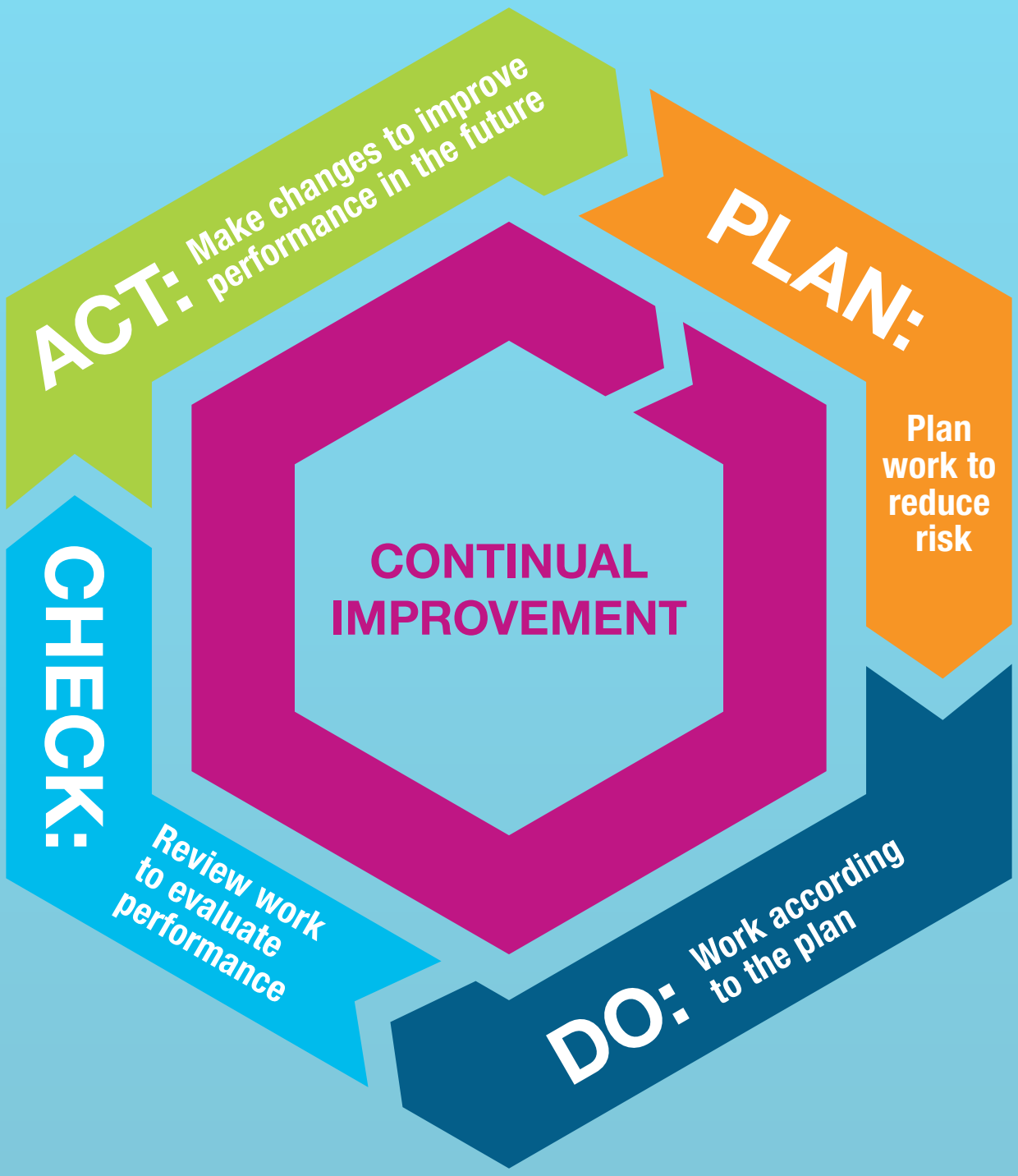


The "Plan-Do-Check-Act" improvement cycle.

Chapter 2

Environmental Management System

Brookhaven Science Associates (BSA), the contractor operating the Laboratory on behalf of the Department of Energy (DOE), is committed to being good stewards of the DOE's land and property, protecting and preserving it for future use.

As part of its commitment to environmentally responsible operations, BSA has established the Brookhaven National Lab (BNL) Environmental Management System (EMS). An EMS ensures that environmental issues are systematically identified, controlled, and monitored. Moreover, an EMS provides mechanisms for responding to changing environmental conditions and requirements, reporting on environmental performance, and reinforcing continual improvement.

The Laboratory's EMS was designed to meet the rigorous requirements of the globally recognized International Organization for Standardization (ISO) 14001 Environmental Management Standard, which provides a framework for efficient, clean and compliant operations, that consider the needs and expectations of various interested parties, both within and outside of the Laboratory. Annual audits by an independent third party are required to maintain registration, with a full recertification assessment of the entire EMS occurring every three years. During 2024, the Lab was recertified as conforming to the standard with no findings. BNL's conformance to the ISO 14001 Standard continues uninterrupted since 2001.

BNL continues to seek opportunities and implement efficient business practices into site operations and infrastructure. The areas of focus are water and energy conservation, waste reduction, recycling, purchase of environmentally friendly products, and greenhouse gas (GHG) management. In 2024, BNL's EMS and Pollution Prevention (P2) Program continued to contribute to the Laboratory's success in improving sustainable operations. The Lab provides strong support for the P2 Program, which seeks ways to eliminate waste and toxic materials on-site and promote other sustainable business activities. The program generates new ideas to grow the Lab's existing recycling program or otherwise improve sustainable operations. In 2024, the P2 Program resulted in nearly $1.6 million in cost avoidance or savings and resulted in the reduction or reuse of over 1,500 tons of waste. The program also funded 14 new proposals, investing approximately $17,900. Support was also provided in 2024 to line organizations for laboratory cleanouts and disposal of chemicals. As a testament to its strong environmental program, the Lab received the Green Electronics Council's Electronic Product Environmental Assessment Tool (EPEAT) Gold Award, its ninth DOE GreenBuy Gold Award, and fifth GreenBuy Superior Award. BNL also met 90% of the GreenSpace criteria product goals in a Research Laboratory renovation, thereby achieving its first GreenSpace Silver Award.

BNL continues to address legacy environmental issues and openly communicates with neighbors, regulators, employees, and other interested parties on environmental issues and cleanup progress on-site. During 2024, BNL hosted six in-person/virtual meetings of the Community Advisory Council (CAC), monthly interagency calls with regulators were held, as were tours, the Open House program, and other community events. BNL is committed to transparency and open communication with its internal and external stakeholders.

2.1
Integrated Safety Management and ISO 14001

The Laboratory's Integrated Safety Management System (ISMS) integrates environmental protection, pollution prevention, safety, health, and quality management into all work planning and execution. The purpose of BNL's ISMS is to integrate DOE's five Core Functions and seven Guiding Principles into all work processes. The five Core Functions, as defined by DOE P 450.4A, Chg 1, Integrated Safety Management Policy, are:

- **Define the scope of work:** Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.
- **Analyze the hazards:** Hazards associated with the work are identified, analyzed, and categorized.
- **Develop and implement hazard controls:** Applicable standards and requirements are identified and agreed upon; controls to prevent and mitigate hazards are identified; the safety envelope is established; and controls are implemented.
- **Perform work within controls:** Readiness is confirmed and work is performed safely.
- **Provide feedback and continuous improvement:** Feedback information on the adequacy of controls is gathered; opportunities for improving the definition and planning of work are identified and implemented.

The seven Guiding Principles, also defined by DOE P 450.4A, Chg 1, are:

- **Line management responsibility for safety:** Line management is directly responsible for the protection of the workers, the public, and the environment.
- **Clear roles and responsibilities:** Clear and unambiguous lines of authority and responsibility for ensuring safety are established and maintained at all organizational levels within the Department and its contractors.
- **Competence commensurate with responsibilities:** Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities.
- **Balanced priorities:** Resources are effectively allocated to address safety, programmatic, and operational considerations. Protecting the workers, the public, and the environment is a priority whenever activities are planned and performed.
- **Identification of safety standards and requirements:** Before work is performed, the associated hazards are evaluated and an agreed upon set of safety standards and requirements is established which, if properly implemented, will provide adequate assurance that the workers, public, and environment are protected from adverse consequences.
- **Hazard controls tailored to work being performed:** Administrative and engineering controls to prevent and mitigate hazards shall be tailored to the work being performed and associated hazards.
- **Operations authorization:** The conditions and requirements to be satisfied for operations to be initiated and conducted shall be clearly established and agreed upon.

The integrated processes within ISMS contribute to BNL maintaining its ISO 14001 registration. The ISO 14001 Standard is globally recognized and defines the structure of an organization's EMS for purposes of improving environmental performance. The process-based structure of the ISO 14001 Standard is based on the "Plan-Do-Check-Act" improvement cycle. The ISO 14001 standard requires an organization to develop a policy, create plans to implement the policy, implement the plans, check progress and take corrective actions, and review the system periodically to ensure its continuing suitability, adequacy, and effectiveness.

The Laboratory has been officially registered to the ISO 14001 Standard since 2001 and was the first DOE Office of Science Laboratory to achieve this registration. The certification requires the Laboratory to undergo annual audits by an accredited, third-party registrar to assure that the system is maintained. BNL's external certification organization, Orion Registrars, Inc., conducted an external certification audit of BNL's conformance to the ISO 14001 Standard in July 2024 with no nonconformances. The assessment verified the Laboratory's continued conformance to the Standard. BNL's certification to the standard remains valid until September 26, 2027.

