SRNS-RP-2022-00002

2021

SAVANNAH RIVER SITE

Environmental Report Summary

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This report highlights the Savannah River Site's environmental performance and engagement with the local communities. Many articles in this Summary are based on the information presented in the *2021 Environmental Report* and touch on the following:

- Significant environmental accomplishments that support Site missions
- Compliance with environmental laws and regulations
- Dose to the public from onsite activities
- Monitoring that supports dose calculations and compliance requirements
- Community involvement

When applicable, text at the bottom of the page identifies the related chapters and sections in the *2021 Environmental Report* where readers may find more detailed information, along with supporting data, maps, and figures.

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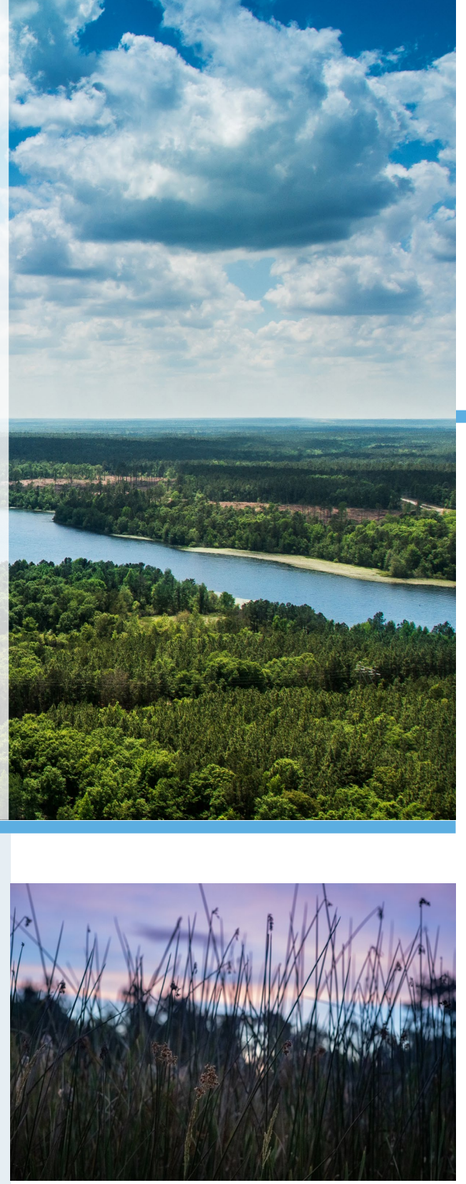

Throughout this document, you will see Savannah River Site workers and visitors distancing themselves from others, wearing masks, or doing both to protect against the spread of COVID-19. When a photograph shows masking and distancing precautions taking place, the subjects were following Site guidelines from the Centers for Disease Control and Prevention, the South Carolina Department of Health and Environmental Control, the Georgia Department of Public Health, and the U.S. Department of Energy. If a photograph shows the subjects interacting within 6 feet of one another or not wearing a mask, they were following the appropriate safety protocol for the COVID-19 pandemic at the time the photograph was taken.

OVERVIEW

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The Savannah River Site is a 310-square-mile U.S. Department of Energy complex along the Savannah River in the sandhills area of three western South Carolina counties. It is 12 miles south of Aiken, South Carolina, and 15 miles southeast of Augusta, Georgia. The population within a 50-mile radius of the Site center in Aiken, Allendale, and Barnwell counties in South Carolina and in Richmond, Burke, and Screven counties in Georgia, is 803,370. The largest population concentration is in the Augusta, Georgia, metropolitan area.

The Atomic Energy Commission, the precursor for the Department of Energy, selected this area in 1950 for E. I. du Pont de Nemours Company to create materials for nuclear weapons for the nation's defense.

In 1972, the Atomic Energy Commission designated the Site as the first National Environmental Research Park, providing it with opportunities to study environmental impacts of energy and defense-related technologies that had taken place. The Savannah River Site supports diverse natural habitats, including pine and hardwood forests, riverine environments, 48,973 acres of wetlands, along with hundreds of species of plants and animals.

Today, the Site's mission is to protect public health and the environment, while also supporting the nation's deterrent program. The Savannah River Site is committed to environmental cleanup, nuclear weapons stockpile stewardship, and disposing of nuclear materials to support the nation's nonproliferation policy. Together, these actions are transforming the Site for future use.

The Department of Energy Office of Environmental Management and the National Nuclear Security Administration oversee the Site and its resources.

Photographs, facing page (from top to bottom): The Savannah River, wetlands, Crackerneck Wildlife Management Area and Ecological Reserve. This page, from top left: Savannah River Ecology Lab study site, tree with fungus, a lily at L Lake, wildflowers at a sediment sampling location.

TOURING the SITE

Bob Bonnett shows visitors key areas at the Savannah River Site. Driver Timothy Schultz is shown in the inset captured from the virtual tour video.

"So, come on. Let's get on the bus!"

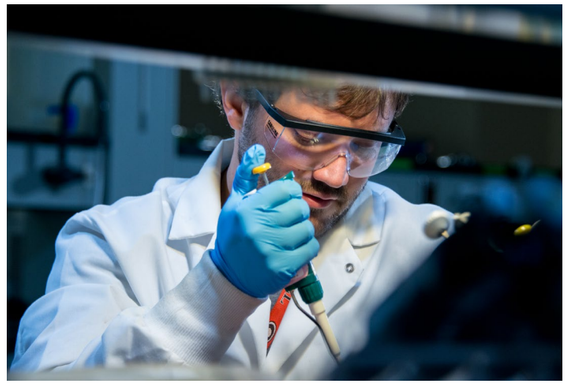
invites an enthusiastic **Bob Bonnett,** the Savannah River Site Tour Program Coordinator. "Our driver today is **Mr. Tim Schultz.** He and I are proud to show you the **Savannah River Site.**"

The Site's popular public tours hit the brakes in spring 2020 with the onset of the COVID-19 pandemic and Site protocols to protect workers and the public. The Savannah River Site quickly adjusted, going into production of a virtual tour, which created an audio, video, and pictorial experience unveiled in 2021 to 16,000 viewers online and dramatically increasing the tour's reach to the public. In previous years, in-person tours could accommodate 34 people, or about 750 people yearly through multiple tours.

The white bus, branded with the Savannah River Site name and logo, pulls away from the curb and embarks on its way, providing a glimpse into both the work in progress and past endeavors at the Department of Energy's site near Aiken, South Carolina. The virtual tour stops at key facilities throughout the project areas, from A Area to Z Area, scattered throughout the 310-square-mile complex.

"For 70 years, the Savannah River Site has been dedicated to maintaining the highest possible safety and security standards, protecting our workers, the public, the environment, and national security interests," Bonnett begins.

Dr. Eugene Odum in the 1950s laid the groundwork for modern ecology.



Today, the Savannah River Ecology Laboratory continues studying the ecosystems of the Savannah River Site.

