Savannah River Site™

ENVIRONMENTAL REPORT SUMMARY FOR 2017

SRNS-RP-2018-00471

The cover photos are courtesy of local photographers who graciously gave SRS permission to display their work.

Front Cover—Large photograph. The iconic Blue Peter Tree at the Aiken Training Track, Aiken, SC. The bottom left photograph was taken at the Brick Pond Park in North Augusta, SC. These two photographs are courtesy of Larry Gleason. The bottom right photograph was taken at the Brick Pond Park in North Augusta, SC. This photograph is courtesy of Mike Baggett.
Back Cover—The Canoe and Kayak Club of Augusta on the Savannah River, downstream of Augusta, GA. This photograph is courtesy of George Reeves.

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Or, go to the SRS Environmental Report webpage at
http://www.srs.gov/general/pubs/ERsum/index.html
and under the SRS Environmental Report for 2017,
complete the electronic customer satisfaction survey.

Savannah River Site

Environmental Report Summary for 2017

CONTENTS

Why This Report Is Important

This report is a summary of the impacts Savannah River Site (SRS) activities have on the environment and the local community. This summary report highlights SRS's

- Significant environmental accomplishments that support Site missions
- Compliance with environmental laws and regulations
- Public dose from SRS activities
- Monitoring that supports dose calculations and compliance requirements
- Community involvement

The full *SRS Annual Environmental Report* provides the public with details on compliance, potential radiation dose, and monitoring as a result of SRS operations that potentially affect the well-being of the communities surrounding the Savannah River Site.

The dose and monitoring chapters provide time trend graphics for key monitoring and radiation dose measurements.

Many articles within this Summary report are based on the information provided in the full *SRS Annual Environmental Report*. For those articles, a text box located at the bottom of the page identifies the related chapters and sections from the full *SRS Annual Environmental Report*.

SRS Annual Environmental Report: **www.srs.gov/general/pubs/ERsum/er17/index.html**

OVERVIEW

Where is the Savannah River Site?

The Savannah River Site is a U.S. Department of Energy (DOE) facility in the western region of South Carolina, along the Savannah River. The Site is approximately 300 square miles and covers parts of Aiken, Allendale, and Barnwell counties.

The Site is dedicated to environmental cleanup, nuclear weapons stockpile stewardship, and disposing of nuclear materials to support U.S. nuclear nonproliferation. SRS operates safely and efficiently to accomplish its mission while protecting public health and the environment.

The Site also develops and deploys technologies to improve the environment and treat waste leftover from the Cold War.

SRS supports diverse natural habitats, including pine and hardwood forests, riverine environments, and approximately 400 wetlands.

White-tailed deer, turkeys, eagles, alligators, and many species of snakes, amphibians, and songbirds thrive on the Site. SRS also manages endangered species populations of the red-cockaded woodpecker, pondberry, and smooth purple coneflower.

In 1972, the Atomic Energy Commission designated SRS the first National Environmental Research Park, which provided opportunities for studying the environmental impacts of energy and defense-related technologies.

Monitoring Program
Backed By History

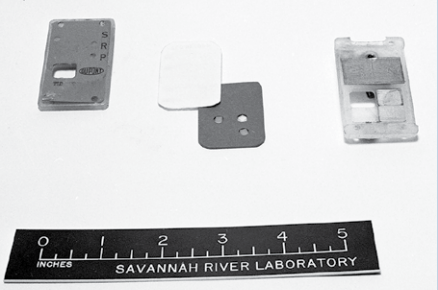
From the early days of SRS, radiation monitoring to determine dose to workers, the public, and the environment has been a routine, yet important, activity.

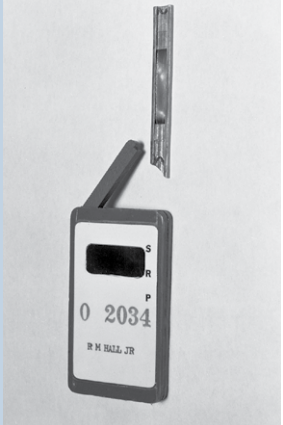
During this time, much of the equipment needed was not readily available, as it is today. Seeing its importance, scientists and engineers at many of DOE's sites were insightful and began developing the equipment needed in this growing field. In the 1950s, 1960s, and 1970s, several Site organizations were involved in developing the devices used onsite to monitor radiation. The Site manufactured equipment with the names "Fish Pole Probe" and "P.I.T. Source Monitor" in the mid-1950s.

The Equipment Engineering Group, formed in 1954, developed devices such as the NIM (nuclear incident monitors) systems, health protection badge readers, and the plant perimeter gamma monitoring system. This perimeter monitoring system was the predecessor to the current thermoluminescent device (TLD) network in use to monitor environmental gamma exposure rates in the environment in and around SRS.

