2 Environmental Management System

One of Brookhaven National Laboratory's highest priorities is ensuring that its environmental commitment is as strong as its passion for discovery. Brookhaven Science Associates (BSA), the contractor operating the Laboratory on behalf of DOE, takes environmental stewardship very seriously. As part of its commitment to environmentally responsible operations, BSA has established the 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, with additional emphasis on compliance, pollution prevention, and community involvement. Annual audits are required to maintain an EMS registration, and recertification audits of the entire EMS occur every 3 years. In 2012, an EMS surveillance audit determined that BNL remains in conformance with the ISO 14001: 2004 Standard.

BNL continued its strong support of its Pollution Prevention Program, which seeks ways to eliminate waste and toxic materials. In 2012, pollution prevention projects resulted in more than $3.0 million in cost avoidance or savings and resulted in the reduction or reuse of approximately 13.1 million pounds of waste. Also in 2012, the BNL Pollution Prevention Council funded three new proposals or special projects, investing approximately $13,500. Anticipated annual savings from these projects are estimated at approximately $179,000, for an average payback period of approximately 1 month. The ISO 14001-registered EMS and the nationally recognized Pollution Prevention Program continue to contribute to the Laboratory's success in promoting pollution prevention.

BNL continues to address legacy issues under the Groundwater Protection group 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, safety, and health management into all work planning and execution. The purpose of BNL's ISMS is to ensure that the way we do 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, as defined by DOE Manual 450.4-1, Integrated Safety Management System Manual, are:

- LINE MANAGER CLEARLY RESPONSIBLE FOR ENVIRONMENT, SAFETY & HEALTH (ES&H): Line management is directly responsible for the protection of the public, the workers, and the 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 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: 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 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.

An ISO 14001 and OHSAS 18001 surveillance audit was conducted by three NSF

auditors in June 2012 (OHSAS 18001 results are not included in this report). The Laboratory was recommended for continued certification to the ISO-14001 standard with one Minor Nonconformance regarding the need for better document control to prevent unintended use of obsolete documents. This Minor Nonconformance is being addressed and will be tracked to closure.

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, makes clear 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 our 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; and to create action plans to achieve the objectives and targets.

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 utilizes several processes to identify and review environmental aspects. Key among these is the Process Assessment Procedure. This is an evaluation that is documented on a Process Assessment Form, which consists of a written process description, a detailed process flow diagram, a regulatory determination of all process inputs and outputs, identification of pollution prevention opportunities, and identification of any assessment, prevention, and control measures that should be considered.

Environmental professionals work closely with Laboratory personnel to ensure that environmental requirements are integrated into each process. Aspects and impacts are evaluated annually to ensure that they continue to reflect stakeholder concerns and changes in regulatory requirements.

2.3.2 Legal and Other Requirements

To implement the compliance commitments of the ESSH Policy and to meet its legal requirements, BNL has systems in place to review changes in federal, state, or local environmental

regulations and to 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 2009, Executive Order (EO) 13514, Federal Leadership in Environmental, Energy, and Economic Performance, establishes sustainability goals for federal agencies and focuses on improving their environmental, energy, and economic performance. In addition to guidance, recommendations, and plans, which are due by specific sustainability due dates, EO 13514 has set numerical targets for agencies.

Each governmental facility is required to have a Site Sustainability Plan (SSP) in place detailing the strategy for achieving these long-term goals, and to provide an annual status. The requirements will influence the future of BNL's EMS program and most have already been incorporated into BNL's SSP. Table 2-1 identifies the EO goal, the actions contained in the SSP, and BNL's performance in 2012.

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. 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 13514
- Significant environmental aspects
- Risk and vulnerability (primarily, threat to the environment)
- Legal requirements (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. In FY 2012 (October 1, 2011 through September 30, 2012), BNL's environmental objectives included:

- Commitment to satisfy all Comprehensive Environmental Compensation and Liability Act (CERCLA) Record of Decision (ROD) requirements for groundwater, soil, and sediment remediation, and the decontamination and decommissioning (D&D) and long term surveillance and maintenance of the BNL reactor facilities.
- Continued improvement of environmental operational performance by supporting

Table 2-1. EO 13514 Goals: Status Summary for Fiscal Year (FY) 2012.