A Area: University of Georgia's Savannah River Ecology Laboratory

After the Site was built in 1951, the Atomic Energy Commission, now the Department of Energy, requested proposals from several area universities to do a one-time baseline study on all the plants and animals found on the Site. University of Georgia's Dr. Eugene Odum, a biologist known for his pioneering work in ecosystem ecology, asked the commission if he could not only study the effects of the construction on the local environment, but also their impact on the operations that would go on there. Until construction, the Site was mainly farmland; he wanted to see how the industrialization of the Site would affect the biota.

The Atomic Energy Commission gave him a grant for $10,000, and in 1954, the ecology laboratory became a permanent entity on the Site.

"In fact, modern ecology as we know it today was born right here at the Savannah River Site through the wonderful vision Dr. Odum had," Bonnett explains.

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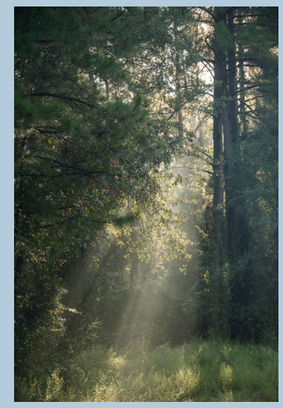
FAST FACTS

- During the first two years of construction at the Savannah River Site, the U.S. Forest Service planted **40,000 trees a day** to create erosion control and to provide secrecy to protect missions in support of the nation's defense. By 1968, the U.S. Forest Service planted the **100 millionth pine seedling**. Since then, the Site has harvested and replanted a **million trees a year**, yielding a return on investment of **$4-7 million a year** in timber sales.



- Of the 310 square miles that comprise the Savannah River Site, only 10% consists of buildings, parking lots, and roads. This leaves **90% of the Site as woodlands.** In 1972, the Site became the **first of seven National Environmental Research Parks.**

- The Savannah River Site has **36 species of snakes.** Five of these are venomous.

- **38,000 construction workers** built the Savannah River Site in **five years.**

- Site infrastructure consists of **230 miles of roads,** including **South Carolina's first cloverleaf** linking the major crossroads leading to Aiken, South Carolina, and Augusta, Georgia.

- In the early 1990s, there were about **26,000 people onsite.** Today, the worker population is close to **11,500 people**.

- The Site's rail system peaked at about **70 miles of track,** making it the **largest private rail system in the United States.** Today, the Site uses about 30 miles of track to transport construction materials and move large items from one area to another.

Get on the Bus virtual tour video: https://youtu.be/XyKm9Sk3LB8

Keep Up to Date on Status of Public Tours: www.srs.gov/general/tour/index.htm 803-952-8994

Mentoring plays an important part to work at the Savannah River National Laboratory.

A Area: Main campus of the Savannah River National Laboratory

Although the Savannah River National Laboratory is the newest of the Department of Energy's 17 national laboratories, it has been onsite since Day One. It helped develop every process that has gone on at Savannah River Site, from handling the waste, to dealing with the tritium supply, to helping maintain all the processes that the Site performs.

The Savannah River National Laboratory's work is important to the Department of Energy, the nation, and the world. For example, it helped the Japan Atomic Energy Agency after the Fukushima nuclear disaster in 2011. Domestically, the laboratory assists the U.S. Department of Homeland Security and the Federal Bureau of Investigation with laboratory resources. It even has the technical expertise needed to reconstruct a radiological crime scene, a feat it has done in the past.

M Area: A History of Missions

The Department of Energy closed M Area in 2010; however, years ago it was an active contributor to Savannah River Site missions. It was here that the Site manufactured all the fuel, target, and safety rods and transported them by onsite rail to one of five reactors, where they were irradiated and then processed in one of the separations facilities.

An early uniform from protective services at the Savannah River Site displayed at the Curation Facility.

An industry-wide practice at the time of the rod manufacturing at the Savannah River Site was to divert the associated wastewater to seepage basins. The wastewater contained solvents from the cleaning agents that the Site used to ensure the rods were ready for service in the reactor areas.

M-Area wastewater discharges allowed solvents to settle in the seepage basin, requiring the Site to remove more than 450,000 pounds of these heavy metals and degreasers. The cleanup that ensued is one of the first such closures in the United States.

Although M Area is closed, one building is still open: the Curation Facility, known as the Site Museum. The Curation Facility houses artifacts dating to before the Savannah River Site existed, along with historical items from the Cold War era of the 1950s through the 1980s.

B Area: Home to Administration and an In-house Environmental Laboratory

B Area houses the administrative offices for the U.S. Department of Energy, management and operations contractor Savannah River Nuclear Solutions, LLC; and Centerra, the Site's uniformed protective force.

The Bioassay Laboratory in B Area performs in-house sampling.

Additionally, B Area is the site of the Environmental Bioassay Laboratory, which specializes in high-volume sample loads with rapid turnaround times. The laboratory averages 42,000 samples a year.

F Area: Former Chemical Separations Area

From B Area, the tour continues to F Area and passes the National Nuclear Security Administration's Savannah River Plutonium Pit Processing Facility, which will have the mission of manufacturing plutonium pits, a critical component of every nuclear weapon.

The National Nuclear Security Administration is employing a two-site strategy, with the Site producing no fewer than 50 pits per year and Los Alamos National Laboratory producing no fewer than 30 pits per year. This approach will provide an effective, responsive, and resilient nuclear weapons infrastructure with the flexibility to adapt to shifting requirements and counter future threats.

The Savannah River Plutonium Pit Processing Facility will manufacture plutonium pits..

The Burial Ground had been the site for waste disposition from early construction projects.

E-Area: Burial Ground, Solid Waste Management for Low-Level Radioactive Products

Solid Waste Management in E Area is responsible for disposing of the Savannah River Site's solid wastes, which include sanitary, construction and demolition, hazardous, low-level radioactive, and job waste. Sanitary waste is taken offsite to the Three Rivers Landfill.

In the early 1970s, the Site stopped using the Burial Ground for radiologically contaminated job waste (shoe covers, clothing, and tools) and some equipment that could not be decontaminated. Instead, it placed the material inside large concrete casks, topped them with a concrete cap, and covered the casks with earth to await permanent disposal.

In the 2000s, the Savannah River Site opened the casks, reclassified the contents, and repackaged them for transport to a geologic repository at the Department of Energy's Waste Isolation Pilot Plant near Carlsbad, New Mexico. The Site has transported about 30,000 55-gallon drums to the repository.

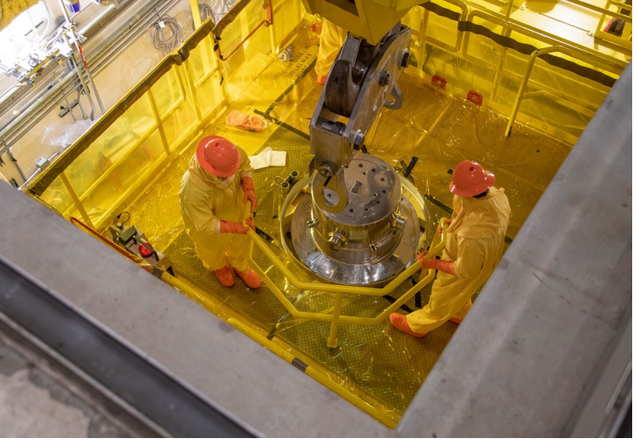
Previously buried waste is reclassified and repacked in casks for shipment to the Waste Isolation Pilot Plant for permanent disposition.

