

Environmental Management System

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Brookhaven Science Associates (BSA), the contractor operating the Laboratory on behalf of the Department of Energy (DOE), takes environmental stewardship very seriously. 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 encompasses ideals such as compliance, pollution prevention, and community involvement. Annual audits are required to maintain an EMS registration; an audit of the entire EMS occurs every three years. In 2017, EMS assessments determined that BNL remains in conformance with the ISO 14001: 2004 Standard.

The Laboratory continues its strong support of its Pollution Prevention Program, which seeks ways to eliminate waste and toxic materials on site. In 2017, pollution prevention projects resulted in nearly \$3.5 million in cost avoidance or savings and resulted in the reduction or reuse of approximately 9.3 million pounds of waste. An additional \$5,000 was spent on funding lab cleanouts and disposal of chemicals.

The ISO 14001-registered EMS continues to contribute to the Laboratory's success in promoting pollution prevention. As a testament to its strong environmental program, the Lab received two environmental awards in 2017: the DOE's Gold Level Green Buy Award and the Green Electronics Council's Electronic Product Environmental Assessment Tool (EPEAT) 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.

2.1 INTEGRATED SAFETY MANAGEMENT, ISO 14001, AND OHSAS 18001

The Laboratory's Integrated Safety Management System (ISMS) integrates Environment (environmental protection and pollution prevention), Safety, Health, and Quality (ESH&Q) management into all work planning and execution. The purpose of BNL's ISMS is to ensure that the way we work integrates DOE's five Core Functions and seven Guiding Principles into all work processes. The five Core

Functions, as defined by DOE P 450.4, *Safety Management System Policy*, are:

- *Define the scope of work:* Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.
- *Identify and analyze hazards associated with the work:* 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/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 on adequacy of controls and continue to improve safety management:* Feedback information on the adequacy of controls is gathered; opportunities for improving the definition and planning of work are identified and implemented; line and independent oversight is conducted; and, if necessary, regulatory enforcement actions occur.

The seven Guiding Principles, also as defined by DOE P 450.4, are:

- *Line manager clearly responsible for ES&H:* Line management is directly responsible for the protection of the public, workers, and environment.
- *Clear ES&H roles and responsibilities:* Clear and unambiguous lines of authority and responsibility for ensuring safety shall be established and maintained at all organizational levels within the Department and with its contractors.
- *Competence commensurate with responsibilities:* Personnel shall possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities.
- *Balanced priorities:* Resources shall be effectively allocated to address safety, programmatic, and operational considerations. Protecting the public, the workers, and the environment shall be a priority whenever activities are planned and performed.
- *Identify ES&H standards and requirements:* Before work is performed, the associated hazards shall be evaluated and an agreed-upon set of safety standards and requirements shall be established which, if properly implemented, will provide adequate assurance that the public, the workers, and the 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 safety processes within ISMS contributed to BNL achieving ISO 14001 and Occupational Health and Safety Assessment Series (OHSAS) 18001 registrations. The ISO 14001 Standard is globally recognized and defines the structure of an organization's EMS for purposes of improving environmental performance. OHSAS 18001 mirrors the ISO 14001 structure for purposes of improving safety and providing a safe and healthy workplace, free from recognized hazards for all operations. The process-based structure of the ISO 14001 and OHSAS 18001 Standards are based on the "Plan-Do-Check-Act" improvement cycle. Both standards require 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's EMS, as a whole, was officially registered to the ISO 14001 Standard in July 2001 and was the first DOE Office of Science Laboratory to obtain third-party registration to this environmental standard. BNL was officially registered to the OHSAS 18001 Standard in 2006 and was again the first DOE Office of Science Laboratory to achieve this registration. Each certification requires the Laboratory to undergo annual audits by an accredited registrar to assure that the systems are maintained.

A new external certification organization, ERM Certification Verification Services, was procured to conduct external verification of BNL's conformance to the ISO 14001 and OHSAS 18001 Standards in 2017. They conducted an initial desk assessment of BNL's systems in December with no issues identified; a follow-up on-site assessment will occur in 2018. BNL also conducted an internal assessment that verified continued conformance to the Standards.

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, issued and signed by the Laboratory Director, states the Laboratory's commitment to environmental stewardship, the safety of the public and BNL employees, and the security of the site. 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 <http://www.bnl.gov>. The goals and commitments focusing on compliance, pollution prevention, community outreach, and continual improvement include:

- *Environment*: We protect the environment, conserve resources, and prevent pollution.
- *Safety*: We maintain a safe workplace, and 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, DOE, and other stakeholders.
- *Continual Improvement*: We continually improve ESSH performance.

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; to evaluate applicable legal and other requirements; to establish objectives and targets; to create action plans to achieve the objectives and targets; and to 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.

BNL uses its work planning process to identify and review environmental aspects associated with activities. A "Process Assessment Procedure" is 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 legal requirements, 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.

Signed in March 2015, Executive Order (EO) 13693, *Planning for Federal Sustainability in the Next Decade*, establishes sustainability goals for federal agencies and focuses on greenhouse gas (GHG) reductions across the government. In addition to guidance, recommendations, and plans, which are due by specific due dates, EO 13693 has set numerical targets for the agencies.

DOE Order 436.1, *Departmental Sustainability*,

provides requirements and responsibilities for managing sustainability within DOE to ensure facilities are working towards sustainability goals established in its Strategic Sustainability Performance Plan (SSPP) pursuant to EO 13639. Each DOE facility is required to have a Site Sustainability Plan (SSP) in place detailing the strategy for achieving these long-term goals and due dates, and to provide an annual status. The requirements influence the future of the Laboratory's EMS program and have been incorporated into BNL's SSP. Table 2-1 identifies the DOE SSP goals, the Laboratory's performance in 2017, and future planned actions and contributions.

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. 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 EO 13693;
- Significant environmental aspects;
- Risk and vulnerability (primarily, threat to the environment);
- Compliance obligations (laws, regulations, permits, enforcement actions, and memorandums of agreement);
- Commitments (in the ESSH Policy) to regulatory agencies and to the public;
- Importance to DOE, the public, employees, and other stakeholders.

Laboratory-level objectives and targets are developed on a fiscal year (FY) schedule. For FY 2017, BNL's environmental objectives included maintaining ISO 14001 and OHSAS 18001 certifications, improving the Laboratory's performance in purchasing environmentally preferable items, and improving spill response capabilities.

2.3.4 Environmental Management Programs

The Environmental Protection Division takes on the largest role for developing action plans for implementing institutional environmental priorities, with other organizations within BNL developing action plans as applicable to their operations. The plans detail how the organization will achieve their 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.

2.3.4.1 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 upgrading petroleum and chemical storage tank facilities, upgrading the sanitary sewer system, closing underground injection control devices, retrofitting or replacing air conditioning equipment refrigerants, and managing legacy facilities. (See Chapter 3 for a list of regulatory programs to which BNL subscribes, and a thorough discussion of these programs and their status.)

2.3.4.2 Groundwater Protection

BNL's Groundwater Protection Program is designed to prevent negative impacts to groundwater and to restore groundwater quality by integrating pollution prevention efforts, monitoring, groundwater restoration projects, and communicating performance. The Laboratory has developed a Groundwater Protection

Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2017.

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 1: Greenhouse Gas (GHG) Reduction		
50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline	Scope 1 & 2 GHG Emissions BNL had a 50% reduction (~118,000 MtCO₂e) in Scope 1 and 2 GHG emissions for FY17. The 32-MW LISF reduced GHGs on Long Island by 32,109 MtCO₂e. Fugitives and Refrigerants The bulk of BNL's process and fugitive GHG emissions were due to periodic purging of carrier gases used in STAR detector subsystems during the FY17 RHIC experimental run. In May, BNL revised its Refrigerant Management Plan, fully incorporating all of the modified and new 40 CFR 82 Subpart F provisions. In July, three training sessions were held with refrigeration and air conditioning technicians and their supervisors on the changes. The Electric Distributions Group follows provisions within the High Energy Equipment Management Plan to account for and effectively manage leaks of SF₆ associated with gaseous dielectric used in high voltage electric equipment.	Scope 1 & 2 GHG Emissions BNL will continue to pursue ongoing initiatives to reduce GHG emissions (e.g., hydropower, REC purchases, energy intensity reductions). Fugitives and Refrigerants BNL will conduct self-audits of its Refrigerant Management Plan in December and July to assess the effectiveness of the Refrigerant Management Plan, identify any deficiencies in the plan, and resolve them in a timely manner.
25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline	Overall Scope 3 GHG emissions are down 26.1% from FY 2016 (6,023 MtCO₂e), and 14.5% lower than the FY 2008 baseline value. In Sept, BNL proposed to the DOE SPO an alternative methodology of calculating GHG emissions from commuting. SPO responded that programming changes would be required to the DOE Sustainability Dashboard first. Commuting GHG emissions rose 12.6%, or 701 MtCO₂e,. Since 2008, GHG emissions from contracted waste are down 32%. GHG emissions from employees using their personal vehicles for business use have decreased 25.6% since FY08. GHG emissions from rental vehicles used for employee business travel rose by 11 MtCO₂e or 3.4% from the FY16 total, but are 2.3% lower than the FY08 total. Air travel GHG emissions rose by 54 MtCO₂e, a 1.5% increase from the FY16 total and 4.1% higher than the FY08 baseline.	BNL will continue to strive to reduce Scope 3 GHG emissions. The EPD will continue to work with BHSO to advocate for the SPO to update the Dashboard and enable BNL to use the alternative methodology for estimating commuting GHG emissions that was proposed in September. EPD and ITD will conduct a survey of recent Blue Jeans videoconference service users. EPD will reach out to HR to jointly explore how the resources and recommendations in the Sustainable Commuting US DOE National Laboratories Report & Toolkit can be used to engage employees and managers on the benefits of ride-sharing, telework, and alternative work schedules.