In 1960, SRS completed the state-of-the-art whole body counting facility and had the system ready in 1961 to monitor employees. In the 1970s, Site personnel supported the development of an automatic TLD reader to read the new TLD badges.

Today, there are many products available to monitor radiation in the work place and the environment with the work performed at DOE sites having formed the foundation.





Facing page, an SRS wetland; this page above, a walkover monitor; this page left, film badges and dosimeters measured gamma radiation exposure. Narrative derived from *Savannah River Site at Fifty*

ACCOMPLISHMENTS

Broad-based Experts

Key to Program Success

Inside the Defense Waste Processing Facility, the only operating radioactive waste glassification plant in the nation

The Site performs its current missions safely and efficiently to protect public health and the environment. Although scaled down from its production days during the Cold War when SRS was key to the nation's defense, SRS's current activities focus on waste processing and treatment, environmental cleanup and remediation, tritium processing, and protecting nuclear material.

SRS accomplishes its missions through the efforts of the multiple organizations that work together. The main organizations operating at SRS include

- DOE
- National Nuclear Security Administration
- Savannah River Nuclear Solutions, LLC
- Savannah River National Laboratory
- Savannah River Remediation, LLC
- Centerra-SRS
- Ameresco
- Parsons
- Chicago Bridge and Iron AREVA MOX Services
- The University of Georgia's Savannah River Ecology Laboratory
- Savannah River Archaeological Research Program
- U.S. Department of Agriculture's Forest Service-Savannah River

2017 *SRS Environmental Accomplishments*

RADIOACTIVE LIQUID WASTE MANAGEMENT

Completed construction and operational testing of SDU-6 **16 months ahead** of schedule and **$25 million** under budget

Installed and completed startup testing of a replacement melter for the Defense Waste Processing Facility

Immobilized 926 thousand curies of radioactivity through the Defense Waste Processing Facility

LOW-LEVEL WASTE MANAGEMENT

Made **nine transuranic waste shipments** to the Waste Isolation Pilot Plant.

RESOURCE CONSERVATION AND RECOVERY ACT

Reached **15 consecutive years** violation-free for all 19 underground storage tanks containing usable petroleum fuel

Complying with
NPDES Permitting

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

NPDES permits that the South Carolina Department of Health and Environmental Control issues to SRS provide specific requirements for sampling locations, parameters to be tested, monitoring frequency, and analytical and reporting methods. SRS collects NPDES samples in the field according to federal guidelines. These guidelines list specific methods for sample collecting, preserving, and analytical methods acceptable for the type of pollutant.

During 2017, SRS sampled 34 NPDES industrial stormwater locations and 28 NPDES industrial wastewater locations. SRS submits monthly reports to South Carolina Department of Health and Environmental Control, documenting the monthly sampling results.

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2017 *Environmental Compliance*

South Carolina Department of Health and Environmental Control issued five Notice of Violations (NOVs) with no financial penalties to SRS.

Onsite drinking water facilities were in compliance with the Safe Drinking Water Act.

SRS completed 504 National Environmental Policy Act (NEPA) reviews with 452 identified as categorical exclusions that required no further action from the Site under NEPA.

SRS had zero Comprehensive Environmental Response, Compensation, and Liability Act reportable releases.

SRS had zero ORPS reportable events with ORPS Group 5 (Environmental) and three ORPS reportable events within ORPS Group 9 (Noncompliance Notification), based on fiscal year reporting.

SRS had 376 construction and operating permits.

SRS made three regulatory self-disclosures, resulting in two of the NOVs named above.

SRS follows federal guidelines to monitor at all applicable SRS outfalls

SUSTAINABILITY

Passive Technologies

Key to Energy and Cost Savings

Environmental sustainability at SRS reduces the amount of waste produced, uses less energy, and implements green approaches to preserve the long-term quality of the environment. These sustainability concepts continue to be important in the Site's environmental remediation program.

For more than 20 years, SRS has been a leader in the DOE complex in developing, testing, and implementing low-maintenance technologies that take advantage of natural processes to clean residual amounts of contaminants from the subsurface. These passive technologies focus on removing and destroying volatile organic contaminants (VOCs), predominantly trichloroethylene (TCE), and stabilizing radionuclides with minimal infrastructure, energy, and maintenance. SRS implements them as part of the remediation approach that balances the operating cost for a technology with the amount of contaminant removed.

DOE's Savannah River National Laboratory (SRNL) developed one of the earliest low-energy technologies that SRS implemented to clean VOC contaminants from the subsurface. The BaroBall™, which SRS first deployed in 1996, uses the changes in atmospheric pressure to remove low concentrations of VOCs that are in the air pockets below ground surface but above the groundwater. It requires no electricity and minimal maintenance. The MicroBlower, a solar-powered extraction system deployed in 2003 as the next generation of the BaroBall™, uses small solar-powered motors to continuously remove VOCs from the subsurface.