H Canyon has been operating for 65 years. Its first mission was to recover uranium and neptunium from fuel tubes.

H-Area: Processing Facilities

H Canyon is the largest shielded radiochemical separations facility active in the United States. It has been operating for 65 years. Although the mission is different than when it first started and recovered uranium and neptunium from fuel tubes used in the reactors, it continues to provide a valuable service to the United States. The separations process at H Canyon isolates the waste product from highly enriched uranium fuel rods coming from the L-Area storage basin and transfers it to H-Tank Farm, along with other Cold War legacy materials. The Site ships the desirable material to a manufacturer to be converted to commercial fuel for reactors.

"We have converted about 310 metric tons of highly enriched uranium to commercial fuel," Bonnett explains. "That's a win-win. We're getting rid of proliferable material and turning it into something useful, such as electricity."



Tritium Extraction Facility personnel receive rods shipped from the Tennessee Valley Authority in preparation for extracting tritium for the nation's nuclear deterrent.

H Area: The National Nuclear Security Administration's Savannah River Tritium Enterprise

Tritium is an isotope of hydrogen and a key component of nuclear weapons. It has a half-life of about 12 years. The National Nuclear Security Administration's Savannah River Tritium Enterprise, also in H Area, recycles tritium warheads, extracting and purifying the tritium. Tritium decays to helium 3, a valuable commodity the Department of Energy's Office of Science uses to produce neutron detection equipment. The Department of Homeland Security uses this equipment worldwide to protect our nation and allies from terrorism.

Savannah River Site's Main Objective: Environmental Management

One of the Site's main objectives is environmental management. The Site's waste left over from Cold War processing has been stored in 51 tanks in F-Tank Farm in F Area and H-Tank Farm in H Area. Most of the tanks' content is salt waste.

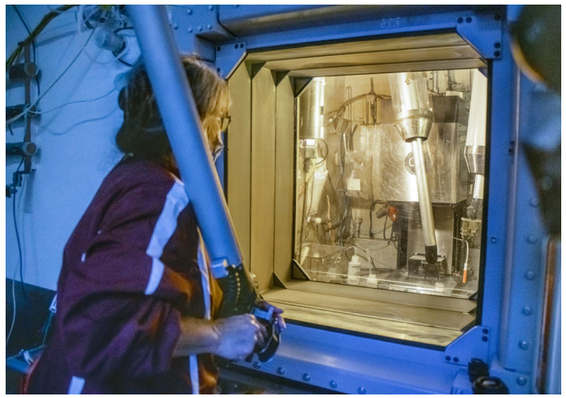
The Savannah River Site achieved the first high-level radioactive waste tank closure in the nation. The Site processed about a million gallons a year of salt waste, allowing it to empty and close 8 of the 51 tanks.

"Since 1997, eight of those tanks have been emptied, cleaned, closed, and filled with grout, never to be used again," Bonnett explains.

> *"The Salt Waste Processing Facility is upping the game on salt waste, allowing the Site to process about 9 million gallons of salt waste a year, emptying the tanks much sooner than expected."*

The tanks also hold sludge, but it is a much smaller volume than the salt waste. The Site mixes the sludge, which contains most of the radiation, with water, allowing it to be a consistency that can flow through pipes to the Defense Waste Processing Facility in S Area. After several processes, the sludge mixes with borosilicate glass at 2,100 degrees Fahrenheit in a steel and ceramic melter. This procedure immobilizes the radioactivity. Each cannister containing the liquid waste chemically bound in the borosilicate glass matrix weighs about 5,000 pounds when filled. The Site is keeping the cannisters temporarily at a glass waste storage facility in S Area until a permanent federal repository is established.

The Defense Waste Processing Facility processes the sludge, mixing it with borosilicate glass at 2,100 degrees Fahrenheit.



The Shielded Cells Facility is actively involved in research and development initiatives that support high-level radioactive waste management programs, such as the Savannah River Site's Defense Waste Processing Facility, Salt Waste Processing Facility, Saltstone, and the closure of Site's radioactive waste storage tanks.

The Salt Waste Processing Facility mixes concrete with slag before it is stored in one of the 32-million-gallon mega-vaults.

Z Area: Salt Waste Processing

Across the street from S Area is Z Area, where the saltstone material from the Salt Waste Processing Facility is mixed with concrete and slag and stored in 32-million-gallon mega-vaults. Processing has increased since the Salt Waste Processing Facility began operating in October 2020. In the past, the Site has used 3- and 5-million-gallon tanks to store the saltstone for permanent disposal as a low-level radioactive waste. The Savannah River Site is building seven 32-million-gallon mega tanks to hold the salt waste. By the end of 2021, two of the tanks were completed, and another two were in progress. They first began operating in 2018.

By the end of 2021, two of the 32-million-gallon mega-vaults were completed, and another two were in progress.

Mock-ups of glovebox handling are held in K Area for training.

The Site conducts training for plutonium handling in K Area.

K Area: Plutonium Storage Facility

Although the Site closed P and R Reactors and grouted them in place more than 10 years ago, K Reactor has been repurposed to part of K Area's principal operations building and the Department of Energy's premier plutonium storage facility. This is largely because of the integrity the reactor building gained from seismic and structural upgrades in the early 1990s. K Reactor ceased operating in 1992.

The K-Area Complex facilitates not only the interim storage of the nation's plutonium and special nuclear materials, but it is also the location of plutonium oxide downblending. This process yields a more secure, nonproliferable mixture that cannot be used for weapons production and can be safely disposed at the Department of Energy's Waste Isolation Pilot Plant.

AMERICA the BEAUTIFUL

Savannah River Ecology Laboratory bird sampling (above and left) in a wetland area of the Site.

- ***Focus Area 1:*** *Create More Parks and Safe Outdoor Opportunities in Nature-Deprived Communities*
- ***Focus Area 2:*** *Support Tribally Led Conservation and Restoration Priorities*
- ***Focus Area 3:*** *Expand Collaborative Conservation of Fish and Wildlife Habitats and Corridors*
- ***Focus Area 4:*** *Increase Access for Outdoor Recreation*
- ***Focus Area 5:*** *Incentivize and Reward the Voluntary Conservation Efforts of Fishers, Ranchers, Farmers, and Forest Owners*
- ***Focus Area 6:*** *Create Jobs by Investing in Restoration and Resilience*
- ***Focus Area 7:*** *Other Actions Supportive of the America the Beautiful Campaign*

Conserve and Restore 30% More by 2030

In December 2021, the U.S. Department of Energy issued its Conservation Action Plan to meet President Joe Biden's call to action to conserve, connect, and restore 30% of the nation's lands and waters by 2030. Three of the featured programs take place at the Savannah River Site, making it a valuable contributor to this decade-long initiative that promises to protect the economy, and the health and well-being of United States citizens.