2.2
Environmental, Safety, Security, and Health Policy

The cornerstone of an EMS is a commitment to environmental protection at the highest levels of an organization. BNL's environmental commitments are incorporated into a comprehensive Environmental, Safety, Security, and Health (ESSH) Policy. The policy continues as a statement of the Laboratory's intentions and principles regarding overall environmental performance. It provides a framework for planning and action and is included in employee, guest, and contractor training programs. The ESSH Policy is posted throughout the Laboratory and on the BNL website at www.bnl.gov/esh/policy.php. The Policy's goals and commitments focus on compliance, pollution prevention, community outreach, and continual improvement:

- **Environment:** We protect the environment, conserve resources, and implement sustainable business practices that protect our future.
- **Safety:** We maintain a safe workplace. We plan our work and perform it safely. We take responsibility for the safety of ourselves, coworkers, and guests.
- **Security:** We protect people, property, information, computing systems, and facilities.
- **Health:** We protect human health within our boundaries and in the surrounding community.
- **Compliance:** We achieve and maintain compliance with applicable ESSH requirements.
- **Community:** We maintain open, proactive, and constructive relationships with our employees, neighbors, regulators, the U.S. DOE, and other stakeholders, including historically marginalized, disadvantaged communities.
- **Continual Improvement:** We continually improve ESSH performance.

Environmental, Safety, Security, and Health Policy

Brookhaven National Laboratory (BNL) is a world leader in scientific research and performs this work in an environmentally responsible and safe manner.

Every employee, contractor, and guest is expected to take personal responsibility for adhering to the following principles:

Environment	We protect the environment, conserve resources, and implement sustainable business practices that protect our future.
Safety	We maintain a safe workplace. We plan our work and perform it safely. We take responsibility for the safety of ourselves, coworkers, and guests.
Security	We protect people, property, information, computing systems, and facilities.
Health	We protect human health within our boundaries and in the surrounding community.
Compliance	We achieve and maintain compliance with applicable ESSH requirements.
Community	We maintain open, proactive, and constructive relationships with our employees, neighbors, regulators, the U.S. Department of Energy, and other stakeholders including historically marginalized, disadvantaged communities.
Continual Improvement	We continually improve ESSH performance.

In addition to my annual review of Brookhaven Lab's progress on ESSH goals and adherence to this policy, I invite all interested parties to provide me with input on our performance relative to this policy, and the policy itself.

Signed JoAnne Hewett, Director December 5, 2023

Brookhaven National Laboratory

2.3
Planning

The planning requirements of the ISO 14001 Standard require BNL to identify the environmental aspects and impacts of its activities, products, and services; evaluate applicable compliance obligations; establish objectives and targets; create action plans to achieve the objectives and targets; and identify and address risks and opportunities that can impact the success of the EMS.

2.3.1 Environmental Aspects

An "environmental aspect" is any element of an organization's activities, products, and services that can impact the environment. As required by the ISO 14001 Standard, BNL evaluates its operations, identifies the aspects that can impact the environment, and determines which of those impacts are significant. The Laboratory's criteria for significance are based on actual and perceived impacts of its operations and on regulatory requirements and are incorporated into BNL work planning process so that they are identified and reviewed. A process assessment procedure can also be used for facilities and equipment or for deeper analysis of activities not sufficiently covered by work planning. Evaluations are documented on work plans and Process Assessment Forms (PAFs).

Environmental professionals work closely with Laboratory personnel to ensure that work plans, PAFs, and other related reviews thoroughly capture all aspects, requirements, and associated environmental controls. Aspects and impacts are evaluated annually to ensure that they continue to reflect stakeholder concerns and changes in regulatory requirements.

2.3.2 Compliance Obligations

To implement the compliance commitments of the ESSH Policy and meet its compliance obligations, BNL has systems in place to review changes in federal, state, or local environmental regulations and communicate those changes to affected staff. Laboratory-wide procedures for documenting these reviews and recording the actions required to ensure compliance are available to all staff through BNL's web-based Standards-Based Management System (SBMS) subject areas. BNL also answers to the DOE regarding its performance against these requirements in addition to how well BNL has implemented sustainable solutions where they will support BNL and DOE operations wherever possible.

2.3.3 Objectives and Targets

The establishment of environmental objectives and targets is accomplished through a Performance-Based Management System. This system is designed to develop, align, balance, and implement the Laboratory's strategic objectives, including environmental objectives. At the very highest level, the system drives BNL's improvement agenda by establishing a prioritized set of key objectives, called the Performance Evaluation Management Plan (PEMP). BSA works closely with DOE to clearly define expectations and performance measures. Factors for selecting environmental priorities include:

- Meeting the intent and goals of relevant executive orders and other requirements;
- Significant environmental aspects;
- Risk and vulnerability (threat to, or from, the environment);
- Compliance obligations (e.g., laws, regulations, permits, enforcement actions, and memoranda of agreement);
- Commitments in the ESSH Policy to regulatory agencies and to the public;
- Importance to DOE, the public, employees, and other stakeholders.

Additional Laboratory-level objectives and targets are developed on a fiscal year (FY) schedule through the implementation of the business planning process. For FY24, BNL's environmental objectives included addressing emerging contaminants in drinking water, supporting the Lab's scientific mission by providing environmental support to significant research projects, supporting building demolition and legacy clean-up issues, maintaining ISO 14001 certification, and furthering progress on objectives relating to energy conservation, water conservation, fleet management, clean/renewable energy, sustainable buildings, green procurement, electronics stewardship, and organizational resilience.

2.4
Environmental Management Programs

The Environmental Protection Division (EPD) takes on the largest role for developing action plans for implementing institutional environmental priorities, while other organizations within BNL develop action plans as applicable to their operations. The plans detail how the organization will achieve its environmental objectives and targets, as well as commit the resources necessary to successfully implement both Laboratory-wide and facility-specific programs. BNL has a budgeting system designed to ensure that priorities are balanced and provide resources essential to the implementation and control of the EMS. The Laboratory continues to review, develop, and fund important environmental programs to further integrate environmental stewardship into all facets of its missions.

2.4.1 Compliance

BNL has an extensive program to ensure that the Laboratory remains in full compliance with all applicable environmental regulatory requirements and permits. Legislated compliance is outlined by the Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs), Clean Water Act (e.g., State Pollutant Discharge Elimination System [SPDES]), Safe Drinking Water Act (SDWA), Resource Conservation and Recovery Act (RCRA), and other programs. Other compliance initiatives at the Laboratory involve special projects, such as monitoring drinking water systems for emerging contaminants, establishing a wildland fire program, increasing on-site pollinator habitat, retrofitting or replacing air conditioning equipment refrigerants, and managing legacy facilities. See Table 3.1 in Chapter 3 for a list of regulatory programs to which BNL subscribes and a thorough discussion of these programs and their status.

2.4.2 Groundwater Protection

BNL's Groundwater Protection Program is designed to prevent negative impacts to groundwater and restore groundwater quality by integrating pollution prevention efforts, monitoring, groundwater restoration projects, and communicating performance. The Laboratory has developed a Groundwater Protection Contingency Plan that defines an orderly process for quickly verifying groundwater monitoring data and taking corrective actions in response to unexpected results (BNL 2024).

Key elements of the groundwater program are full, timely disclosure of off-normal occurrences and regular communication on the performance of the program. Chapter 7 and the Site Environmental Report (SER) Volume II, Groundwater Status Report, provide comprehensive details about this program, its performance, and monitoring results for 2024.

2.4.3 Waste Management

Due to the world-class research it conducts, BNL generates a wide range of wastes. These wastes include materials common to many businesses and industries, such as municipal solid waste (MSW) and non-hazardous construction and demolition (C&D) debris. Per Figure 2-2, BNL generated 291 tons of MSW and 1235 tons of C&D waste during 2023.

To a much smaller degree, the Laboratory's unique scientific activities also generate specialized waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, industrial, and mixed waste. BNL's Waste Management Facility (WMF), operated by the EPD, is responsible for collecting, storing, transporting, and managing the disposal of these specialized wastes. This facility was designed for handling hazardous, industrial, radioactive, and mixed waste, and is comprised of two staging areas: a facility for hazardous, industrial, and mixed waste in Building 855, regulated by RCRA, and a reclamation building for

radioactive material in Building 865. The RCRA building is managed under a permit issued by the New York State Department of Environmental Conservation (NYSDEC).

These buildings are used for short-term storage of waste before it is packaged or consolidated for off-site shipment to permitted treatment and disposal facilities. Waste can either be generated from routine operations, defined as ongoing industrial and experimental operations, or from non-routine, defined by waste generated by remediation projects, facility decommissioning activities, or one-time events (e.g., lab cleanouts). In 2024, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 2.7 tons
- Mixed waste: 7 ft^3
- Radioactive waste: 1,226 ft^3
- Other Regulated Waste (e.g., petroleum products, wastewater): 28.9 tons

Hazardous waste generation from routine operations, which consists of a wide variety of chemical waste from routine research activities, remained within expectations in 2024. Nonroutine hazardous waste during 2024 consisted of a variety of unused, expired, or contaminated materials generated from maintenance activities and building cleanouts.

There were seven tons of mixed waste generated from facility maintenance during 2024 as shown in Figure 2-1b and fourteen tons of nonroutine mixed waste generated from the demolition of hazardous and radioactively contaminated facilities as part of site improvement activities.

Routine radioactive waste generated primarily from BNL's medical isotope research program trends down as shown in Figure 2-1c though more waste generation is expected in the future as isotope production increases. A minimal quantity of nonroutine radioactive waste from the demolition of Building 197 was also disposed during 2024.