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory		
Reduce building energy intensity (British Thermal Units per Gross Square Foot [BTU/GSF]) by 30% by FY 2015 from a FY 2003 baseline	▪ FY 2003: 323,780 ▪ FY 2012: 297,605 Percent Change: -8.1%	▪ Energy Conservation Measures include use of HVAC setback, efficient chillers, steam charge-back to users, and lighting upgrades.
Achieve 5% annual electricity consumption from renewable sources in FY 2010-2012 and 7.5% by FY 2013 onward	▪ Long Island Solar Farm (LISF) began operation on 11/01/11; 50,646,000 kWh/yr power generated on site in FY 2012.	▪ BNL Research & Development Solar Array at 800+ kW. ▪ Initiate investment-grade feasibility study for a combined heat and power facility. ▪ Completion of an ongoing wind energy and biomass feasibility study. ▪ Continue bio-based fuel for satellite boilers.

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Table 2-1. EO 13514 Goals: Status Summary for Fiscal Year (FY) 2012 *(continued).*

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory *(continued)*		
Sulfur hexafluoride (SF_6) reduction	▪ FY 2008: 965 ▪ FY 2012: 1,049 Percent Change: +8.7%	▪ First draft High Energy Equipment Management Plan prepared; the plan is a proactive approach for detecting, preventing, and repairing leaks of SF6 dielectric. ▪ Final plan targeted for completion second quarter of FY 2013.
Achieve individual building or process metering for 90% of electricity consumed by 10/01/12 and for 90% of steam, natural gas, and chilled water consumed by 10/01/15	▪ BNL is exceeding targets for metering.	▪ Advanced steam and water metering to be installed, where appropriate.
Install cool roofs when economical for roof replacement (unless project has a previous CD-2 approval; new roofs must have thermal resistance of at least R-30	▪ Continue to factor DOE cool roof requirements into all roofing projects. ▪ While conformance with ASRAE reflectivity standards is attainable, meeting R-30 insulation value is often not economically viable. ▪ In FY 2012, only partial re-roofing of 3,100 square feet of Building 725 economically viable. ▪ FIMS updated to reflect effort. ▪ New construction of Interdisciplinary Science Building (ISB) will meet cool roof criteria.	▪ Roofing project managers reminded of requirement to evaluate economic viability for all roofing projects. ▪ BNL expects to add the cool roof areas of ISB to Facility Information Management System (FIMS) in FY 2013. ▪ A 9,000 square foot long-beam line addition to Building 740 is being constructed with cool roof.
Training	▪ Costs for training on Energy Policy Act 1992 in FY 2012 were $27,800.	▪ International certifications obtained by many professionals within the Facilities & Operations organization ▪ Awaiting further guidelines from DOE on training requirements.
Achieve net zero energy in new or major renovation facilities	▪ No FY 2012 projects met criteria.	▪ Review of FY 2013 planned projects did not find any projects meeting criteria to require consideration.
Evaluate 25% of 75% of facility energy use over 4-year cycle	▪ 100% of applicable buildings evaluated within the last 4 years.	▪ Facility Condition Assessments and Energy Audits are combined, reducing costs and ensuring 4-year cycle is met.
Reduce Scope 3 Greenhouse Gas (GHG) reduction by 13% by FY 2020 from a FY 2008 baseline; reduce employee travel GHG by 12% by FY 2020 from a FY 2008 baseline	▪ FY 2008: 20,003 ▪ FY 2012: 21,996 ▪ Percent Change: +10 ▪ As electric loads increase from 2013-2016, GHG from transmission and distribution will rise proportionately. ▪ Increases in employee population have contributed to rise in commuting GHG.	▪ Policy Council supported the establishment of flex work week for non-bargaining non-exempt employees and compressed work week schedules for non-bargaining employees. ▪ Procedures to implement policy will be developed in second quarter, FY 2013. ▪ New pilot carpool coop established in Wading River community in November 2012; pilot will be expanded to several additional areas.
Reduce Scopes 1 and 2 GHG by 28% by FY 2010 from a FY 2008 baseline	▪ FY 2008: 205,3542 ▪ FY 2012: 138,020 Percent Change: -32.8 ▪ FY 2012 adjusted for Long Island Solar Farm: 92,100 Percent Change: 44.8	▪ Hydro power, Long Island Solar Farm Research and Development PV Array, combined heat and power, and Renewable Energy Credits to meet renewable energy requirement.
Goal 2: High Performance and Sustainable Buildings (HPSB), Energy Saving Performance Contracts (ESPC) Initiative, Regional and Local Planning		
Ensure 15% of existing buildings more than 5,000 gross square feet (GSF) are compliant with the Guiding Principals (GPs) of HPSB by FY 2015	▪ Energy conservation measure project design completed. ▪ Funding enabled early construction starts on several projects.	▪ Completion of several projects, including RTU for Bldg. 438, night setback controls in Bldg. 438, occupancy sensors in all HPSB buildings, and HPSB improvements in Bldg. 817.
Ensure all new construction, major renovations, and alterations of buildings greater than 5,000 GSF comply with GPs	▪ No FY 2012 projects met criteria.	▪ A review of FY 2013 planned projects found no projects meeting criteria. ▪ BNL will seek CD-0 for the ISB II project in FY 2013. ▪ ISB II will be designated to obtain a Leadership in Energy and Environmental Design (LEED) Gold rating.