Beginning in 2006, SRS began testing another SRNL-deployed passive technology to enhance the natural degradation of TCE in the subsurface. The technology uses edible vegetable oil—the same grade as you use at home—to coat the TCE, which then becomes a food source for the naturally occurring bacteria. The bacteria eating the vegetable oil degrades the TCE. As groundwater flows, the oil moves to other areas of the

plume and increases the bacteria's ability to destroy TCE in those areas. SRS periodically adds oil to the subsurface based on measured TCE concentrations in the groundwater. The savings associated with transitioning from the original pump-and-treat technology to using edible vegetable oil is approximately $1 million per year.

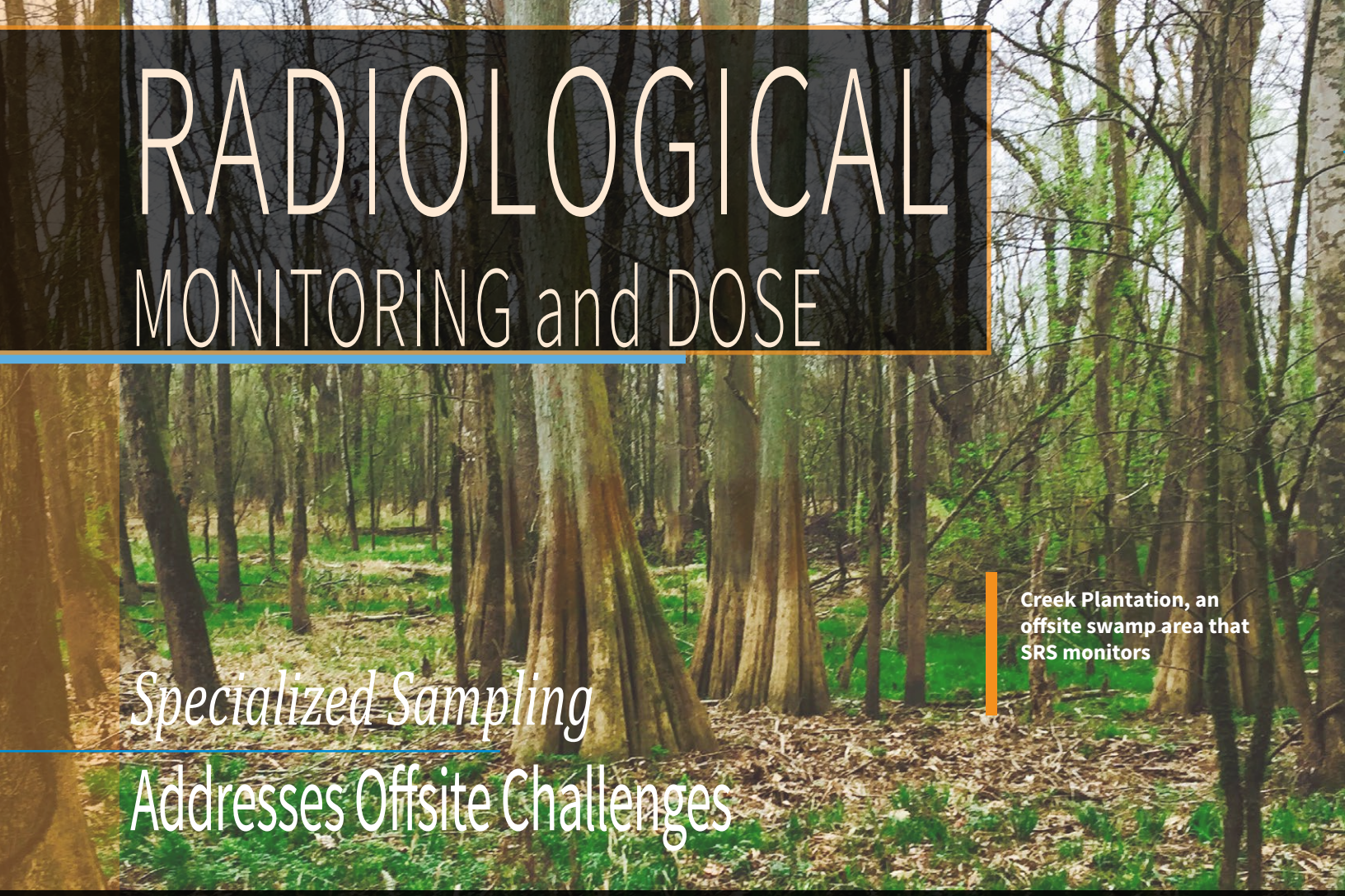
Stabilization has been central to sustainable remediation of metals and radionuclides in SRS groundwater. In 2002, SRS developed and deployed a passive technology to stabilize strontium-90 and uranium that were mobile in the groundwater due to codisposed acids. This technology replaced the pump-and-treat system that was both energy- and maintenance-intensive.

