90, and seven individual samples per species for Mercury at each location (however, there may be variation within each year).
In 2023, DOE-SR discontinued their process of sampling for individual large flathead catfish. Due to this, Tables 4, 8, and 12 will have NS for DOE-SR Number of Detects and Result.

Table 1. Cesium-137 in Edible Bass

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	0	ND
	DOE-SR	0	ND
Upper Three Runs	DHEC	0	ND
	DOE-SR	1	0.030
Fourmile Branch	DHEC	0	ND
	DOE-SR	3	0.069
Steel Creek	DHEC	1	0.026
	DOE-SR	2	0.058
Lower Three Runs	DHEC	1	0.039
	DOE-SR	3	0.144
Hwy. 301	DHEC	0	ND
	DOE-SR	2	0.016

Table 2. Cesium-137 in Edible Channel Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	0	ND
	DOE-SR	1	0.035
Upper Three Runs	DHEC	0	ND
	DOE-SR	1	0.042
Fourmile Branch	DHEC	1	0.056
	DOE-SR	3	0.023
Steel Creek	DHEC	1	0.062
	DOE-SR	3	0.090
Lower Three Runs	DHEC	1	0.300
	DOE-SR	3	0.043
Hwy. 301	DHEC	0	ND
	DOE-SR	2	0.012

11.5.0 TABLES AND FIGURES

2023 DHEC and DOE-SR Data Comparison (SRNS, 2024)

Table 3. Cesium-137 in Edible Composite Flathead Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	0	ND
	DOE-SR	0	ND
Upper Three Runs	DHEC	0	ND
	DOE-SR	1	0.018
Fourmile Branch	DHEC	1	0.062
	DOE-SR	1	0.031
Steel Creek	DHEC	1	0.060
	DOE-SR	3	0.080
Lower Three Runs	DHEC	1	0.038
	DOE-SR	3	0.129
Hwy. 301	DHEC	1	0.025
	DOE-SR	3	0.023

Table 4. Cesium-137 in Edible Individual Large Flathead Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	1	0.036
	DOE-SR	NS	NS
Upper Three Runs	DHEC	1	0.048
	DOE-SR	NS	NS
Fourmile Branch	DHEC	1	0.066
	DOE-SR	NS	NS
Steel Creek	DHEC	1	0.083
	DOE-SR	NS	NS
Lower Three Runs	DHEC	1	0.156
	DOE-SR	NS	NS
Hwy. 301	DHEC	1	0.028
	DOE-SR	NS	NS

Table 5. Strontium-89/90 in Non-Edible Bass

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	0	ND
	DOE-SR	2	0.446
Upper Three Runs	DHEC	0	ND
	DOE-SR	3	0.580
Fourmile Branch	DHEC	0	ND
	DOE-SR	3	0.892
Steel Creek	DHEC	1	0.192
	DOE-SR	3	0.890
Lower Three Runs	DHEC	0	ND
	DOE-SR	3	0.456
Hwy. 301	DHEC	0	ND
	DOE-SR	3	0.548

Table 6. Strontium-89/90 in Non-Edible Channel Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	0	ND
	DOE-SR	3	0.544
Upper Three Runs	DHEC	0	ND
	DOE-SR	3	0.467
Fourmile Branch	DHEC	1	0.242
	DOE-SR	3	0.782
Steel Creek	DHEC	1	0.160
	DOE-SR	3	0.759
Lower Three Runs	DHEC	0	ND
	DOE-SR	3	0.453
Hwy. 301	DHEC	0	ND
	DOE-SR	1	0.591

11.5.0 TABLES AND FIGURES

2023 DHEC and DOE-SR Data Comparison (SRNS, 2024)

Table 7. Strontium-89/90 in Non-Edible Composite Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	0	ND
	DOE-SR	3	0.555
Upper Three Runs	DHEC	1	0.161
	DOE-SR	3	0.460
Fourmile Branch	DHEC	1	0.119
	DOE-SR	2	0.506
Steel Creek	DHEC	1	0.117
	DOE-SR	3	0.560
Lower Three Runs	DHEC	1	0.075
	DOE-SR	2	0.467
Hwy. 301	DHEC	0	ND
	DOE-SR	2	0.600

Table 8. Strontium-89/90 in Non-Edible Individual Large Flathead Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	0	ND
	DOE-SR	NS	NS
Upper Three Runs	DHEC	0	ND
	DOE-SR	NS	NS
Fourmile Branch	DHEC	0	ND
	DOE-SR	NS	NS
Steel Creek	DHEC	1	0.118
	DOE-SR	NS	NS
Lower Three Runs	DHEC	0	ND
	DOE-SR	NS	NS
Hwy. 301	DHEC	1	0.095
	DOE-SR	NS	NS

Table 9. Mercury in Edible Bass

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	1	0.24
	DOE-SR	7	0.32
Upper Three Runs	DHEC	1	0.34
	DOE-SR	7	0.59
Fourmile Branch	DHEC	1	0.47
	DOE-SR	7	0.39
Steel Creek	DHEC	1	0.66
	DOE-SR	7	0.39
Lower Three Runs	DHEC	1	0.32
	DOE-SR	7	0.51
Hwy. 301	DHEC	1	0.44
	DOE-SR	7	0.54

Table 10. Mercury in Edible Channel Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	1	0.14
	DOE-SR	7	0.17
Upper Three Runs	DHEC	1	0.12
	DOE-SR	7	0.15
Fourmile Branch	DHEC	1	0.21
	DOE-SR	7	0.17
Steel Creek	DHEC	1	0.32
	DOE-SR	7	0.18
Lower Three Runs	DHEC	1	0.14
	DOE-SR	7	0.22
Hwy. 301	DHEC	1	0.16
	DOE-SR	7	0.17

11.5.0 TABLES AND FIGURES

2023 DHEC and DOE-SR Data Comparison (SRNS, 2024)

Table 11. Mercury in Edible Composite Flathead Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	1	0.15
	DOE-SR	7	0.20
Upper Three Runs	DHEC	1	0.25
	DOE-SR	7	0.19
Fourmile Branch	DHEC	1	0.14
	DOE-SR	7	0.20
Steel Creek	DHEC	1	0.38
	DOE-SR	7	0.28
Lower Three Runs	DHEC	1	0.24
	DOE-SR	7	0.36
Hwy. 301	DHEC	1	0.17
	DOE-SR	7	0.24

Table 12. Mercury in Edible Individual Large Flathead Catfish

Location	Agency	Number of Detects	Result (pCi/g)
NSBLD	DHEC	1	0.52
	DOE-SR	NS	NS
Upper Three Runs	DHEC	1	0.65
	DOE-SR	NS	NS
Fourmile Branch	DHEC	1	0.78
	DOE-SR	NS	NS
Steel Creek	DHEC	1	0.80
	DOE-SR	NS	NS
Lower Three Runs	DHEC	1	0.23
	DOE-SR	NS	NS
Hwy. 301	DHEC	1	0.49
	DOE-SR	NS	NS

11.5.0 TABLES AND FIGURES

Notes for Figures 1-3:
Missing bars indicate <MDA
Red Drum and Mullet samples could not be analyzed for mercury due to a holding time error.