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Table 2-1. EO 13514 Goals: Status Summary for Fiscal Year (FY) 2012 *(continued).*

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 2: High Performance and Sustainable Buildings (HPSB), Energy Saving Performance Contracts (ESPC) Initiative, Regional and Local Planning *(continued)*		
ESPC initiative, IE, and third party financing	▪ Utility Energy Services Contracts (UESC) Phase I Scope and contract documents completed. ▪ Ready for requests for proposals.	▪ UESC Phase I to be awarded in FY 2013. ▪ UESC Phase II expected in FY 2014.
Regional and local planning	▪ BNL continues to investigate public transportation and increased car-pool ridership. ▪ Local renewable energy is supported through the LISF and the National Energy Research Scientific Computing Center (NERSC). ▪ Natural Resource activities include measuring impact of large-scale solar installations. ▪ Stakeholder involvement includes hosting numerous conferences and routine communications with regulatory and community groups.	▪ Continue to measure ecological impacts of solar installations. ▪ Continue routine meetings with regulatory and local environmental groups.
Goal 3: Fleet Management		
Achieve a 10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline beginning in FY 2015	▪ Alternative fueling infrastructure exists for compressed natural gas, 85% ethanol fuel (E85), diesel, and biodiesel.	▪ Continue to purchase alternative fuel vehicles (AFVs) and remove petroleum vehicles as much as possible.
Achieve a 2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline	▪ BNL is reducing petroleum consumption by replacing gasoline and diesel vehicles with AFVs, as budgets permit.	▪ Continue to purchase AFVs and remove petroleum vehicles as much as possible.
Ensure that 75% of light duty vehicle purchases consist of AFVs by FY 2000 and thereafter	▪ In FY 2012, 100% of light duty vehicles purchased were AFVs.	▪ Continue to purchase 100% light duty vehicles as AFVs.
Submit the Right-Sizing the Fleet Management Plan for approval and identify mission critical/non-mission critical vehicles by 12/31/2012	▪ Right-Sizing the Fleet Management Plan was developed.	▪ Right-Sizing the Fleet Management Plan will be submitted on schedule.
Goal 4: Water Use Efficiency and Management		
Reduce water intensity by 26% by FY 2020 from a FY 2007 baseline	▪ Water use down 10% since 2007 due to decreased process cooling usage at the Alternative Gradient Synchrotron and elsewhere on site. ▪ BNL has focused heavily on water conservation prior to FY 2007; water use down 57% since 1999. ▪ Final design and site preparation for water recharge project in FY 2013.	▪ Continue to practice cost-effective water conservation. ▪ Implement the groundwater recharge project, which will replenish over 70% of BNL's water usage directly back to the aquifer.
Reduce water consumption of industrial, landscaping, and agricultural (ILA) water by 20% by FY 2020 from a FY 2010 baseline	▪ No permanent landscaping or agricultural water use.	▪ No actions are planned.
Goal 5: Pollution Prevention and Waste Reduction		
Divert at least 50 percent of non-hazardous solid waste, excluding construction and demolition debris by FY 2015	▪ BNL's non-hazardous solid waste recycling rate was 57% in FY 2012.	▪ During FY 2012, the focus will be on recycling awareness for new employees and contractors. ▪ Re-emphasize recycling in computer-based training.
Divert at least 50 % of construction and demolition debris by FY 2015	▪ BNL's construction and demolition materials and debris recycling rate was 95%+ in FY 2012.	▪ Continue sending construction and demolition materials to the on-site Borrow Pit for consolidation and recycling.