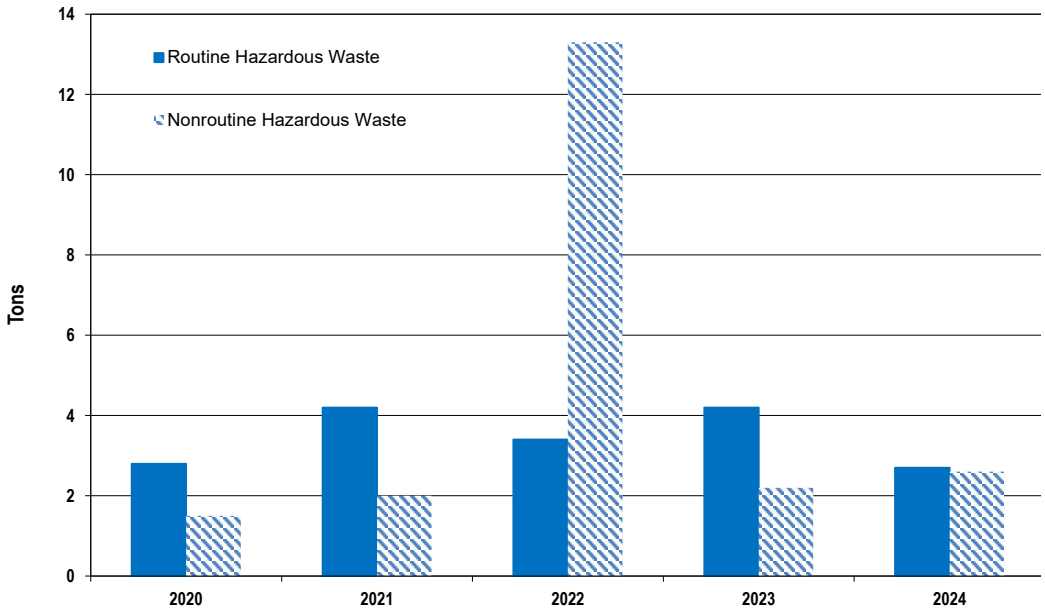


Figure 2-1a. Hazardous Waste Generation from Routine and Nonroutine Operations, 2020-2024.

Figure 2-1b. Mixed Waste Generation from Routine and Nonroutine Operations, 2020-2024.

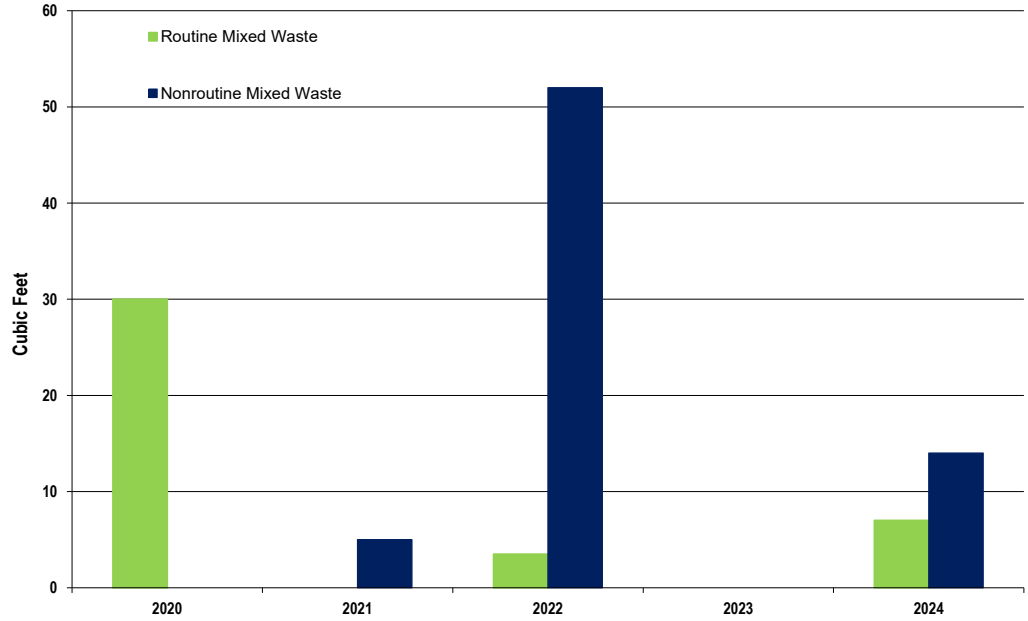
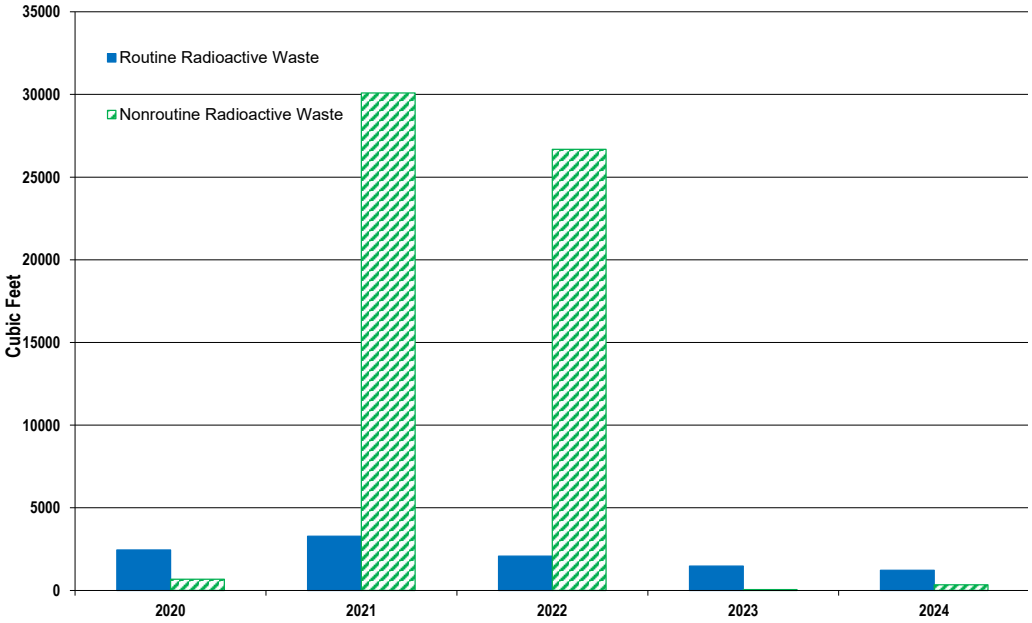


Figure 2-1c. Radioactive Waste Generation from Routine and Nonroutine Operations, 2020-2024.



2.4.4 Pollution Prevention and Waste Minimization

The BNL P2 Program reflects national and DOE pollution prevention goals and policies and represents an ongoing effort to make pollution prevention and waste minimization an integral part of BNL's operating philosophy. P2 and waste reduction goals flow throughout the Laboratory via the EMS having been incorporated into the DOE contract with BSA, BNL's ESSH Policy, and BNL's efficient business practices. Key elements of the P2 Program include:

- Eliminate or reduce emissions, effluents, and waste at the source where possible, as practicable; Conserve natural resources and energy;
- Assess opportunities to evaluate other methods of power generation to determine best technology to fuel future growth;
- Reuse and recycle materials;
- Achieve or exceed BNL/DOE waste minimization, P2, recycling, and affirmative procurement goals;
- Comply with applicable requirements (e.g., New York State Hazardous Waste Reduction Goal, executive orders, etc.);
- Reduce waste management costs;
- Improve employee and community awareness of P2 goals, plans, and progress.

The BNL P2 and recycling programs have achieved long-term reductions in waste generated by routine operations. However, Lab population growth and site improvement activities will challenge this trend. Overall waste trends can be seen in Figure 2-2 with increases in C&D debris generated due to ongoing construction of the Science User Support Center (SUSC) and other site improvement activities. These activities will continue for the foreseeable future. Roughly 30% of staff work a hybrid home/office schedule with some fully remote employees. MSW generation shows a slight increase with expectations that volumes will continue to increase in the future without the identification and implementation of new diversion opportunities.

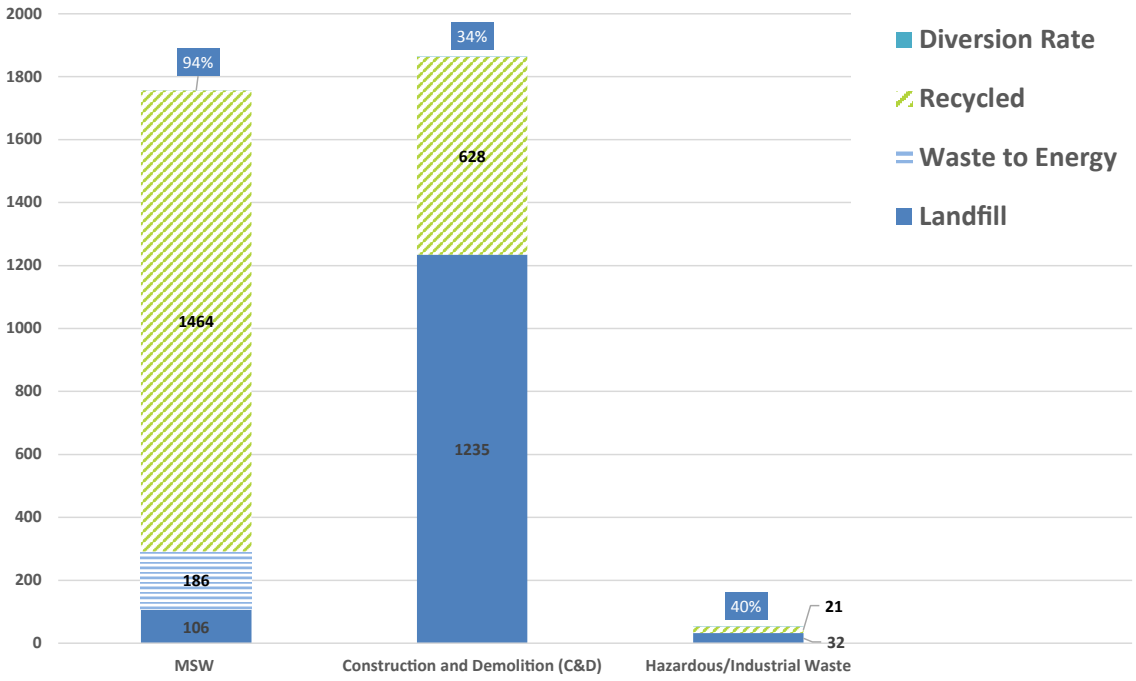
BNL's EMS establishes objectives and targets to drive pollution prevention and waste reduction as part of overall sustainable business practices, including the annual P2 Program that provides funds to purchase equipment or other materials to either reduce an environmental risk or reduce or eliminate a waste stream. Table 2-1 describes all the waste streams that were diverted from disposal as MSW during 2024, and provides the number of pounds of materials reduced, reused, or recycled, as well as the estimated cost benefit of each project.