Figure 1. 2023 DHEC Cesium-137 in Fish Composites

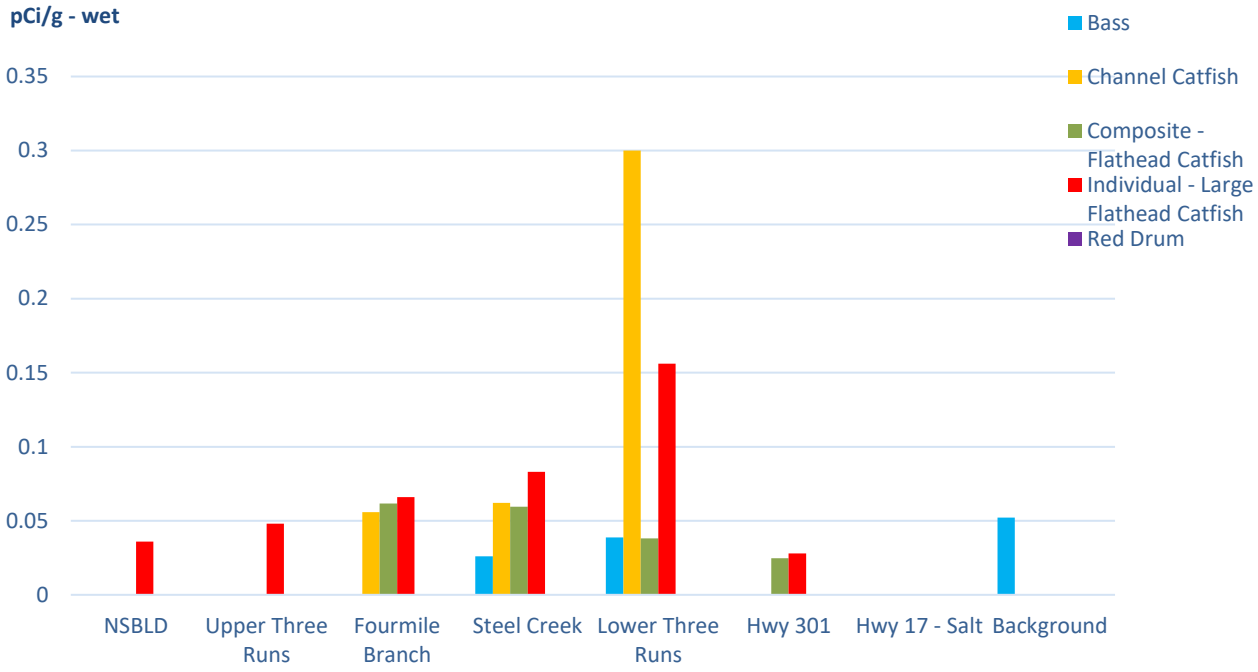
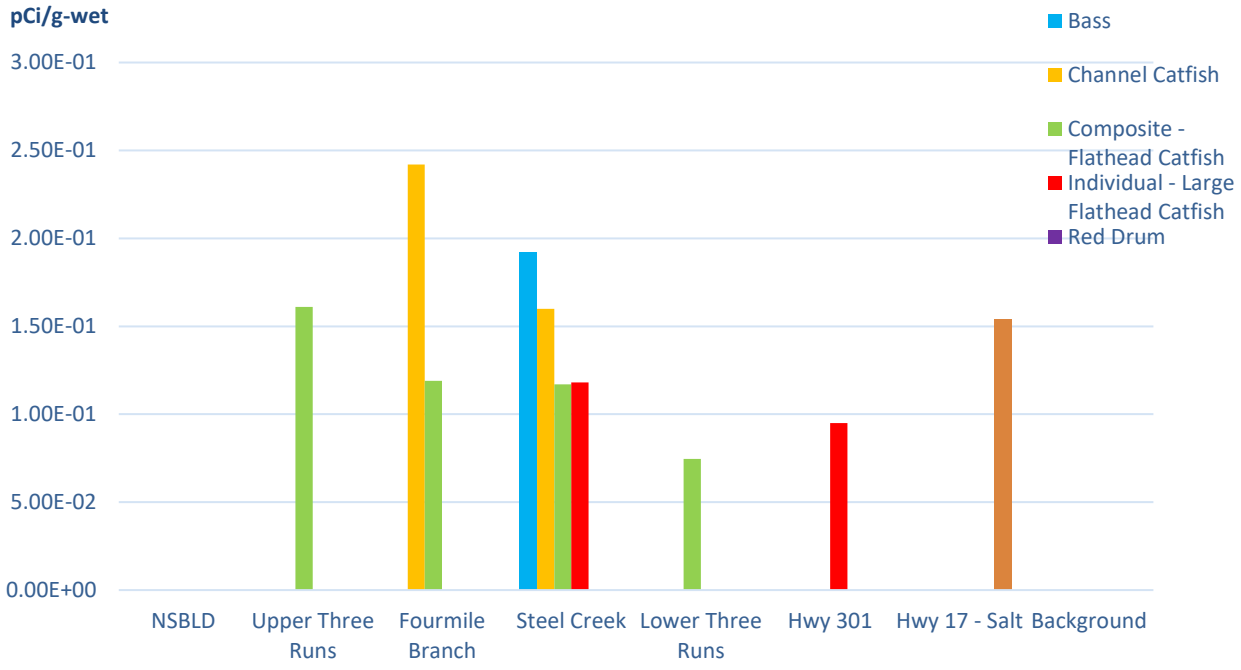


Figure 2. 2023 DHEC Strontium-89/90 in Fish Bone Composites



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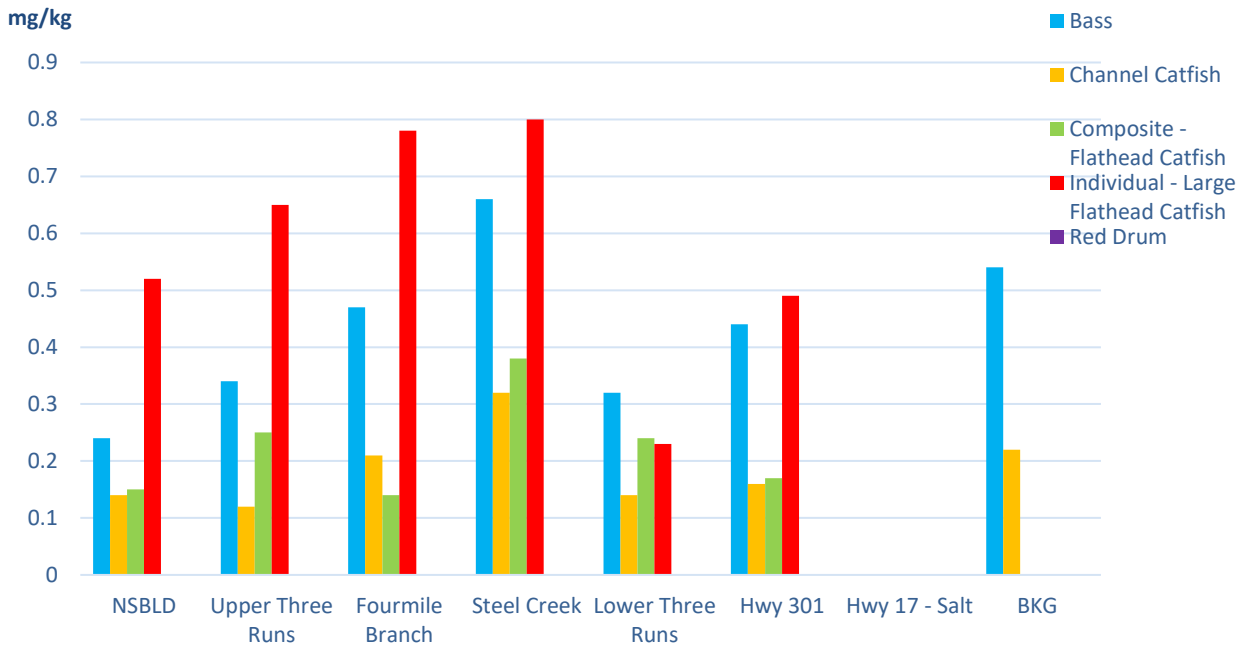
11.5.0 TABLES AND FIGURES

Figure 3. 2023 DHEC Mercury in Fish



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11.6.0 SUMMARY STATISTICS

2023 DHEC Cesium-137 Levels in Savannah River Fish (pCi/g–wet)

Edible	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects	Number of Samples
Bass	0.032	0.009	0.032	0.026	0.039	2	6
Channel Catfish	0.139	0.139	0.062	0.056	0.300	3	6
Composite - Flathead Catfish	0.046	0.018	0.049	0.025	0.062	4	6
Individual – Large Flathead Catfish	0.070	0.047	0.057	0.028	0.156	6	6

Cs-137 results represent the activity level in fish tissue.

2023 DHEC Strontium-89/90 Levels in Savannah River Fish (pCi/g–wet)

Edible	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects	Number of Samples
Bass	0.192	NA	0.192	0.192	0.192	1	6
Channel Catfish	0.201	0.058	0.201	0.160	0.242	2	6
Composite - Flathead Catfish	0.118	0.035	0.118	0.075	0.161	4	6
Individual – Large Flathead Catfish	0.107	0.016	0.107	0.095	0.118	2	6

NA means Not Applicable
Sr-89/90 results represent the activity level in an aliquot of fish bone.

11.6.0 SUMMARY STATISTICS

2023 DHEC Mercury Levels in Savannah River Fish (mg/kg)

Edible	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detects	Number of Samples
Bass	0.412	0.148	0.390	0.240	0.660	6	6
Channel Catfish	0.182	0.074	0.150	0.120	0.320	6	6
Composite - Flathead Catfish	0.222	0.090	0.205	0.140	0.380	6	6
Individual – Large Flathead Catfish	0.578	0.213	0.585	0.230	0.800	6	6

Mercury results represent the activity level in fish tissue.

Chapter 12 Radiological Monitoring of Game Animals on and Adjacent to SRS

12.1.0 PROJECT SUMMARY

DHEC conducts game animal monitoring activities around SRS due to white-tailed deer and feral hogs having the highest potential of mammalian species for human exposure pathway from Cesium-137 (Cs-137) (Haselow, 1991). The game animal project addresses concerns of potentially contaminated white-tailed deer and feral hogs migrating off SRS. It also provides valuable information concerning potential exposure to Cs-137 from consuming game animals harvested around SRS.

Deer sample being prepared in the field for analysis

White-tailed deer and feral hogs have access to several contaminated areas on and off SRS which allows them to be a vector for the redistribution of contaminants (primarily Cs-137). A five-mile study area was established based on a typical white-tailed deer upper limit home range to ensure that potentially contaminated deer residing at or near the SRS boundary would be included in the sample set. DOE-SR data is from on-site deer only. In 2023, DHEC was able to collect samples on-site in addition to samples collected within the study area shown in Section 12.4.0, Map, which provides a better comparison of data with DOE-SR.