By introducing an alkaline solution, the pH in the groundwater rises to the level where the strontium-90 and uranium are absorbed to the soil. The alkaline solution is added when the groundwater pH decreases to a trigger point. Like implementing edible vegetable oil treatment, the transition from active technology to injecting the alkaline solution saved approximately $1 million per year.

*Harnessing the forces of nature with low-energy solutions to clean the subsurface has saved **many millions of dollars** at the **Savannah River Site.***

Facing page from left, BaroBall™ and vegetable oil technologies, and a deep soil rig, prepping for groundwater stabilization; this page, taking readings from the MicroBlower

RADIOLOGICAL MONITORING and DOSE



Creek Plantation, an offsite swamp area that SRS monitors

Specialized Sampling Addresses Offsite Challenges

For more than 40 years, SRS has been sampling soil and vegetation in the Savannah River Swamp south of the Site to determine the residual amount and distribution of radioactivity that was deposited during SRS operations in the 1960s. The monitored area is approximately 5 square miles of the Savannah River Swamp within the privately owned Creek Plantation, located along the Savannah River and sharing a border with the southern boundary of SRS. Of this total area, radioactivity is measured in approximately 1.7 square miles. Radioactivity is decreasing with time.

Because access to the swamp presents a logistical challenge, it is important to be strategic in sampling. To facilitate this, in 1974 the Site began using remote monitoring along with ground surveys to identify radioactively contaminated areas in the Savannah River Swamp. The results of this monitoring assisted SRS in identifying 10 sampling trails into the swamp, ranging from 240 to 3,200 feet in length. Fifty-two monitoring locations are designated on the trails to allow for continued monitoring at a consistent set of locations. Each trail cuts across the swamp, with the 10 trails providing data on the amount of radioactive contamination from SRS to Little Hell Landing, south of the Site.

The sampling consists of collecting soil and vegetation samples and placing and retrieving thermoluminescent devices (TLDs) to measure external gamma exposure. This practice of using remote monitoring to inform sample collection continues today and supported the collection of additional samples during the 2017 comprehensive sampling.

The comprehensive sampling is conducted on a five-year schedule. Between comprehensive events, annual sampling is performed on a subset of locations. These locations represent the historical highest concentrations and locations where concentrations were newly identified as elevated. Events, such as floods, that may result in radioactive contaminant redistribution in the sediments, are the basis for SRS conducting additional comprehensive sampling.

The original comprehensive survey was conducted in 1974, with a limited survey occurring in 1972. Sampling has been performed annually since that time, except when high water levels limited safe access. Over time, concentrations are decreasing. This is due to both radioactive decay and movement of contaminants as rainwater and floodwaters transport them.

Additional Information in 2017 Annual Site Environmental Report: **Chapter 5, Section 5.7**

Assigning Dose

To the Representative Person

The representative person is not someone you've met or even have much in common with, but this individual has a great influence on protecting your health, your quality of life, and safeguarding the environment you live in. This person represents **YOU,** but in a very unlikely scenario.

This unnamed, unfaced person exists only in calculations and dose models as a hypothetical human who is between you and the radiation originating from Savannah River Site projects and missions.

The representative person is not male or female and is not young or old, but a is an age- and gender-averaged human who represents the residents surrounding the Savannah River Site.

The premise is if the dose the representative person receives is at or below the U.S. Department of Energy's dose limit prescribed as safe for the public, then you, a resident who does not seek out exposure pathways, would be at an even safer level.

How is the Representative Person's Exposure Significant?

In each scenario below, which describe liquid and air pathway exposures based on location and duration, the representative person is in a position that maximizes the amount of potential radiation that a human could be exposed to.

1. Lives near the Site boundary all day, every day
2. Consumes milk, meat, vegetables grown or raised at the Site boundary
3. Drinks water and eats fish from the Savannah River
4. Participates in recreational activities on the river or spends time near the river every day

The representative person's exposure is at the 95th percentile of national and regional data, meaning that this hypothetical person is participating in the exposure scenarios to an extent greater than 95% of the population.

DOE has decided that a 100 mrem a year dose limit is a safe level of radiation for the public to receive from both liquid and air pathways. The dose limit is the same for all DOE sites. For 2017, SRS calculated the all-pathway (liquid and air exposure) representative person dose to be 0.25 mrem a year, which is just one-quarter of one percent of the universal DOE limit for safe exposure.