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Table 2-1. EO 13514 Goals: Status Summary for Fiscal Year (FY) 2012 *(concluded).*

DOE Goal	BNL Performance Status	BNL Planned Actions and Contributions
Goal 6: Sustainable Acquisition		
Ensure 95% of procurements meet sustainability requirements annually and include sustainable acquisition clause	▪ All contract actions for construction and custodial products met sustainable acquisition requirements in FY 2012.	▪ Performance in sustainable acquisition will be documented in the FY 2012 PPTRS reporting system. ▪ Requirements for bio-based products will be incorporated into BNL's Terms and Conditions in FY 2013.
Goal 7: Electronic Stewardship and Data Centers		
Ensure all data centers are metered to measure a monthly Power Usage Effectiveness (PUE) (100% by FY 2015)	▪ Additional meters added in FY 2012. ▪ Identification of remaining required metering complete.	▪ Installation of remaining metering will be completed in FY 2013 and FY 2014.
Achieve maximum annual weighted average PUE of 1.4 by FY 2015	▪ Large Data Center currently at 1.52. ▪ Completion of data center study to develop plan for obtaining PUE <1.4 in FY 2012.	▪ Develop funding strategy as required based upon report issued from data center study.
Ensure 100% of eligible PCs, laptops, and monitors have power management actively implemented and in use by FY 2012	▪ LANDesk power management implemented on all suitable systems.	▪ Continue to assess if any additional systems can use the power management systems.
Goal 8: Agency Innovation & Government-Wide Support		
Agency Innovation and Government-Wide support	▪ On-site generation.	▪ Completion of the construction of the Solar Test Array.

implementation of the modifications to BNL's Sewage Treatment Plant (STP) and submitting preliminary designs to the New York State Department of Environmental Conservation (NYSDEC); implementation of the Freon remediation project; and improvement of radiological waste characterization.

- Improvement of radiological operational performance through establishment of an improved moratorium metals program to allow metals recycling, management of the electronic capture/digitization of radiological exposure records in support of the Energy Employees Occupational Illness Compensation Program Act (EEIOCPA) and incorporation of the electronic data into the Health Physics Reporting System (HPRS) database; and conducted an independent review of the Radiological Controls Division assessment process.
- Third-party verification of ESS&H program effectiveness. This included recertification of the ISO 14001 and OHSAS 18001 registrations.
- Manage and reduce the impact of legacy activities at the Laboratory. This included minimizing the inventory of radioactive sealed sources and supporting the coordination and transfer of Facilities and Materials between DOE Office of Science and DOE Environmental Management.

These objectives and targets have been implemented and efforts are continuing, where necessary.

2.3.4 Environmental Management Programs

Each organization within BNL develops an action plan detailing how they 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 to 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 Management 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 also developed a Groundwater Protection Contingency Plan that defines an orderly process for quickly taking corrective actions in response to unexpected monitoring results. 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 2012.

2.3.4.3 Waste Management

As a byproduct of 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 waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, and mixed waste.

Facilities for collecting, storing, transporting, and managing the disposal of waste generated at the Laboratory include BNL's Waste Management Facility (WMF), managed and operated by the Environmental Protection Division (EPD). This modern facility was designed for handling hazardous, industrial, radioactive, and mixed waste and is comprised of two staging areas: a facility for hazardous waste and mixed waste (both hazardous and radioactive) in Building 855, which is regulated by RCRA, and a reclamation building for radioactive material in Building 865. The RCRA building is managed under a permit issued by 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. Due to the relatively small quantities and infrequent generation of mixed waste, BNL has reduced its waste storage footprint by consolidating hazardous and mixed wastes into its RCRA waste building.

In 2012, BNL received approval from NYSDEC to close Building 870, a former mixed waste storage facility. Subsequent to this approval, the Laboratory submitted a modification to it's RCRA permit to NYSDEC to remove all references to this building; the modification was approved in 2012.