Cesium-137 is the isotope of focus for game due to its ability to accumulate in an animal's skeletal muscles (Brisbin & Smith, 1975). When contaminated game is eaten by hunters, Cs-137 is readily incorporated into the human body because of its similarity to potassium-40 (K-40) in physiological processes (Davis, 1963).

12.2.0 RESULTS AND DISCUSSION

Game Monitoring Summary Statistics can be found in Section 12.6.0 and all Game Monitoring Data can be found in the 2023 DHEC Data File.

DHEC analyzed muscle tissue collected in 2023 for Cs-137 from 10 deer and 3 hogs collected from area hunters via hunting clubs, plantations, and Crackerneck Wildlife Management Area within a five-mile study area adjacent to SRS (Section 12.4.0, Map). 34 deer and 5 hog samples were collected from Hunt Zone 9 which is within the SRS borders. Additionally, 5 deer tissue samples were collected and analyzed from a background location at Pinckney Island National Refuge (Hunt Zone 8). Sample size, location, and collection dates were dependent on the participating hunters.

Cesium-137 and the naturally occurring K-40, Pb-212, and Pb-214 were the only isotopes detected in DHEC game samples collected in 2023**.** Naturally occurring isotopes will not be discussed in this report. Cesium-137 concentrations from deer and hogs collected in the SRS perimeter and on-site study area are shown in Section 12.5.0, Figure 1.

DOE-SR does not collect game animal samples within the off-site DHEC study area and off-site hunter doses are based on DOE-SR models.

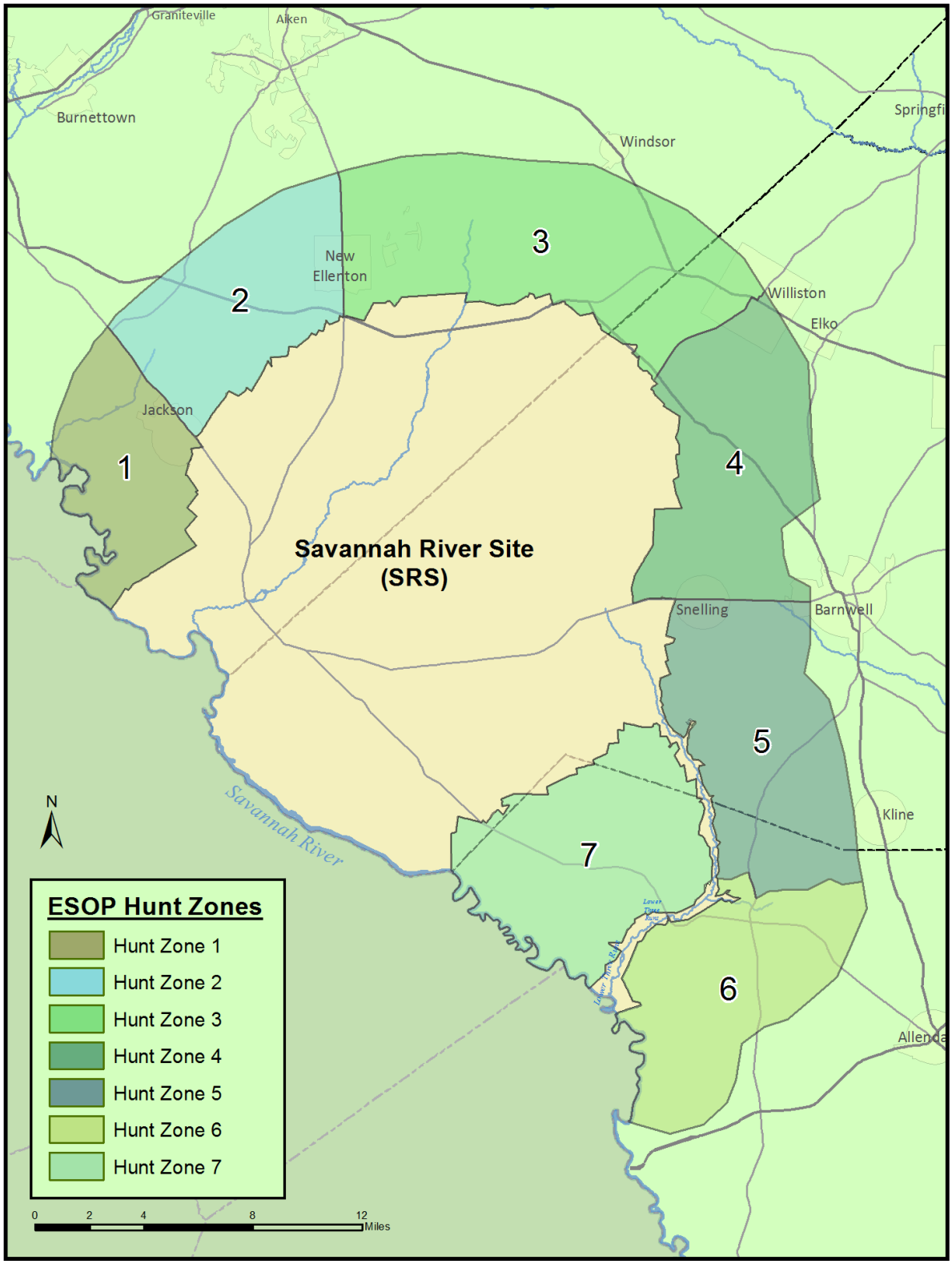
12.3.0 CONCLUSIONS AND RECOMMENDATIONS

Historic SRS operations released known Cs-137 contamination to Steel Creek, Par Pond, Lower Three Runs, their floodplains, and the Savannah River swamp (Till et al., 2001). All of which impact hunt zones 4, 5, 6, and 7 (Section 12.4.0, Map). Although a portion of Cs-137 was deposited on SRS from site operations, levels found in the study area and background location are likely results of above ground nuclear weapons testing (Haselow, 1991). Age, sex, body weight, soil type, diet, and collection location may affect the Cs-137 activities found in white-tailed deer and hogs (Haselow, 1991). A hunter consuming deer from SRS, the study area, or background locations would most likely ingest a portion of the activity associated with these animals. Refer to the 2023 DHEC Critical Pathway Dose section of this report for a better understanding of the contamination found in game versus other food sources.

DHEC will continue to monitor Cs-137 levels in deer and hogs within the established study area and background locations to assess trends. DHEC will continue to pursue new hunters within the five-mile study area to ensure adequate sample numbers can be achieved each year. DHEC will also put additional efforts into trapping wild hogs within the study area.