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CHAPTER 2: ENVIRONMENTAL MANAGEMENT SYSTEM

Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2017. *(continued).*

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 2: Sustainable Buildings		
25% energy intensity (Btu per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY 2025 from an FY 2015 baseline	BNL's energy intensity for FY17 was 226,029 Btu/gsf and was 7% lower than the new base year of 2015. Energy savings from UESC were verified for the second year and contributed to the lower energy intensity value. The Temperature Setback Policy is continually communicated to the Lab via several methods, including Earth Day events and presentations to FPMs, FCMs, and Lab management.	One of the biggest challenges for BNL will be to meet the new 25% energy intensity reduction goal by FY25. BNL has begun a UESC Phase II effort. If enough cost-effective projects can be identified for Phase II, BNL may be able to meet or make progress toward the new 25% reduction goal. BNL will continue to pursue an aggressive Temperature Setback Policy in FY18 and communicate its importance to the Lab population. BNL will continue all of the best practices currently in place, including HVAC setback, steam charge-back, and lighting upgrades.
EISA Section 432 energy and water evaluations	Energy audits of HVAC systems, lighting, and office equipment continued in FY17. They are being performed in conjunction with ongoing condition assessment surveys in order to reduce additional costs and administrative oversight needs. All information has been placed in EPA's Portfolio Manager Program for benchmarking.	BNL will continue with the cost effective Energy Survey/Facility Condition Assessment (FCA) approach in FY18 and beyond.
Meter all individual buildings for electricity, natural gas, steam and water, where cost effective and appropriate	BNL is meeting the metering goals for electricity, natural gas, and chilled water. During FY17, 12 advanced electric meters were installed; 3 advanced chilled water meters were replaced; 2 advanced steam meters were installed; and 2 existing advanced meters were connected to the building automation system.	Additional meters will be installed as opportunities become available.
At least 15% (by building count) of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the revised Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter	Currently 24% of non-excluded buildings have achieved 100% of the Guiding Principles and an additional 11% are at 90% or higher.	Projects currently in various stages of planning (such as the SUSC and the CFR major renovation of Building 725) will be designed to meet the Guiding Principles.
Efforts to increase regional and local planning coordination and involvement	Discovery Park Discussions continued with LIRR staff on the Discovery Park vision and funding was approved in the State budget. Deer Management FY17 Deer Management Plan was implemented, removing 202 deer. Pollinator Task Force The pollinator support plants at the LISF included 21 total species of wildflowers, mostly non-native, and hosted 19 butterfly species and 9 bee species.	Discovery Park Efforts toward the realization of Discovery Park will continue with support from local, regional, and federal stakeholders. BNL will continue to work closely with LIRR, Suffolk County, and the Town of Brookhaven to determine the best possible site for the relocation of the Yaphank Train Station. Deer Management Deer management strategy will be reassessed with NYSDEC and Lab management to find a cost alternative to the current culling program and determine the feasibility of an on-site hunt in FY18 to minimize herd to ~250 deer. Pollinator Task Force The Lab will continue to work to implement best management practices established by the Pollinator Task Force and continue pollinator-related research.

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Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2017. *(continued).*

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Net Zero Buildings: 1% of the site's existing buildings above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY 2025	Discussions continued with BHSO and DOE-HQ. BNL has the option of applying the output of the NSERC to make it net-zero. The determination will be made in concert with BHSO.	BNL will continue to engage the national lab community on techniques to economically meet the net zero requirements. Starting in 2020, where economically viable, BNL will ensure net-zero requirements are included in future designs.
Net Zero Buildings: All new buildings (>5,000 GSF) entering the planning process designed to achieve energy net-zero beginning in FY 2020	MPO hosted net-zero energy training in FY17. Based on the training, 3 future buildings will be evaluated for net-zero designation.	BNL will consider net-zero concepts in the preliminary design of the SUSC.
Goal 3: Clean & Renewable Energy		
"Clean Energy" requires that the percentage of an agency's total electric and thermal energy accounted for by renewable and alternative energy shall be not less than: 10% in FY 2016-2017, working towards 25% by FY 2025	BNL's "Clean Energy" requirement for 2017 was 53,990,000 kWh. BNL purchased 60,800,000 kWh of RECs for 2017 to meet the "Clean Energy" requirement.	BNL will continue to operate the NSERC facility and provide for expansion to a full MW when sufficient funds are identified. REC purchases will continue to meet the renewable energy and clean energy goals.
"Renewable Electric Energy" requires that renewable electric energy account for not less than 10% of a total agency electric consumption in FY16-17, working towards 30% of total agency electric consumption by FY 2025	BNL's "Renewable Energy" requirement for 2017 was 38,358,000 kWh. BNL purchased 60,800,000 kWh of RECs for 2017 to meet the "Clean Energy" requirement, thereby exceeding the "Renewable Energy" requirement. All of BNL's RECs have been and will continue to be purchased through a competitive solicitation process. In 2017, the Northeast Solar Energy Research Center (NSERC) facility produced 968,485 kWh on-site.	Renewable energy systems, especially solar hot water, will continue to be considered in all new construction projects and major building renovations (including the Science and User Support Center [SUSC]).
Goal 4: Water Use Efficiency and Management		
36% potable water intensity (Gal per gross square foot) reduction by FY 2025 from a FY 2007 baseline	Potable-water usage fell from 931 million gallons/year in FY 1999 (average of 2.55 million gallons per day) to about 407 million gallons/year in FY 2017 (average of 1.12 million gallons per day), a reduction of 56.3%.	BNL will continue to implement BNL's Water Management Plan.
30% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline		BNL will continue to utilize water-efficient processes and plumbing fixtures to conserve water in new construction buildings and renovations.
Goal 5: Fleet Management		
30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY 2025 from a FY 2014 baseline (2017 target: 4%)	For FY17, we achieved total GHG emissions of 422.37 gCO2e/mile. This represents a 47% reduction from our FY14 baseline. We achieved this by replacing older, less fuel-efficient gasoline vehicles with newer alternative fuel vehicles, most with E-85 capabilities.	BNL will continue to work with GSA to obtain the newest vehicles with alternative fuel capabilities wherever possible. Fleet management will work with GSA to ensure that plug-in hybrids and zero emissions vehicles replace at least 20% of new passenger vehicle acquisitions by FY 2020 and 50% by FY 2025. BNL intends to implement Telematics in Light Duty Vehicles on or before 2/1/18.

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Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2017. *(continued).*

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter		
10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter		
75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV)		
50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025		
Goal 6: Sustainable Acquisition		
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts	BNL has incorporated contract clauses within its vendor contracts that designate environmentally preferred products (EPP), services, and equipment. BNL completed implementation of its online purchasing system—the Vinimaya system (“E-Buy”). In 2017, BNL established EMS objectives to improve EPP purchasing performance for the Electronic Product Environmental Assessment Tool (EPEAT) electronics and office products. BNL also promoted the EPP program during this past year’s Earth Day activities.	During 2018, BNL will continue to work on the Commonly Ordered Items page, provide E-Buy training specific to EPP purchasing requirements, and provide feedback to the user community on EPP products. BNL will also write new EMS objectives to promote that program and drive improvement.
Goal 7: Pollution Prevention and Waste Reduction		
Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris	During FY17, BNL’s recycling rate (annual diversion rate for non-hazardous solid waste) was approximately 73%.	BNL’s waste diversion program is expected to remain intact in the future years and may grow with the addition of food waste composting pending the start-up of a commercial food waste composter in relatively close proximity to the Lab.
Divert at least 50% of construction and demolition materials and debris	BNL diverts 95%+ of its construction debris to an on-site borrow pit for future conversion to recycled concrete aggregate (RCA). In FY17, BNL brought a concrete crusher on-site and generated approximately 3,500 tons of RCA.	This practice will continue.

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Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2017. (continued).