BNL employee recycling gloves.

During 2024, the program funded 14 new proposals, investing approximately $17,900. The proposals involved reducing spill risk, reducing plastic waste in laboratories, promoting use of bio-friendly alternative products, and promoting overall environmentally sustainable business practices. The implementation of P2 opportunities, recycling programs, and conservation initiatives has reduced both waste volumes and management costs. In 2024, these efforts resulted in nearly $1.6 million in cost avoidance or savings and approximately 1,587 tons (over 3 million pounds) of materials being reduced, recycled, reused or sent for energy recovery.

Figure 2-2. Waste Disposal in Tons, 2020-2024.

Figure 2-3. Waste Diversion in Tons, 2024.



In 2024, BNL collected approximately 1,272 tons of scrap metal for recycling which is over double the normal amount generated. The additional amount was generated out of the Collider-Accelerator Department (C-AD) as they begin to cleanout the facility in preparation for transition to the Electron Ion Collider (EIC). The transition will generate a large amount of metal for the following several years. Cardboard, office paper, bottles and cans, construction debris, motor oil, lead, automotive and uninterrupted power supply (UPS) batteries, electronic scrap, fluorescent light bulbs, and tires were also recycled. Table 2-1 shows the total number of tons of materials recycled. The baseline recycling rate goal for federal facilities is 50%. BNL's annual average recycling rate for MSW diversion from a landfill consistently outperforms the baseline. The 2024 annual recycling rate was 94%. The table also indicates other non-MSW waste streams such as used motor oil, lead scrap, lead batteries, and fluorescent bulbs which are regulated hazardous and industrial waste streams that are being recycled are shown, but not counted, in BNL's MSW recycling rate.

In 2024, BNL's P2 program was once again honored by receiving the Green Electronics Council's EPEAT Award for purchasing EPEAT-registered electronic products which meet strict environmental criteria that address the full product lifecycle, from energy conservation to toxic materials to product longevity and end-of-life management. BNL also received its ninth DOE GreenBuy Gold Award and fifth GreenBuy Superior Award. Additionally, BNL met 90% of the GreenSpace criteria product goals in a Research Laboratory renovation, thereby achieving its first GreenSpace Silver Award.

Table 2-1. BNL Pollution Prevention, Waste Reduction, and Recycling Programs, 2024.

Municipal Solid Waste (MSW)	Tons	Estimated Revenue/ Cost Savings	Project Description Details
Office Paper	31	$11,000	Collected and transported to a transfer facility for recycling along with regular trash, daily construction and demolition debris (C&D) from daily maintenance activities, and other recyclables. Savings are based on cost to dispose of as trash at $240/ton vrs. recycling at a flat fee of $13K for all paper and cardboard and no cost/revenue for bottles and cans.
Cardboard	60		
Bottles/Cans	9		
Printer Toner Cartridges	1	$120	Savings are based on cost to dispose of as trash vrs. recycling at $0 cost/revenue.
Metals	1,272	$737,760	Cost avoidance was based on disposal as trash, plus revenue based on $0.17/lb.
Tires	8	$1,920	Truck tires were sent for recycling from the motor pool at $0 cost/revenue. Cost savings were based on cost to dispose of as trash at $240/ton.
Blasting Garnet	21	$4,140	Garnet used in machine shop shipped for recycling at a cost of $900 and cost avoidance for disposal as MSW at $240/ton
Electronic Waste	56	$69,440	Cost avoidance was based on disposal as trash, plus revenue based on $0.50/lb.
Wood Pallets	8	$800	Pallets in reusable condition are collected centrally on-site by the Facilities and Operations (F&O) Directorate and picked up by a local company at no cost/revenue. Eight tons represents 304 pallets, avoiding C&D disposal cost of $0.05/lb.
Subtotal: Tons of Material Recycled:	**1,464**	**$825,180**	**Total Savings Achieved**
Tons of MSW sent to a Waste to Energy (WtE) facility:	**186**		
Tons of MSW Landfilled:	**106**		**Total MSW diverted from a landfill = 94%**
Total tons MSW:	**1,758**		**Total rate of recylcing = 86%**

(continued on next page)

Table 2-1. BNL Pollution Prevention, Waste Reduction, and Recycling Programs, 2024 *(concluded)*.

Construction and Demolition Debris Recycled	Tons	Estimated Revenue/ Cost Savings	Project Description Details
Total Tons of Material Recycled	628	$26,840	Demolition of multiple buildings. Revenue from metals plus cost savings from disposing as C&D waste.
Total Tons of C&D Waste Landfilled	1,235	($123,500)	34% Total Diverted from a C&D Landfill.

Other Regulated Waste Streams (Hazardous/Industrial Waste) Recycled	Tons	Estimated Revenue/ Cost Savings	Project Description Details
Used Oil (Motor Pool, Oil Skimmer) (Sent for Energy Recovery)	4	$3,414	Used motor oil from automobiles and compressor oil condensors is sent to a vendor for energy recovery. In 2024, they collected 1,030 gallons (4 tons) for $1,260, which avoided the costs for disposal as used oil at $51/drum plus the cost of 19 shipping drums at $195/drum.
Lead Acid Batteries (Recycled)	17	$19,040	Avoided universal waste disposal costs of $0.41/lb for lead & sulfuric acid batteries by sending directly for recycling at $0.15/lb revenue.
Fluorescent Light Bulbs	1	($1,422)	Waste management manages these bulbs as universal waste and has them recycled.
Total Tons of Material Diverted:	**22**	**$21,032**	**Total Cost/Savings Achieved**
Total Hazardous & Industrial Waste Disposed:	**32**	**41%**	**Total Diversion from Other Disposal/Treatment (Hazardous Waste, Used Oil, Waste Water)**

Materials Reused On-site (Not included in diversion calculations)	Tons	Estimated Revenue/ Cost Savings	Project Description Details
Carbon Reuse - GW Cleanup Systems	34	$63,000	Sent off-site for regeneration then returned for reuse. Savings is based on the cost to buy new carbon.
Electronic Reuse	4	$648,000	The Laboratory resues electronic equipment if possible. If not reused, the electronics would provide scrap metal revenue at $0.50/lb. Savings are based on the cost of purchasing the reused items as new items minus the scrap value.
Total Tons of Material Diverted:	**38**	**711,000**	**Total Cost Avoidance Achieved**

Total of All Material Recycled or Reused: 1,587 Tons
Total Savings and Cost Avoidance from Recycling and Reuse: $1.6 Million