From time to time, as regulations change, trends emerge, analyses show new information, and Site releases fluctuate, SRS adjusts how it measures the representative person's exposure. For 2017, SRS made two changes in the locations it placed the representative person.

The first change was for doses involving liquid pathways. The representative person moved from Savannah River Mile 118.8 near the U.S. Highway 301 bridge to River Mile 141.5, which is above the old location and slightly downriver from the Steel Creek mouth. Moving the representative person near the Steel Creek mouth, where the values are higher and less diluted than they are downstream, gives a more accurate indication of the potential dose to the public from eating fish caught at this location on the Savannah River.

The second change was for doses involving air pathways. The Site looks at the person living offsite but still close to the boundary, as described in the scenarios above. Starting in 2017, the Site determined the dose for an adult worker at the Three Rivers Landfill, located inside the Site security perimeter, but with an entrance accessible to the public from South Carolina Highway 125 in Aiken County, near Jackson, South Carolina. Three Rivers Landfill employees are not Site employees and are considered members of the public to comply with DOE Orders and regulations issued by the National Emissions Standards for Hazardous Pollutants Compliance (NESHAP). Because these workers are only at this site during the work week, their exposure is less than the representative person, who spends all year at the Site boundary.

What is

Radiation Dose?

Radiation dose to a person is the amount of energy the human body absorbs from a radioactive source located either inside or outside of the body. Radioactive sources typically transfer energy in the form of rays (such as gamma or X-rays) or high-energy particles (such as alpha or beta particles).

Humans, plants, and animals can receive radiation doses from both natural and man-made sources. Radiation can come from as far away as outer space and from as near as the ground on which you are standing. Because it is naturally all around us, we cannot eliminate radiation from our environment.

SRS typically reports radiation dose in a unit of measure called a "millirem" (mrem). The average annual dose for U.S. residents from these sources is 625 mrem. The average dose of naturally occurring radioactive minerals in the ground and water, and cosmic radiation from outer space is 311 mrem. Man-made sources of background radiation include the following:

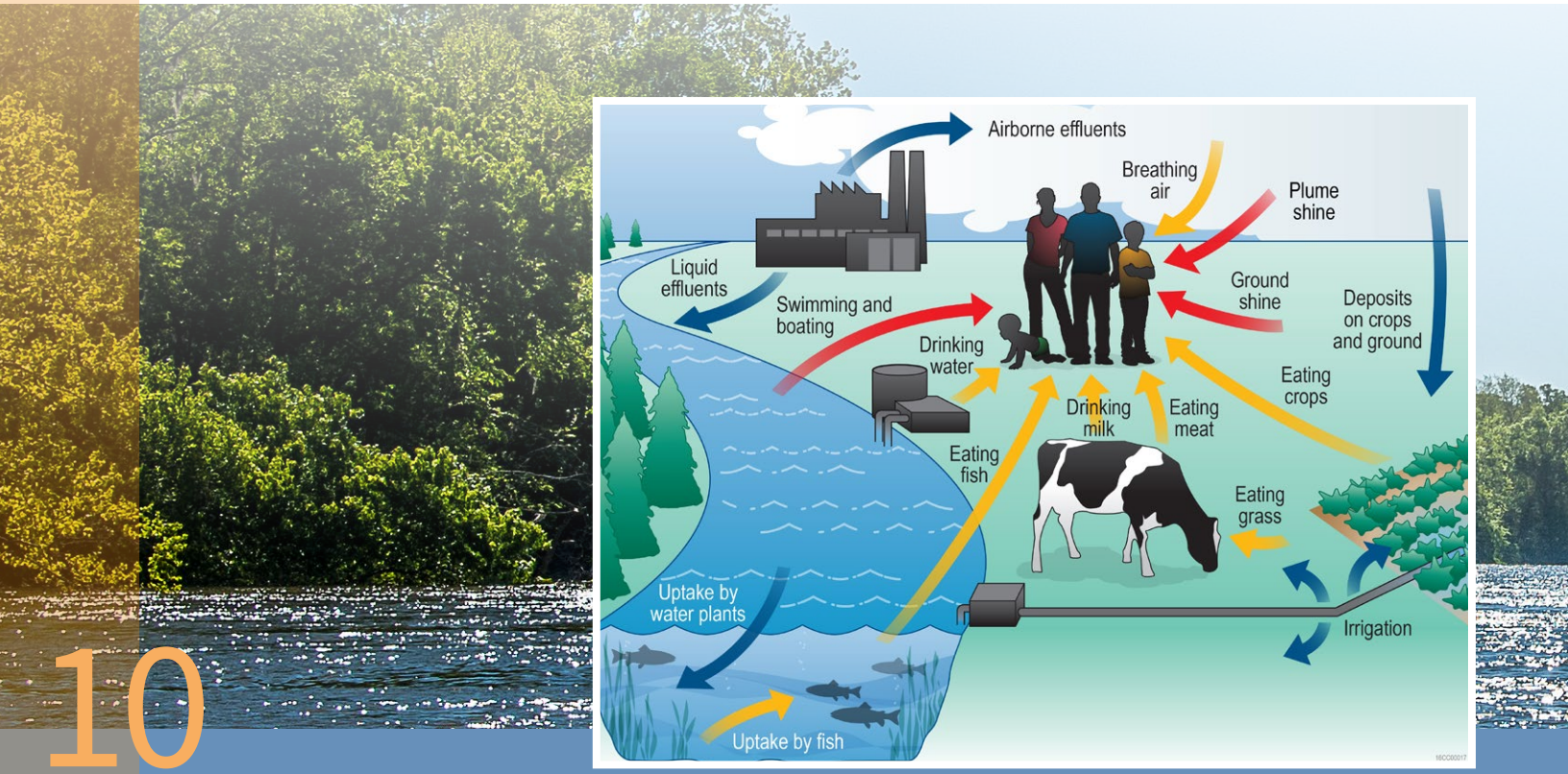
- Medical procedures (300 mrem)
- Consumer products (13 mrem)
- Industrial and occupational exposures (1 mrem)