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 8: Energy Performance Contracts		
Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of E.O. 13693	Internally funded energy conservation and sustainability-related initiatives include a continuation of various best practices, such as temperature setback and small lighting and water conservation projects. As a result of a budget constrained environment, BNL, like other DOE sites, has been increasingly using third-party financing options that utilize cost savings to pay for the projects. BNL completed its first UESC in 2015, which is performing well and meeting the original energy savings estimates. As a result, a second UESC project is being planned and will incorporate lessons learned from UESC Phase I. The manager of Energy Management at BNL is a Certified Energy Manager. All BNL Facility Complex Managers have the Certified Facility Manager recognition from the International Facilities Management Association.	BNL is in the process of developing a UESC Phase II project that will likely including various energy conservation measures, such as lighting, HVAC controls, solar preheating, energy (chilled water) storage, efficient boilers, and others. While it is not possible to estimate energy savings at this early stage, we anticipate savings to be equal to or greater than the recent UESC Phase I project.
Goal 9: Electronic Stewardship		
Purchases – 95% of eligible acquisitions each year are EPEAT-registered products	The contract governing the procurement of printers, laptops, and desktop computers ordered through the BNL E-Pro system requires that they have an EPEAT “Gold” certification.	The Laboratory will continue to require that all printers, laptops, and desktop computers ordered through the E-Pro system have an EPEAT “Gold” certification.
Power management – 100% of eligible PCs, laptops, and monitors have power management enabled	All systems in the BNL domain that are capable of power management have the setting enabled.	BNL will continue to evaluate the feasibility of extending the desktop computer power management policy to other operating systems.
Automatic duplexing – 100% of eligible computers and imaging equipment have automatic duplexing enabled	The majority of printers and copiers are not centrally managed. BNL has published Managed Printing guidelines, which recommend the use of network/department-wide printers configured for black ink only and duplex printing.	BNL will continue to communicate the importance and benefits of duplex printing.
End of Life – 100% of used electronics are reused or recycled using environmentally sound disposition options each year	BNL disposed of approximately 21 tons of electronic equipment through an R2 certified recycler during 2017.	BNL will continue to evaluate methods of increasing computer useful life and will continue to dispose of electronic waste in an environmentally sound manner through a certified R2 recycler.
Data Center Efficiency. Establish a power usage effectiveness target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers	BNL completed an evaluation of our existing data centers in response to the Data Center Optimization Initiative (DCOI) from the summer of 2016. Our internal assessment identified 8 data centers that meet the new DCOI criteria. Additional resources will be needed to meet the goal of PUE < 1.5. The Core Facility Revitalization (CFR) project is being designed to renovate Building 725. This project includes repurposing a significant portion of the building for use as a new computing facility with associated support space and new infrastructure.	Meeting the PUE of 1.5 for the existing data centers will require a significant investment. Further, 4 of the 8 existing data centers will require the installation of new metering to determine their actual PUE. The data center associated with the CFR project is in the design phase and is targeting a PUE of < 1.3 in accordance with the recent DCOI. The CFR project has received CD-1 approval and could start construction in FY19.

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Table 2-1. BNL Site Sustainability Plan: Status Summary for Fiscal Year 2017. (concluded).

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 10: Climate Change Resilience		
Update policies to incentivize planning for, and addressing the impacts of climate change	Emergency Response and Local/Regional Coordination During FY17, the BNL OEM revised and edited all emergency management plans and procedures to meet the requirements of the new DOE O151.1D. During major weather events, OEM participates on the National Weather Service regional severe weather calls. BNL is also part of Suffolk County's Comprehensive Emergency Plan. Risk/Vulnerability Assessment During implementation of DOE O 151.1D, OEM changed the BNL Hazards Survey to an All-Hazards Survey for effects of severe weather phenomenon on the BNL site. BNL OEM has also developed a THIRA program that meets the DOE requirement for extreme events and includes severe weather phenomenon. Workforce Protocols The Lab's Flexible Work Arrangements policy provides many options for employees to manage their work schedules during times of severe weather events and potentially limit commuting on-site. In January 2017, HR launched its new Recognition and Reward Program, which includes additional non-cash mechanisms for recognizing staff members who exhibit the Lab Values, including the value of Environmental Stewardship. Climate-Resilient Design of New or Newly Retrofitted Buildings BNL does not currently have design guidelines specifically for climate-resilient design. However, as a retrofit projects are designed using higher and lower temperatures than required by ASHRAE as a means of incorporating forward-looking climate data into the design of our capital improvement projects.	Emergency Response and Local/Regional Coordination All OEM plans and procedures will continue to be reviewed and updated as required by DOE O151.1D. Additionally, OEM will continue to engage with local and regional partners in information-sharing and coordination activities regarding emergency management and response. Workforce Protocols BNL will continue to evaluate its workforce policies and programs in light of our understanding of climate change and its projected impact on human health and safety. Climate-Resilient Design of New or Newly Retrofitted Buildings BNL will evaluate the applicability of the draft Climate Resiliency Design Guidelines developed by NYC's Office of Recovery and Resiliency, and plans to utilize them on Laboratory projects once finalized.
Update emergency response procedures and protocols to account for projected climate change, including extreme weather events		
Ensure workforce protocols and policies reflect projected human health and safety impacts of climate change		
Ensure site/lab management demonstrate commitment to adaptation efforts through internal communications and policies		
Ensure that site/lab climate adaptation and resilience policies and programs reflect best available current climate change science, updated as necessary		

Contingency Plan that defines an orderly process for quickly verifying the results and taking corrective actions in response to unexpected monitoring results (BNL 2013c). Key elements of the groundwater program are full, timely disclosure of any off-normal occurrences, and regular communication on the performance of the program. Chapter 7 and SER Volume II, Groundwater Status Report, provide additional details about this program, its performance, and monitoring results for 2017.

2.3.4.3 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 office wastes (e.g., paper, plastic, etc.), aerosol cans, batteries, paints, and oils. However, 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 (i.e., mixed waste is hazardous waste that is also radioactive). BNL's Waste Management Facility (WMF), operated by the Environmental Protection Division (EPD), is responsible for collecting, storing, transporting, and managing the disposal of these specialized wastes. This modern facility was designed for handling hazardous, industrial,

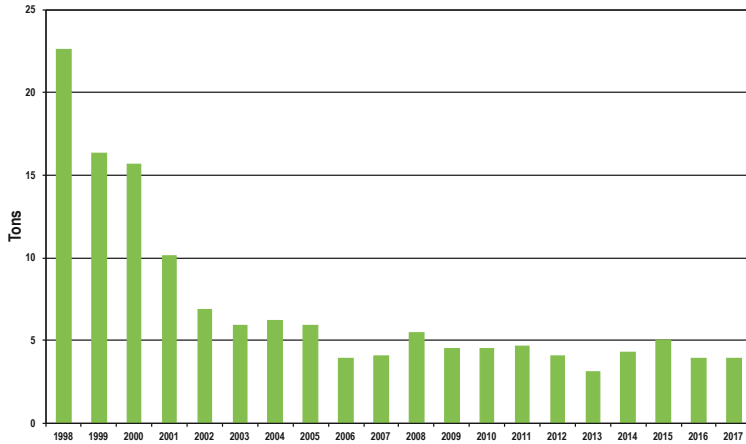


Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1998 – 2017.

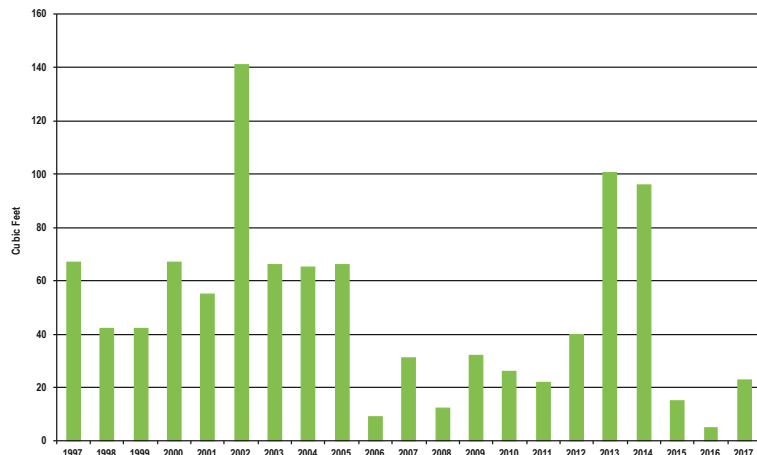


Figure 2-1b. Mixed Waste Generation from Routine Operations, 1998 – 2017.

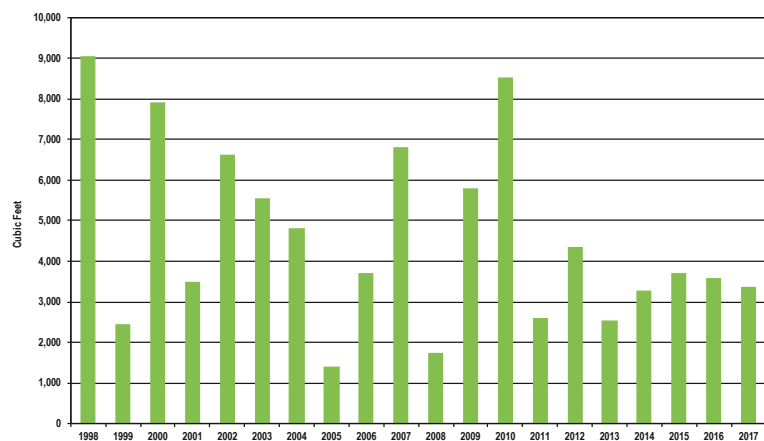


Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1998 – 2017.

