Chapter 7: Groundwater Management Program

The purpose of the Savannah River Site's (SRS's) groundwater management program is to protect, monitor, remediate, and use groundwater. With this focus, the program accomplishes the following:

- Ensures future groundwater contamination does not occur
- Monitors groundwater to identify areas of contamination
- Remediates groundwater contamination as needed
- Conserves groundwater

2019 Highlights

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

Groundwater Contaminant Removal—SRS removed 12,952 pounds (lbs) of volatile organic compounds (VOCs) from groundwater and the vadose zone and prevented 51 curies of tritium from reaching SRS streams.

Offsite Groundwater Monitoring (Georgia)—For more than 15 years, tritium detections in Georgia groundwater monitoring wells have been well below the MCL for tritium (20 pCi/mL). This data supports the conclusions drawn from a U.S. Geological Survey that indicate there is no mechanism by which groundwater could flow under the Savannah River and contaminate Georgia wells (Cherry 2006).

7.1 INTRODUCTION

Some of SRS's past operations have released chemicals and radionuclides into the soil and contaminated the groundwater around hazardous waste management facilities and waste disposal sites. Because of these past releases, SRS operates extensive groundwater monitoring and groundwater remediation programs.

The SRS groundwater monitoring program requires regular well sampling to monitor for groundwater contaminants. The well monitoring meets sampling requirements in the Federal Facility Agreement (FFA) for the Savannah River Site (FFA 1993) and in Resource Conservation and Recovery Act (RCRA) permits, and ensures the Site is meeting South Carolina Department of Health and Environmental Control (SCDHEC) and U.S. Environmental Protection Agency (EPA) drinking water quality standards. SRS uses SCDHEC-certified laboratories to analyze groundwater samples.

The monitoring data show that most of the contaminated groundwater is in the central area of SRS, and none extends beyond the SRS boundary. Groundwater contamination at SRS is primarily limited to the Upper Three Runs/Steed Pond Aquifers and the Gordon/Lost Lake Aquifers (Figure 7-1). SRS submits summaries of groundwater data to regulatory agencies, and, if necessary, remediates or removes the contamination. Appendix E lists the documents that SRS submits to the regulatory agencies reporting groundwater monitoring data.

SRS uses several technologies to remediate groundwater that exceeds the MCLs or the RSLs. Remediation includes closing waste units to reduce the potential for contaminants to reach groundwater, actively treating contaminated water, and employing passive and natural (attenuation) remedies.

Groundwater remediation at SRS focuses on VOCs and tritium. VOCs in groundwater, mainly trichloroethylene (TCE) and tetrachloroethylene (PCE), originate from their use as degreasing agents in industrial work at SRS. Tritium in groundwater is a byproduct of nuclear materials production at SRS. Corrective measures at SRS range from active treatment, such as using oxidants to destroy the VOCs in place, to passive measures, such as monitored natural attenuation and phytoremediation (using trees and plants to remove or break down contaminants). These practices are removing VOCs from the groundwater and effectively reducing tritium releases into SRS streams and the Savannah River.

7.2 GROUNDWATER AT SRS

The groundwater flow system at SRS consists of the following four major aquifers separated by confining units:

- Upper Three Runs/Steed Pond
- Gordon/Lost Lake
- Crouch Branch
- McQueen Branch

Chapter 7—Key Terms

Aquifer *is an underground water supply found in porous rock, sand, gravel, etc.*

Attenuation *is a reduction of groundwater contaminants over time due to naturally occurring physical, chemical, and biological processes.*

Confining Unit *is the opposite of an aquifer. It is a layer of rock or sand that limits groundwater movement in and out of an aquifer.*

Contaminants of Concern *are contaminants found at the unit that have undergone detailed analysis and have been found to present a potential threat to human health and the environment.*

Groundwater *is water found underground in cracks and spaces in soil, sand, and rocks.*

Maximum Contaminant Level (MCL) *is the highest level of a contaminant allowed in drinking water.*

Plume *is a volume of contaminated water originating at a waste source (for example, a hazardous waste disposal site). It extends downward and outward from the waste source.*

Recharge *occurs when water from the surface travels down into the subsurface, replenishing the groundwater.*

Regional Screening Level (RSL) *is the risk-based concentration derived from standardized equations combining exposure assumptions with toxicity data.*

Remediation *cleans up sites contaminated with waste due to historical activities.*

Surface water *is water found above ground (for example, streams, lakes, wetlands, reservoirs, and oceans).*

Vadose Zone *is the subsurface layer below the land surface and above the water table. The vadose zone has a low water-compared-to-saturated zone; therefore, it is also referred to as being unsaturated.*

Waste Unit *is an area that is, or may be, posing a threat to human health or the environment. It ranges in size from a few square feet to tens of acres and includes basins, pits, piles, burial grounds, landfills, tank farms, disposal facilities, process facilities, and contaminated groundwater.*