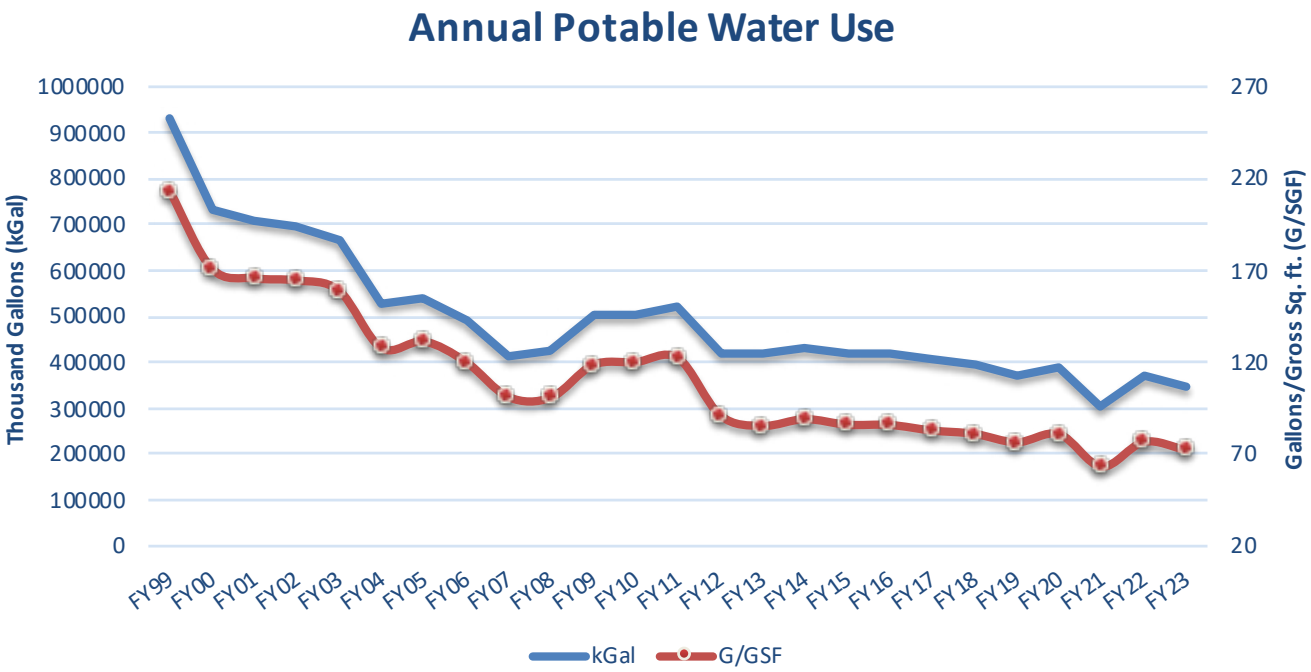
2.4.5 Water Conservation

BNL's water conservation program has achieved a dramatic 63% reduction in water use from the mid-1990's resulting in savings of half billion gallons of water every year. Much of that reduction was achieved in the early years prior to 2007. Figure 2-4 shows the 18-year water intensity (gallon/gross square foot) since the major reductions were achieved, which has stayed consistent with a drop in use during the COVID-19 period and increasing use since due to returning staff as well as Lab growth. Usage will continue to increase, with an anticipated bump expected in five years when the EIC begins operation based on that facility's projected cooling needs.

The Laboratory continually evaluates water conservation as part of facility upgrades or new construction initiatives. These efforts include more efficient and expanded use of chilled water for cooling and heating, ventilation, and air conditioning (HVAC) systems to reduce use of once-through cooling water for other systems. The Laboratory's goal is to continue to integrate water saving design into new facilities and maintain current reductions while ensuring the flow at the Sewage Treatment Plant (STP) is sufficient for efficient plant operations.

Moreover, BNL has shifted its wastewater treatment in recent years to primarily an aquifer recharge system. This method of wastewater rejection significantly reduces the Lab's impact on the depletion of the subsurface sole source aquifer that supplies Long Island's communities. This aquifer recharge also prevents run-off and the conveyance of surface pollutants to local waterways.

Figure 2-4. Annual Potable Water Use, 2007 - 2024.



2.4.6 Energy Management and Conservation

The Laboratory's Energy Management Group continues to reduce energy use and costs by identifying and implementing cost-effective, energy-efficient projects; monitoring energy use and utility bills; and assisting in obtaining the least expensive energy sources possible. The group is responsible for developing, implementing, and coordinating BNL's energy management efforts.

2.4.6.1 Site Energy Usage

BNL's 3.2 million gallon chilled water storage tank used to reduce peak electric demand by producing and storing chilled water is getting cleaned remotely, via drone.

BNL has more than 4.8 million square feet of building space. Many scientific experiments at the Laboratory use particle beams generated and accelerated by electricity, with the particles controlled and aligned by large electromagnets. In 2024, BNL used 296 million kilowatt hours (kWh) of electricity, 57,312 gallons of No. 6 heavy fuel oil, 9,816 gallons of No. 2 light fuel oil, 15,118 gallons of propane, and 554 million cubic feet of natural gas. Fuel oil and natural gas are used to produce steam at the Central Steam Facility (CSF), with light fuel oil also being used in satellite boilers around campus. Responding to market conditions, fuel oil and natural gas have been historically used whenever each respective fuel is least expensive, or when the local utility requires a natural gas curtailment event to stabilize supply lines in the community. Given the price disparity between natural gas and oil, the Laboratory will continue to purchase natural gas over oil in the future. A side benefit is the reduction of greenhouse gas emissions that will result from burning natural gas over oil.

In 2024, natural gas prices once again continued to be lower than fuel oil prices. However, BNL continued to burn a significant amount of its supply of #6 fuel oil for heat in anticipation of the upcoming ban of the purchase of #6 fuel oil recently enacted by New York State. BNL plans to transition to No. 4 fuel oil as a primary fuel source after the remaining No. 6 fuel oil has been used over the course of 2025. Additional information on natural gas and fuel oil use can be found in Chapter 4.

New York State has electric load reduction curtailment programs that will activate when the New York Independent System Operator expects customer demand to meet or exceed the available supply. BNL could not participate in this program in 2024 as the Relativistic Heavy Ion Collider (RHIC) continued operation of the 25 megawatt (MW) RHIC throughout the summer.

In 2024, BNL's energy supply included 120,014 MWh of clean, renewable hydropower energy, 552,447 kWh of on-site generated solar photovoltaic (PV), and 24 million kWh of purchased renewable energy certificates (RECs). The Laboratory will consider seeking alternative renewable energy sources pending directives and funding from the new administration.

BNL is the site of the Long Island Solar Farm (LISF). The array is one of the largest solar PV arrays (32 MW) in the Northeast and spans 195 acres with more than 164,000 panels. The LISF was designed to produce an average of 44 million kWh of power for Long Island and has been performing over 50 million kWh/year. As an outcome of allowing this large array to be constructed on-site, the Laboratory has developed a solar research program that conducts research and development for solar power storage and inverter efficiencies.

2.4.6.2 Current Conservation Efforts

To reduce energy use and costs at non-research facilities, several activities were continued or undertaken by the BNL Energy Management Group in 2024:

- **BNL receives a 15 MW block allocation of renewable (nearly zero GHG) hydropower from the New York Power Authority:** The hydropower used in 2024 provided a net GHG reduction of 70,310 MT CO_2e.
- **Continued progress occurred on several energy efficiency initiatives, such as the following:** New electric, chilled water, and steam meter installations; funding for energy efficiency initiatives; the purchase of RECs in meeting Environmental Protection Act 2005 renewable electricity requirements; and training various parties on energy conservation initiatives.
- **Energy Conservation:** Energy and water evaluations are completed for 25% of the site each year. Cost-effective projects are identified and proposed for funding, as appropriate.
- **Renewable Energy:** Project support continues for the LISF and Northeast Solar Energy Research Center (NSERC) facilities and annual purchases of RECs to meet targeted goals.
- **Central Chilled Water Facility (CCWF):** The CCWF continues to utilize a 3.2-million-gallon chilled water storage tank to reduce peak electric demand by producing and storing chilled water during the night.
- **Natural Gas Purchase Contract:** BNL is currently saving over $2 million per year using natural gas compared to oil.
- **Energy Savings:** Work continues in the replacement of aging, inefficient metal halide lighting fixtures with new LED high bay and low bay fixtures, as appropriate. Typically, 200 to 300 fixtures are replaced annually, saving tens of thousands of kWhs each year and reducing costs by several thousand dollars.
- **Demand Response:** The Energy Management team has also performed an audit of the controls system with regards to demand response and has programmed the following demand response scenarios to curtail summer usage:
  - Tier 1 – Raising office area cooling set points by 1 °F.
  - Tier 2 – Raising office area cooling set points by an additional 1 °F and humidity setpoints by 10%.
  - Tier 3 – Raising office area cooling setpoints by a total of 4 °F and humidity setpoints an additional 10%.
- **Energy Savings Reinvestment Program:** In calendar year (CY) 2023, BNL completed its payments for its Utility Energy Service Contract (UESC) freeing up capital. This freed capital is now being used as part of a piloted energy savings reinvestment program focused on essential maintenance and upgrade projects that promote additional energy savings. In 2024, projects that were started included: replacement of the fill in the central chilled water south cooling towers, right sizing condenser water pumps in the chilled water plant to reduce energy consumption, and overhauling site cooling towers including B555 and B488. Projects continued in CY25.

2.4.7 Natural and Cultural Resource Management Programs

Through its Natural Resource Management Plan (BNL 2021), BNL continues to enhance its Natural Resource Management Program for the Lab and the Upton Ecological and Research Reserve. The Laboratory also continues to enhance its Cultural Resource Management Program. A BNL Cultural Resource Management Plan (BNL 2023) was developed to identify and manage properties that are determined to be eligible for inclusion on the National Register of Historic Places. See Chapter 6 for further information about these programs.

2.4.8 Environmental Restoration

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress in 1980. As part of CERCLA, the Environmental Protection Agency (EPA) established the National Priorities List, which identifies sites where clean-up of past contamination is required. BNL was placed on the list with 27 other Long Island sites, 12 of which are in Suffolk County. Each step of the CERCLA cleanup process is reviewed and approved by DOE, EPA, and NYSDEC, under an Interagency Agreement (IAG) (USEPA 1992). Although not formal signatories of the IAG, the New York State Department of Health (NYSDOH) and the Suffolk County Department of Health Services (SCDHS) also play key roles in the review process.

Most of the contamination at the Laboratory is associated with past accidental spills and outmoded practices for handling, storing, and disposing of chemical and radiological material. BNL follows the CERCLA cleanup process, which includes the following steps:

- Identification of the presence or potential presence of a hazardous substance that may pose a threat to public health, welfare, or the environment;
- Conduct a preliminary assessment followed by a remedial investigation, if necessary, to characterize the nature and extent of contamination and assess the associated risks;
- Issue a Record of Decision (ROD), which is the corrective action agreed to by DOE, EPA, and NYSDEC with input from the public;
- Perform the Remedial Design/Remedial Action, which includes final design, construction specifications, and carrying out the selected corrective action; and
- Perform removal actions (time critical or non-time critical) under the CERCLA process as appropriate.