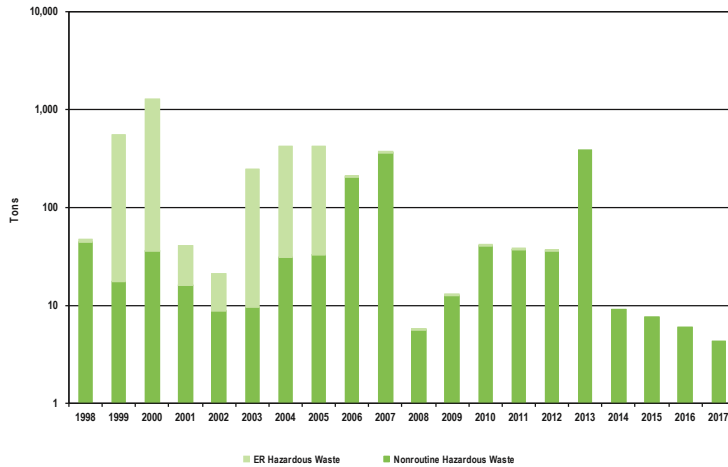


Figure 2-1d. Hazardous Waste Generation from ER and Nonroutine Operations, 1998 – 2017.

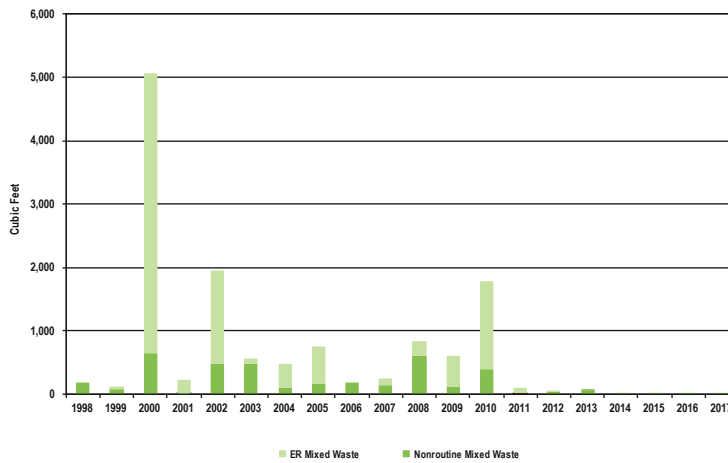


Figure 2-1e. Mixed Waste Generation from ER and Nonroutine Operations, 1998 – 2017.

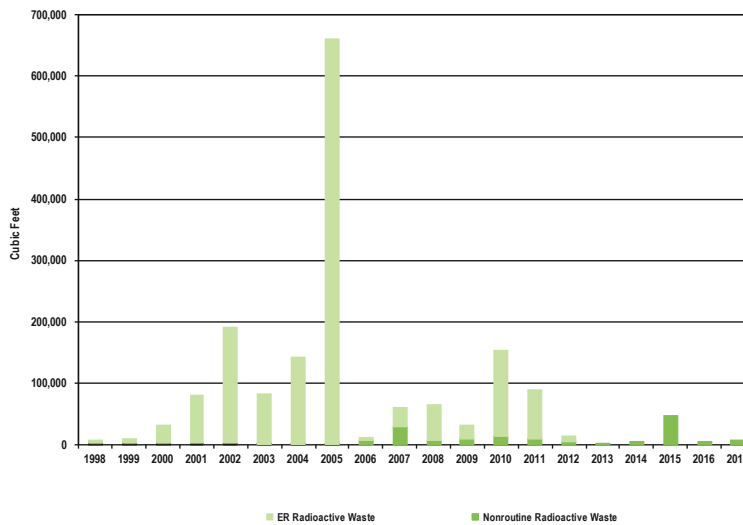


Figure 2-1f. Radioactive Waste Generation from ER and Nonroutine Operations, 1998 – 2017.

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. In 2017, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 3.9 tons
- Mixed waste: 23 ft³
- Radioactive waste: 3,345 ft³

Hazardous waste from routine operations in 2017 stayed consistent from 2016 generation rates, as shown in Figure 2-1a, based on stable generating activities over the year as compared to the year before. Mixed waste generation increased from 2016 rates, as shown in Figure 2-1b. The change is due to fluctuations in operations at BNL's accelerator facilities. As shown in Figure 2-1c, the radioactive waste quantity for routine operations decreased slightly from the year before. Routine operations are defined as ongoing industrial and experimental operations. Wastes generated by remediation projects, facility decommissioning activities, or one-time events (e.g., lab

cleanouts) are considered non-routine.

BNL's inventory of legacy waste has been significantly reduced over the years. Small quantities of legacy waste were associated with small-scale facility cleanouts, such as the partial cleanout of Building 820 and the demolition of the Biology green houses and the Fleming House. Figures 2-1d through 2-1f show waste generated from non-routine operations. Waste generation from these activities has varied significantly from year to year. This is expected, as various decommissioning and remedial actions are conducted.

2.3.4.4 *Pollution Prevention and Waste Minimization*

The BNL Pollution Prevention (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.

Pollution prevention and waste reduction goals have been incorporated into the DOE contract with BSA, into BNL's ESSH Policy, the PEMP associated with the Laboratory's operating contract with DOE, and BNL's SSP. Key elements of the P2 Program include:

- Eliminate or reduce emissions, effluents, and waste at the source where possible, as practicable;
- Procure environmentally preferable products (known as "affirmative procurement");
- Conserve natural resources and energy;
- 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;
- Implement P2 projects;
- Improve employee and community awareness of P2 goals, plans, and progress.

The BNL P2 and recycling programs have achieved reductions in waste generated by routine operations, as shown in Figures 2-1a through 2-1c.

This continues a positive trend, and is further evidence that pollution prevention planning is well integrated into the Laboratory's work planning process. These positive trends are also driven by the EMS emphasis on preventing pollution and establishing objectives and targets to reduce environmental impacts. Table 2-2 describes the P2 projects implemented through 2017, and provides the number of pounds of materials reduced, reused, or recycled, as well as the estimated cost benefit of each project.

The implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has reduced both waste volumes and management costs. In 2017, these efforts resulted in nearly \$3.5 million in cost avoidance or savings and approximately 9.3 million pounds of materials being reduced, recycled, or reused annually.

The Laboratory has an active and successful solid waste recycling program, which involves all employees. In 2017, BNL collected approximately 621 tons of scrap metal for recycling. Cardboard, office paper, bottles and cans, construction debris, motor oil, lead, automotive batteries, electronic scrap, fluorescent light bulbs, and drill press/machining coolant were also recycled. Table 2-3 shows the total number of tons (or units) of the materials recycled. The baseline recycling rate goal for federal facilities is 50 percent; since 2000, BNL's annual average recycling rate has consistently ranged above this baseline. The 2017 annual recycling rate equaled the previous year at 74 percent.

During 2017, BNL's sustainability program was honored by receiving two Environmental Awards:

- US DOE's Gold Level Green Buy Award for voluntarily purchasing "greener products" that reduce environmental impacts. This award acknowledges the efforts of Laboratory Divisions (such as Staff Services, Grounds, Custodial Services, and the Modernization Project Office) that make sustainable product purchasing decisions.
- The Green Electronics Council's EPEAT (Electronic Product Environmental Assessment Tool) Award for purchasing EPEAT-registered electronic products which meet

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2016	Waste Type	Potential Costs for Treatment and Disposal	Revenue/(Cost) of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Building 452 Oil Skimmer	Source Reduction	3,000	Industrial Waste	\$1,030	\$0	\$1,030	Reduces oily-water waste stream (non-halogenated oil) from air compressors by skimming off oil and leaves water phase. Water may be discharged to sanitary system. Resulting oil sent to vendor for reprocessing/reuse at no cost for 2017.
Electronic Reuse	Reuse	38,000	Electronic Waste	\$2,978,000	(\$15,200)	\$2,962,800	The Laboratory tracks electronic equipment and takes a reuse credit for transfer of equipment to another user. Savings is based on the cost to purchase a new version of the item minus the scrap value of that item.
Building Demolition Recycling	Recycling	N/A	Industrial Waste	\$0	\$0	\$0	On-site demolition products (steel and concrete) are segregated, recycled, and reused. Materials collected during 2017 (Biology Greenhouses, B180 Fleming House, B820 Cleanout) were not tracked separately this year, but are captured in other recycling streams in this table.
Animal Bedding Conveying System	Composting	4,600	Medical Waste	\$1,192	\$0	\$1,192	Animal bedding material is conveyed to a dumpster that is emptied and composted at the stump dump. Savings is calculated on the assumption that otherwise, the material would be disposed on as Regulated Medical Waste.
Lead Acid Batteries	Recycled	1,280	Universal Waste	\$346	\$0	\$346	Avoids universal waste disposal costs for lead and sulfuric acid batteries.
Blasocut Machining Coolant	Recycled/ Reused	15,502	Industrial Waste	\$56,256	\$0	\$56,256	Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it Laboratory-wide. In 2017, 1,950 gallons (15,502 lb) of Blasocut lubricant were recycled. Recycling involves aeration, centrifuge, and filtration. This avoids cost of disposal as industrial waste and an avoided cost of buying 35 drums of concentrate (\$1315/drum) and empty drums for shipping (\$95/drum).
Fluorescent Bulbs	Recycled	5,000	Universal Waste	\$5,650	(\$2,748)	\$2,902	Fluorescent bulbs are collected as sent to a recycling facility under the Universal Waste exemption rule. Savings is in comparison to cost to dispose of them as hazardous waste.