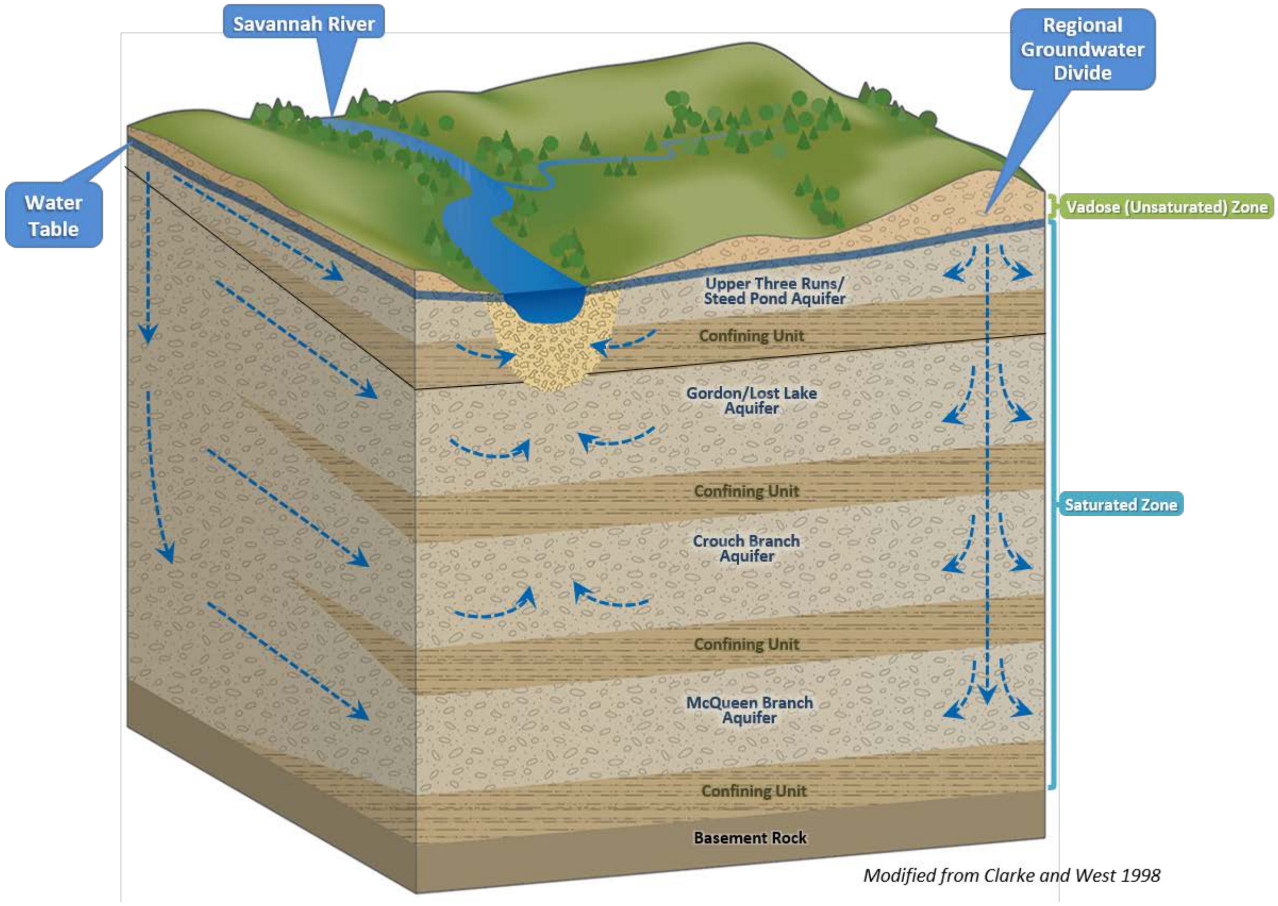

Figure 7-1 Groundwater at SRS

Groundwater flow in recharge areas generally migrates downward and laterally. It eventually flows into the Savannah River and its tributaries or migrates into the deeper regional flow system. Figure 7-1 presents a three-dimensional block diagram of these units at SRS and the generalized groundwater flow patterns within those units. Water moving from the ground's surface into the aquifers can carry contamination along with it, resulting in underground plumes of contaminated water (Figure 7-2).

7.3 GROUNDWATER PROTECTION PROGRAM AT SRS

SRS has designed and implemented a groundwater protection program to prevent new releases to groundwater and to remediate contaminated groundwater to meet federal and state laws and regulations, U.S. Department of Energy (DOE) Orders, and SRS policies and procedures. It accomplishes the following:

- Protects groundwater
- Monitors groundwater
- Remediates groundwater
- Conserves groundwater

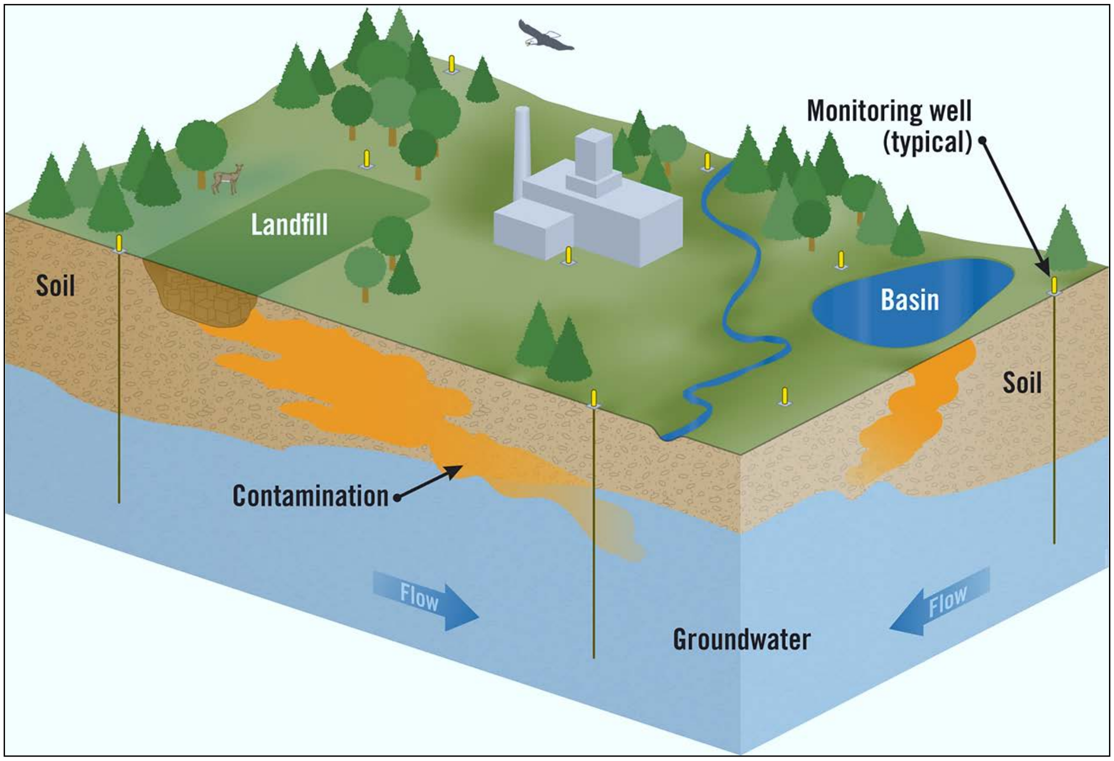

Figure 7-2 How Contamination Gets to Soil and Groundwater

7.3.1 Protecting SRS Groundwater

SRS groundwater management focuses on preventing and monitoring groundwater contamination, protecting the public and environment from contamination, and preserving groundwater quality for future use. Groundwater protection is performed through the following:

- Preventing or controlling groundwater contamination sources from construction sites, hazardous waste management facilities, and waste units
- Monitoring groundwater and surface water to detect contaminants
- Reducing contaminants via a groundwater cleanup program

7.3.2 Monitoring SRS Groundwater

The purpose of monitoring groundwater is to observe and evaluate changes in the groundwater quality over time and to establish, as accurately as possible, the baseline quality of the groundwater occurring naturally in the aquifers. The SRS groundwater monitoring program includes two primary components: groundwater contaminant source monitoring and groundwater surveillance monitoring. SRS evaluates groundwater-monitoring data frequently to identify whether new groundwater contamination exists or if should modify the current monitoring program.