DOE has established dose limits to the public so that operations will not contribute significantly to this average annual background exposure.

DOE Order 458.1, Radiation Protection of the Public and the Environment, establishes 100 mrem/year as the annual dose limit to a member of the public that can come from Site operations.

Exposure to radiation potentially occurs through the following pathways, as the figure below illustrates:

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



2017

Potential Radiation Dose

In 2017, SRS did not significantly increase potential radiation exposure to the public.

The potential doses from SRS radioactive discharges to air and water were well below regulatory standards for the public and the environment. Compliance with DOE Order 458.1 is discussed in Chapter 6, Radiological Dose Assessment, of the *SRS Annual Environmental Report.* The potential radiation dose to the public is included in that chapter.

The combined dose from air and water pathways—called the "all pathway" dose—was 0.25 mrem in 2017, which is well below the DOE public dose limit of 100 mrem/yr. Of this 0.25 mrem/yr dose, 0.22 mrem was from liquid releases, and 0.027 was from releases to the air.

The all-pathway dose for 2017 is slightly higher than the 2016 total dose of 0.19 mrem. SRS attributes this to a small increase in the water pathway dose as a result of SRS moving the representative person location.

Cellular Technology

Aids Surface Water Compliance

Surface water sampling is a central part of SRS's nonradiological environmental monitoring program. The data from these samples document the Site's compliance with the Clean Water Act, National Pollutant Discharge Elimination System (NPDES) requirements, and adherence to water quality standards.

More than 77 sampling locations are dispersed across the 310 square miles of the Site, with approximately 80% of them being in remote locations with limited access. Timing is a major challenge for this program.

TECHNOLOGY

Wireless technology triggers sampling at remote locations when conditions meet criteria

SRS can collect stormwater samples only during a qualifying rain event. To collect a sample, two conditions must be met:

1) At least 72 hours must have elapsed since the previous flow event, and
2) The sample must be collected during the first 30 minutes of the initial flow.

Timing challenges include traveling to the sample locations to meet criteria 2 above, preserving some samples immediately upon collection, and short times allowed between collecting and analyzing some samples. There are also potential safety concerns because technicians often collect these samples over rough terrain and during the actual storm, when there is the potential for lightning strikes.

The solution incorporates cellular technology with traditional field sampling equipment. The field setup includes Teledyne ISCO sequential samplers with liquid level actuators, cellular modems, and rain gauges that initiate text notifications and trigger the equipment to collect a stormwater sample. Using this technology also allows a technician to control sampling devices with a cellphone. Each outfall is uniquely programmed based on watershed flow characteristics. This modern approach to sampling allows SRS to meet permit requirements, keep workers safe, and protect human health and the environment.

Remediating SRS Groundwater

Visual check of water quality

SRS's environmental remediation program has been in place for more than 20 years. The Federal Facility Agreement (FFA) for the Savannah River Site documents the remediation schedule as agreed to between the South Carolina Department of Health and Environmental Control, U.S. Environmental Protection Agency, and Department of Energy–Savannah River.

Remediation focuses on removing mass, reducing contaminant levels, and reducing the exposure of humans and the environment to contaminants that exceed standards. This often involves treating groundwater contamination sources.