In 2024, BNL's 10 active groundwater treatment systems removed approximately 41 pounds of volatile organic compounds (VOCs), 0.1 millicurie (mCi) of strontium-90 (Sr-90), 0.7 pounds of per- and polyfluoroalkyl substances (PFAS), and returned approximately 1.1 billion gallons of treated water to the sole source aquifer. In accordance with a CERCLA Action Memorandum to conduct a Time Critical Removal Action, operation of two groundwater treatment systems to address PFAS contamination from the Former Firehouse and Current Firehouse/Building 170 source areas continued. Groundwater characterization data and modeling identified the need to modify the Operable Unit (OU) VI ethylene dibromide treatment system with additional extraction wells to capture deeper contamination. These two new deep extraction wells began operation in January 2024. These groundwater systems are operated in accordance with approved Operations and Maintenance manuals. In addition, as identified in the 2021 CERCLA Five Year Review, an in-situ chemical treatment was performed in the Building 96 residual source area to reduce the mobility of contaminants and enhance their degradation to improve the cleanup timeframe.

Institutional controls were also monitored and maintained for the cleanup areas in accordance with the RODs to help ensure the remedies remain protective of human health and the environment. An annual evaluation of these controls was submitted to the regulatory agencies. Furthermore, in 2024, BNL continued the surveillance and maintenance of the Brookhaven Graphite Research Reactor (BGRR) and the High Flux Beam Reactor (HFBR). Table 2-2 provides a description of each OU and a summary of environmental restoration actions taken. See Chapter 7 and SER Volume II, Groundwater Status Report for further details.

Table 2-2. Summary of BNL 2024 Environmental Restoration Activities.

Project	Description	Environmental Restoration Actions
Soil Projects	Operable Unit (OU) I/II/III/VII/X	Performed inspections, monitoring, and maintenance of institutional controls for cleanup areas. Installed two soil borings in the OU X Current Firehouse source area to characterize subsurface soil for per and poly fluoroalkyl substances (PFAS) from ground surface to the groundwater table.
Groundwater Projects	OU I/III/V/VI	Continued operation of seven groundwater treatment systems that remove volatile organic compounds (VOCs) and one system that removes strontium-90 (Sr-90). Removed 41 pounds of VOCs and 0.1 mCi of Sr-90 during the treatment of approximately 759 million gallons of groundwater. Since the first groundwater treatment system started operating in December 1996, approximately 7,914 pounds of VOCs and 35 mCi of Sr-90 have been removed, while treating approximately 33 billion gallons of groundwater.
Groundwater Projects	OU I/III/V/VI	Collected and analyzed approximately 1,327 sets of groundwater samples from 657 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) monitoring wells. Installed 16 temporary wells and collected multiple samples from each location to delineate/track the OU I Sr-90 plume. The operation of two new extraction wells commenced in January 2024, to remediate ethylene dibromide in the deeper portion of the aquifer in the OU VI plume. An in-situ chemical treatment consisting of liquid carbon and zero valent iron (ZVI) was performed in the Building 96 residual source area to reduce the mobility of VOCs and enhance their degradation. Influent, effluent, and individual extraction wells were sampled for PFAS and 1,4-dioxane at eight groundwater treatment systems currently treating VOCs and Sr-90 for compliance monitoring with recently established New York State discharge stands for these analytes.
	OU X (PFOS/ PFOA/1,4-Dioxane	As part of the Time-Critical Removal Action (TCRA) under CERLCA, continued the operation of two PFAS groundwater treatment systems, the Current Firehouse/Building 170 system and the Former Firehouse system. Approximately 0.7 pounds of PFAS were removed from the aquifer and approximately 320 million gallons of treated groundwater were returned to the aquifer in 2024. Since the startup of the Current Firehouse/Building 170 system in October 2022 and the Former Firehouse system in January 2023, a total of approximately 1.3 pounds of PFAS have been removed and approximately 666 million gallons of groundwater have been treated. Installed and sampled eight temporary Geoprobe® wells to track an apparent shift in the Current Firehouse/Building 170 PFAS plume, and 15 temporary vertical profile wells to delineate PFAS and 1,4-dioxane downgradient of the Current Firehouse/Building 170. Four new permanent monitoring wells were installed based on the results of the temporary vertical profile wells to monitor the downgradient portions of the Current Firehouse/Building 170 plume. Collected groundwater samples from two soil borings installed in the Current Firehouse source area. A total of 17 monitoring wells from the Current Firehouse/Building 170 plume and 13 wells from the Former Firehouse plume were also monitored for 1,4-dioxane.
Peconic River	OU V	A population survey of fish in the on-site portion of the Peconic River was performed under BNL's Environmental Surveillance Program. In 2024, the fish population did not support sampling.

(continued on next page)

Table 2-2. Summary of BNL 2024 Environmental Restoration Activities *(Concluded.)*

Project	Description	Environmental Restoration Actions
Reactors	Brookhaven Graphite Research Reactor (BGRR)	Continued long-term surveillance and maintenance, including minor repairs and maintenance items.
	High Flux Beam Reactor (HFBR)	Continued long-term surveillance and maintenance, including minor repairs and maintenance items.
	Brookhaven Medical Research Reactor (BMRR)	The final BMRR Stack Demolition Closeout Report was issued to the regulators in January 2023.
Former Buildings 810/811	Former Radiological Liquid Processing Facility	Maintained institutional controls of the area.
Building 801	Inactive Radiological Liquid Holdup Facility	Performed routine surveillance and maintenance of the facility.
Former Building 650	Inactive Radiological Decontamination Facility	Maintained institutional controls of the area.

2.5
Implementing the Environmental Management System

2.5.1 Structure and Responsibility

All employees at BNL have clearly defined roles and responsibilities in key areas, including environmental protection. Supervisors are required to work with their employees to develop and document Roles, Responsibilities, Accountabilities, and Authorities (R2A2s). BSA has clearly defined expectations for management and staff which must be included in the R2A2 document. Under the BSA performance-based management model, senior managers must communicate their expectation that all line managers and staff take full responsibility for their actions and be held accountable for ESSH performance. Environmental and waste management technical support personnel assist the line organizations with identifying and carrying out their environmental responsibilities. Environmental Compliance Representatives (ECRs) are deployed to organizations throughout the Laboratory as an effective means of integrating environmental planning and pollution prevention/waste minimization into the work planning processes of the line organizations. A comprehensive training program for staff, visiting scientists, and contractor personnel is also in place, thus ensuring that all personnel are aware of their ESSH responsibilities.

2.5.2 Communication and Community Involvement

In support of BNL's commitment to open communication and community involvement, the Stakeholder Relations Office (SRO) develops best-in-class communications, science education, government relations, and community involvement programs that advance the science and science education missions of the Laboratory. The SRO contributes to the public's understanding of science, enhances the value of the Laboratory as a community, and ensures that internal and external stakeholders are properly informed and have a voice in decisions of interest

and importance to them. The SRO also works to maintain relationships with BNL employees and external stakeholders, such as neighbors, business leaders, elected officials, and regulators to provide an understanding of the Laboratory's science and operations, including environmental restoration activities, and to incorporate community input into BNL's decision making process.

To facilitate stakeholder input, the SRO's Office of Community Engagement, in coordination with the EPD, participates in or conducts on- and off-site meetings which include discussions, presentations, and workshops. Community Engagement and EPD staff attend local civic association meetings, conduct Laboratory tours, and coordinate informal information sessions and formal public meetings, which are held during public comment periods for environmental projects.

The SRO's Media and Communications Office manages programs to increase internal stakeholder awareness, understanding, and support of Laboratory initiatives; fosters two-way communications; and updates internal stakeholders on BNL priorities, news, programs, and events.

The SRO's Office of Workforce Development and Science Education manages various education initiatives and programs that support the scientific mission at BNL and the DOE. Programs include Summer Science Explorations for grades four through twelve, the Science Learning Center, and the DOE's Workforce Development for Teachers and Scientists which sponsors various internship opportunities.

Student participating in an Office of Workforce Development and Science Education learning activity.

2.5.2.1 Communication Forums

To create opportunities for effective dialogue between the Laboratory and its stakeholders, several forums for communication and involvement have been established, such as the following:

- The CAC, established by BNL in 1998, advises Laboratory management primarily on environmental, health, and safety issues related to BNL that are of importance to the community. The CAC is comprised of 26 member organizations and individuals representing civic, education, employee, community, environmental, business, and health interests. The CAC sets its own agenda in cooperation with the Laboratory and meets six times a year. The CAC is one of the primary ways the Laboratory keeps the community informed. Meetings are open to the public and are announced on the BNL homepage calendar and on the Stakeholder Relations website which links to the CAC webpage, meeting agendas, and past meeting presentations and minutes. An opportunity for public comment is provided at each meeting. Organizations interested in participating on the CAC are encouraged to attend meetings and make their interest known.
- Monthly teleconference calls are held with parties to the Laboratory's IAG and other federal, state, and local regulators to update them on project status. The calls also

provide the opportunity to gather input and feedback and to discuss emerging environmental findings and initiatives.

- Stakeholder Relations also manages several outreach programs that provide opportunities for stakeholders to become familiar with the Laboratory's facilities and research projects. Outreach programs include:
  - *Tour Program:* Opportunities to learn about BNL are offered to college and university groups. Tour groups visit the Laboratory's scientific machines and research facilities and meet with scientists to discuss research. Agendas are developed to meet the interests of the groups and often include environmental stewardship issues such as water quality and groundwater protection.
  - *Explore Brookhaven Open Houses:* Held on four Sundays each summer, these open houses enable the public to visit BNL science facilities, experience hands-on activities, and learn about the Lab's scientific research. In 2024, more than 5,000 visitors participated in the program.