12.4.0 MAP

Game Monitoring Locations



2023 ESOP Game Animal Monitoring www.scdhec.gov

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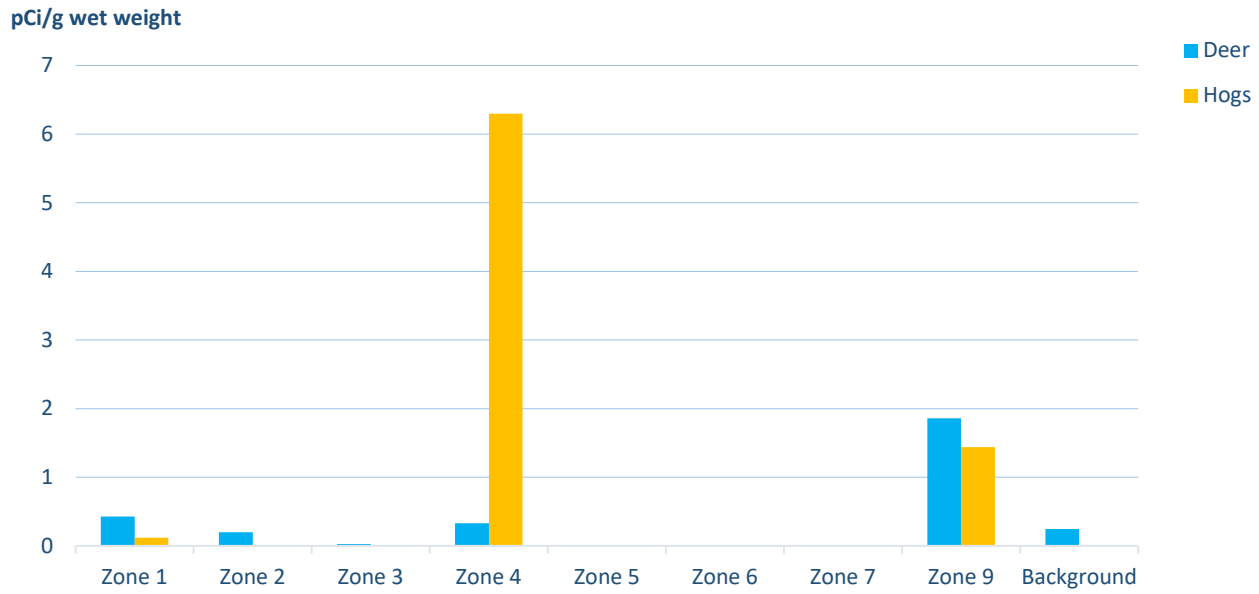
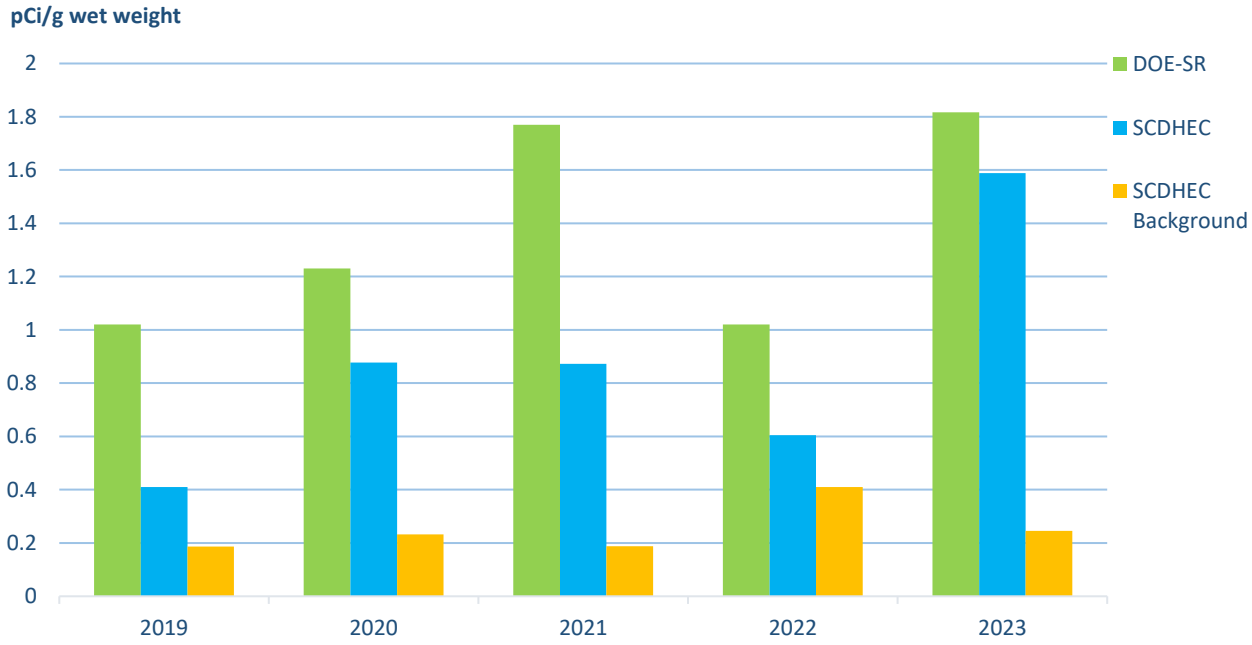
12.5.0 TABLES AND FIGURES

Figure 1. 2023 DHEC Hunt Zone Average Cs-137 Concentration in Game



Zones 5, 6, and 7 did not have deer samples in 2023. Zones 2, 3, 5, 6, 7, and the background did not have hog samples in 2023.

Figure 2. 2019-2023 Average Cs-137 Concentration in Deer (SRNS, 2020-2024; DHEC, 2020b-2024)



2019-2023 background location was Pinckney Island National Wildlife Refuge.
2019-2020 DOE-SR is based on Field Gross Average Cs-137 Concentration. 2021-2023 DOE-SR is based on Lab Average Cs-137 Concentration due to lack of Field Gross Averages for DOE-SR these years (SRNS, 2020-2024).

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12.6.0 SUMMARY STATISTICS

2023 Cs-137 Concentration (pCi/g wet weight) in Deer

	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detections	Number of Samples
Study Area Deer	1.589	1.285	1.260	0.027	5.440	41	44
Background Deer	0.245	0.148	0.203	0.128	0.485	5	5

2023 Cs-137 Concentration (pCi/g wet weight) in Deer DHEC Hunt Zones

Hunt Zone	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detections	Number of Samples
Zone 1 Deer	0.426	0.200	0.426	0.284	0.568	2	2
Zone 2 Deer	0.199	0.229	0.199	0.038	0.361	2	2
Zone 3 Deer	0.027	NA	0.027	0.027	0.027	1	4
Zone 4 Deer	0.329	0.424	0.329	0.029	0.629	2	2
Zone 9 Deer	1.859	1.244	1.500	0.126	5.440	34	34

Zones 5, 6, and 7 did not have deer samples in 2023.

2023 Cs-137 Concentration (pCi/g wet weight) in Hogs DHEC Hunt Zones

Hunt Zone	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detections	Number of Samples
Zone 1 Hogs	0.121	NA	0.121	0.121	0.121	1	1
Zone 4 Hogs	6.299	1.438	6.299	5.282	7.315	2	2
Zone 9 Hogs	1.439	1.443	0.952	0.080	3.270	5	5

Zones 2, 3, 5, 6, 7, and the background did not have hog samples in 2023.

12.6.0 SUMMARY STATISTICS

2023 Cesium-137 Data Comparison for DHEC and DOE-SR Deer and Hog (Hunt Zone 9) (SRNS, 2024)

Game Species	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect	Number of Detections	Number of Samples
Deer	1.859	1.244	1.500	0.126	5.440	34	34
	1.817	1.248	1.540	0.113	5.260	41	41
Hogs	1.439	1.443	0.952	0.080	3.270	5	5
	1.464	1.512	0.869	0.083	3.540	6	6

Shaded areas represent DHEC data and unshaded areas represent DOE-SR data.

Chapter 13 Critical Pathway and Dose Assessment

13.1.0 PROJECT SUMMARY

DHEC implemented a Radionuclide Dose Calculation Project/Critical Pathway Project to calculate the potential exposure or dose to the public within 50-miles of an SRS center point. This study area was chosen for comparison to the DOE-SR 80-km (50-mile) radius dose results. Individual project managers chose differing sample locations/schemes within this study area to establish trends in media radionuclide concentrations.

DHEC and DOE-SR programs were evaluated based on media potential exposure in mrem (Section 13.2.4). The figures in Section 13.4.0 illustrate the trends and central tendencies in the critical pathway potential dose exposures. The annual dose is calculated on average exposed individual (AEI) and maximum exposed individual (MEI) bases which are summarized in Section 13.4.0, Table 1.

13.2.0 RESULTS AND DISCUSSION

All 2023 Dose Data can be found in Section 13.5.0. All yearly dose results are reported in millirem (mrem).

The DHEC MEI is a hypothetical subsistence and survivalist type of individual who resides downriver in the area below all SRS contributions to the Savannah River, visits the entire 50-mile perimeter study area, and receives the MEI dose based on the single highest detection per radionuclide per media detected in the environment. The 2023 data and dose results are discussed under the following headings in this section: 2023 AEI and MEI Dose, Critical Pathways 2023 Summary, and DOE-SR/DHEC 2023 Comparisons. Total AEI Dose covers the 2014-2023 period, whereas other headings discuss only 2023 data. Not all media were collected for all years during this summary period (2014-2023).

The critical pathways were analyzed both on a millirem (mrem) basis and percentage of dose basis (Section 13.4.0, Table 4). Percentages denote relative importance, whereas mrem denotes potential exposure levels. The dose critique attempts to point out the limits of this dose estimate and why any DOE-SR and DHEC estimates may or may not be similar.

13.2.1 2023 AEI AND MEI DOSE

The basis for dose calculations is not limited to any pathway of dose exposure based on lifestyle or media encountered but is simply a tabulation of detected dose found in media sampled regardless of applicability to an individual. Only the highest contributor for the AEI and the MEI is used for the following: groundwater derived drinking water and Savannah River derived drinking water, the various types of fish that are sampled, sediment at creek mouths and boat landings, and swimming at creek mouths and boat landings. Table 1 in Section 13.4.0 summarizes all DHEC detections by media on an AEI and MEI detection basis. Apart from wild game, background readings are not subtracted before dose calculations are performed.

The AEI dose is a conservative estimate based on consumption rates, represented by the consumption rate column in the data tables, average dose per media (Section 13.5.0), and is based on sample results only with no modeling. In 2023, the calculated AEI dose was 5.502

mrem (Section 13.4.0, Table 1), with 5.487 mrem from food dose. If wild game is not consumed the AEI dose falls to 0.184 mrem. The AEI dose skews high, as only detections are used in the dose calculations. For a typical person in the study area, the dose they receive should be lower than the AEI dose.

In 2023, the total calculated MEI dose was 17.294 mrem, of which 17.243 mrem was attributable to food consumption. If wild game is not consumed, the MEI dose falls to 1.244 mrem. The MEI basis column uses the single highest detection for a media radionuclide and calculates dose as if the high dose occurrence was somehow stored and the exposure continued throughout the year. If the individual did not store the media at the location, date, and time of DHEC sample collection and achieve a full year's exposure to that media, then the MEI estimate represents a sizable overestimate.

Only speciated doses for specific radionuclides were included in the estimated doses for 2023. The use of detections only in determining AEI dose per radionuclide per media, the calculation of dose based on the MEI detection for each radionuclide/media, and conservative consumption rates provided a protective dose estimate. Each media radionuclide dose, excluding Naturally Occurring Radioactive Material (NORM), was considered as part of a critical pathway with potential contributions through the inhalation, ingestion, and direct exposure routes.