SRS uses groundwater-monitoring data to determine the effects of Site operations on groundwater quality. The program supports the following critical activities:

- Complying with environmental regulations and DOE directives
- Evaluating the status of groundwater plumes

- Evaluating potential impacts from activities planned near or within the groundwater plume footprint
- Enhancing groundwater remediation through basic and applied research projects

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

As a result of discussions with EPA and SCDHEC, SRS adds emerging contaminants to analyte lists when historical or process knowledge indicates that a contaminant could now be of concern. Emerging contaminants are chemicals that have been detected in drinking water supplies, but their risk to human health and the environment is not fully understood. 1,4-Dioxane is one of the emerging contaminants that SRS monitors regularly in conjunction with VOC plumes. During 2019, SRS began assessing the past and present use of per- and polyfluoroalkyl substances (PFAS) at the Site. PFAS are a category of manmade chemicals, another family of emerging contaminants of concern. Initial groundwater sampling will begin in 2020, along with continued assessments of past use. The EPA, SCDHEC, and the Interstate Technology Regulatory Council webpages have current information on the state of knowledge and regulatory status of PFAS.

7.3.2.1 Groundwater Surveillance Monitoring

Surveillance monitoring at SRS focuses on collecting and analyzing data to characterize the groundwater flow and the presence or absence of contaminants. Characterization at SRS includes the following activities:

- Collecting soil and groundwater samples to determine the extent of contamination
- Obtaining geologic soil cores or seismic profiles to better determine underground structural features, as warranted
- Installing wells to periodically collect water-level measurements and groundwater samples
- Developing maps to help define groundwater flow
- Performing calculations based on water elevation data to estimate groundwater velocities
- Analyzing regional groundwater to provide a comprehensive understanding of SRS groundwater movement—and specifically contaminant movement—near facilities, individual waste units, and at the Site boundary

Checking a Passive Soil Vapor Extraction Well (top photo) and Sampling Equipment (lower photo)

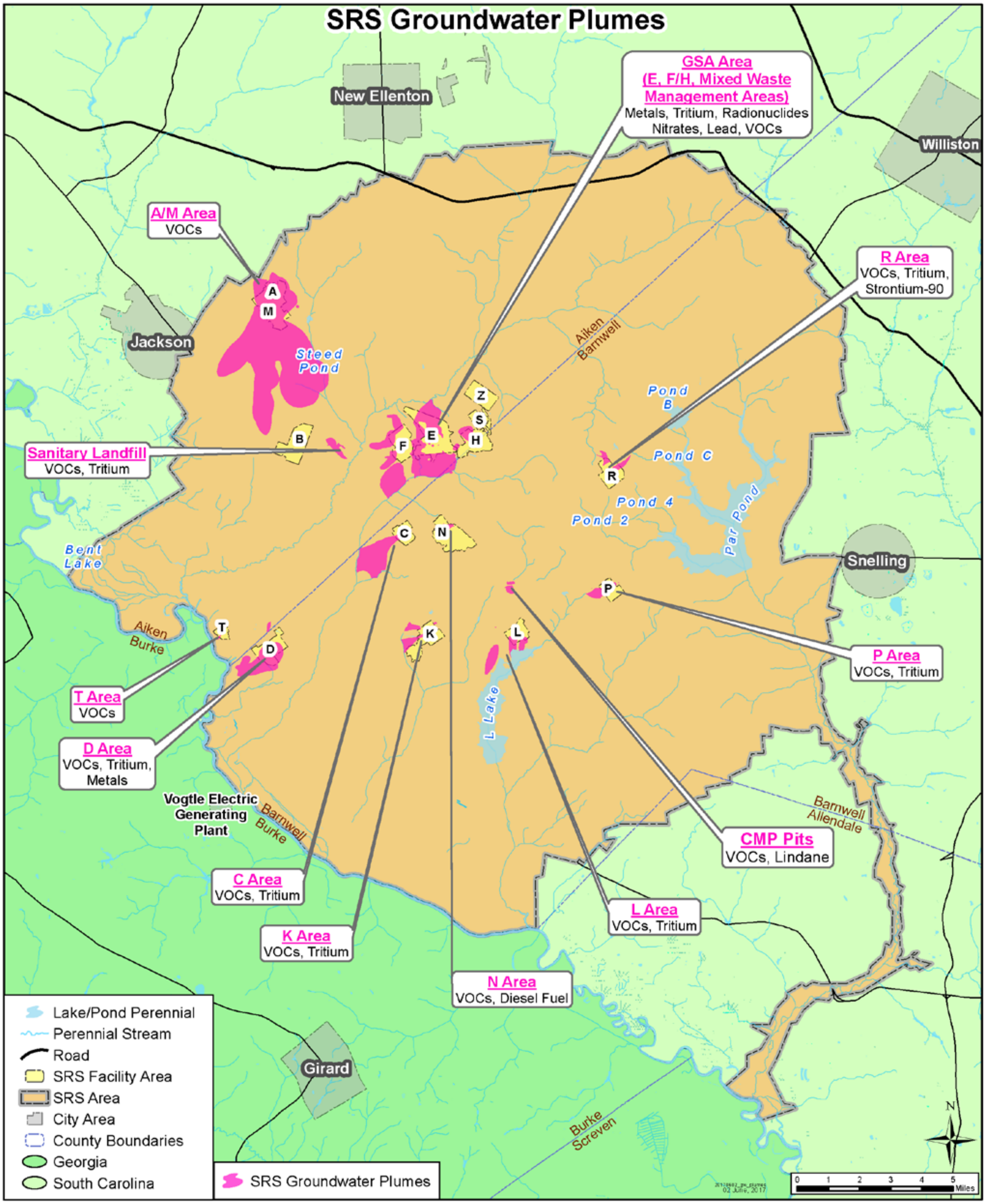

Figure 7-3 Groundwater Plumes at SRS

7.3.2.2 2019 Groundwater Data Summary

SRS uses more than 150 wells to monitor a significant plume beneath A/M Area. Some of these monitoring wells lie within a half-mile of the northwestern boundary of SRS. The direction of groundwater flow in the area parallels the Site boundary; however, groundwater flow direction can fluctuate. Because of this, SRS concentrates on the groundwater results from the wells along the Site boundary, as well as those between A/M Area and the nearest population center, Jackson, South Carolina (Figure 7-4). The data show no exceedances of drinking water standards (MCLs or RSLs) in SRS boundary wells near A/M Area. No detectable contamination exists in most of these SRS boundary wells.