In 2012, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 4.1 tons
- Mixed waste: 40 ft^3
- Radioactive waste: 4,340 ft^3

Hazardous waste from routine operations in 2012 was basically unchanged from 2011 generation rates, as shown in Figure 2-1a. Mixed waste generation increased from 2011 rates, as shown in Figure 2-1b, and can be attributed primarily to increased activities at the Collider Accelerator Department (CAD). As shown in Figure 2-1c, the radioactive waste quantity for routine

operations also increased from the previous year and is also primarily attributed to increased operations at CAD. Routine operations are defined as ongoing industrial and experimental operations.

Wastes generated by remediation projects, decommissioning activities performed by the Environmental Restoration Projects (ERP) Group, or one-time events (e.g., lab clean-out) are considered non-routine. In 2012, BNL's EPD continued to reduce the inventory of legacy waste materials through laboratory cleanouts. Wastes from restoration and decommissioning activities included primary debris remaining from the BGRR decommissioning. Other non-routine wastes included disposal of lead-contaminated debris, lead shielding, and polychlorinated biphenyl (PCB) wastes.

Figures 2-1d through 2-1f show wastes generated under the ERP Group, as well as other non-routine operations. Waste generation from these activities has varied significantly from year to year. This is expected, as various remedial actions are conducted.

2.3.4.4 Pollution Prevention and Waste Minimization

The BNL Pollution Prevention (P2) Program is an essential element for the successful accomplishment of the Laboratory's broad mission. The P2 Program reflects the 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 Performance Evaluation Management Plan 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, and ensure that they are "as low as reasonably achievable"
- 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

Three Pollution Prevention proposals were funded in 2012, for a combined investment of approximately $13,500. The anticipated annual savings from these projects is estimated at $179,000, for an average payback period of approximately 1 month. The BNL P2 and recycling programs have achieved significant 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 2012 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 significantly reduced both waste volumes and management costs. In 2012, these efforts resulted in more than $3.0 million in cost avoidance or savings and approximately 13.1 million pounds of materials being reduced, recycled, or reused annually.

The Laboratory also has an active and successful solid waste recycling program, which involves all employees. In 2012, BNL collected approximately 142 tons of office paper for recycling. Cardboard, bottles and cans, construction debris, motor oil, scrap metals, 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 in 2012.

2.3.4.5 Water Conservation

BNL's water conservation program has achieved dramatic reductions in water use since the mid 1990s. 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. Through an annual program at the Laboratory, approximately $50K per year is allocated to replace existing conventional plumbing fixtures with low-flow devices.

BNL's goal is to reduce the consumption of potable water and reduce the possible impact of clean water discharges on Sewage Treatment Plant (STP) operations. Figure 2-2 shows the 14-year trend of water consumption. Total water consumption for 2012 was approximately 111 million gallons less than in 2011. This decrease can be attributed to water conservation efforts and less water used for cooling. In each of the past 5 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

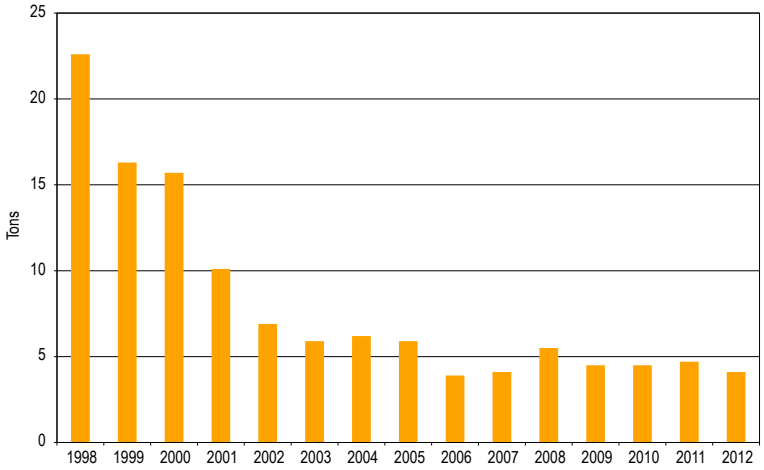

Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1998 – 2012.