The MEI dose can be received by only one individual since that individual had to consume the specific dose basis animals. Two elevated dose bases (AEI and MEI) were used because they were measured and protective without the inclusion of screening value assumptions for alpha and beta. The assumption of all alpha as plutonium-239 (Pu-239) and all beta as strontium-90 (Sr-90) may double the calculated dose without evidence for that assumption in speciated data. Unspeciated dose assignments were discontinued in 2011 and replaced by calculating a MEI dose potential from the single highest detection per radionuclide per media.

13.2.2 CRITICAL PATHWAYS 2023 SUMMARY

Atmospheric Pathway 2023 Summary

The DHEC 2023 atmospheric pathway contributed dose to the individual through the inhalation of tritium (H-3) in air, the consumption of food, predominantly from wild game but also including milk, edible vegetation, and fungi, as well as direct exposure from soil and the incidental consumption of soil with edible vegetation. Section 13.4.0, Table 2 illustrates the dominance of the atmospheric pathway, which accounted for 5.391 mrem, at 97.98 percent, of dose to the AEI and 16.298 mrem, at 94.24 percent, of dose to the MEI. The primary contributor to the atmospheric pathway was Cs-137 in wild game.

Liquid Pathway 2023 Summary

The DHEC 2023 liquid pathway estimated AEI dose to the individual was from the consumption of fish, drinking water from the Savannah River, and ingestion from swimming (Section 13.4.0, Table 2). The liquid pathway contributions to dose exposure were secondary to those contributed by the atmospheric pathway. In 2023, the liquid pathway contribution to the AEI was 0.111 mrem, accounting for 2.02 percent of dose. The contribution to the MEI dose was 0.996 mrem, at

5.76 percent. The primary contributors to the liquid pathway were Cs-137 and Sr-89/90 in fish.

Food Sub-pathway 2023 Summary

The food sub-pathway was covered under the atmospheric and liquid pathways with the exception of these additional observations. The annual 2023 DHEC AEI food sub-pathway dose order, highest to lowest for averages, was wild game-hog (5.113 mrem), wild game-deer (0.205 mrem), fish (0.102 mrem), fungi (0.042 mrem), cow milk (0.023 mrem), and vegetation (0.002 mrem). Incidental soil ingestion did not contribute any quantifiable dose.

The 2023 MEI food sub-pathway order was wild game-hog (15.34 mrem), fish (0.957 mrem), wild game-deer (0.710 mrem), fungi (0.125 mrem), cow milk (0.106 mrem), and vegetation (0.005 mrem). Incidental soil ingestion did not contribute any quantifiable dose.

Cs-137 was the predominant dose contributor to food through the consumption of hog for the AEI and the MEI. It should be noted that deer and hog consumption rates are based on the edible portions of the relevant harvested animals and they vary from year to year. In 2023 the consumption rates were 68.01 pounds for the deer AEI and 123.75 pounds for the deer MEI. The hog dose AEI and MEI were based on 52.50 pounds and 108.00 pounds respectively. Cs-137 also contributed to dose from fish, milk, and fungi; Sr-89/90 contributed to dose from fish and from milk. Tritium contributed a small amount of dose through fruits and vegetables (edible vegetation).

Isotopic Contribution Summary

Most of the AEI dose exposure in 2023 was due to Cs-137: 5.405 mrem (98.24 percent) of the 5.502 mrem total (this number varies slightly from the total below due to rounding error). The primary contributor to the Cs-137 AEI dose was wild game (hog, 5.113 mrem). Sr-89/90 was the second highest dose contributor in 2023 at 0.081 mrem while tritium accounted for 0.015 mrem. Cs-137, Sr-89/90, and tritium were each detected in the atmospheric and the liquid pathways.

Cs-137 was also the primary contributor to the MEI, at 16.611 mrem (96.05 percent) of the 17.294 mrem total, with Sr-89/90 second, at 0.630 mrem, and H-3 third at 0.053 mrem. Cs-137 in wild game (hog, 15.340 mrem) was the single largest dose contributor to the MEI.

13.2.3 2014-2023 TOTAL AEI DOSE

Section 13.4.0, Table 4 summarizes dose associated with all media on an AEI basis from 2014-2023. The critical pathway basis of comparison for DHEC detected dose comes from releases of radionuclides that were deposited outside of SRS during 2014-2023 and within 50 miles of the SRS center point although animals that are harvested off-site may have migrated from on-site. Additionally, the Chelsea and Purrysburg drinking water locations are located outside of the 50 mile zone.

Table 4 illustrates the dominance of the atmospheric pathway accumulated dose which accounted for 97.97 percent, over the liquid pathway, at 2.03 percent. The food sub-pathway was the

dominant route, accounting for 99.56 percent of accumulated exposure. The AEI received a 2.764 mrem average dose per year during the 2014-2023 period.

Section 13.4.0, Figures 1-3 and Table 4 illustrate the various pathways of dose exposure. The AEI basis critical pathway dose for 2023, 5.502 mrem, is less than the 7.00 mrem dose an individual typically receives from living in a brick house for one year (Wahl, 2011). Section 13.4.0, Figures 1-3 illustrate the media exposure trends via line graphs.

The predominant source of AEI exposure from 2014-2023 was wild game (deer and hog). In total it accounted for 22.671 mrem, which amounts to 82.03 percent of the total accumulated AEI exposure (27.636 mrem) during that time period. Following wild game were fungi (3.800 mrem; 13.75 percent), edible vegetation (0.529 mrem; 1.91 percent), and fish (0.479 mrem; 1.73 percent). Fish was also the primary contributor to the liquid pathway accumulated dose. Furthermore, wild game accounted for 83.73 percent of the accumulated dose from the atmospheric pathway and 82.40 percent of the food sub-pathway.

The predominant route of accumulated exposure from 2014-2023 for water sources was public system water from the Savannah River (0.081 mrem). Groundwater derived drinking water accounted for 0.010 mrem although this was not added into the total (only the highest source of drinking water is used). The primary routes for minor sources of accumulated dose were from the inhalation of tritium in air (0.025 mrem), surface soil resuspension inhalation (0.009 mrem), and direct exposure to soil (0.006 mrem).

13.2.4 DOE-SR AND DHEC 2023 COMPARISONS

DOE-SR calculates potential doses to members of the public from atmospheric and liquid releases, as well as from special-case exposure scenarios, on an annual basis (SRNS, 2024). These include liquid pathway and air pathway doses, an all-pathway dose, a sportsman dose, on-site and off-site hunter doses, and an off-site fisherman dose. The DOE-SR dose estimates are analogous to DHEC dose estimates as follows, although it should be taken into account that there are differences between DOE-SR and DHEC sampling and dose estimation protocols:

1. The DOE-SR all-pathway dose and the sum of the DHEC fish, wading, swimming, public system drinking water from the Savannah River, vegetation, milk, and inhalation doses, serve as a means of comparison of the dose a member of the public in the study area (an individual who doesn't consume wild game or gather edible mushrooms) could receive from SRS activities during a given year (The DHEC All-Pathway Approximation).

2. The DOE-SR off-site hog and deer consumption doses and the DHEC hog and deer consumption doses serve as a means of comparison of the dose a hunter or survivalist type of individual who consumes wild game could receive.

3. The DOE-SR creek mouth fisherman dose being derived from fish caught at the mouths of creeks that empty into the Savannah River: DHEC uses the highest creek mouth location to calculate a creek mouth fisherman dose. In 2023 the highest DOE-SR fish dose applicable to the creek mouth fisherman was from bass from Lower Three Runs. DHEC's creek mouth fisherman dose as presented in Table 3 was from channel catfish at

the mouth of Four Mile Branch.

The DOE-SR all-pathways representative person dose and the DHEC all-pathway approximation were the most relevant dose estimates that represent the potential dose exposure for the general public in 2023. The DOE-SR all-pathways representative person dose for 2023 was 0.16 mrem (Section 13.4.0, Table 3). The DHEC All-Pathway Approximation was 0.66 mrem in 2023 which is 0.66 percent of the DOE all-pathway dose standard of 100 mrem/yr (SRNS, 2024).

In 2023, the DOE-SR creek mouth fisherman dose (0.17 mrem) used bass caught from the mouth of Lower Three Runs and was lower than DHEC's estimate (0.66 mrem), which used Cs-137 and Sr-89/90 in channel catfish from Fourmile Branch. DHEC's creek mouth bass dose at Lower Three Runs was 0.05 mrem. The DOE-SR off-site deer hunter dose estimate of 5.30 mrem was higher than DHEC's 0.71 mrem estimate while the off-site hog hunter estimate of 4.44 mrem was lower than DHEC's estimate of 15.34 mrem (Section 13.4.0, Table 3; SRNS, 2024).

13.2.5 DOSE CRITIQUE

In 2023, most sampling resulted in less than minimum detectable activity (MDA) determinations and was not included in the DHEC summary statistics, which used detections only. The use of detections only in calculations was protective and biases the measures of central tendency higher (Gilbert, 1987).