Although most SRS-contaminated groundwater plumes do not approach the Site boundary, the potential to affect Site streams exists when contaminated groundwater flows into nearby streams. SRS monitors and evaluates groundwater contamination that flows into Site streams and remediates it as appropriate. In conjunction with stream monitoring, as discussed in Chapter 5, *Radiological Environmental Monitoring Program*, Section 5.4.3, *SRS Stream Sampling and Monitoring*, SRS conducts extensive monitoring near SRS waste units and operating facilities, regardless of their proximity to the boundary. *Savannah River Site Groundwater Management Strategy and Implementation Plan* (SRNS 2017) contains details concerning groundwater monitoring and conditions at individual sites.

Table 7-1 identifies the typical contaminants of concern (COCs) found in SRS groundwater and their significance. These COCs are a result of historical SRS operations that released chemicals and radionuclides into the soil and groundwater near hazardous waste management facilities and waste disposal sites. Table 7-2 presents a general summary of the most common contaminants found in groundwater at SRS facility areas, based on 2019 monitoring data, and compares the maximum concentrations to the appropriate drinking water standards. Table 7-2 shows the major COCs in the groundwater beneath SRS, including common degreasers (TCE and PCE) and radionuclides (tritium, gross alpha, and nonvolatile beta emitters).

Since the early 1990s, SRS has directed considerable effort to assessing the likelihood of flow beneath the Savannah River from South Carolina to Georgia. A groundwater model developed by the U.S. Geological Survey indicates there is no mechanism by which groundwater could flow under the Savannah River and contaminate Georgia wells (Cherry 2006). SRS continues to monitor for tritium in groundwater wells in Georgia (Figure 7-5) by collecting samples annually during the second half of the year. Detections of tritium in groundwater in these Georgia offsite wells have been below 1.5 pCi/mL (1,500 pCi/L) since 1999 (Figure 7-6). The MCL, or drinking water standard, for tritium is 20 pCi/mL (20,000 pCi/L). The 2019 results had no detectable concentrations of tritium.

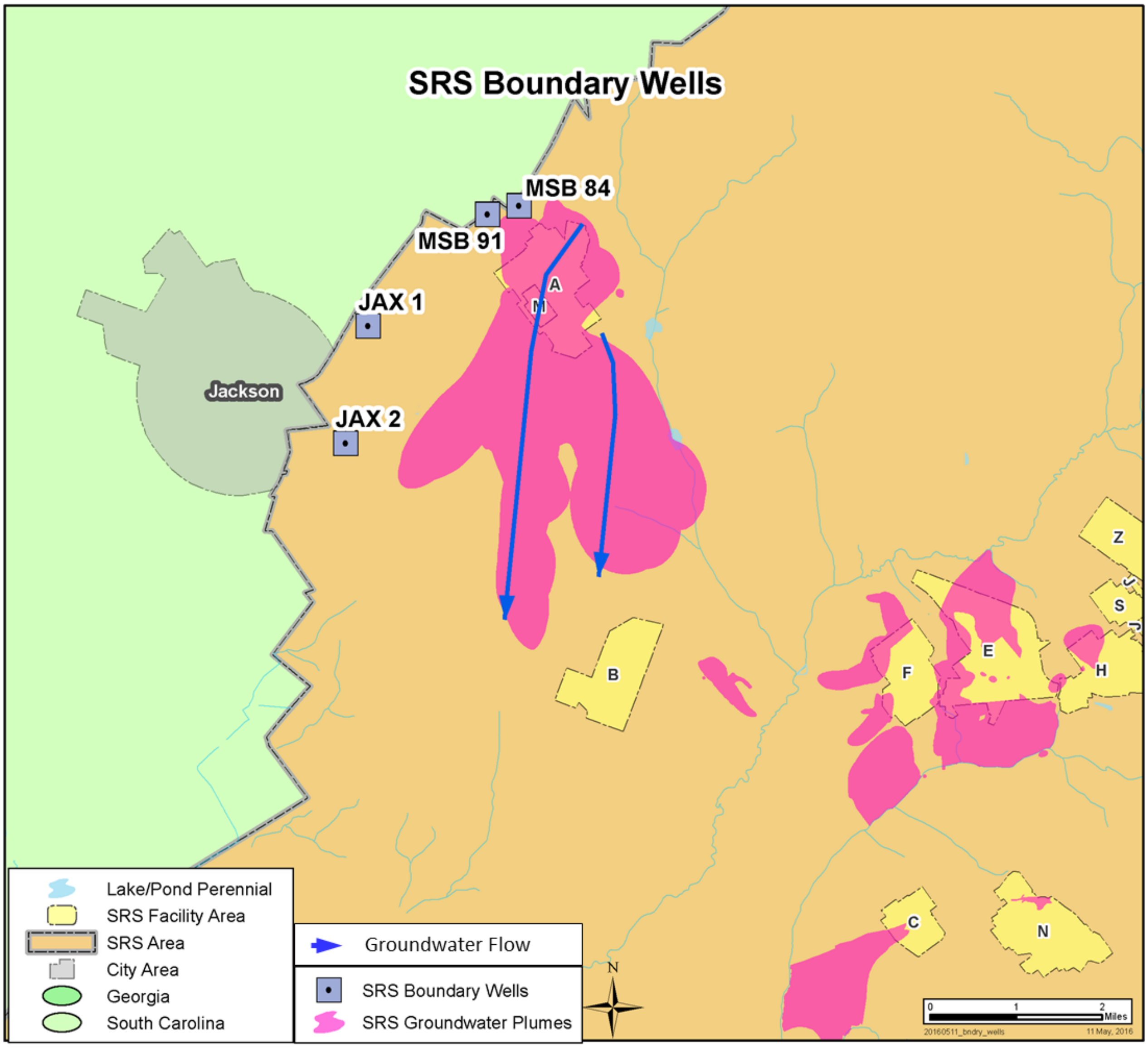

Figure 7-4 Location of Site Boundary Wells at SRS—Between A/M Area and Jackson, South Carolina