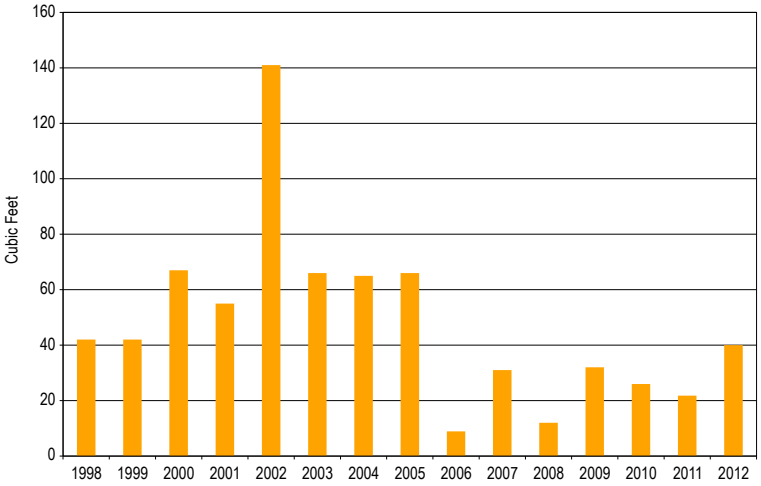

Figure 2-1b. Mixed Waste Generation from Routine Operations, 1998 – 2012.

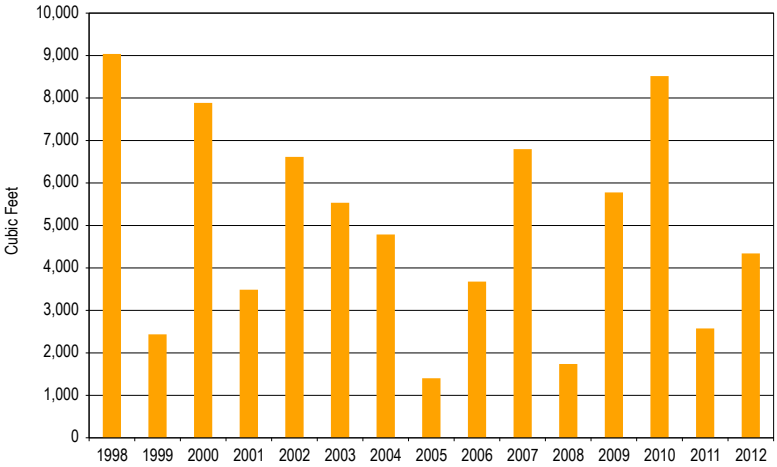

Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1998 – 2012.

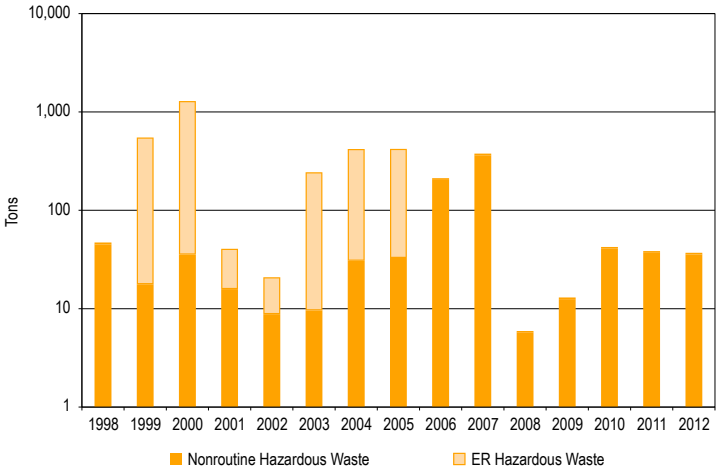

Figure 2-1d. Hazardous Waste Generation from ER and Nonroutine Operations, 1998 – 2012.