President Biden's Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad,* and a report jointly issued by Federal resource agencies and the White House Council on Environmental Quality, *Conserving and Restoring America the Beautiful,* launched the campaign to conserve, connect, and restore lands, waters, and wildlife on which the nation depends.

The Department of Energy conducts operations on 2.4 million acres in 24 states, making it the fourth largest land-managing federal agency. The mission is to ensure America's security and prosperity by addressing energy, environmental, and nuclear challenges through transformative science and technology solutions. To do this, the Department of Energy has named seven focus areas. Projects at the Savannah River Site capture three of these: Focus Areas 3, 4, and 7.

Focus Area 3: Forest Management

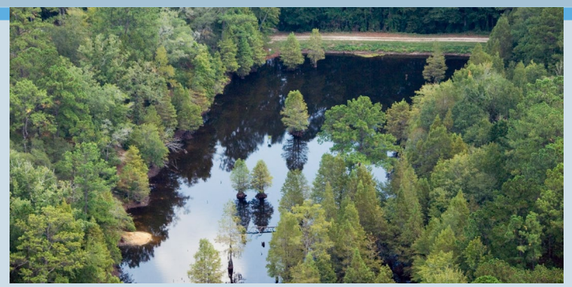
Ninety percent of the Site's 198,400 acres is natural forest, inhabited by approximately 250 species of birds, 1,500 species of plants, 100 species of reptiles and amphibians, 50 species of mammals, 100 species of fish, and 600 species of aquatic insects.

The Savannah River Site's Forest Management Program ensures these species can flourish and that ecological systems are sustained, protected, and returned to their natural resilience. The U.S. Forest Service-Savannah River facilitates the comprehensive program for the Site, through wildland fire suppression, threatened and endangered species restoration, invasive species control, habitat management, watershed management, boundary maintenance, managing secondary roads, and related research.

Additionally, the Natural Resources Wildlife Program safeguards Site forest habitat from non-native plant species and damaging animals, such as feral hogs, to protect and conserve wildlife through careful habitat planning and management. The University of Georgia's Savannah River Ecology Laboratory monitors the land and provides opportunities for ecological research.

The red-cockaded woodpecker habitat restoration is important to Forest Management.

The Department of Energy has measured the success of this program in part by the red-cockaded woodpecker habitat restoration. Between 1985 and 2020, active breeding groups increased from 1 to 145. The growth rate over the past five years has averaged 12%.



The Reserve is a research resource and public recreation attraction.

Focus Area 4: Crackerneck Wildlife Management Area and Ecological Reserve

The Department of Energy-owned Crackerneck Wildlife Management Area and Ecological Reserve in Jackson, South Carolina, is adjacent to the Savannah River Site and plays a critical role in conserving fish, wildlife, and other natural resources on its 10,600 acres. The area offers diverse recreational opportunities for hunting and fishing, as well as nonconsumptive uses such as biking, equestrian, hiking, canoeing, wildlife or other natural resource observation, photography, environmental education, and environmental interpretation.

On top of providing recreational facilities to thousands of visitors, the reserve serves as an additional research area for the University of Georgia's Savannah River Ecology Laboratory. All reptiles and amphibians here are protected.

State and natural resource and conservation organizations, the South Carolina Department of Natural Resources, and Heritage Preserves are partners in the reserve.

Focus Area 7: Savannah River Site Research Set-Aside Areas

Designated as the first of seven National Environmental Research Parks in 1972 by the Department of Energy, the Savannah River Site is an important ecological component of the Southeastern Mixed Forest Ecoregion.

The Savannah River Site has 30 set-aside research reserves, representing 7% of the property, which are kept in a natural state and capture the major vegetative characteristics of the Site. Some of the set-asides also protect significant archaeological sites and provide natural settings for educational and public outreach activities.

The Department of Energy maintains the 30 set-aside research reserves in a natural state that represent the 8 major vegetation communities that are characteristic of the Site: old fields, fall-line sandhills, upland hardwoods, pine forests, bottomland hardwood forests, swamp forests, Carolina bays, and freshwater streams and impoundments. Many long-term ecological studies in scientific disciplines from archaeology to zoology are conducted in these set-aside areas. The Savannah River Ecology Laboratory administers the Set-Aside Program.

The Department of Energy measures the success of its Set-Aside Program by the growth in the Savannah River Ecology Laboratory's graduate student population and high-impact scientific publications and funding awards. In the last five years, the laboratory has increased its scientific publications by more than 30% and its trained graduates by more than 80%.

RADIOLOGICAL MONITORING and DOSE

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.

Radiation dose is typically reported in a unit of measure called a "millirem." The average dose from naturally occurring radioactive minerals in the ground and water, and cosmic radiation from outer space is 311 millirem/year. The average annual dose for U.S. residents from both natural and man-made sources is 625 millirem.

Man-made sources of background radiation include the following:

- Medical procedures (300 millirem/year)
- Consumer products (13 millirem/year)
- Industrial and occupational exposures (1 millirem/year)

The Department of Energy has established dose limits to the public to prevent Site operations from contributing significantly to this average annual background exposure. DOE Order 458.1, *Radiation Protection of the Public and the Environment,* establishes 100 millirem/year as the annual dose limit to a member of the public that can come from Site operations.

The Savannah River Site uses portable monitors, including the Eberline Model AC-3 alpha scintillation detector in the radiological control inspector's right hand, and the Pancake GM Detector in his left hand.

2021 Potential Radiation Dose

In 2021, the Savannah River Site did not increase potential radiation exposure to the public.

The potential doses from Site radioactive discharges to air and water were below all regulatory standards for the public and the environment. The *2021 Environmental Report* in Chapter 6, *Radiological Dose Assessment,* discusses how the Site calculates the potential public doses and shows compliance with DOE Order 458.1.

The combined dose from air and water pathways—2021 potential radiation dose also known as the "all pathway" dose—was 0.30 millirem, which is well below the DOE public dose limit of 100 millirem/year. Of this 0.30 millirem/year dose, 0.28 millirem was from liquid releases, and 0.017 millirem was from releases to the air.

The Department of Energy established the dose limit to protect the public and environment from the potential effects of radiation released during Site operations. The Savannah River Site continues to remain far below the 100 millirem/year public dose limit.

The Site's Bioassay Laboratory samples foods to assess potential effects to local produce from Site operations.

Why is the Representative Person's Exposure Significant?

The Site calculates the radiation exposure to the public from both liquid and airborne sources based on a conservative maximum exposure scenario of a human living near the Site.

The scenario factors in that the person

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

Radiation exposure scenarios are conservatively based in part on the representative person's interaction with the Savannah River.

Determining the Source of Exposure

An exposure pathway is the way someone could be exposed to releases from a source, whether it's airborne or liquid. Determining the source of exposure is a multistep process.

The first step is to identify a contaminant source and the location from which the chemical or radiological source is released.