Table 7-1 Typical Contaminants of Concern at SRS

Contaminants	Sources	Limits, Exposure Pathways, and Health Effects
Gross Alpha	Alpha radiation emits positively charged particles from the radioactive decay of certain elements including uranium, thorium, and radium. Alpha radiation in drinking water can be in the form of dissolved minerals or a gas (radon).	MCL is 15 pCi/L. An alpha particle cannot penetrate a piece of paper or human skin. It causes increased risk of cancer through ingestion or inhalation.
Nonvolatile Beta	Beta decay commonly occurs among neutron-rich fission byproducts produced in nuclear reactors.	MCL is 4 mrem/yr. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
Tritium	Radioactive isotope of hydrogen with a half-life of 12.3 years. It emits a very weak beta particle and behaves like water.	MCL is 20 pCi/mL. It primarily enters the body when people swallow tritiated water. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
Trichloroethene/ Tetrachloroethene	VOCs used primarily to remove grease from fabricated metal parts.	MCL is 5 µg/L. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
Vinyl Chloride	VOC formed as a degradation product of TCE/PCE.	MCL is 2 µg/L. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.
1,4-Dioxane	Synthetic industrial chemical used as a stabilizer for VOCs to reduce degradation.	RSL for tap water is 0.46 µg/L. It causes increased risk of cancer through ingestion, inhalation, or dermal exposure.

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

Location	Major Contaminant	Units	2019 Max Concentration	Well	MCL/ RSL	Likely Stream Endpoints
A/M Area	Tetrachloroethylene	µg/L	110,000	MSB101CC	5	Tims Branch/Upper Three Runs in Swamp in West
	Trichloroethylene	µg/L	28,700	MSB107CC	5	
	1,4-Dioxane	µg/L	100	ARP 1A	6.1[a]	
C Area	Tetrachloroethylene	µg/L	8.05	CRP 5C	5	Fourmile Branch and Castor Creek
	Trichloroethylene	µg/L	2,000	CRP 20CU	5	
	Tritium	pCi/mL	4,940	CRW023C	20	
CMP Pits (G Area)	Tetrachloroethylene	µg/L	1,940	CMP 34D	5	Pen Branch
	Trichloroethylene	µg/L	795	CMP 35D	5	
	Lindane	µg/L	29.8	CMP 35D	0.2	
D Area	Beryllium	µg/L	133	DCB 23C	4	Savannah River Swamp
	Tetrachloroethylene	µg/L	8.73	DCB 45C	5	
	Trichloroethylene	µg/L	115	DCB 62	5	
	Vinyl Chloride	µg/L	19.1	DOB 15	2	
	Tritium	pCi/mL	238	DCB 26AR	20	
E-Area MWMF	Trichloroethylene	µg/L	353	BSW 4D2	5	Upper Three Runs/Crouch Branch in North; Fourmile Branch in South
	1,4-Dioxane	µg/L	580	BSW 6C3	6.1[a]	
	Tritium	pCi/mL	18,400	BSW 4D2	20	
	Nonvolatile Beta	pCi/L	31.9	SEP002B	50[b]	
	Gross Alpha	pCi/L	14	BSW 8D3	15	
F Area	Trichlorethylene	µg/L	22.7	FBP 43DL	5	Fourmile Branch
	Tritium	pCi/mL	93.7	FGW012C	20	
	Gross Alpha	pCi/L	1,380	FGW005C	15	
	Nonvolatile Beta	pCi/L	1,250	FGW005C	50[b]	

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

Location	Major Contaminant	Units	2019 Max Concentration	Well	MCL/ RSL	Likely Stream Endpoints
F-Area HWMF	Trichloroethylene	µg/L	15.4	FSB 78C	5	Fourmile Branch
	Tritium	pCi/mL	1,190	FSB 78C	20	
	Gross Alpha	pCi/L	410	FSB 94DR	15	
	Nonvolatile Beta	pCi/L	693	FSB 94C	50[b]	
F-Area Tank Farm	Tritium	pCi/mL	3.14	FTF 19	20	Fourmile Branch/ Upper Three Runs
	Nonvolatile Beta	pCi/L	746	FTF 28	50[b]	
	Manganese	µg/L	219	FTF009R	430	
H Area	Trichloroethylene	µg/L	4.1	HGW 2D	5	Upper Three Runs/ Crouch Branch in North; Fourmile Branch in South
	Gross Alpha	pCi/L	27.9	HAA 15A	15	
	Nonvolatile Beta	pCi/L	93.5	HAA 13A	50[b]	
	Tritium	pCi/mL	25.2	HGW 2D	20	
H-Area HWMF	Trichloroethylene	µg/L	195	HSB120C	5	Fourmile Branch
	Tritium	pCi/mL	1,300	HSB129C	20	
	Gross Alpha	pCi/L	32.9	HSB102D	15	
	Nonvolatile Beta	pCi/L	373	HSB 68DR	50[b]	
H-Area Tank Farm	Tritium	pCi/mL	47.1	HAA 12C	20	Fourmile Branch/ Upper Three Runs
	Nonvolatile Beta	pCi/L	21.1	HAA 4D	50[b]	
	Manganese	µg/L	458	HAA 10D	430	
K Area	Tetrachloroethylene	µg/L	6.33	KDB 1	5	Indian Grave Branch
	Trichloroethylene	µg/L	2.7	KRP 9	5	
	Tritium	pCi/mL	2,570	KRB 19D	20	
L Area	Tetrachloroethylene	µg/L	48	LSW 25DL	5	L Lake
	Trichloroethylene	µg/L	4.7	LSW030DL	5	
	Tritium	pCi/mL	390	LSW 25DL	20	
P Area	Trichloroethylene	µg/L	7,730	P003L	5	Steel Creek
	Tritium	pCi/mL	14,300	PSB002B	20	
R Area	Trichloroethylene	µg/L	22	RAG008B	5	Mill Creek in Northwest; Tributaries of PAR Pond
	Tritium	pCi/mL	769	RDB 3D	20	
	Carbon-14	pCi/L	144	RDB 3D	2,000	
	Strontium-90[c]	pCi/L	135	RSE 10	8	
Sanitary Landfill	1,4-Dioxane	µg/L	140	LFW 62C	6.1[a]	Upper Three Runs
	Trichloroethylene	µg/L	5.35	LFW 32	5	
	Vinyl Chloride	µg/L	13.3	LFW 10A	2	
TNX	Trichloroethylene	µg/L	6.71	TRW 2	5	Savannah River
Z Area	Technetium-99	pCi/L	99.5	ZBG002C	900	Upper Three Runs
	Nitrate-Nitrate as Nitrogen	mg/L	5.4	ZBG002D	10	
	Nonvolatile Beta	pCi/L	74.2	ZBG002D	50[b]	

Notes:
MWMF is the Mixed Waste Management Facility; HWMF is the Hazardous Waste Management Facility; TNX is the 678-T facilities; CMP is the Chemicals, Metals, and Pesticides Pits.
µg = micrograms

[a] The 1,4-Dioxane standard is a RCRA-permitted Groundwater Protection Standard.
[b] The MCL for nonvolatile beta activity (pCi/L or pCi/mL) equivalent to 4 mrem/yr varies according to which specific beta emitters are present in the sample. At SRS this value equates to 50 pCi/L.
[c] At R Area, strontium-90 is sampled every two years. It was last sampled in 2019.