The NORM averages and maximums were not included in the dose estimates as this dose was considered to be part of the background dose for the study area. The yearly dose averages were based on DHEC detections only and are overestimated since most sample results were less than MDA. The justification for using detections only was to allow for undetected radionuclides and media. The justification for selecting higher source consumption levels was due to the conceptualization of the DHEC MEI as a survivalist type who consumed natural media at a greater than typical use rate. The basis for both considerations was to be protective of the public and environment.

The inclusion of alpha and beta assumed dose in the past provided an excessively high dose estimate and was not supported by media radionuclide species detections. The inclusion of calculations based on a single highest maximum detection for each radionuclide/media was a more definable basis for establishing an upper bound rather than the dose assumption of unknown alpha as Pu-239 and unknown beta as Sr-90. This upper bound is not practically achievable by the MEI due to the unlikely probability of exposure to all maximums at a constant rate throughout the year (via storage of media). However, since most of the dose was due to wild-type food consumption containing Cs-137, then a single individual who ate all of the worst case deer, hog, and edible plant and mushrooms could approach the MEI dose if these media were stored and consumed over the entire year.

The DHEC 2007 Critical Pathway Dose Report noted that 38.50 percent of the dose was assigned and represented a potential dose overestimate that may in fact be NORM detections (alpha and beta). The DHEC dose calculations since then were still protective due to the use of detections only in determining dose, the calculation of a maximum dose for the MEI based on a single maximum detection for each radionuclide/media, and the use of conservative consumption

rates.

The AEI was given prominence as protective for general dose considerations, and the reader should be aware that the AEI dose estimate was conservative or biased high due to the use of detections only for dose calculation. For example, the omission of less than MDA assignments from calculations would raise any calculated number to a higher value. Alternatively, less than MDA actually represents an undetermined low number that may be zero or any number up to the given MDA value for that analysis.

This project used dose instead of risk so that direct comparisons of dose could be made with similar media data published in the SRS Annual Site Environmental Reports. It should also be recognized that DHEC uses sampling methods for various media that are similar to, but not necessarily the same, as DOE-SR's. Additionally, DOE-SR uses modeled radionuclide releases for some dose estimates while DHEC uses only sample results.

13.3.0 CONCLUSIONS AND RECOMMENDATIONS

The 2023 results indicated that monitoring of the primary inhalation, ingestion, and direct exposure routes from the atmospheric and liquid pathways should continue. Groundwater, surface water, sediments, plants, and animals should be monitored for contaminants that are associated with past and present SRS operations. Early detection is paramount to protecting the public and the environment if a release to off-site streams or groundwater occurs. DHEC will continue to monitor SRS and adjacent areas for the primary radionuclide contributors to dose potentially associated with DOE-SR operations.

13.4.0 TABLES AND FIGURES

Table 1. DHEC Dose Estimates (mrem) for all Media: AEI and MEI

Pathway	Route	Source of Exposure	AEI	MEI
Atmospheric	Inhalation	Surface Soil Resuspension	0.000	0.000
Atmospheric	Inhalation	Inhalation of H-3 in Air	0.004	0.009
Air Inhalation Total			**0.004**	**0.009**
Liquid	Ingestion	Fish	0.102	0.957
Atmospheric	Ingestion	Cow Milk	0.023	0.106
Atmospheric	Ingestion	Wild Game (Deer)	0.205	0.710
Atmospheric	Ingestion	Wild Game (Hog)	5.113	15.34
Atmospheric	Ingestion	Vegetation (Fruit and Vegetables)	0.002	0.005
Atmospheric	Ingestion	Fungi	0.042	0.125
Atmospheric	Ingestion	Soil Ingestion with Food	0.000	0.000
Food Ingestion Total			**5.487**	**17.243**
Liquid	Ingestion	Public System Drinking Water - Savannah River	0.009	0.036
Liquid	Ingestion	Drinking Water - Groundwater	ND	ND
Liquid	Ingestion	Ingestion from Swimming	0.000	0.003
Drinking Water Total			**0.009**	**0.039**
Liquid	Direct	Exposure from Wading at Boat Landings	0.000	0.000
Liquid	Direct	Exposure from Wading at SRS Creek Mouths	0.000	0.000
Atmospheric	Direct	Exposure from Soil	0.002	0.003
Direct Exposure Total			**0.002**	**0.003**
Overall Total Dose			**5.502**	**17.294**

Note:

1. ND is sampled but No Detections in 2023
2. Drinking Water - Groundwater includes aquifers that supply both public and private wells.
3. Drinking Water Total is the sum of the Savannah River/Groundwater dose, whichever is higher, and the Ingestion from Swimming dose.
4. If wild game is not eaten the AEI falls to 0.184 mrem while the MEI falls to 1.244 mrem.

Table 2. DHEC Dose Estimates (mrem) for the Atmospheric and Liquid Pathways: AEI and MEI

Critical Pathway Summary	AEI	MEI
The Atmospheric Pathway Totals	5.391	16.298
The Liquid Pathway Totals	0.111	0.996
Combined Dose	**5.502**	**17.294**

13.4.0 TABLES AND FIGURES

Table 3. DOE-SR/DHEC Dose Comparisons

Pathway	Comparison Basis	DOE-SR[1]	DHEC[2]
All-Pathway	DHEC All-Pathway Approximation[3]	0.16	0.66
Sportsman	Onsite Hunter[4]	9.42	NA
Sportsman	Onsite Turkey[5]	ND	NS
	Creek Mouth Fisherman[6]	0.17	0.66
	Offsite Hunter Deer	5.30	0.71
	Off-site Hunter Hog	4.44	15.34
	Edible Fungi	NS	0.13

Notes:
1. DOE-SR data from Table 6-5 and Table 6-7 (SRNS, 2024).
2. Based on DHEC maximums or single highest detection basis for all media per route of exposure unless otherwise specified (Table 1).
3. Sum of DHEC highest fish at Steel Creek, swimming ingestion, Savannah River derived drinking water, vegetation, milk, and atmospheric inhalation.
4. DHEC does not assign onsite dose.
5. SRS did sample turkeys in 2023 but none were greater than background.
6. Compares DOE-SR and DHEC fish results from the mouths of creeks that flow into the Savannah River. In 2023 DOE-SR's dose came from bass at the mouth of Lower Three Runs while DHEC's was from channel catfish at Four Mile Branch.

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13.4.0 TABLES AND FIGURES

Table 4. 2014-2023 AEI Exposure: Total AEI Dose (mrem) and Percentage

Pathway	AEI Media Categories	2023[1]	2014-2023[2]	2014-2023 % AEI[3]
Atmospheric	Surface Soil Resuspension Inhalation	0.000	0.009	0.033
Atmospheric	H-3 Inhalation	0.004	0.025	0.090
Liquid	Fish	0.102	0.479	1.733
Atmospheric	Cow Milk	0.023	0.036	0.130
Atmospheric	Wild Game (Deer and Hog)	5.318	22.671	82.034
Atmospheric	Vegetation (Fruit and Vegetables)	0.002	0.529	1.914
Atmospheric	Fungi	0.042	3.800	13.750
Atmospheric	Soil Ingestion with Food	0.000	0.000	0.000
Liquid	Drinking Water from the Savannah River	0.009	0.081	0.293
Liquid	Drinking Water from Groundwater[4]	ND	0.010	NA
Liquid	Ingestion from Swimming	0.000	0.000	0.000
Liquid	Exposure from Wading at Boat Landings	0.000	0.000	0.000
Liquid	Exposure from Wading at Creek Mouths[5]	0.000	0.000	0.000
Atmospheric	Exposure from Soil	0.002	0.006	0.022
Totals[6,7]		5.502	27.636	100%

Notes:
1. The 2023 column is average dose in mrem during 2023.
2. The 2014-2023 column is total dose in mrem over the 2014-2023 ten-year period.
3. The AEI % basis column is the percentage of the 2014-2023 total dose from a given media.
4. Only the highest drinking water source is used for the ten year total and percentages.
5. Only the highest wading dose is used for wading.
6. Percentages may not equal 100 percent due to rounding.
7. The average dose received per year is 2.764 mrem.