PubSci, a science cafe event sponsored by BNL

The Laboratory also participates in and hosts various outreach events throughout the year such as Science in the Community programs, a science cafe called PubSci, a Science on Screen event at a local cinema, and the Port Jefferson Mini-Maker Faire. All Hands staff meetings are held throughout the year to keep employees apprised of Lab updates and new programs.

The SRO's Media & Communications Office issues press releases to news and media outlets and the Internal Communications Office publishes electronic and printed weekly employee newsletters, such as Brookhaven This Week and The Brookhaven Digest. In addition, a Director's Office web-based publication, Monday Memo, is issued bi-weekly to employees and focuses on topics important to the Laboratory population. The Laboratory maintains an informative website at www.bnl.gov, where these publications, as well as extensive information about BNL's science and operations, past and present, are posted. In addition, employees and the community can subscribe to the Laboratory's e-mail news service.

Community members can subscribe to the weekly e-newsletter, Brookhaven This Week, found on the Media Communications webpage at www.bnl.gov, which keeps Lab employees and the community informed about happenings at BNL, explains some of the science behind Laboratory research, and invites subscribers to educational and cultural events. Additionally, a new email was established to facilitate easy communication with community members: community@bnl.gov.

2.5.2.2 Community Involvement in Cleanup Projects

In 2024, BNL updated stakeholders on the progress of environmental clean-up projects, additional initiatives, and health and safety issues via briefings, and presentations given at CAC meetings. These topics included the following:

- **Cyber Security at BNL:** was presented by the Chief Information Security Officer, Ian Ballantyne. Topics included the cyber organization at BNL, the regulatory, threat and operational environments and cyber responsibilities of the organization.
- **BNL's Commitment to Emission Reduction:** was presented by Deputy Director for Operations Ann Emrick, and Energy Manager, Benedetto Schiraldi. The presentation covered BNL's strategic energy objectives, reducing gas emissions and energy management moving forward.
- **Small Business and Procurement Opportunities at BNL:** including sustainable purchasing and the Green Buy Award program. The small business presentation was given by Mary Rogers, the Lab's Small Business Liaison Officer and discussed the Lab's small business engagement, eligibility requirements, and procurement opportunities. Debbie Bauer, Subject Matter Expert for Environmentally Preferred Purchasing for EPD, and Suhani Gandhi, Project Manager for the Modernization Project Office discussed the environmentally preferable purchasing program in relation to the EPA Comprehensive Procurement Guidelines.
- **BNL Strategy in Biopreparedness:** Martin Schoonen, Associate Lab Director for Environment, Biology, Nuclear Science and Nonproliferation presented about National Laboratory capabilities to address future biological crises.
- **Explore Brookhaven open houses:** Danielle Pontieri, from Stakeholder Relations, invited CAC members and their friends and families to participate and spread the word about the Lab's open houses taking place on four Sundays over the summer. The open houses are free and open to the public.
- **Results from the 2024 Survey of the CAC:** covered topics such as meeting time, topic, tour, and moderator preferences and feedback about scientific and environmental presentations.
- **Natural and Cultural Resources:** The CAC received updates on BNL's natural resources, such as deer and fire management, and the risk to the Long Island Pine Barrens from the southern pine beetle.
- **Environmental Updates:** In 2024, the CAC also received environmental updates such as the general status of the groundwater contaminant plumes and remediation systems; emerging contaminants PFAS and 1,4 Dioxane in groundwater; proposed New York State and EPA drinking water standards for these contaminants; and updates on the SER.

2.5.3 Monitoring and Measurement

BNL's EMS specifies requirements for conducting general surveillance to determine impact from site operations to the environment. DOE O 458.1 Admin Chg. 4, (2020), Radiation Protection of the Public and Environment, requires DOE sites to maintain surveillance monitoring for determining radiological impacts, if any, to the public and environment from site operations.

BNL's EMS includes an Environmental Monitoring Program (EMP) which is a comprehensive, site-wide program that identifies potential pathways for exposure of the public and employees, evaluates the impact activities have on the environment, and ensures compliance with environmental permit requirements. The EMP defines how the Laboratory will monitor effluents and emissions to ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures. The plan uses the EPA's Data Quality Objective approach for documenting the decisions associated with the monitoring program. In addition to the required triennial update, an annual electronic update is also prepared. The monitoring programs are reviewed and revised, as necessary, to reflect changes in permit requirements, changes in facility-specific monitoring activities, or the need to increase or decrease monitoring based on a review of previous analytical results. As shown in Table 2-3, in 2024, there were 6,791 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges under the EMP. Specific sampling programs for the various media are described further in Chapters 3 through 8. The EMP addresses three components: compliance, restoration, and surveillance monitoring.

Table 2-3. Summary of BNL Sampling Program Sorted by Media, 2024.

Environmental Media	No. of Sampling Events (a)	Purpose
Groundwater	1468	Groundwater is monitored to evaluate impacts from past and present operations on groundwater quality under the Environmental Restoration, Environmental Surveillance, and Compliance sampling programs. See Chapter 7 and Site Environmental Report (SER) Volume II, Groundwater Status Report, for further details.
On-Site Recharge Basins	56	Recharge basins used for wastewater and stormwater disposal are monitored in accordance with discharge permit requirements and for environmental surveillance purposes. See Chapter 5 for further details.
Potable Water	20 C	Potable water wells and the BNL distribution system are monitored routinely for chemical and radiological parameters to ensure compliance with Safe Drinking Water Act requirements. In addition, samples are collected under the Environmental Surveillance Program to ensure the source of the Laboratory's potable water is not impacted by contamination. See Chapters 3 and 7 for further details.
Sewage Treatment Plant (STP)	121	The STP influent and effluent and several upstream and downstream Peconic River stations are monitored routinely for organic, inorganic, and radiological parameters to assess BNL impacts. The number of samples taken depends on flow. For example, samples are scheduled for collection at Station HQ monthly, but if there is no flow, no sample can be collected. See Chapters 3 and 5 for further details.
Precipitation	8	Precipitation samples are collected from two locations to determine levels of mercury present in rain to support long-term monitoring of atmospheric disposition of mercury.
Air – Tritium	249	Silica gel cartridges are used to collect atmospheric moisture for subsequent tritium analysis. These data are used to assess environmental tritium levels. See Chapter 4 for further details.
Air – Particulate	378 ES/C 49 NYSDOH	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. Samples are also collected for the New York State Department of Health Services as part of their program to assess radiological air concentrations statewide. See Chapter 4 for further details.
Fauna	31	Fish and deer are monitored to assess impacts on wildlife associated with past or current BNL operations. See Chapter 6 for further details.
Flora	12	Vegetation is sampled to assess possible uptake of contaminants by plants and fauna, since the primary pathway from soil contamination to fauna is via ingestion. See Chapter 6 for further details.
Soils	107	Soil samples are collected as part of the Natural Resource Management Program to assess faunal uptake, during Environmental Restoration investigative work, during the closure of drywells and underground tanks, and as part of preconstruction background sampling.

(continued on next page)

Table 2-3. Summary of BNL Sampling Program Sorted by Media, 2024. *(Concluded.)*

Environmental Media	No. of Sampling Events (a)	Purpose
Miscellaneous	142	Samples are collected periodically from potable water fixtures and dispensers, manholes, and spills to assess process waters and to assess sanitary discharges.
Groundwater Treatment Systems Monitoring	1154	Samples are collected from groundwater treatment systems operated under the Comprehensive Environmental Response, Compensation, and Liability Act program. The Laboratory has ten operating groundwater treatment systems. See discussion in Chapter 7.
State Pollutant Discharge Elimination System (SPDES)	335	Samples are collected to ensure that the Laboratory complies with the requirements of the New York State Department of Environmental Conservation-issued SPDES permit. Samples are collected at the STP, recharge basins, and four process discharge sub-outfalls to the STP.
Flow Charts	520	Flowcharts are exchanged weekly as part of BNL's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	97	Tests are performed on select petroleum storage facility monitoring wells to determine if floating petroleum products are present. The number of wells and frequency of testing is determined by NYSDEC licensing requirements (e.g., Major Petroleum Facility), NYSDEC spill response requirements (e.g., Motor Pool area), or other facility-specific sampling and analysis plans.
Radiological Monitor Checks	482	Daily instrumentation checks are conducted on the radiation monitors located in Buildings 569 and 592. These monitors are located 30 minutes upstream of the STP and at the STP. Monitoring at these locations allows for diversion of wastes containing radionuclides before they are discharged to the STP recharge basins.
Quality Assurance / Quality Control Samples (QA/QC)	1306	To ensure that the concentrations of contaminants reported in the SER are accurate, additional samples are collected. These samples detect if contaminants are introduced during sampling, transportation, or analysis of the samples. QA/QC samples are also sent to the contract analytical laboratories to ensure their processes give valid, reproducible results.
Landfill gas	256	Soil gas monitoring of methane and hydrogen sulfide concentrations is conducted around each landfill. Soil gas monitoring data are evaluated for the potential for hazardous concentrations of gas near the landfill areas and the potential for off-site migration.
Total number of sampling events	**6791**	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2024), as well as samples collected to monitor Environmental Restoration (CERCLA) projects, air and water treatment system processes, and by the Environmental Protection Division Field Sampling Team as special requests. The number does not include samples taken by Waste Management personnel, waste generators, or Environmental Compliance Representatives for waste characterization purposes.