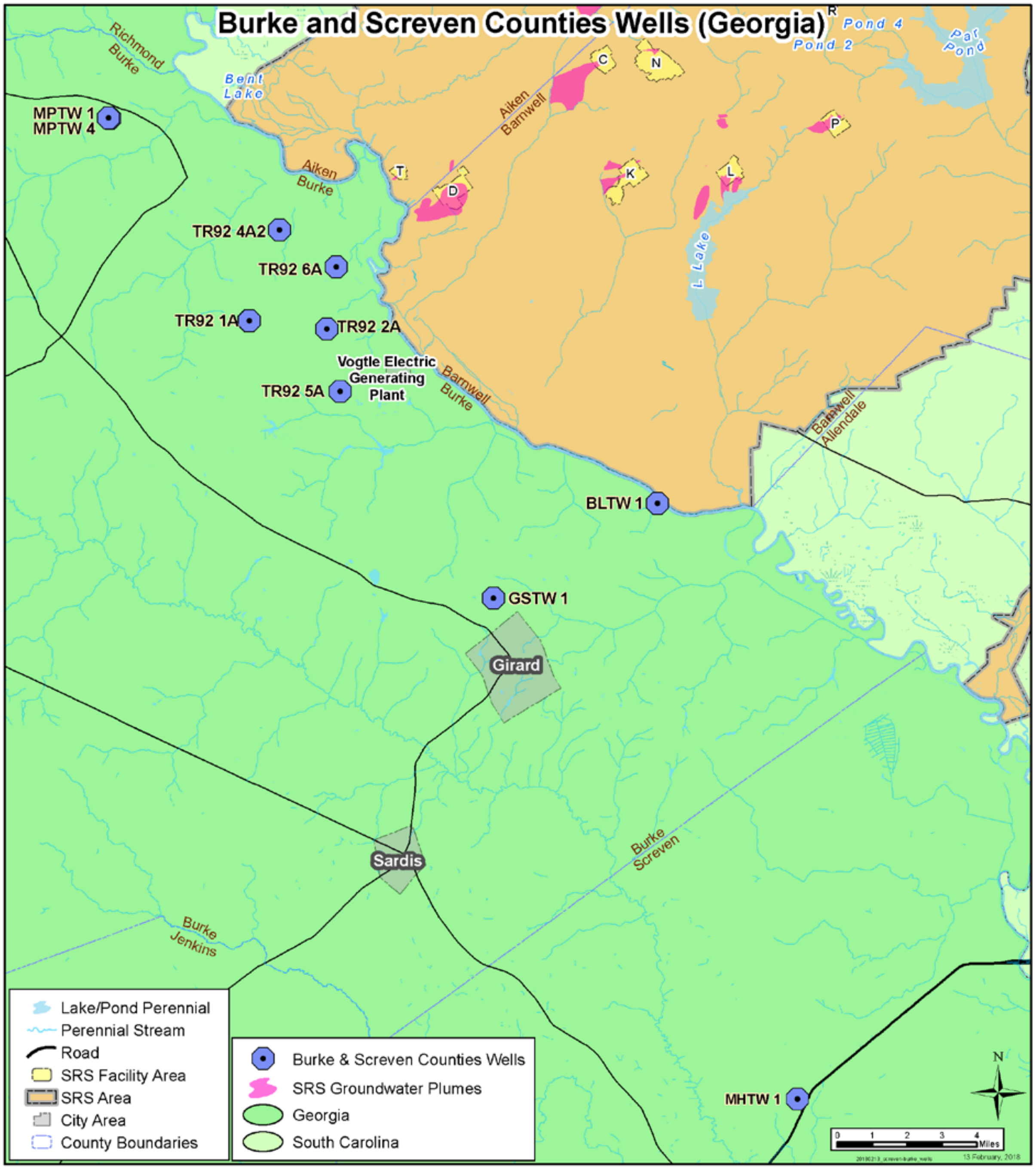

Figure 7-5 Location of Monitoring Wells Sampled for Tritium in Burke and Screven Counties, Georgia