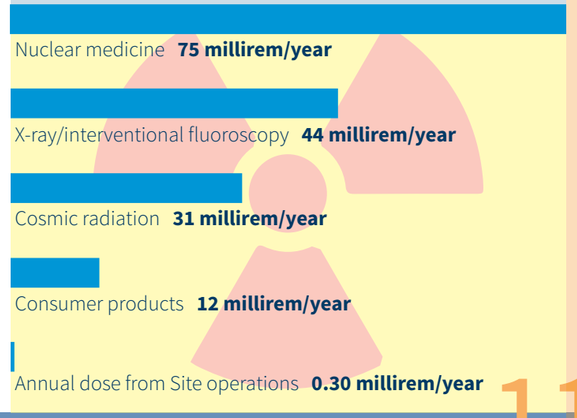
The next step looks at how the source might move or change in the environment. Some sources break down when exposed to air, water, or microorganisms, such as bacteria. Air, soil, and water are the major elements that can move or change a source in the environment.

The third step looks at where people could come in contact with the source. Some examples of this include outdoor or indoor air, drinking water taps, swimming in the river, and the local food supply.

The fourth step looks at how the chemical enters a person's body. In other words, is it possible to inhale or breathe in the source; to drink or ingest the source from water, soil, or the food supply; or to absorb the source by touching water or soil?

The fifth and final step in determining the exposure pathway evaluates whether there are people in the community who could be exposed to the sources.

A comparison of common sources of dose against the Site dose from operations is shown below.



ENVIRONMENTAL ACCOMPLISHMENTS

Footprint Reduction: D-Area Cooling Tower

In October 2021, the Savannah River Site demolished a 70-year-old industrial cooling tower. The project generated more than 85,000 cubic feet of waste and scrap metal that can leave the Site for disposition or reuse, helping the Site achieve aggressive footprint reduction goals.

As part of the early defense mission during the Cold War, the Site constructed the cooling tower over a large concrete basin in D Area to remove heat from water to generate steam at a nearby powerhouse. The Site's D-Area facilities extracted water from the Savannah River, which borders the Site, to use in the reactors.

The 3,800-square-foot tower stood about 50 feet tall. Its large concrete foundation reached 7 feet in depth to form the water-filled holding basin.

The project team completed the project cost-effectively, ahead of schedule, and without a safety incident.

Crews also removed two large motors and fans on top of the tower that drew cooling air across cascading water within the structure.

As footprint reduction continues, each project provides techniques that help better address other closure sites, reducing costs and project duration.

The D-Area closure project calls for removing 34 structures and returning the former waste site to a more natural state, thereby reducing maintenance and environmental surveillance. By the later part of 2021, the Savannah River Site had removed 89% of the D-Area footprint.

The Savannah River Site demolished the 50-foot-tall D-Area Cooling Tower pictured above. Demolition included removing the cooling water pipes and plates that held the cooling water pumps (photographs below).

FAST FACTS

TANK CLOSURE

- Processed more than 3.14 million gallons of waste into grout and disposed of it in the Saltstone Disposal Facility.
- Filled 62 canisters with 230,000 pounds of glass waste mixture at the Defense Waste Processing Facility, immobilizing 1.06 million curies of high-level radioactive waste in 2021.
- Completed construction of the second mega-vault, SDU-7, and continued construction of SDU-8 and SDU-9. These two units are being built in tandem, optimizing resources.

ENVIRONMENTAL MANAGEMENT SYSTEM

- Recycled 51% (242 metric tons) of nonhazardous solid waste.
- Continued to reduce greenhouse gas emissions, exceeding federal goals.
- Continued to exceed its fleet management goals. More than 87% of the current fleet of light-duty vehicles are hybrid, electric, or vehicles that use E-85 (85% ethanol, 15% unleaded gasoline) fuel.
- Received recognition as part of the Department of Energy agency-wide Sustainability Awards, under the Innovative Approach to Sustainability Category for the P-Area Permeable Reactive Barrier Wall Project.

WASTE SITE REMEDIATION and CLOSURE

- Completed the cleanup of one waste unit during the 2021 fiscal year, and work continued on eight additional units during this time. Of the Site's total 515 waste units, 412 had been completed by December 2021.

RADIOACTIVE WASTE MANAGEMENT

- Sent eight transuranic waste shipments to the Waste Isolation Pilot Plant for deep geologic disposal.
- Continued to operate the E-Area Low-Level Waste Facility and the Saltstone Disposal Facility in a safe and protective manner.

ENVIRONMENTAL COMPLIANCE

- Conducted 966 National Environmental Policy Act reviews to identify potential environmental impacts from proposed federal activities. The Site identified 875 of these as categorical exclusions that did not require action.
- Managed 532 operating and construction permits. South Carolina Department of Health and Environmental Control did not issue any Notices of Violation.
- Air and water discharges containing radionuclides were well below the DOE public dose limit of 100 millirem/year.
- All 17 of the Underground Storage Tanks were in compliance.

PFAS: Facilitating an Action Plan

Chemicals found in everyday items that keep eggs from sticking to the pan, dental floss gliding in between teeth, and the rain from penetrating all-weather coats are also the focus of newly started monitoring at the Savannah River Site.

Per- and polyfluoroalkyl substances, abbreviated as "PFAS," are a group of human-made chemicals used in consumer and industrial products that are resistant to natural biodegradation. Certain PFAS can accumulate and stay in the human body for long periods of time, which can lead to adverse health effects. They have been present in everyday life since the 1940s.

When local and federal regulatory agencies determine that an unregulated contaminant, such as PFAS, could pose a risk to human health or the environment, they classify it as an "emerging contaminant of concern." The Environmental Protection Agency identifies solutions to address these substances, which present unique issues and challenges. This happened when PFAS-containing aqueous film forming foam, used by firefighters as a suppressant to extinguish fires, became an emerging regulatory concern.

As a result of the Environmental Protection Agency's action plan, the Savannah River Site in 2019 began assessing its past and present use of PFAS. These studies showed that Site firefighters used the PFAS-containing aqueous film forming foam during training at two locations in D Area. The Site sampled existing groundwater wells downgradient of these two locations and found PFAS related to the historical use of this firefighting foam.