(continued on next page)

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2016	Waste Type	Potential Costs for Treatment and Disposal	Revenue/(Cost) of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Used Motor Oil	Energy Recovery	18,792	Industrial Waste	\$6,755	\$0	\$6,755	Used motor oil from the motor pool and the on-site gas station is given to Strebels Laundry Service to fire their boilers. In 2017, they collected 2,610 gallons (18,792 lbs) of oil at no charge to BNL, which avoided the costs for disposal and 53 shipping drums (\$95/drum).
Office Paper	Recycled	168,000	Regular Trash	\$8,820	\$2,100	\$10,920	Cost avoidance based on \$105/ton for disposal as trash, plus \$25/ton revenue.
Cardboard	Recycled	148,000	Regular Trash	\$7,770	\$2,220	\$9,990	Cost avoidance based on \$105/ton for disposal as trash, plus \$30/ton revenue.
Electronic Waste	Recycled	46,200	Electronic Waste	\$2,426	\$23,408	\$25,834	Cost avoidance based on \$105/ton for disposal as trash, plus \$23,408 revenue.
Metals	Recycled	1,242,000	Industrial Waste	\$65,205	\$95,597	\$139,725	Cost avoidance based on \$105/ton for disposal as trash, plus \$95,597 revenue.
Bottles/Cans	Recycled	15,800	Industrial Waste	\$830	\$0	\$830	Cost avoidance based on \$105/ton for disposal as trash.
Construction Debris - Concrete	Recycled	7,000,000	C&D Debris	\$201,250	\$0	\$201,250	Concrete crushed and reused onsite. Cost avoidance based on \$57.5/ton cost to dispose as C&D debris.
Construction Debris - Other	Recycled	512,000	C&D Debris	\$26,880	(\$14,720)	\$12,160	Cost avoidance based on \$105/ton for disposal as trash vrs \$57.5/ton to dispose as C&D debris.
Food Waste	Reused	7,800	Regular Trash	\$410	\$0	\$410	Roughly 30 lbs of food waste per day is diverted to the STP for use as organic feedstock for the plant. Savings is based on cost to dispose of as trash.
Tires	Recycled	11,095	Regular Trash	\$582	\$0	\$582	Truck tires sent for recycling from the motor pool. Cost savings is based on cost to dispose of as trash.
Garnet	Recycled	41,000	Industrial Waste	\$46,330	(\$2,000)	\$44,330	Garnet used in machine shop sent for recycling. Cost savings is based on cost to dispose of as Regulated Industrial Waste.
TOTALS		9,278,069		3,409,730	88,657	3,477,311	

Table 2-3. BNL Recycled Program Summary, 2000-2017.

Recycled Waste *	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Mixed paper	336	246	209	182	185	193	184	177	151	127	174	186	142	160	150	91	89	84
Cardboard	132	127	157	176	179	143	135	121	147	152	141	126	100	97	78	12.4	73	74
Bottles/Cans	19.5	29.3	19	23	22	22.1	27.7	24.4	19.6	23.7	24	22.5	18	16.5	17.1	22.1	11	7.9
Tires	0		3.5	12.3	11	12.8	32.5	19.9	34.5	15.5	10.1	9.2	10	7.1	7.6	5.4	6.4	5.5
Construction debris	243	289	304	334	367	350	297	287	302	312	416	256	380	304	351	372	266	256
Used motor oil (gallons)	3,296	3,335	1,920	3,920	3,860	4,590	2,780	2,020	1,500	1,568	1,700	1,145	1,585	1,550	2,000	1,320	2,730	2,610
Metals	534	44	48	193	128	559	158	382	460	91	131	84	278	174	256	737	426	621
Automotive batteries	2.2	4.8	6.3	4.6	5	4.6	5.5	2.5	2.7	4	1.6	2.1	2	2.1	1.4	1.9	1.4	0.6
Printer/Toner cartridges (units)	n/a	363	449	187	105	0	0	0	3,078	1,251	4,132	4,186	4,100	11,233	2,174	2,037	n/a	977
Fluorescent bulbs (units)	5,874	17,112	25,067	13,611	12,592	7,930	11,740	25,448	36,741	10,223	8,839	20,220	15,727	13,540	19,807	15,956	9,604	4,294
Blascoat coolant (gallons)	n/a	n/a	8,180	5,030	6,450	3,890	3,970	2,432	3,340	3,810	4,830	5,660	5,610	5,650	4,850	2,550	2,350	1,950
Tritium exit signs (each)	n/a	n/a	28	181	142	0	0	0	0	0	0	18	0	0	0	0	0	0
Smoke detectors (each)	n/a	n/a	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electronic reuse	n/a	n/a	0	0	0	0	0	0	16.3	11.4	12	11.6	3.2	1.4	10.5	25	17	19
Scrap electronics	n/a	n/a	0	0	0	6.1	70.3	40.5	48.9	17	16.7	19.9	30.9	23	29.3	42	24	23.1
Animal Bedding (composted)	n/a	n/a	0	0	0	0	6.3	19.6	42	41	52	54	3.3	30	10	15	11	2.3
Garnet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.5
Recycling Rate (%)	65	54	57	60	61	63	62	64	68	59	63	59	63	76	58	77	74	74
Demolition Projects																		
Metals	n/a	n/a	8	23	11	6	35	0	0	0	0	0	60	90	0	0	0	0
Concrete	n/a	n/a	891	590	3,000	328	5,505	6,175	0	0	4,050	0	4,050	3,500	4,000	0	4,200	3,500
Construction and debris	n/a	n/a	790	388	1,200	157	818	0	0	0	0	0	0	0	0	0	0	0

Notes: All units are tons, except where noted.

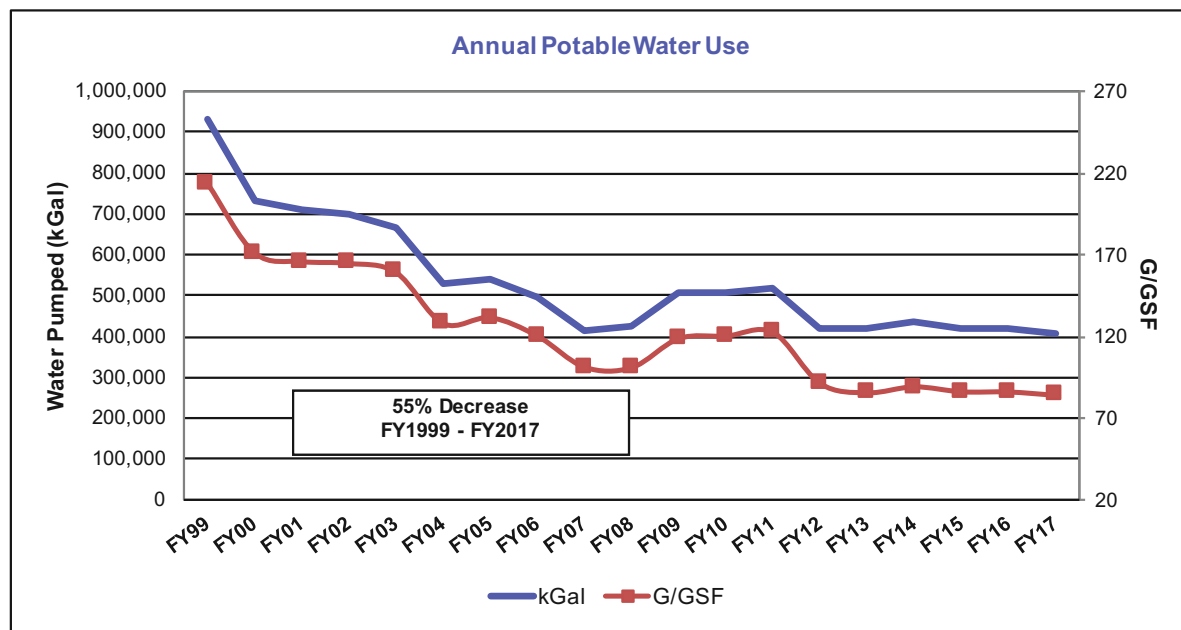


Figure 2-2. Annual Potable Water Use, 1999-2017.

strict environmental criteria that address the full product lifecycle, from energy conservation to toxic materials to product longevity and end-of-life management.