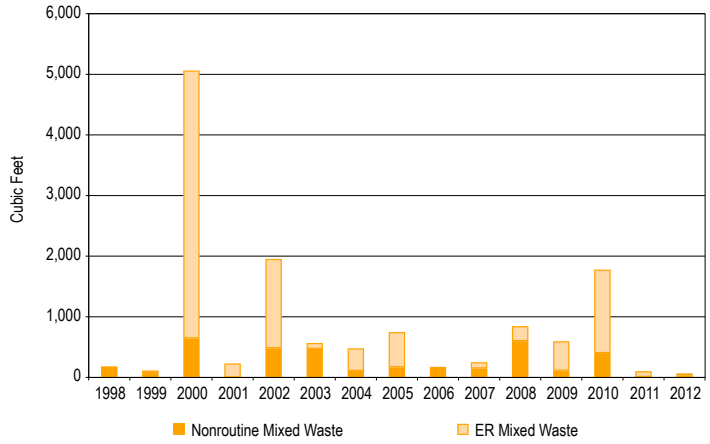

Figure 2-1e. Mixed Waste Generation from ER and Nonroutine Operations, 1998 – 2012.

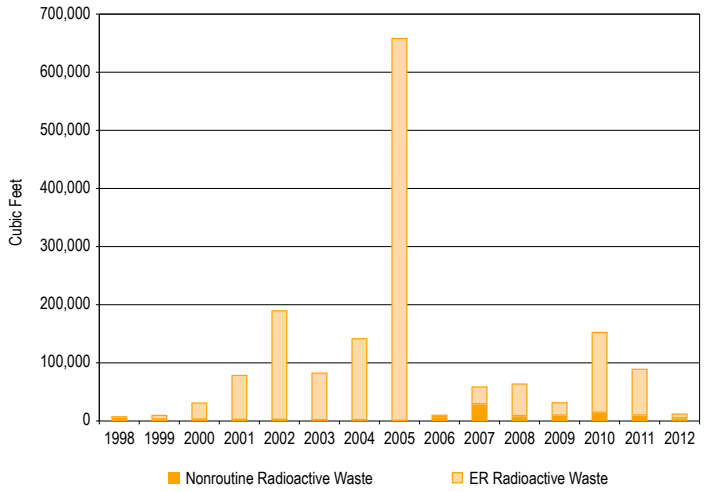

Figure 2-1f. Radioactive Waste Generation from ER and Nonroutine Operations, 1998 – 2012.

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 Plan and assisting DOE in meeting the energy and sustainability goals in EO 13514; DOE Order 436.1, Environmental Protection Program; and the Secretary's initiatives. The Laboratory's SSP addresses all aspects of the DOE energy, water, and sustainability goals.

The Laboratory has more than 4 million square feet of building space. Many BNL scientific experiments use particle beams generated and accelerated by electricity, with the particles controlled and aligned by large electromagnets. In 2012, the Laboratory used approximately 278 million kilowatt hours (kWh) of electricity, 108,000 gallons of fuel oil, 17,000 gallons of propane, and 581 million ft^3 of natural gas. Fuel oil and natural gas produce steam at BNL's Central Steam Facility (CSF). Responding to market conditions, fuel oil and natural gas were used whenever each respective fuel was least expensive. However, whenever possible, BNL will purchase natural gas over oil in order to help reduce greenhouse gas emissions (GHG). Additional information on natural gas and fuel oil use can be found in Chapter 4. In addition, over