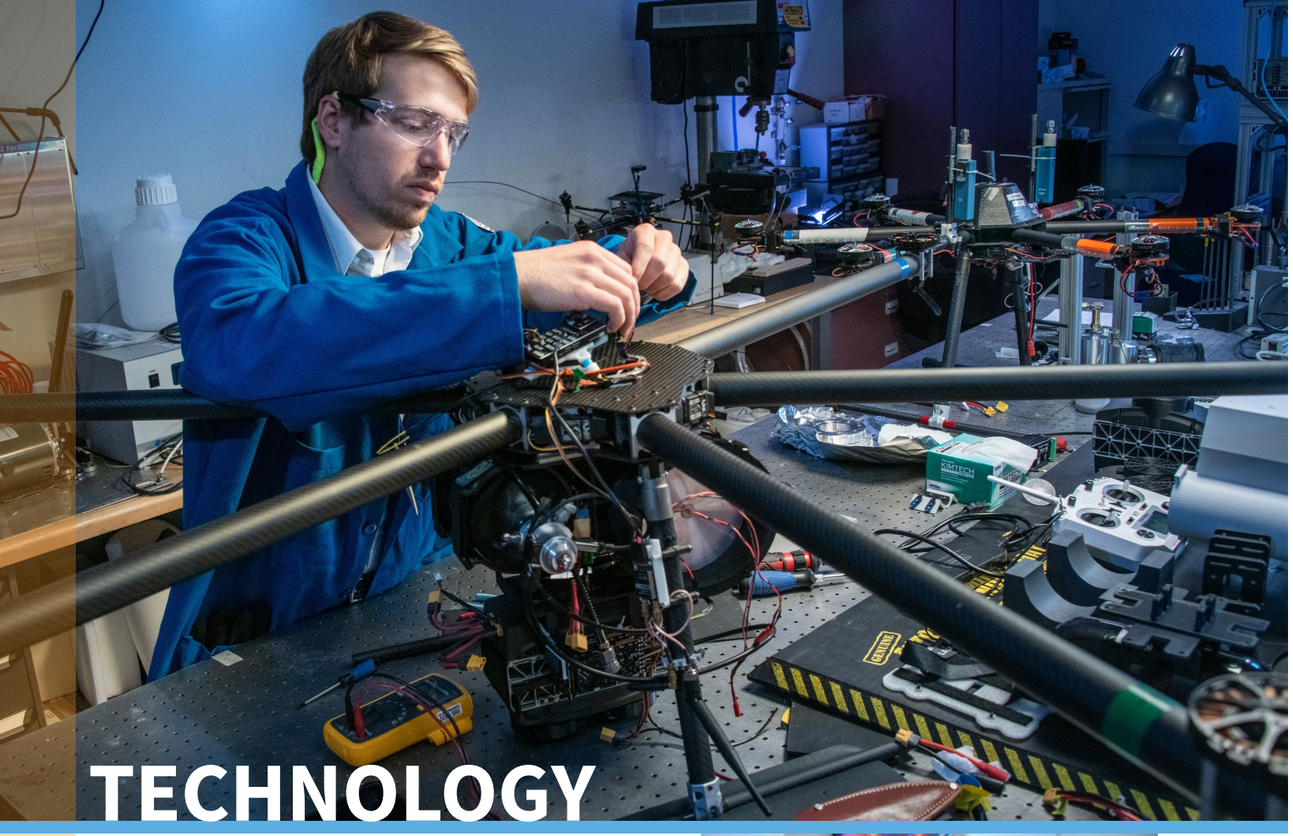
Additionally, the Savannah River Site researched materials to replace the PFAS-containing foam. In January 2021, the Site obtained an alternative fluorine-free foam and had it available for training and firefighting.

In April 2021, the Site solidified the discontinued foam by mixing it with an absorbent and concrete and allowing it to cure in two 25-cubic yard roll-off containers. These containers are still onsite, awaiting authorization for off-site disposal.

In October 2021, the Environmental Protection Agency announced its "PFAS Strategic Roadmap," which set timelines for the agency to take specific actions and make bold policies to protect public health and the environment, along with creating accountability for polluters.

The Site continues to actively protect public health and the environment. It is a contributor to the Department of Energy's PFAS Coordinating Committee and has added responsibilities to a subject matter expert position to stay abreast of dynamic Department of Energy, federal, and state guidance, policies, and regulations associated with PFAS.

Additional Information in 2021 Environmental Report: Chapters 3 and 7



TECHNOLOGY

Unmanned Aircraft System Unit Award

The Savannah River National Laboratory unmanned aircraft system team has earned accolades from the U.S. Department of Energy's Office of Aviation Management for its management, operations, maintenance, training, safety, and best practices.

The 2021 Unmanned Aircraft System Unit Award recognized the Laboratory for its missions, which include exercises with the U.S. Marines and the U.S. Air Force, infrastructure inspections, aerial photography and videography, emergency response exercise support, training, research and development, and other U.S. government support. In 2021, the Savannah River National Laboratory logged more than 100 flight hours and 350 flights.

Since the Site drone program launched in 2009, it has drastically grown in scope and is now being used in environmental remediation across the Site. In 2021, for the first time, the Site used camera-mounted drones to inspect protective covers over former waste sites. The drones hovered 10 to 12 feet above remediation sites for detailed views and soared up to 150 feet for a broader perspective to ensure the structural integrity of the covers, which consist of geosynthetic materials and soil, topped with grass and sod.

This aerial surveillance provides a way to meet the needs of federal and state regulators who conduct annual Site inspections. By using drones in the inspection process, Site employees and regulators have less of a need to visit and walk the cleanup sites, which collectively total more than 100 acres of land, to inspect the protective covers.

If an inspection detects damaged fencing, erosion, or areas where hogs have rooted up the soil, maintenance crews are notified of the location so they can make repairs.

The unmanned aircraft system unit currently has 10 aircraft in its inventory, and the team works closely with the U.S. Department of Energy-Savannah River aviation manager and safety officer to plan and conduct onsite missions under an approved flight readiness review board.

The U.S. Department of Energy's Office of Aviation Management awarded Savannah River National Laboratory for its unmanned aircraft program.

Remote Refrigerated Sampling

New technology employed by the Savannah River Site's Environmental Monitoring Program is allowing scientists to use computers and cellphones to remotely conduct crucial sampling steps. This move significantly reduces time in the field and improves the quality control of data.

To comply with federal and state regulations, the Site adheres to specific monitoring techniques before it can discharge water into minor tributaries, and, ultimately, into the Savannah River. Environmental Monitoring Program scientists and technicians have met these requirements, but with the following time-consuming limitations:

- To calibrate the flowmeter, technicians have had to physically go to the sampling site and observe the actual stream and staff gauge.
- To maintain the chilled samples at the required 6 degrees Celsius or lower, technicians had to go to the remote monitoring locations and pack the sample bottles with ice. During warm weather, there were times the technicians have had to apply ice a second time.

After the Environmental Monitoring Program identified and researched these quality control, time, and temperature challenges, scientists began testing a pilot program for sampling and monitoring technologies that allow for more efficient compliance with permits and regulations.

What they designed was a solar-powered, network solution that bundles a variety of instruments into a user-friendly system suitable for the Environmental Monitoring Program to install at water monitoring stations across the Site. The technology included setting up and upgrading a flowmeter with an internal modem, which enables a user on a computer or cellphone to call into it. The Environmental Monitoring Program also installed a camera to satisfy the requirement of seeing the stream and the staff gauge when calibrating the flowmeter. Additionally, the Environmental Monitoring Program placed a refrigerated sampler that alleviates the need for technicians to drive to the sampling site to put ice on the sampler. Like the flowmeter, the refrigerated sampler comes with a modem so technicians can call it or text it to turn it on.

To verify compliance with permits and regulations, the Environmental Monitoring Program installed a rain gauge at the sampling sites, enabling technicians to meet the requirement of waiting 48 hours after a rain event to collect a sample.