Notes:
(a) A sampling event is the collection of samples from a single georeferenced location. Multiple samples for different analyses (i.e., tritium, gross alpha, gross beta, and volatile organic compounds) can be collected during a single sample event.
C = Compliance
ES = Environmental Surveillance

2.5.3.1 Compliance Monitoring

Compliance monitoring is conducted to ensure that wastewater effluents, air emissions, and groundwater quality comply with regulatory and permit limits issued under the federal Clean Air Act, Clean Water Act, Oil Pollution Act, SDWA, and the New York State equivalents.

Air emissions monitoring is conducted at reactors no longer in operation, accelerators, and other radiological emission sources, as well as the CSF. Real-time, continuous emission monitoring equipment is installed and maintained at some of these facilities, as required by permits and other regulations. At other facilities, samples are collected and analyzed periodically to ensure compliance with regulatory requirements. Analytical data are routinely reported to the permitting agencies. See Chapters 3 and 4 for details.

Wastewater monitoring is performed at the point of discharge to ensure that the effluent complies with release limits in the Laboratory's SPDES permits. Twenty point-source discharges are monitored—nine under BNL's SPDES Permit and eleven under equivalency permits issued to the Environmental Restoration Program for groundwater treatment systems. As required by permit conditions, samples are collected daily, weekly, monthly, or quarterly, and monitored for organic, inorganic, and radiological parameters. Monthly discharge monitoring reports that provide analytical results and an assessment of compliance for that reporting period are filed with the NYSDEC. See Chapter 3, Section 3.6, for details.

Groundwater monitoring is performed to comply with regulatory operating permits. Specifically, monitoring of groundwater is required under the Major Petroleum Facility License for the CSF, the RCRA permit for the Waste Management Facility, and the SPDES permit for the STP. Extensive groundwater monitoring is also conducted under the CERCLA program (described in Section 2.4.8 above). Additionally, to ensure that the Laboratory maintains a safe drinking water supply, BNL's potable water supply is monitored as required by the SDWA, which is administered by SCDHS.

2.5.3.2 Restoration Monitoring

The Groundwater Protection Group operates and maintains groundwater treatment systems to remediate contaminant plumes both on- and off-site. BNL maintains an extensive network of groundwater monitoring wells to verify the effectiveness of the remediation effort. Modifications to groundwater remediation systems are implemented, as necessary, based upon a continuous evaluation of monitoring data and system performance. Details on groundwater monitoring and restoration program are provided in Chapter 7 and in SER Volume II, Groundwater Status Report.

2.5.3.3 Surveillance Monitoring

Surveillance monitoring is performed, in addition to compliance monitoring, to assess potential environmental impacts that could result from routine facility operations. The BNL Surveillance Monitoring Program involves collecting samples of ambient air, surface water, groundwater, flora, fauna, and precipitation.

Samples are analyzed for organic, inorganic, and radiological contaminants. Additionally, data collected using thermoluminescent dosimeters (TLDs) (i.e., devices that measure radiation exposure) strategically positioned on- and off-site are routinely reviewed under this program. Control samples (also called background or reference samples) are collected on- and off-site to compare Laboratory results to areas that could not have been affected by BNL operations.

The monitoring programs can be broken down further by the relevant law or requirement (e.g., Clean Air Act) and even further by specific environmental media and type of analysis. The results of monitoring and the analysis of the monitoring data are the subject of the remaining chapters of this report. Chapter 3 summarizes environmental requirements and compliance data, Chapters 4 through 8 give details on media-specific monitoring data and analysis, and Chapter 9 provides supporting information for understanding and validating the data shown in this report.

2.5.4 EMS Assessments

To periodically verify that the Laboratory's EMS is operating as intended, assessments are conducted as part of BNL's Contractor Assurance Program. Self-assessment is the systematic evaluation of internal processes and performance. Two types of assessments are conducted: the ISO 14001 Standard conformance assessment and the regulatory compliance assessments.

The approach for the ISO 14001 program self-assessment includes evaluating programs and processes within organizations that have environmental aspects to verify conformance to the ISO 14001 Standard.

The assessment is performed by qualified external assessors or BNL staff members who do not have line responsibility for the work processes involved. Progress toward achieving environmental objectives is monitored, as are event-related metrics to determine the overall effectiveness of the EMS. The assessment determines if there are Laboratory-wide issues that require attention, and facilitates the identification and communication of best management practices used in one part of the Laboratory that could improve performance in other parts of the Lab.

Compliance assessments are also performed by BNL staff members who do not have line responsibility for the work processes involved to ensure that operations comply with Laboratory requirements that reflect external compliance requirements. These assessments verify the effectiveness and adequacy of management processes (including self-assessment programs) at the division, department, directorate, and Laboratory levels. Special investigations are conducted to identify the root causes of events and identify corrective actions and lessons learned if regulatory noncompliance or impact occurs to correct the problem and prevent reoccurrence.

BNL management routinely evaluates progress on key environmental improvement projects. The Laboratory and DOE periodically perform assessments to facilitate the efficiency of assessment activities and ensure that the approach to performing the assessments meets DOE expectations.

The Laboratory's Contractor Assurance Program is augmented by programmatic external audits conducted by DOE. BSA staff and subcontractors also perform periodic independent reviews, and an independent third-party conducts ISO 14001 registration audits of BNL's EMS. The Laboratory is subject to extensive oversight by external regulatory agencies (see Chapter 3 for details). Results of all assessment activities related to environmental performance are included, as appropriate, throughout this report.

2.5.5 Best Practices

As a follow-up to assessments, the Laboratory reviews areas that need improvement, as well as areas that are recognized for their best practices. BNL's Fire Management program has become one of the Lab's examples of best practices, especially in the 13 years following the 2012 Crescent Bow Fire. The Natural and Cultural Resource Program in particular, has made great strides in managing the forest, proactively utilizing mechanical treatments to prepare various forest management units for burns with the goal of mitigating wildland fuels to protect values at risk on both the Lab site and the adjacent Ridge community. The Lab coordinates closely with the NYSDEC, Long Island Central Pine Barrens Commission, and other partner agencies to execute safe and effective prescribed burns. The success of this fire management program has been heralded by the New York Wildfire and Incident Management Academy, who hosts its training academy at the Lab every year.

The Laboratory's Natural and Cultural Resources Program is also recognized for its best practices in the area of Cultural Resources with its careful stewardship of the Camp Upton historic collection for World War I and II, and artifacts showcasing its 78-year history. In fact, due to the unique nature of history and artifacts at the Lab, the last few years have seen local museums highlight the Lab's historic collections. In 2022, the Long Island Museum highlighted an "Atoms to Cosmos: The Story of Brookhaven National Laboratory" which featured an exhibit dedicated to the Lab's seven Nobel Prizes, and five National Medals of Science over its 75-year history, including Camp Upton's importance in

Atoms to Cosmos display at the Bellport Brookhaven Historical Society Exhibit.

preparing soldiers for World War I and II. In 2024, the Bellport-Brookhaven Historical Society featured an entire exhibit on "The Innovators: Inventors and Scientists of the Bellport Area" which showcased scientists who worked at Brookhaven Lab and lived in the hamlets of Bellport and Brookhaven. This exhibit included artifacts on loan to the Historical Society from Brookhaven Lab. Lab scientists met with the Museum curators over many months to ensure the accuracy of the exhibits and to highlight the cutting-edge discovery science at the Lab.

2.6
Environmental Stewardship at BNL

BNL has extensive knowledge of its potential environmental vulnerabilities and current operations due to its mature work planning and control system, and the management systems for groundwater protection, environmental restoration, carbon footprint reduction, and information management. Compliance assurance programs have improved the Laboratory's compliance status and P2 projects have reduced costs, minimized waste generation, and reused and recycled significant quantities of materials. BNL is openly communicating with neighbors, regulators, employees, and other interested parties on environmental issues and progress.

Electric vehicle charging at a BNL charging port.

The Laboratory's environmental programs and projects have been recognized with international, national, and regional awards, and audits have consistently observed a high level of management involvement, commitment, and support for environmental protection and the EMS. To maintain stakeholder trust, the Laboratory will continue to deliver on commitments and demonstrate improvements in environmental performance.

The SER is an important communication mechanism, as it summarizes BNL's environmental programs and performance each year. BNL is often asked to share its experiences, lessons learned, and successes. Additional information about the Laboratory's environmental programs is available on BNL's website at http://www.bnl.gov.

For over 75 years, the unique, leading-edge research facilities and scientific staff at BNL have made many innovative scientific contributions possible. Today, BNL continues its research mission while focusing on cleaning up and protecting the environment.

References and Bibliography

BNL 2023. Cultural Resource Management Plan for Brookhaven National Laboratory. BNL-100708-2023. Brookhaven National Laboratory, Upton, NY. April 2023.

BNL 2021. Natural Resource Management Plan for Brookhaven National Laboratory. BNL-112669-2021. Brookhaven National Laboratory, Upton, NY.

BNL 2022. Brookhaven National Laboratory Environmental Monitoring Plan Update. Brookhaven National Laboratory, Upton, NY. January 2023.

BNL 2023. Groundwater Protection Contingency Plan– Response to Unexpected Monitoring Results. Environmental Monitoring Procedure EM-SOP-309. Brookhaven National Laboratory, Upton, NY. August 8, 2023.

ISO 14001: 2015. Environmental Management Systems – Requirements with Guidance for Use. Third Edition, 9-15-2015, International Organization for Standardization. Geneva, Switzerland.

Climate Leadership and Community Protection Act (CLCPA, 2019), New York State.

USEPA 1992. 1992 Interagency Agreement, Administrative Docket Number: II-CERCLA-FFA-00201. U.S. Environmental Protection Agency.

BNL 2024. Environmental Monitoring Plan for Brookhaven National Laboratory. for Brookhaven National Laboratory, Upton, NY.