Remediation of SRS's largest groundwater plume, located in A/M Area, began in 1988. As of 2017, 1.54 million pounds of chlorinated solvent, consisting of trichloroethylene and tetrachloroethylene, have been removed. Multiple technologies have been operated with comparable cumulative removal results. The initial technology that was implemented consisted of pumping groundwater from wells to an above-ground treatment system. As the contaminant removal rate decreased, SRS began an integrated approach of using multiple technologies. Active soil vapor extraction of contaminants in the vadose zone, followed by thermal treatment of contaminants remaining in source areas within the groundwater resulted in increased contaminant removal.

In 2017, SRS conducted a study in a portion of the A/M Area plume to investigate using humate amendments to enhance the attenuation of VOCs. If successful, this attenuation-based treatment will be another innovative technology SRS implements to further remediate the A/M Area plume.

ENGAGING the PUBLIC

Tour attendees on the bus, above, and during orientation

Site Tours

Sharing History, Programs with the Community

The Savannah River Site hosted 22 tours during 2017, allowing more than 1,000 people to see firsthand the historic and operational facilities at SRS that were responsible for producing plutonium and tritium during the Cold War.

Tour participants learn about the Site's current missions and the focus on the future. Among many sights, tour participants get to view the animals at the University of Georgia's Savannah River Ecology Laboratory.

SRS holds the free four-hour tours throughout the year. Each tour accommodates up to 50 people. Seats on the commercial buses are filled through reservations on a first-come, first-served basis. Tour participants must be at least 18 years old and be a U.S. citizen.

Tours start at the Aiken County Applied Research Center, located off Highway 278, near New Ellenton.

Sign up: ***https://www.srs.gov/general/tour/public.htm*** **803-952-8994**

Members of the CAB assemble at a meeting venue

CAB Engages Citizen Input

on Site Projects and Policies

The SRS Citizens Advisory Board (CAB) provides advice and recommendations to DOE on environmental restoration, waste management, and other related issues of concern. The CAB meets publicly six times a year at locations in South Carolina and Georgia that have a proximity-vested interest in the impact of Site operations on their communities. The SRS CAB made 11 recommendations to DOE-Savannah River for 2017. These recommendations and responses are available on the CAB's webpage.

The board's membership is carefully considered to reflect a full diversity of viewpoints in the affected community and region. Board members are directly affected by DOE site clean-up activities.

The Citizens Advisory Board is headed by a chair and vice chair who represent the CAB at Environmental Management Site-Specific Advisory Board meetings and to the public. The remaining board members are divided into four issues-based committees, which include the Facilities Disposition & Site Remediation Committee, the Nuclear Materials Committee, the Strategic & Legacy Management Committee, and the Waste Management Committee.

The various committees within the CAB meet bimonthly to discuss topics such as environmental clean-up on the Site, budget management, materials handling, historic preservation, and plans for the future uses of the Site.

Agency liaisons from DOE, the U.S. Environmental Protection Agency-Region IV, and the South Carolina Department of Health and Environmental Control participate at the table during CAB meetings.

Facilitating
Environmental Justice

A TREAT Workshop attendee looks at a sampling collection container

Mandated by the U.S. Environmental Protection Agency, the Environmental Justice program at SRS ensures no group of people should bear a disproportionate share of negative environmental consequences from Site operations.

The concerns these groups express can influence the EPA's decision-making process associated with setting standards, permitting facilities, awarding grants, and issuing licenses and regulations.

SRS uses programs to enhance engagement from the target communities. One such program is the Teaching Radiation, Energy, and Technology (TREAT) workshop, which gives teachers and members of the public the opportunity to learn about environmental radiation.

Others programs at SRS include community outreach meetings addressing job training, grants, environmental monitoring, and emergency response; student internships on environmental contamination research projects; and acquiring cutting-edge environmental analytical laboratory equipment for the Savannah State University environmental sciences students and students in the DOE-Headquarters Environmental Scholars Program, which the Oak Ridge Institute for Science and Education in Tennessee facilitates.

Making the Way for
Stakeholder Involvement

Savannah River Site management is committed to keeping the public informed about Site projects. SRS has built long-term regional support through public and intergovernmental involvement.