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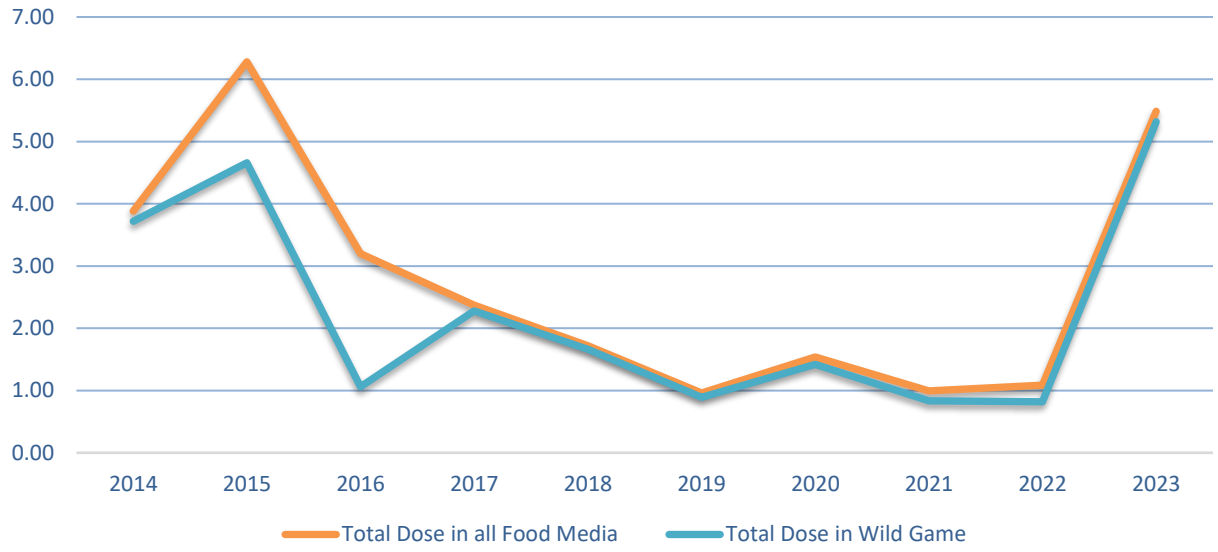
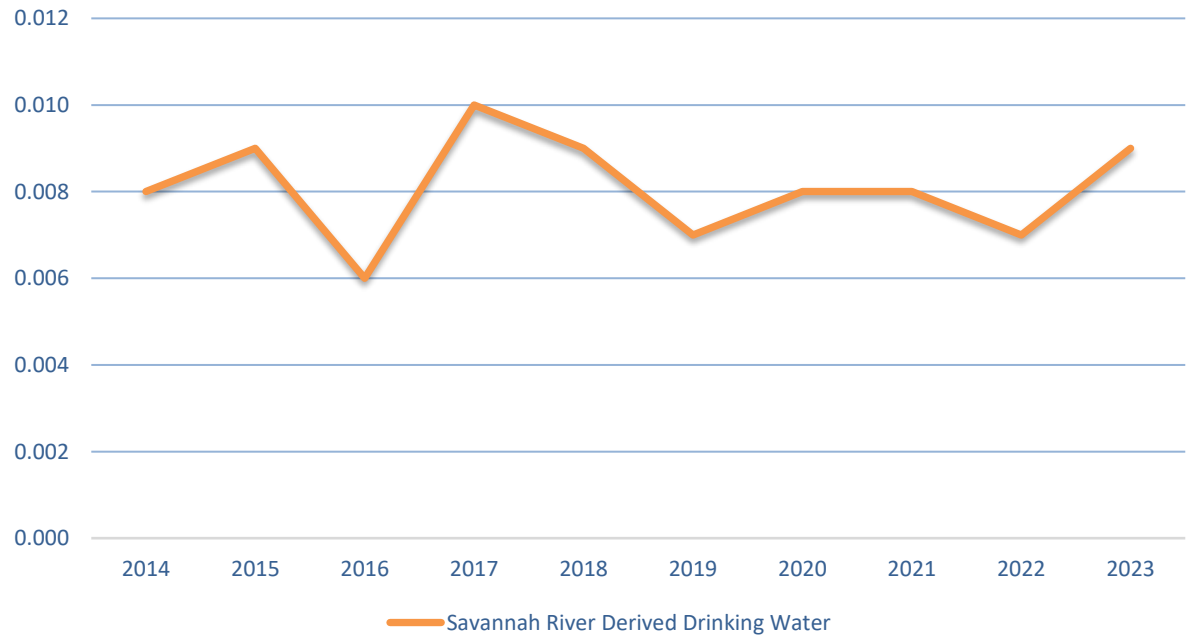
13.4.0 TABLES AND FIGURES

Figure 1. 2014-2023 DHEC AEI Food Dose



Note: This graph shows the total food AEI dose trend and the trend for the primary contributor to that dose for 2023 in mrem.

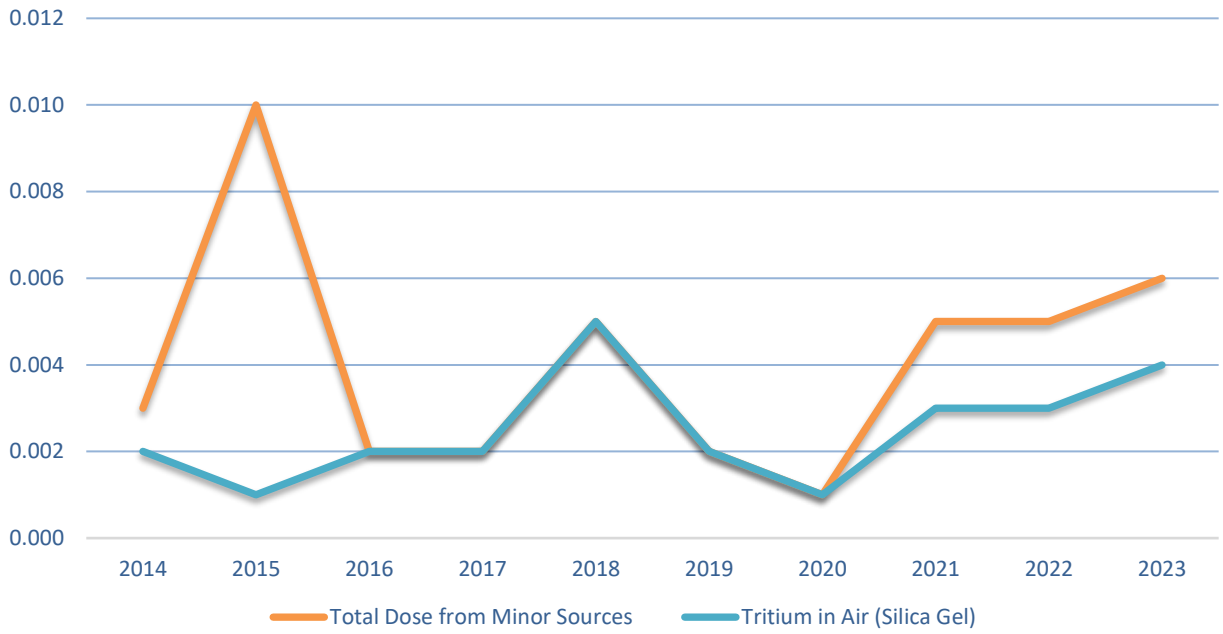
Figure 2. 2014-2023 DHEC AEI Water Dose



Note: This graph shows the water AEI dose trend for drinking water obtained from the Savannah River in mrem. Only groundwater derived or Savannah River derived drinking water is used, whichever is higher.

13.4.0 TABLES AND FIGURES

Figure 3. 2014-2023 DHEC AEI Dose from Minor Sources



Note: This graph shows the total minor sources AEI dose trend and the trend for the primary contributor to that dose from 2023 in mrem.

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13.5.0 2023 DOSE DATA

Notes apply to all data tables:

1. ND is No Detects
2. NA is Not Applicable
3. NS is Not Sampled
4. All consumption rates are from Aranceta et al., 2006; Botsch et al., 2000; EPA, 2011; and SRNS, 2024.
5. Dose in the following tables may be presented differently from the text or in the above tables and graphs due to rounding error.

AEI Fish Dose

Dose from Fish Ingestion (AEI)				
Media	**Radionuclide**	**Activity (pCi/g)**	**Consumption Rate (kg/yr)**	**Dose (mrem)**
Bass	Cs-137	0.032	3.7	0.006
Bass	Sr-89/90	0.192	3.7	0.073
Channel Catfish	Cs-137	0.139	3.7	0.026
Channel Catfish	Sr-89/90	0.201	3.7	0.076
Flathead Catfish	Cs-137	0.046	3.7	0.009
Flathead Catfish	Sr-89/90	0.118	3.7	0.045
Large Flathead	Cs-137	0.070	3.7	0.013
Large Flathead	Sr-89/90	0.107	3.7	0.040
Drum	Cs-137	ND	3.7	ND
Drum	Sr-89/90	ND	3.7	ND
Mullet	Cs-137	ND	3.7	ND
Mullet	Sr-89/90	0.154	3.7	0.058
Fish Total				**0.102**

13.5.0 2023 DOSE DATA

MEI Fish Dose

Dose from Fish Ingestion (MEI)				
Media	**Radionuclide**	**Activity (pCi/g)**	**Consumption Rate (kg/yr)**	**Dose (mrem)**
Bass	Cs-137	0.039	24.0	0.047
Bass	Sr-89/90	0.192	24.0	0.471
Channel Catfish	Cs-137	0.300	24.0	0.363
Channel Catfish	Sr-89/90	0.242	24.0	0.594
Flathead Catfish	Cs-137	0.062	24.0	0.075
Flathead Catfish	Sr-89/90	0.161	24.0	0.395
Large Flathead	Cs-137	0.156	24.0	0.189
Large Flathead	Sr-89/90	0.118	24.0	0.289
Drum	Cs-137	ND	24.0	ND
Drum	Sr-89/90	ND	24.0	ND
Mullet	Cs-137	ND	24.0	ND
Mullet	Sr-89/90	0.154	24.0	0.378
Fish Total				**0.957**

AEI Milk Dose

Dose from Milk (AEI)				
Media	**Radionuclide**	**Activity (pCi/L)**	**Consumption Rate (kg/yr)**	**Dose (mrem)**
Milk	H-3	ND	69.0	ND
	Cs-137	4.983	69.0	0.017
	Sr-89/90	0.775	69.0	0.005
	I-131	ND	69.0	ND
Milk Total				**0.023**

MEI Milk Dose

Dose from Milk (MEI)				
Media	Radionuclide	**Activity (pCi/L)**	**Consumption Rate (kg/yr)**	**Dose (mrem)**
Milk	H-3	ND	260.0	ND
	Cs-137	5.370	260.0	0.070
	Sr-89/90	1.350	260.0	0.036
	I-131	ND	260.0	ND
Milk Total				**0.106**

13.5.0 2023 DOSE DATA

AEI Wild Game Dose

Dose from Wild Game (AEI)		
Media	**Radionuclide**	**Dose**
Deer	Cs-137	0.205
Hog	Cs-137	5.113
Game Total		**5.318**

Note: Deer AEI is based on an edible portion of 68.01 lbs; Hog is based on 52.50 lbs.