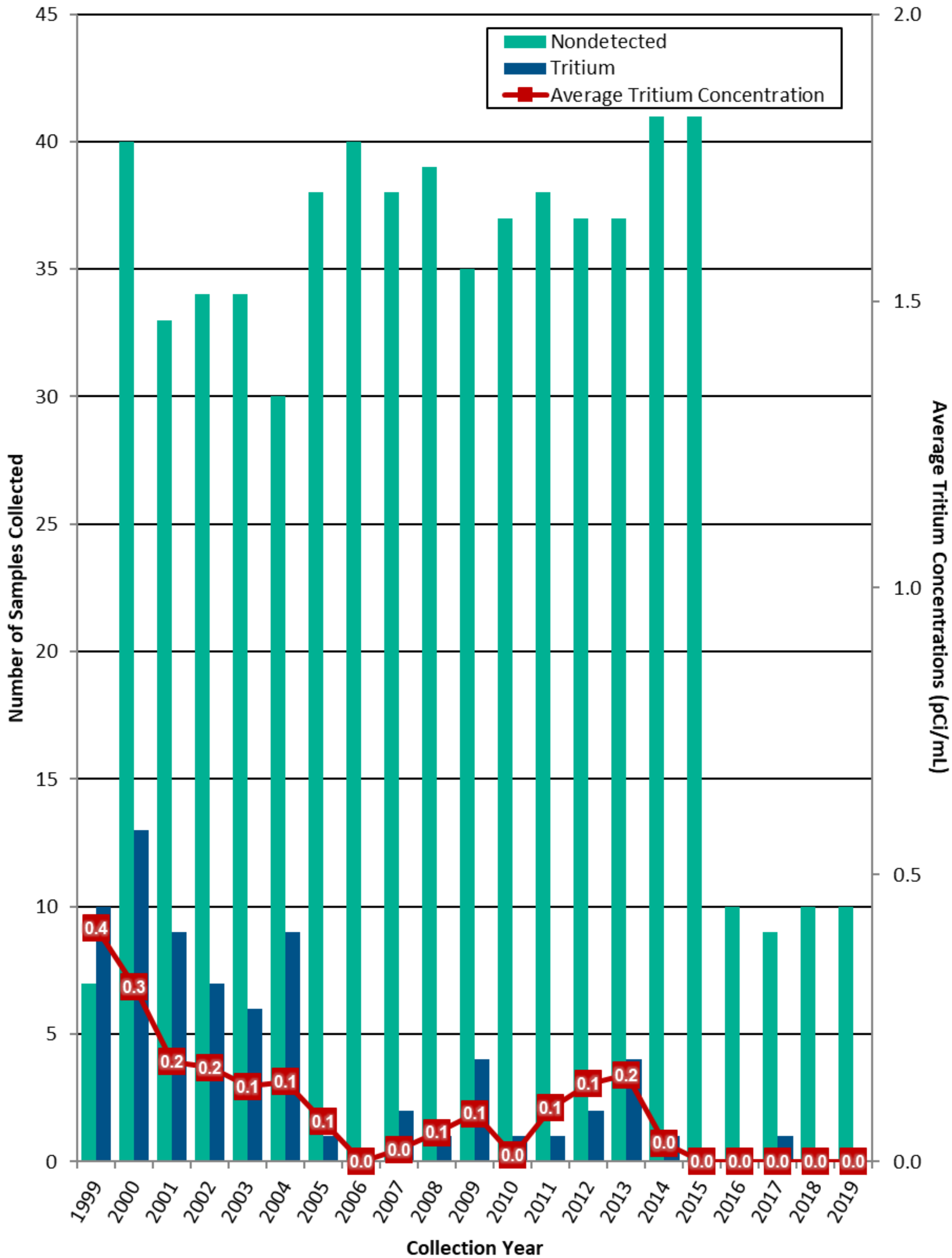

Figure 7-6 Tritium Concentration in Wells Sampled in Burke and Screven Counties, Georgia

7.3.3 Remediating SRS Groundwater

SRS's environmental remediation program has been in place for more than 20 years. The Federal Facility Agreement (FFA) for the Savannah River Site (FFA 1993) specifies that RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act regulate remediating and monitoring contaminated groundwater. Remediation focuses on removing mass, reducing contaminant levels, and reducing the exposure of humans and the environment to contaminants that exceed either the MCLs or RSLs. Table 7-2 identifies the MCLs and RSLs for the primary contaminants of concern in SRS groundwater.

For each remediation project, SRS determines the degree to which the groundwater is contaminated. After completing this evaluation, SRS and the regulatory agencies decide upon a strategy for remediating the groundwater.

SRS often applies remedial actions to the groundwater contamination source. For instance, SRS widely uses soil vapor extraction, a technology that extracts contaminated soil vapor from the vadose (unsaturated) zone to remove VOCs. This technology minimizes the VOCs that will reach the water table. Recently, SRS has emphasized converting soil vapor extraction (SVE) systems requiring permanent electrical power to passive systems using solar power or barometric pumping.

SRS implements several groundwater remedial technologies. These technologies manage the rate the contaminants move and reduce the risk of contaminant exposure to human health and ecological receptors. Thirty-nine remediation systems are currently operating. In 2019, SRS removed 12,952 lbs of VOCs from the groundwater and the vadose zone and prevented 51 curies of tritium from reaching SRS streams (SRNS 2020). SRS has worked for more than 20 years to reduce the tritium flux to Fourmile Branch. Since 2000, SRS has reduced the tritium flux to Fourmile Branch by almost 70% using groundwater remedial technologies (subsurface barriers and water capture with phyto-irrigation). The MWMF Phytoremediation Project has the largest tritium reductions of the technologies currently in use on the Site.

A/M Area is SRS's largest groundwater plume, as shown in Figure 7-3. The earliest identified contamination in the A/M Area plume is associated with the M-Area and Metallurgical Laboratory Hazardous Waste Management Facility (HWMF), located in the general proximity of the "M" shown in Figure 7-4. Remediation at these two facilities began in 1983, when SRS pumped groundwater from wells to an above-ground treatment system, followed by SVE, and then by thermal treatment, as shown in Figure 7-7. As of 2019, these technologies have removed 1.56 million pounds of solvent, consisting of TCE and PCE.

Treatment technologies that SRS has recently implemented to address VOCs include the in-place injection of oxidants and adding carbon source and microbes to stimulate bioremediation to intercept and destroy VOCs transported by groundwater. An innovative technology the Savannah River National Laboratory (SRNL) developed at SRS to address VOC contamination is humate amendment injection. Humate is an agricultural organic amendment. Humate injection consists of adding dissolved humate directly to the contaminated aquifer. This technology increases the sorption of TCE to aquifer sediment and biodegrades the TCE in the naturally oxygen-rich groundwater. A study investigating using humate amendments to enhance the attenuation of the VOCs began in 2017 and is in progress for the southern sector of the A/M Area plume. Humate injection is expected to continue into 2020.