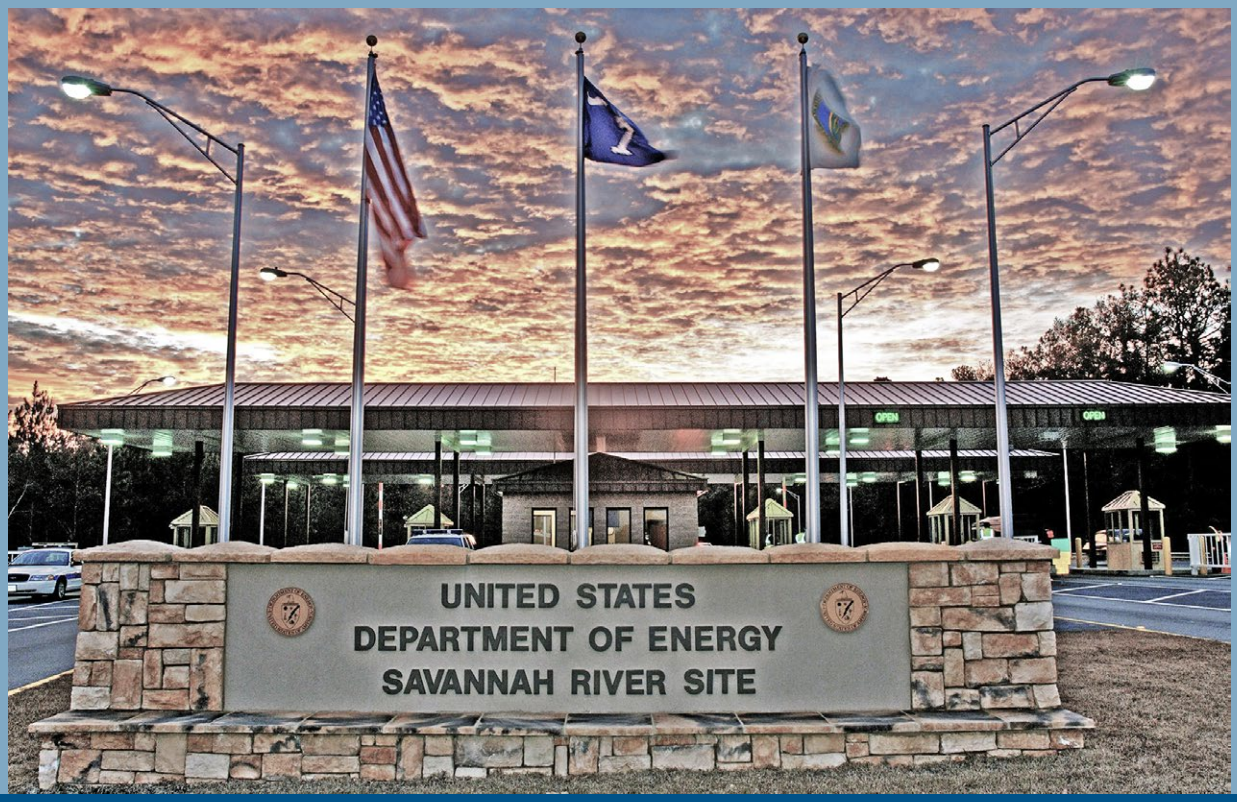
The Site achieves stakeholder involvement through a variety of activities that are responsive to input from the public. Some of these are discussed in other articles in this section.

Specifically, SRS fosters communication and information exchange with groups with vested interest in the Site through

- Assisting stakeholder groups with analyzing environmental management plans

Senate Armed Service Staffers on a Site tour

- Increasing public awareness of the impact of contaminant releases or potential releases during cleanup
- Allowing community groups to propose alternative plans that may achieve better results
- Explaining how the Site establishes priorities to promote cleanup and safety



SAVANNAH RIVER SITE

Department of Energy-Environmental Management

To Learn More About the Focus on Environmental Safety:
Visit the SRS website: http://www.srs.gov/general/srs-home.html
View or download the Savannah River Site Environmental Report for 2017:
http://www.srs.gov/general/pubs/ERsum/er17/index.html

For More Information about
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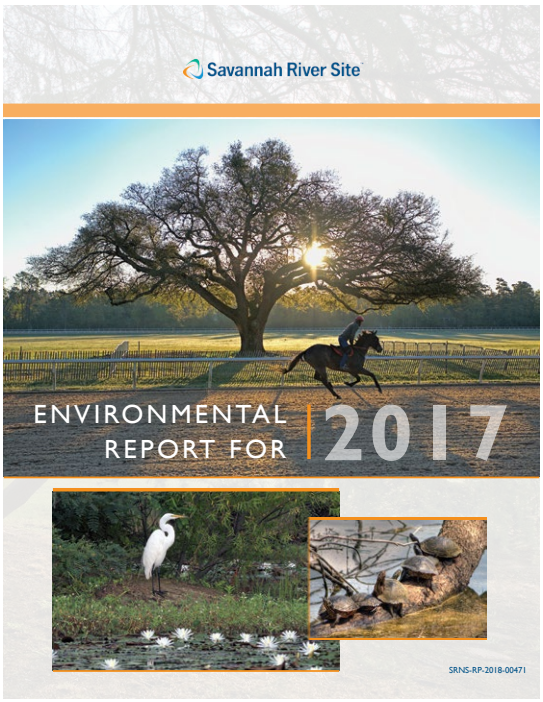

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