2.3.4.5 Water Conservation

BNL's water conservation program has achieved dramatic reductions in water use since the mid-1990's. 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 and reuse of once-through cooling water for other systems, such as cooling towers. Treated effluent (i.e., water that is near drinking quality) from BNL's Sewage Treatment Plant (STP) is recharged (or recycled) back to the aquifer, returning well over 100 million gallons per year. Through an annual maintenance program, conventional plumbing fixtures are replaced with modern low-flow devices.

The Laboratory's goal is to reduce the consumption of water and reduce the possible impact of clean water dilution on STP operations. Figure 2-2 shows the 18-year trend of water consumption. Total water consumption in 2017 was down slightly from 2016. The water

intensity (gallon/square foot) also continues to decrease. In each of the past ten years, the water consumption total was approximately half the 1999 total—a reduction of nearly a half billion gallons per year.

2.3.4.6 Energy Management and Conservation

Since 1979, the Laboratory's Energy Management Group has been working 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 and assisting DOE in meeting the energy and sustainability goals in EO 13693, DOE Order 436.1, and the Secretary's initiatives. The Laboratory's SSP addresses all aspects of the DOE energy, water, transportation, and other sustainability goals.

BNL has more than 4.9 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 2017, BNL used approximately 270 million kilowatt hours (kWh) of electricity, 105,000 gallons of fuel oil, 14,591 gallons of propane,

and 565 million cft of natural gas. Fuel oil and natural gas produce steam at the Central Steam Facility (CSF). Responding to market conditions, fuel oil and natural gas have been historically used whenever each respective fuel is least expensive. In 2017, natural gas prices were lower than fuel oil prices for most of the year. As a result, natural gas was used to meet 98.3 percent of the heating and cooling needs of the Laboratory's major facilities. Given the price disparity between natural gas and oil, the Laboratory will continue to purchase natural gas over oil, further reducing GHG emissions. Additional information on natural gas and fuel oil use can be found in Chapter 4.

BNL continues to participate in available electric load reduction curtailment programs. Through this program, the Laboratory has agreed to reduce electrical demand during critical days throughout the summer when New York Independent System Operator expects customer demand to meet or exceed the available supply. In return, BNL sometimes receives a rebate for each megawatt reduced on each curtailment day. The Laboratory strives to keep electric loads at a minimum during the summer by scheduling operations at the Relativistic Heavy Ion Collider to avoid peak demand periods. In 2017, this scheduling reduced the electric demand by 25 MW, saving approximately \$1.0 million in electric demand costs and helping to maintain the reliability of the Long Island Power Authority (LIPA) electric system to meet all of its users' needs. BNL also maintains a contract with the New York Power Authority (NYPA) that resulted in an overall cost avoidance of \$27.4 million in 2017. In addition, BNL's energy supply includes approximately 120 million kWh of clean, renewable energy credits (RECs) received through the Long Island Solar Farm (LISF) and purchased 61 million kWh of RECs for 2017. The Laboratory will continue to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs.

In 2011, BP Solar completed construction of the LISF on BNL property. The array is currently the largest solar photovoltaic (PV) array (32 MW) in the Northeast and spans 195 acres with more than 164,000 panels. BNL worked

extensively with LIPA, BP Solar, the State of New York, and other organizations to evaluate the site and develop the project with LIPA purchasing the output through a 20-year Power Purchase Contract. The annual output for 2017 was 49.64 million kWh and resulted in an avoidance of approximately 32,100 tons of carbon. At the time of the installation the estimated annual output was 44 million kWh. The actual output for the first six operational years was an average of 51.1 million kWh/year, substantially above the estimated annual average value. As an outcome of constructing this large array on site, the Laboratory has developed a solar research program that looks at impacts of climate change on large utility-scale PV systems, as well as research and development for solar power storage and inverter efficiencies. The Federal Energy Management Program recognizes the importance of the efforts of BNL and the DOE Brookhaven Site Office to host the LISF, and provides credit toward BNL's SSP renewable energy goal.

In May 2014, the Laboratory completed the installation of the first phase of the solar PV research array as part of the Northeast Solar Energy Research Center (NSERC). In 2016, the array was increased to 816 kW with substantial funding assistance from the Sustainability Performance Office (SPO). In 2017, the NSERC generated 968,445 kWh of electricity. To reduce energy use and costs at non-research facilities, several additional activities were continued or undertaken by the BNL Energy Management Group in 2017:

- *NYPA Power Contract:* Fifth full year of a 10-year contract that includes 15 MW of renewable (nearly zero GHG) hydropower. This contract saved \$27.4 million in 2017.
- *DOE Sustainability Initiative:* The Energy Management Group continues to provide substantial support to the Federal/DOE-wide Sustainability Initiative and has created a BNL Sustainability Leadership Team. The team has developed a formal site-wide sustainability program beyond DOE requirements, participates in one of three subcommittees for DOE on sustainability initiatives, and provides numerous evaluations and

estimates on energy use, GHG, renewable energy, and energy-efficiency options.

- *Substantial Progress on several initiatives included in BNL's annual SSP:* New electric and steam meter installations; funding for energy conservation initiatives; new energy-efficient lighting installed in parking lots and offices; the purchase of RECs in meeting BNL's SSP goal; and training various parties on energy conservation initiatives.
- *Utility Energy Services Contract (UESC):* A UESC contract/project was completed in 2015 with National Grid that installed energy-efficient lighting, new building controls, and an energy-efficient water chiller. The environmental benefits of this UESC were estimated to include: electrical savings of 3,549,114 kWh/year, fuel savings of 89,541 mmBtu/year, a GHG reduction of 7,022 MT-CO₂e, and a building energy intensity reduction of 11 percent. To date, actual energy savings meet or exceed the original estimates. Through a comprehensive Measurement and Verification process, BNL has been able to verify that actual energy savings were within a few percent of the original projections for the first two years of operation.
- *Energy Conservation:* Energy and water evaluations are completed for 25 percent of the site each year. Cost-effective projects are identified and proposed for funding, as appropriate.
- *High Performance Sustainability Buildings (HPSB):* Substantial completion of various energy and water conservation projects to achieve compliance in the EPA Portfolio Manager program. BNL is currently on target to meet or exceed the HPSB goal.
- *Renewable Energy:* Continued project support for the LISF and NSERC facilities and annual purchases of REC's to meet targeted goals.
- The Central Chilled Water Facility 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 approximately \$4 million per year using natural gas compared to oil.

- *Energy Savings:* As mentioned above, 25 MW of demand is rescheduled each year to avoid coinciding with the utility summer peak, saving over \$1.0 million in electricity charges. In addition, work continues in the replacement of aging, inefficient T-40 fluorescent lighting fixtures with new, high efficiency T-8 lighting fixtures or LED 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. Due to continued conservation efforts, overall facilities energy usage for 2017 was approximately 30 percent less than in 2003, producing annual savings of \$2.9 million.

The National Energy Conservation Policy Act, as amended by the Federal Energy Management Improvement Act of 1988 and the Energy Policy Acts of 1992 and 2005, as well as the Energy Independence and Security Act of 2007, requires federal agencies to apply energy conservation measures and to improve federal building design to reduce energy consumption per square foot (Energy Intensity). Current goals included with EO 13693 are to reduce energy consumption per square foot, relative to 2015, by 25 percent by the year 2025. As shown in Figure 2-3, BNL's energy use per square foot in 2017 was 30 percent less than in FY 2003. Going forward BNL will be comparing the current Energy Intensity values to the new base year of 2015. It is important to note that energy use for most buildings and facilities at the Laboratory is largely weather dependent.

2.3.4.7 Natural and Cultural Resource Management Programs

Through its Natural Resource Management Plan (BNL 2016), BNL continues to enhance its Natural Resource Management Program in cooperation with the Foundation for Ecological Research in the Northeast 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 2013a) was developed to identify and manage properties that are determined to be eligible or potentially