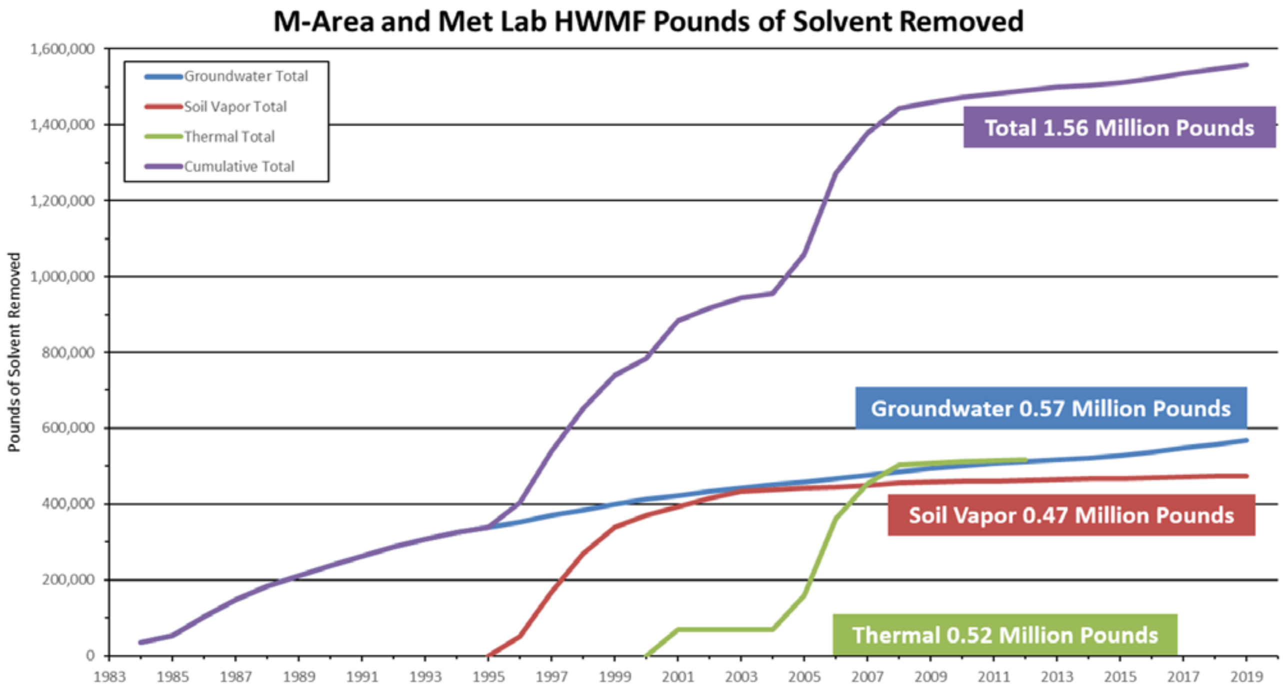

Figure 7-7 Solvent Removed from A/M-Area Groundwater Plume

Overall, the size, shape, and volume of most SRS groundwater plumes are shrinking because most of the contaminant sources have remediation systems in place. The *Savannah River Site Groundwater Management Strategy and Implementation Plan* (SRNS 2017) contains details concerning groundwater monitoring and conditions at individual sites.

7.3.3.1 Technologies Implemented in 2019

P-Area Groundwater

SRS has implemented an innovative remediation technology using 760 tons of iron filings recycled from the automotive industry to treat groundwater contaminated by solvents in a section of an aquifer beneath the SRS.

The Site mixed the filings, which are ground-up iron parts from automotive engines, with a food-grade, starch-like material and injected it into 22 wells, each 12 feet apart. The high-pressure injection fractures the subsurface rock, creating space to be filled by the mixture. Upon completion, a four-inch thick, water-permeable wall consisting of iron filings will extend to its deepest point, approximately 135 feet below the earth's surface.

Installing P-Area Groundwater Remediation Technology

Groundwater will flow through the 264-foot long, 23,000-square foot metal wall, which neutralizes the solvents. SRS completed the water-permeable wall in December 2019.

C-Area Groundwater

SRS removed 99% of the degreasing chemicals found in the groundwater during an earlier cleanup action that used high-voltage electricity to heat the subsurface, vaporizing the trichloroethylene (TCE), which was then extracted. However, TCE in the groundwater from C Reactor to Castor Creek still exists in a narrow plume about one mile long.

In 2019, SRS implemented a low-cost, low-energy cleanup method using native microorganisms and emulsified edible oils at C Area to safely reduce the discharge of TCE from groundwater into Castor Creek. Extensive study and testing have proven that a certain type of microbe native to this area actively degrades TCE. SRNS and SRNL collaborated to develop, test, and deploy the emulsified edible oil in T Area. SRNL began studying this treatment option in 2006, followed by a treatability study in T Area in 2008, with additional injections occurring 2010, 2013, and 2015. Based on the successful results in T Area, SRS implemented this remediation at C Area to address the TCE plume.

At C Area, SRS injected approximately 36,000 gallons of edible oil (vegetable oil) mixed with water, a pH buffer, vitamin B12, and vitamin C through 15 injection wells or pipes (one row of 5 locations; one row of 10 locations) driven into the earth to a precise depth within the aquifer below. The injected oil and microbes thoroughly mix with the groundwater moving through this area and coat particles of sand and clay in the subsurface. The TCE in the groundwater adheres to the oil, where microbes consume both, resulting in harmless compounds.

SRNS Employees Take Baseline Groundwater Samples Prior to the Start of the C-Area Cleanup Project

Conservative estimates indicate the Site will treat more than 1 million gallons of groundwater per year. Remediating the groundwater using microbes and oil costs 30-60% less than many traditional types of TCE remediation at SRS.

7.3.4 Conserving SRS Groundwater

As in the past, SRS continues to report its drinking and process water use to SCDHEC. In 2019, SRS used 2.45 million gallons of water per day. Information on SRS water conservation is in Chapter 2, *Environmental Management System*.

SRS manages its own drinking and process water supply from groundwater beneath the Site. Approximately 40 production wells in widely scattered locations across the Site supply SRS domestic and process water systems. Eight of these wells are domestic water systems that supply drinking water. The other 32 wells provide water for all SRS facility operations. The *SRS Environmental Report* for 2019 webpage contains a map of SRS domestic water systems under the *Environmental Maps* heading.

The A-Area domestic water system now supplies treated water to most Site areas. The system is made up of a treatment plant, distribution piping, elevated storage tanks, and a well network. The wells range in capacity from 200 to 1,500 gallons per minute. Remote facilities, such as field laboratories, barricades, and pump houses, use small drinking water systems and bottled water. SRS domestic water systems meet state and federal drinking water quality standards. SCDHEC samples the systems quarterly for chemical analyses. Monitoring the A-Area water system for bacteria occurs monthly. SCDHEC performs sanitary surveys every two years on the A-Area system and inspects the smaller systems every three years. All 2019 water samples complied with SCDHEC and EPA water quality standards. Information on compliance activities associated with the SRS drinking water system is in Chapter 3, *Compliance Summary*, Section 3.3.7.2, *Safe Drinking Water Act (SDWA).*

A, F, H, and S Areas have process water systems to meet SRS demands for boiler feedwater, equipment cooling water, facility washdown water, and makeup water. SRS uses the makeup water for cooling towers, fire storage tanks, chilled-water-piping loops, and Site test facilities. Process water wells ranging in capacity from 100 to 1,500 gallons per minute supply water to these systems. In K Area, L Area, and Z Area, the domestic water system supplies the process water system. At some locations, the process water wells pump to ground-level storage tanks, where SRS implements corrosion control measures. At other locations, the wells directly pressurize the process water distribution piping system without supplemental treatment.