With the equipment in place, technicians access real-time video from a networked camera and trigger the refrigerated sampler to start or stop the sampling. Watching the livestream, technicians can remotely adjust the flowmeter, change program settings for the refrigerated sampler, verify that the sampler is working properly, and view sampler data in real-time. In the event of an emergency that requires sampling, technicians can activate the system remotely to begin collecting a sample.

The Environmental Monitoring Program is increasing efficiency, reducing time spent on setup, and cutting costs. It is also enhancing quality control of the data with its real-time collection. All of this improves the Site's readiness for emergency response with remote connection capabilities, and enhances the Savannah River Site's environmental compliance to federal and state regulations.

The refrigerated sampler allows Savannah River Site scientists to control and preserve samples remotely, saving time in the field and allowing quick response to emergencies, if needed.

Additional Information in 2021 Environmental Report: **Chapter 4, Section 4.3**

SUSTAINABILITY

The Excess Express team moves pallets (above) and prepares to load excess items (below). Excess Express streamlines salvaging procedures, letting other Site departments devote time to their specialized responsibilities.

‘Excess Express’ Helps Savannah River Site Reduce, Reuse, Recycle

The aptly named Excess Express is a cost-effective process for the Savannah River Site’s thousands of employees to recycle excess materials in just a matter of days, leaving the tedious paperwork and lengthy salvaging procedures to the experts.

Streamlining the process to excess supplies frees time and resources for individual departments and facilities to perform their own specialized tasks. The Excess Express team has taken on recycling and disposition-related tasks that most employees find difficult and time consuming, such as preparing forms and gathering items to place on pallets.

Since the program started in 2017, the Site has reduced the average number of days needed to excess material from 45 to just a few. Excess Express, which taps into the knowledge of subject-matter experts well-versed in reusing excess property, to date has distributed more than $17 million in materials and equipment for reuse.

The Savannah River Site can reuse excess equipment or send it off-site to state and federal government agencies, or to nearby community organizations, such as the nonprofit Savannah River Community Reuse Organization, which will sell the equipment to help businesses in a five-county region around the Site. Some items made with metal go to the Site’s Salvage Excess Yard for recycling, while other items are appropriately disposed.

The Excess Express team places importance on good stewardship of government assets and practices that safely dispose of materials and equipment its customers no longer need.

A Savannah River Site fire truck has been transitioned from federal service to the Hollow Creek Volunteer Fire Department and its chief, Captain Glenn Poole (right).

Volunteer Fire Department Puts ‘Hook and Ladder’ to Good Use in Aiken County

A multiyear effort to modernize the Savannah River Site emergency fleet paved the way to transition a fire truck from federal to community service at the Hollow Creek Volunteer Fire Department in Aiken County.

The Savannah River Site looks to recycling and reusing equipment of all sizes that it no longer needs to fulfill its commitment to sustainability and environmental stewardship. In this case, the Site also provided a donation that will help secure the safety of a community.

Hollow Creek Volunteer Fire Department is located along the Aiken County and Lexington County border, near Wagner, South Carolina. As a strictly volunteer fire department, donations and grants are the heartbeat that ensures ongoing volunteer fire response in rural communities.

The former Site fire truck can carry up to six firefighters and is also equipped with three ladders and enough space to hold needed tools to assist firefighters when faced with challenging and rapidly changing conditions.

In its previous career at the Savannah River Site, this truck was an integral part of the Site’s emergency response capabilities, responding during Site emergency drills, training and, when needed, emergencies onsite or in one of the five neighboring counties.

The modernization of the emergency fleet began in 2012. Since then, the Site has added five new fire engines and four remounted ambulances with plans for further enhancements in the future.

Environmental Management Systems Deemed ‘Robust’

A third-party conformance audit of the Environmental Management System of the Savannah River Site’s management and operations contractor and liquid waste contractor concluded the companies’ environmental programs conformed to the standard required by the U.S. Department of Energy Order 436.1, *Sustainability*.

In April 2021, Savannah River Nuclear Solutions coordinated with the Department of Energy-Savannah River for an independent conformance audit of its and Savannah River Remediation’s Environmental Management System. A Department of Energy-Headquarters representative and a lead auditor from a third-party who works outside the control or scope of the Environmental Management System conducted the audit, which was held both onsite and remotely. The audit consisted of document inspections, personnel interviews, and facility visits.

Department of Energy Order 436.1 requires that contractors develop and implement an Environmental Management System that conforms with the International Organization for Standardization’s 14001 Standard. The standard specifies the requirements that ensure an organization achieves its Environmental Management System goals of enhancing environmental performance, fulfilling compliance obligations, and achieving environmental objectives. To ensure that an Environmental Management System conforms with the standard, the Department of Energy requires that it undergo a formal audit every three years.

The 2021 audit concluded that the Environmental Management System conforms with the standard and the organizations’ environmental protection requirements, and that the environmental compliance programmatic infrastructure is comprehensive and robust. Further, the audit determined the Environmental Compliance organization is well organized, technically competent, and effectively engaged in regulatory compliance, environmental remediation activities, and the protection of the environment in Site operations. The audit also concluded that strong organizational and personnel commitments to environmental stewardship are readily evident throughout the contractors’ organizations.

The audit identified four opportunities for improvement. These recommended improvements could strengthen the overall structure of the Environmental Management System and included program enhancements such as increasing personnel training on the standard and improving integration of the standard into the structure of environmental programs.

ENGAGING the PUBLIC

Programs Excel Despite COVID-19 Restrictions

Ironically, the COVID-19 pandemic isolated communities and families, but it also opened opportunities for tens of thousands of students to virtually interact with scientists and educators far away from their geographic home base.

As educators and students across the United States and abroad found academic resources, field trips, and extracurricular programs nonexistent or limited by COVID-19, the Savannah River Site accepted this challenge and took on a new approach to education outreach that overcame the challenges of social distancing, distance learning, and working during the pandemic.

Before COVID-19, the education outreach program at the Site was managing 12 different programs, all of which focused on face-to-face communication with teachers and students. After extensive research into options, the education outreach group at the Savannah River Site decided to develop a platform using technology offered through internet-based applications. To do this, it relied on Site resources from video production, graphics, laboratories, research and development engineering, and information technology to contribute expertise.

The new outreach programs use virtual field trips to facilitate environmentally relevant topics such as habitats, conservation, freshwater ecosystems, and sampling to determine pond health. Additionally, a video, *In the Beam, Science in the Fast Lane,* explores how a mass spectrometer functions. While watching, students journey through this highly sensitive piece of equipment by riding on an electron beam to demonstrate the spectrometer's ability to identify the molecular makeup of a substance.

Beth Eberland and Kimberly Fickling (center and right), from the Ruth Patrick Science Center at the University of South Carolina Aiken, preparing for field work during the filming of a virtual field trip.

In addition to illustrating complicated technology and ecological conservation, these resources also expose students to potential careers in fields related to science, technology, engineering, and math.

The National Science Teaching Association, the largest association of science teachers worldwide, shared the free audio-visual resources the Savannah River Site developed, such as virtual field trips and a video, during the pandemic with its 40,000 members in the science education field. Teachers from across the country, the world, the continent, and even from the Southern Hemisphere in New South Wales, Australia, contacted the Site and expressed their interest in the virtual learning tools.