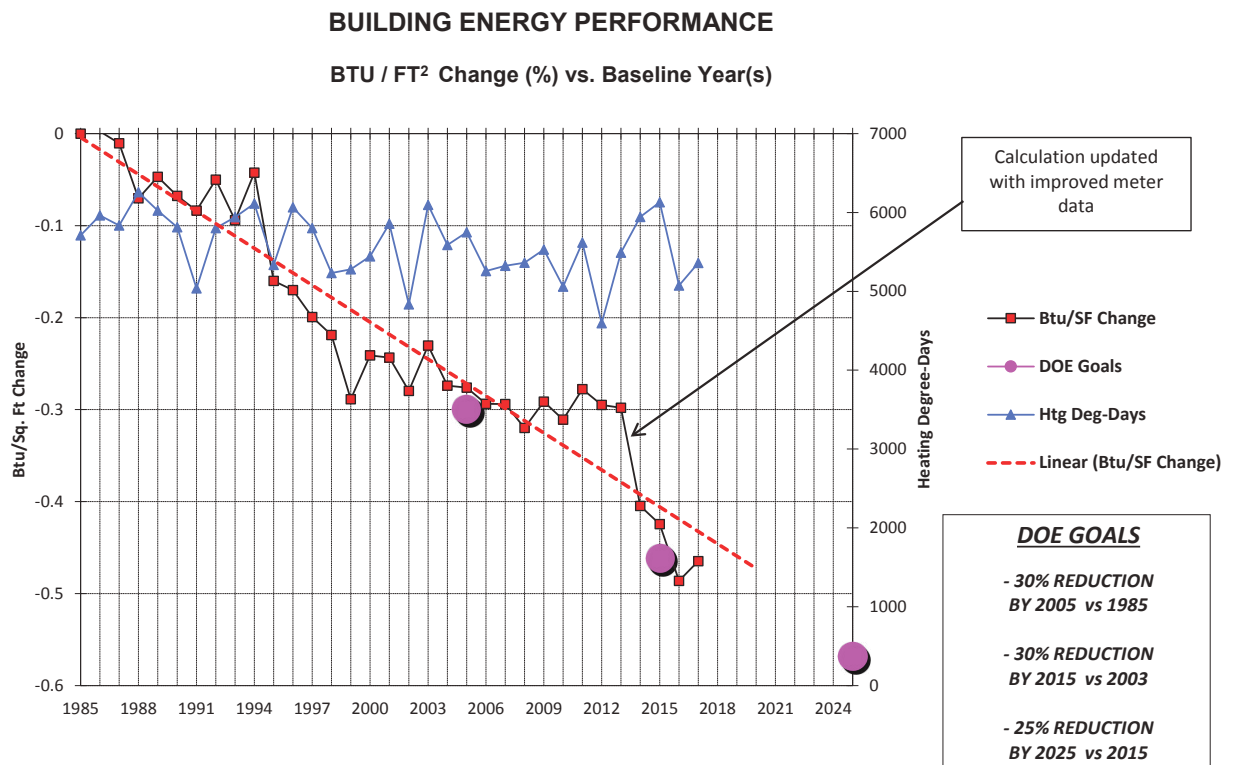


Figure 2-3. BNL Building Energy Performance for 2017 (Btu/SF Change Percent vs. Baseline Years).

eligible for inclusion on the National Register of Historic Places. See Chapter 6 for further information about these programs.

2.3.4.8 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, EPA established the National Priorities List, which identifies sites where cleanup 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 Inter-agency Agreement (IAG). This agreement was formalized in 1992. Although not a formal signatory of the IAG, the Suffolk County Department of Health Services (SCDHS) also plays a key role 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 process, which includes the following steps:

- Conduct a remedial investigation to characterize the nature and extent of contamination and assess the associated risks;
- Prepare a feasibility study and proposed plan to identify and evaluate remedial action alternatives and present the proposed alternative;
- Issue a Record of Decision (ROD), which is the remedy/corrective action agreed to by DOE, EPA, and NYSDEC;
- Perform the Remedial Design/Remedial Action, which includes final design, construction specifications, and carrying out the remedy selected.

In 2017, BNL's 11 active groundwater treatment systems removed approximately 71

pounds of volatile organic compounds (VOCs) and 0.5 mCi of strontium-90 (Sr-90) and returned 0.5 billion gallons of treated water to the sole source aquifer. Following the update of the groundwater model with VOC characterization data collected since 2016, additional groundwater extraction wells will need to be installed to ensure that the cleanup goals for the Western South Boundary plume are met. Design of the additional extraction wells was initiated in 2017. As a follow-up to the January 2017 sampling of 22 on and off-site monitoring wells for the solvent stabilizing compound 1,4-Dioxane, SCDHS requested additional samples be

collected. Samples from seven additional monitoring wells, the effluent from five treatment systems and the STP effluent were collected by BNL and analyzed for 1,4-Dioxane in December 2017 and January 2018. All 1,4-Dioxane results were below the current New York State standard of 50 µg/L for unspecified organic contaminants.

In the summer of 2017, the excavation and disposal of 108 cubic yards of mercury-contaminated sediment in a small area of the Peconic River on BNL property were performed. Also in 2017, long-term surveillance and maintenance of the Brookhaven Graphite Research Reactor

Table 2-4. Summary of BNL 2017 Environmental Restoration Activities.

Project	Description	Environmental Restoration Actions
Soil Projects	Operable Unit (OU) I/II/III/VII	Performed monitoring and maintenance of institutional controls for cleanup areas.
Groundwater Projects	OU III/V/VI	- Continued operation of nine groundwater treatment systems that remove volatile organic compounds (VOCs), and two systems that remove strontium-90 (Sr-90). 71 pounds of VOCs and 0.5 mCi of Sr-90 were removed during the treatment of 0.95 billion gallons of groundwater. Since the first groundwater treatment system started operating in December 1996, approximately 7,526 pounds of VOCs and 33 mCi of Sr-90 have been removed, while treating approximately 27 billion gallons of groundwater. - Collected and analyzed approximately 1,299 sets of groundwater samples from 553 monitoring wells. - Installed 14 temporary wells and collected multiple samples from each location.
Peconic River	OU V	Excavation and disposal of 108 cubic yards of mercury-contaminated sediment in a small area on BNL property was completed in the summer of 2017.
Reactors	Brookhaven Graphite Research Reactor (BGRR)	Continued long-term surveillance and maintenance, including repair to the roof drain and flashing on the below ground duct doghouses, repositioning the cap vehicle weight restriction signs.
	High Flux Beam Reactor (HFBR)	Continued long-term surveillance and maintenance, including repair to the outside roof drain, and removal of a small tree against the foundation.
	Stack (Building 705)	Continued long-term surveillance and maintenance, including pump-out of the stack drain tank, collection and disposal of stack paint chips on the grounds, and repair of the aviation lights on the stack.
	Brookhaven Medical Research Reactor (BMRR)	Continued surveillance and maintenance activities.
Former Buildings 810/811	Former Radiological Liquid Processing Facility	Continued surveillance and maintenance, and maintained institutional controls of the remaining area of contaminated soil to the north of the former facility.
Building 801	Inactive Radiological Liquid Holdup Facility	Performed routine surveillance and maintenance of the facility.
Building 650	Inactive Radiological Decon Facility	Performed routine surveillance and maintenance of the facility.

and the High Flux Beam Reactor (HFBR) continued. In accordance with the ROD, demolition of the HFBR stack will be completed by the end of fiscal year 2020. The groundwater systems operate in accordance with the Operations and Maintenance manuals, while the Peconic and surface soil cleanup areas are monitored via the Soil and Peconic River Surveillance and Maintenance Plan (BNL 2013c). Institutional controls are 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 is submitted to the regulators.

Table 2-4 provides a description of each Operable Unit, and a summary of environmental restoration actions taken. See Chapter 7 and SER Volume II, Groundwater Status Report, for further details.

2.4 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT SYSTEM

2.4.1 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 (R2A2). 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. The Environmental Compliance Representative Program, initiated in 1998, is an effective means of integrating environmental planning and pollution prevention 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.

2.4.2 Communication and Community Involvement

In support of BNL's commitment to open communication and community involvement, the External Affairs & Stakeholder Relations (EASR) Office develops best-in-class communications, science education, government relations, and community involvement programs that advance the science and science education missions of the Laboratory. EASR contributes to the public's understanding of science, enhances the value of the Laboratory as a community asset, and ensures that internal and external stakeholders are properly informed and have a voice in decisions of interest and importance to them. EASR 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 stewardship and restoration activities, and to incorporate community input into BNL's decision-making process.

To facilitate stakeholder input, EASR's Stakeholder Relations Office participates in or conducts on- and off-site meetings which include discussions, presentations, roundtables, and workshops. Stakeholder Relations staff attend local civic association meetings, canvass surrounding neighborhoods, conduct Laboratory tours, and coordinate informal information sessions and formal public meetings, which are held during public comment periods for environmental projects.

BNL's Internal 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 EASR's Office of Educational Programs 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 12, the Science Learning Center, internships, contests in science, technology, engineering, or math, and postdoctoral programs.

2.4.2.1 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 Brookhaven Executive Roundtable (BER), established in 1997 by DOE's Brookhaven Site Office, meets routinely to update local, state, and federal elected officials and their staff, regulators, and other government agencies on environmental and operational issues, as well as scientific discoveries and initiatives.
- The Community Advisory Council (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 27 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 typically meets monthly, except for July and August. 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 and 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 Interagency Agreement 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, university, professional, and community 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 may include sustainability and environmental stewardship issues. Tours were provided for more than 2,125 visitors in 2017.
 - *Summer Sundays*: Held on four Sundays each summer, these open houses enable the public to visit BNL science facilities, experience hands-on activities, and learn about research projects and environmental stewardship programs. In 2017, more than 5,000 visitors participated in the program.
 - *PubSci*: BNL's science café and conversation series features distinguished Laboratory scientists who appear at public venues to discuss cutting-edge topics and research in an informal setting. During 2017, science-interested community members and BNL and Stony Brook University researchers discussed "Dark Matter, Dark Energy."
 - *Science on Screen*: This partnership program with the Huntington Cinema Arts Centre presents classic, cult, or documentary movies that provide BNL scientists an opportunity to discuss their research. In 2017, the Centre featured a showing of "Still Alice," a 2014 American independent film based on the true story of a linguistics professor diagnosed with Alzheimer's disease; BNL and Stony Brook University researchers highlighted research on Alzheimer's disease at BNL's National Synchrotron Light Source-II.