MEI Wild Game Dose

Dose from Wild Game (MEI)		
Media	**Radionuclide**	**Dose**
Deer	Cs-137	0.710
Hog	Cs-137	15.340
Game Total		**16.050**

Note: Deer MEI is based on an edible portion of 123.75 lbs; Hog is based on 108.00 lbs.

AEI Edible Vegetation Dose

Dose in Edible Vegetation (AEI)				
Media	**Radionuclide**	**Activity (pCi/g)**	**Consumption Rate (kg/yr)**	**Dose (mrem)**
Fruit and Vegetables	H-3	0.243	92	0.002
	Cs-137	ND	92	NA
Fruit and Vegetable Total				**0.002**
Nuts	H-3	NS	NA	NA
	Cs-137	NS	NA	NA
Nuts Total				**NA**
Fungi	H-3	ND	3.65	ND
	Cs-137	0.229	3.65	0.042
Fungi Total				**0.042**
Combined Vegetation Total				**0.044**

13.5.0 2023 DOSE DATA

MEI Edible Vegetation Dose

Dose in Edible Vegetation (MEI)				
Media	**Radionuclide**	**Activity (pCi/g)**	**Consumption Rate (kg/yr)**	**Dose (mrem)**
Fruit and Vegetables	H-3	0.287	248	0.005
	Cs-137	ND	248	ND
Fruit and Vegetable Total				**0.005**
Nuts	H-3	NS	NA	NA
	Cs-137	NS	NA	NA
Nuts Total				**NA**
Fungi	H-3	ND	10	ND
	Cs-137	0.249	10	0.125
Fungi Total				**0.125**
Combined Vegetation Total				**0.130**

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13.5.0 2023 DOSE DATA

AEI Ingestion from Surface Water and Wells Dose

Ingestion from Surface Water and Wells (AEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Savannah River Sourced Drinking Water		pCi/L	L/yr	mrem
Surface Water	**H-3**	**433**	**300**	**0.009**
Groundwater Sourced Drinking Water		pCi/L	L/yr	mrem
Groundwater	**H-3**	**ND**	**300**	**ND**
Ingestion from Surface Water and Wells Total				**0.009**

Notes:
1. Groundwater aquifers that are known to be used for drinking water were used and samples were collected as part of the groundwater project. Individual groundwater sourced drinking water taps were not sampled.
2. Only the highest dose is used for the total.

MEI Ingestion from Surface Water and Wells Dose

Ingestion from Surface Water and Wells (MEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Savannah River Sourced Drinking Water		pCi/L	L/yr	mrem
Surface Water	**H-3**	**644**	**800**	**0.036**
Groundwater Sourced Drinking Water		pCi/L	L/yr	Mrem
Groundwater	**H-3**	**ND**	**800**	**ND**
Ingestion from Surface Water and Wells Total				**0.036**

Notes:
1. Groundwater aquifers that are known to be used for drinking water were used and samples were collected as part of the groundwater project. Individual groundwater sourced drinking water taps were not sampled.
2. Only the highest dose is used for the total.

13.5.0 2023 DOSE DATA

AEI Incidental Water Ingestion and Direct Exposure from Water Dose

Incidental Water Ingestion and Direct Exposure from Water (AEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Swimming at Savannah River Creek Mouths				
Surface Water Swimming	H-3	pCi/L	L/yr	mrem
Ingestion		**1569**	**0.189**	**0.000**
Surface Water Swimming	H-3	pCi/L	hrs/yr	mrem
Surface Water Immersion		**1569**	**9**	**0.000**
Savannah River Creek Mouth Total				**0.000**

Incidental Water Ingestion and Direct Exposure from Water (AEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Swimming at Savannah River Boat Landings				
Surface Water Swimming	H-3	pCi/L	L/yr	mrem
Ingestion		**799**	**0.189**	**0.000**
Surface Water Swimming	H-3	pCi/L	hrs/yr	mrem
Surface Water Immersion		**799**	**9**	**0.000**
Savannah River Boat Landing Total				**0.000**

MEI Incidental Water Ingestion and Direct Exposure from Water Dose

Incidental Water Ingestion and Direct Exposure from Water (MEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Swimming at Savannah River Creek Mouths				
Surface Water Swimming	H-3	pCi/L	L/yr	mrem
Ingestion		**16785**	**2.57**	**0.003**
Surface Water Swimming	H-3	pCi/L	hrs/yr	mrem
Surface Water Immersion		**16785**	**36**	**0.000**
Savannah River Creek Mouth Total				**0.003**

Incidental Water Ingestion and Direct Exposure from Water (MEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Swimming at Savannah River Boat Landings				
Surface Water Swimming	H-3	pCi/L	L/yr	mrem
Ingestion		**7151**	**2.57**	**0.001**
Surface Water Swimming	H-3	pCi/L	hrs/yr	mrem
Surface Water Immersion		**7151**	**36**	**0.000**
Savannah River Boat Landing Total				**0.001**

13.5.0 2023 DOSE DATA

AEI Sediment at Creek Mouths and Boat Landings Dose

Sediment at Creek Mouths and Boat Landings (AEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Sediment Dose		pCi/g	hrs/yr	mrem
Creek Mouths	**Cs-137**	**0.275**	**9**	**0.000**
Boat Landings	**Cs-137**	**0.097**	**9**	**0.000**
Sediment Total				**0.000**

MEI Sediment at Creek Mouths and Boat Landings Dose

Sediment at Creek Mouths and Boat Landings (MEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Sediment Dose		pCi/g	hrs/yr	mrem
Creek Mouths	**Cs-137**	**0.536**	**36**	**0.000**
Boat Landings	**Cs-137**	**0.239**	**36**	**0.000**
Sediment Total				**0.000**

AEI Surface Soil Ingestion Dose

Surface Soil Ingestion (AEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Surface Soil		pCi/g	Mg/day	mrem
Ingestion	Cs-137	0.129	20	0.000
Soil Ingestion Total				**0.000**

Note: This represents soil inadvertently consumed with plants.

MEI Surface Soil Ingestion Dose

Surface Soil Ingestion (MEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Surface Soil		pCi/g	Mg/day	mrem
Ingestion	Cs-137	0.195	20	0.000
Soil Ingestion Total				**0.000**

Note: This represents soil inadvertently consumed with plants.

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AEI Soil Direct Dose

Soil Direct (AEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Surface Soil		pCi/g	hrs/yr	mrem
External Direct	Cs-137	0.129	4380	0.002
Direct Soil Total				**0.002**

MEI Soil Direct Dose

Soil Direct (MEI)				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Surface Soil		pCi/g	hrs/yr	mrem
External Direct	Cs-137	0.195	4380	0.003
Direct Soil Total				**0.003**

13.5.0 2023 DOSE DATA

AEI Atmospheric Inhalation Dose

Atmospheric Inhalation (AEI)				
Surface Soil Resuspension and Air Inhalation				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Surface Soil Resuspension		**pCi/g**	**m3/yr**	**mrem**
Inhalation	Cs-137	0.129	5000	0.000
Surface Soil Resuspension Total				**0.000**
Air Inhalation (Silica Gel)		**pCi/m^3**	**m3/yr**	**mrem**
Inhalation	H-3	4.29	5000	0.004
Atmospheric Inhalation Total				**0.004**

MEI Atmospheric Inhalation Dose

Atmospheric Inhalation (MEI)				
Surface Soil Resuspension and Air Inhalation				
Source	**Radionuclide**	**Activity**	**Consumption Rate**	**Dose**
Surface Soil Resuspension		**pCi/g**	**m3/yr**	**mrem**
Inhalation	Cs-137	0.195	6400	0.000
Surface Soil Resuspension Total				**0.000**
Air Inhalation (Silica Gel)		**pCi/m^3**	**m3/yr**	**Mrem**
Inhalation	H-3	8.19	6400	0.009
Atmospheric Inhalation Total				**0.009**

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