Efforts to work through the COVID-19 pandemic and endemic will continue to play an important role in the future of education outreach. Examples include creating a new program, *STEMulating Conversations with Savannah River Site Experts,* as well as video and virtual reality programs that bring the Savannah River Site to classrooms throughout South Carolina and Georgia.

Environmental Justice

Mandated by the Department of Energy's Office of Legacy Management, the Environmental Justice program at the Savannah River Site ensures no group of people bears a disproportionate share of negative environmental consequences from Site operations.

Funded by the Department of Energy, the Environmental Justice program encourages groups to express concerns that influence the decision-making process associated with setting standards, permitting facilities, awarding grants, and issuing licenses and regulations.

The Savannah River Site uses various methods to enhance engagement from the target communities. One such program is the annual Teaching Radiation, Energy, and Technology workshop, which gives local teachers and community leaders the opportunity to learn more about radiation, energy, and technology from Department of Energy experts. This extra level of lecture and hands-on training allows educators to more thoroughly and creatively pass on the information to their students in the classroom. The Site held the 2021 workshop at the University of South Carolina Aiken in July and explored topics such as the annual Site wildlife hunts and animal monitoring process.

Other Environmental Justice programs at the Site include community outreach meetings that focus on job training, grants, environmental monitoring, and emergency response. The Site also offers hands-on training in the form of student internships focusing on environmental contaminant analysis research projects.

The Savannah River Site is committed to the principles of Environmental Justice and ensuring that all programs, policies, and activities support these principles, thereby facilitating meaningful involvement by affected communities and stakeholders.

Stakeholder Involvement

Savannah River Site management has built long-term support at all tiers of community and government and is committed to keeping the public informed about Site projects. From individuals, schools, and municipalities, to a broader reach encompassing state and national officials, the Site has ensured that it has a framework from which communication and information exchange purposely between itself and those with a vested interest in Site missions.

The foundation of the stakeholder program is the belief that the public has the right to know what the U.S. Department of Energy is doing in the community and to have input in the decision-making process. Stakeholder engagement offers those who will be affected by the outcome of Site work a chance to voice their opinions. This ensures the Department of Energy has a shared vision with the public.

The Site involves stakeholders through a variety of activities that solicit input from the public, including the following:

- Assisting stakeholder groups with analyzing environmental management plans
- 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
- Involving elected officials in Site tours and discussions about technologies, project milestones, and new and ongoing missions

Site employees host South Carolina Senator Tim Scott staff members Al Jenkins (second from left) and Alyssa Richardson (second from the right).

The Savannah River Site works closely with the U.S. Environmental Protection Agency Region 4 and the South Carolina Department of Health and Environmental Control to reduce risk and accelerate environmental cleanup at the Site. The Savannah River Site effectively communicates with regulators to streamline essential documentation showing compliance with the federal Resource Conservation and Recovery Act, which tracks and manages hazardous wastes from generation to disposal, and the Comprehensive Environmental Response, Compensation, and Liability Act, which addresses the protection and cleanup of the environment from known releases of hazardous substances.

One organization that is a valuable conduit between the Savannah River Site and the public is the Citizens Advisory Board. The advisory board is a group of appointed citizens who make recommendations to the Department of Energy regarding Site cleanup.

Members of the Citizens Advisory Board at a meeting venue.

Citizens Advisory Board

For more than 25 years, the Savannah River Site Citizens Advisory Board, called the CAB, has been the eyes and ears of the local community, providing insight into and a voice on Department of Energy programs, policies, and projects. It is one of eight advisory boards the Department of Energy has in place across the complex to facilitate advice and recommendations on site-specific issues and concerns. The board also provides an opportunity for the community to reach the Site and its regulators, sharing public thought and opinion.

The board's current 20 members, from six Georgia and South Carolina counties, reflect diverse viewpoints in the community and region surrounding the Savannah River Site. Members are from Aiken and Barnwell counties in South Carolina, and Richmond and Columbia counties in Georgia. Additionally, two members are from Beaufort County in South Carolina, and one is from the Savannah, Georgia, area in Chatham County. They are all residents of communities that Savannah River Site operations and clean-up activities directly affect. A chair and vice chair, who represent the Citizens Advisory Board at the Department of Energy's Environmental Management Site-Specific Advisory Board meetings and to the public, head the organization. The remaining board members belong to the following four issues-based committees:

- Facilities Disposition and Site Remediation
- Nuclear Materials
- Waste Management
- Administrative and Outreach

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

The Department of Energy started the Citizens Advisory Board in 1994 to serve as a local recommendation-giving entity. Since its inception, the members have made 370 recommendations. Generally, the board issues advice on environmental restoration, waste management, and other related topics of interest.

The Citizens Advisory Board schedules public meetings at rotating locations throughout the region, extending from east central Georgia to the South Carolina Lowcountry, to enable a wide range of attendees and viewpoints. Agency liaisons from the Department of Energy, the U.S. Environmental Protection Agency Region 4, and the South Carolina Department of Health and Environmental Control also participate in the meetings.

The board streams meetings for those who can't attend, and a video archive of past meetings and newsletters exists on its website for future reference. In keeping with the commitment to provide meaningful involvement in the decision-making process, the board held five meetings in 2021. The first four meetings were virtual and streamed live to board members, stakeholders, and the public due to the COVID-19 pandemic and travel restrictions. The last meeting of the year was in person and held in November in Hilton Head Island, South Carolina.

The advisory board is also dedicated to providing outreach to the community through Site tours; an online CAB University, which offers background information on general Site missions and quizzes to test knowledge takeaway; and a line-up of speakers that civic groups can engage for events and meetings.

Citizens interested in applying for membership do not need to have any special skills or extensive knowledge about the Savannah River Site. The general requirement is to have a willingness to attend meetings and learn about the plans and activities at the Site, and provide advice and recommendations from a public individual's perspective.

SAVANNAH RIVER SITE

Department of Energy-Office of Environmental Management

To Learn More About the Focus on Environmental Safety:
Visit the SRS website: www.srs.gov/general/srs-home.html

View or download the *Savannah River Site 2021 Environmental Report*: www.srs.gov/general/pubs/ERsum/

For More Information about the Department of Energy-Savannah River Operations Office or this report, please contact:

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Or, go to the *SRS Environmental Report* webpage at www.srs.gov/general/pubs/ERsum/er21/index.html and under the *2021 Environmental Report,* complete the electronic customer satisfaction survey.

The cover of the *2021 SRS Environmental Report Summary* features photographs by two Savannah River Site employees and a member of the community.

The photograph of the Carolina bay in Aiken was taken by Aiken resident Mark Hudson. The photograph of the Augusta Canal, taken by Battelle Savannah River Alliance's Charles Crawford, and the hummingbird, taken by Savannah River Nuclear Solutions' Ross Fanning, were entries to the Snap SRS photography contest, which is open to Savannah River Site employees.

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