The Laboratory also participates in and hosts various outreach events throughout the year such as festivals, workshops, BNL's Earth Day celebration, the World Science Festival, the City of Science, and the Port Jefferson Mini-Maker Faire. Brown bag lunch meetings for employees are held periodically and cover topics of interest, including project updates, newly proposed initiatives, wildlife management concerns, and employee benefits information.

BNL's Media & Communications Office issues press releases to news and media outlets and the Internal Communications Office publishes electronic and printed weekly employee newsletters—*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 administrative 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 ask questions or comments by clicking on the "Let us know" link found under "Listening to you" on the Stakeholder Relations website at www.bnl.gov/stakeholder/. Community members can also 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.

2.4.2.2 Community Involvement in Cleanup Projects

In 2017, BNL updated stakeholders on the progress of environmental cleanup projects, additional initiatives, and health and safety issues via mailings, briefings, and presentations given at CAC and BER meetings.

These topics included the following:

- *Natural & Cultural Resources Update:* The CAC received updates on BNL's natural resources, including the following: status of flora and fauna on-site; specifics about the Peconic River post cleanup surveillance; Cesium 137 in deer, terrestrial vegetation and soil; and mercury in precipitation. The group was also informed of the implementation of the Lab's cultural resources tagging project; the Annual Groundwater Update; the general status of Plumes and Remediation Systems/

System Optimization; Building 452 freon-11 and g-2 tritium plume status; current groundwater issues and upcoming plans; NYSDEC/NYSDOH data request; 1,4 Dioxane; and the Five-Year Review Status.

- *Environmental Updates:* The CAC also received updates on the following environmental cleanup topics: Building 811 demolition project; the Former Hazardous Waste Management Facility (Former HWMF); Sr-90 plume update; western south boundary area VOC characterization update; ethylene dibromide detection in off-site monitoring well; Freon-11 treatment system; 1,4-Dioxane planned groundwater sampling; and the Five-Year Review Status.
- *Accelerator Complex Cooling Leak:* In 2017, CAC members were informed of an Accelerator Complex cooling leak with specifics provided on the timing of the leak; technical details of the cooling water system; the source of tritium; environmental impacts; groundwater monitoring plans; repairs to the system; and next steps.
- *Deer Management:* The 2017 Deer Management plan was presented to the CAC with information on the current deer population; implementation of the deer management plan; meat processing and distribution; and path forward.
- *1, 4 Dioxane Sampling:* In response to a recommendation by the NYSDEC/NYSDOH during their review of the 2015 Groundwater Status Report, BNL agreed to collect samples from 22 representative groundwater monitoring wells on and off site that currently or historically had significant trichloroethane concentrations or are downgradient of those locations. The CAC was provided with the sample data from those sites, which included drinking water supply wells and groundwater monitoring data. The Lab reported it will continue to monitor regulatory discussion and action on this emerging chemical of concern and keep the CAC informed.
- *Environmental Updates:* Information was provided regarding the supplemental Peconic River WC-06 Cleanup and the Deer Management Program.

- *Groundwater Updates:* In June 2017, the CAC was provided with an update on the VOC plume at the Laboratory's western south boundary. Later in the year, the group was presented with a review of plumes, treatment systems, performance and progress on groundwater systems.

2.4.3 Monitoring and Measurement

DOE Order 436.1 requires DOE sites to maintain an EMS which conforms to the ISO14001 Standard for Environmental Management Systems. BNL's EMS specifies requirements for conducting general surveillance to determine impact from site operations to the environment. DOE Order 458.1 Admin Chg 3, (2013), *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, sitewide 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 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 2-5, in 2017, there were 5,492 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges under the Environmental Monitoring Program. Specific sampling programs for the various media are described

further in Chapters 3 through 8.

The Environmental Monitoring Program addresses three components: compliance, restoration, and surveillance monitoring.

2.4.3.1 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. Included in compliance monitoring are the following:

- 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-four point-source discharges are monitored: 12 under BNL's SPDES Permit, and 12 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 Sewage Treatment Plant. Extensive groundwater monitoring is also conducted under the CERCLA program (described in Section 2.4.3.2 below). Additionally, to ensure that the Laboratory maintains a safe drinking water supply, BNL's potable water supply is monitored as required by SDWA, which is administered by SCDHS.

2.4.3.2 Restoration Monitoring

The Environmental Restoration Program 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. Additionally, surface water, sediment and fish sampling is conducted to verify the effectiveness of the Peconic River cleanup efforts. Peconic River monitoring is coordinated with the Surveillance Monitoring Program to ensure completeness and to avoid any duplication of effort.

Details on the Peconic River monitoring program are provided in Chapter 6, and details on groundwater monitoring and restoration program are provided in Chapter 7 and SER Volume II, *Groundwater Status Report*.

2.4.3.3 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.

Table 2-5. Summary of BNL Sampling Program Sorted by Media, 2017.

Environmental Media	No. of Sampling Events(a)	Purpose
Groundwater	1,450	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 SER Volume II, <i>Groundwater Status Report</i> , for further detail.
On-Site Recharge Basins	50	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 detail.
Potable Water	54 ES 204 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 detail.
Sewage Treatment Plant (STP)	122	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 detail.
Precipitation	8	Precipitation samples are collected from two locations to determine if radioactive emissions have impacted rainfall, and to monitor worldwide fallout from nuclear testing. The data are also used, along with wind speed, wind direction, temperature, and atmospheric stability to help model atmospheric transport and diffusion of radionuclides. See Chapter 4 for further detail.
Air – Tritium	234	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 detail.
Air – Particulate	328 ES/C 48 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 (NYSDOH) as part of their program to assess radiological air concentrations statewide. See Chapter 4 for further detail.

(continued on next page)

Table 2-5. Summary of BNL Sampling Program Sorted by Media, 2017. (concluded).

Environmental Media	No. of Sampling Events(a)	Purpose
Fauna	18	Fish and deer are monitored to assess impacts on wildlife associated with past or current BNL operations. See Chapter 6 for further detail.
Flora	14	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 detail.
Soils	197	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.
Miscellaneous	276	Samples are collected periodically from potable water fixtures and dispensers, manholes, spills, to assess process waters, and to assess sanitary discharges.
Groundwater Treatment Systems Monitoring	922	Samples are collected from groundwater treatment systems and as long-term monitoring after remediation completion under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. The Laboratory has 11 operating groundwater treatment systems. See discussion in Chapter 7.
State Pollutant Discharge Elimination System (SPDES)	308	Samples are collected to ensure that the Laboratory complies with the requirements of the New York State Department of Environmental Conservation (NYSDEC)-issued SPDES permit. Samples are collected at the STP, recharge basins, and four process discharge sub-outfalls to the STP.
Flow Charts	555	Flowcharts are exchanged weekly as part of BNL's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	102	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	492	Daily instrumentation checks are conducted on the radiation monitors located in Buildings 569 and 592. These monitors are located 30 minutes upstream and at the STP. Monitoring at these locations allows for diversion of wastes containing radionuclides before they are discharged to the Peconic River.
Quality Assurance/Quality Control Samples (QA/QC)	110	To ensure that the concentrations of contaminants reported in the Site Environmental Report 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.
Total number of sampling events	5,492	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2017), 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

Samples are analyzed for organic, inorganic, and radiological contaminants. Additionally, data collected using thermoluminescent dosimeters (devices to measure radiation exposure) strategically positioned on and off site is routinely reviewed under this program. Control samples (also called background or reference samples) are collected on and off the 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 mediaspecific monitoring data and analysis, and Chapter 9 provides supporting information for understanding and validating the data shown in this report.

2.4.4 EMS Assessments

To periodically verify that the Laboratory's EMS is operating as intended, assessments are conducted as part of BNL's Self-Assessment 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 ISO14001 program self-assessment includes evaluating programs and processes within organizations that have environmental aspects to verify conformance to the ISO14001 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, as well as facilitates the identification and communication of "best management" practices used in one

part of the Laboratory that could improve performance in other parts.

- Compliance assessments are also performed by BNL staff members who do not have line responsibility for the work processes involved to ensure that operations are in compliance 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 problems, as well as 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 Self-Assessment 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 ENVIRONMENTAL STEWARDSHIP AT BNL

BNL has extensive knowledge of its potential environmental vulnerabilities and current operations due to on-going process evaluations, the work planning and control system, and the management systems for groundwater protection, environmental restoration, and information management. Compliance assurance programs have improved the Laboratory's compliance status and pollution prevention 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. To maintain stakeholder trust, the Laboratory will continue to deliver on commitments and demonstrate improvements in environmental performance. The Site Environmental Report is an important communication mechanism, as it summarizes BNL's environmental programs and performance each year. Additional information about the Laboratory's environmental programs is available on BNL's website at <http://www.bnl.gov>.

Due to external recognition of the Laboratory's knowledge and unique experience implementing the EMS program, BNL is often asked to share its experiences, lessons learned, and successes. 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.

For over 70 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.

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