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2012	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Replacement of small PCB capacitors	Substitution	N/A	PCB	$4,000	$4,000	$0	Collider Accelerator removed and replaced 50 small PCB-containing capacitors and removed an additional 25 PCB-containing capacitors from obsolete equipment.
Once thru cooling	Water Conservation	7,188,480	Water	$0	$4,000	$0	Replaced a once thru cooling system with a closed loop system supplied by BNL's Chilled Water Plant.
Replacement of X-Ray film processing with chemiluminicent Imaging	Substitution	835	Hazardous and Industrial Liquid Wastes	$27,000	$5,500	$179,000	Cost savings reflect labor savings, waste disposal savings, and items (such as film) which no longer need to be purchased.
Motion sensors in Building 725	Energy Conservation	N/A	Greenhouse Gas/Energy Conservation	N/A	$0	$6,000	Installation of motion-sensored lighting in hallways, restrooms, and conference rooms in Building 725 during 2011.
LED lighting in 490 Conference Room	Energy Conservation	N/A	Greenhouse Gas/Energy Conservation/ Manpower	$2,940	$0	$3,710	(40) 65-Watt incandecent bulbs were replaced with LED bulbs during 2011; savings of $1190/ year in energy costs and $2520/year in manpower costs.
Plastic granulator for Medical Department	Recycling	N/A	Regulated Medical Waste	$5,500	$0	$5,500	Plastic granulator shreds Laboratory plasticware (petri dishes, flacks, etc.) rendering it unrecogniziable.
Motion sensors for Building 820	Energy Conservation	N/A	Greenhouse Gas/Energy Conservation	N/A	$0	$1,650	Installation of motion-sensored lighting in Physics research area of Building 820.
Sewage sludge	Publicly-Owened Treatment Works (POTW)	3,000	Low-Level Radiological Waste	$500,000	$12,000	$488,000	Rad constituents were eliminated from within the Sewage Treatment Facility and the sludge is now sent to a POTW.
Alkaline batteries	Recycling	174	Industrial Waste	$10	$0	$10	150 pounds of alkaline batteries were collected and sent for recycling.
BioDiesel tank, E-85, CNG	Alternative Fuels	0	Greenhouse Gas/Energy Conservation	$0	$0	$0	BNL is utilizing different alternative fuels to operate maintainance vehicles.
Motion sensors for on-site labs*	Energy Conservation	N/A	Greenhouse Gas/Energy Conservation	N/A	$0	$5,817	Installation of motion detector lighting in common areas of Buildings 490 and 463.
"Bio Circle Cleaner" parts washer	Substitution	640	Hazardous Waste	$10,000	$0	$10,000	Eliminates the need for toxic solvents, chemical storage, and disposal associated with the cleaning of vacuum parts.

(continued on next page)

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2012	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Aerosol can disposal system	Recycling	528	Hazardous Waste	$43,872	$0	$43,872	Empty aerosol cans are recycled as scrap, rather then sent to the Waste Management Division as hazardous waste. Eight units (F&O=5; CA=1; NSLS=1; BES =1) each handle 66 lbs of hazardous waste.
Electronic Reuse	Reuse	23,287	E-Waste	$58,218	$0	$58,218	BNL tracks electronic equipment and takes a reuse credit for transfer of equipment to another user.
Building demolition recycling	Recycling	11,000,000	Industrial Waste	$484,935	$25,000	$459,935	On-site demolition products (steel and concrete) are segregated, recycled, and reused.
System One parts cleaner	Substitution	1,280	Hazardous Waste	$12,000	$0	$12,000	Central Fabrications and Motor Pool each purchased a System One parts washer to re-distill dirty solvent, eliminating the need for a vendor, such as Safety Kleen. Removed grit and sludge are mixed with the waste oil.
Animal bedding conveying system	Composting	74,000	Low-level Radiological Waste	$898,128	$0	$898,128	Animal bedding material is no longer sent to sanitary sewer. It is now conveyed to a dumpster that is emptied and composted at the stump dump. The sanitary sludge was previously sent out as low-level radioactive waste.
Lead acid batteries	Recycled	4,000	Universal Waste	$29,248	$0	$29,248	Avoids hazardous waste disposal costs for approximately 40 lbs of lead per battery.
Short half-life waste - CA	Decay in Storage	142	Radioactive Waste	$56,232	$0	$56,232	During 2012, 21 boxes of filters from Buildings 914 and 918 (147 ft^3) were managed in accordance with BNL decay-in-storage requirements, rendering the wastes eligible for volumetric release.
Cooling Tower chemicals	Source Reduction	6,000	Industrial Waste	$12,000	$0	$12,000	Ozone water treatment units were installed on cooling towers at the National Space Radiation Laboratory (957), the Special Ejection Magnet (912A), and the Relativistic Heavy Ion Collider Reseach Facility (1004) for biological control of cooling water. These systems eliminate the need for water treatment chemicals (typically toxic biocides), save labor, and reduce analytical costs for monitoring cooling tower blowdown.

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2012	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Blasocut machining coolant	Recycled/ Reused	44,880	Industrial waste	$110,530	$0	$120,130	Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it Laboratory-wide. In 2012, 5,610 gallons (44,580 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 12 drums of concentrate ($800/drum) and 113 empty drums for shipping ($50/drum).
Fluorescent bulbs	Recycled	15,727	Universal Waste	$802,077	$20,000	$782,077	Fluorescent bulbs are collected and sent to a recycling facility under the Universal Waste exemption rule.
Tyvek	Recycled	105	Industrial Waste	$6	$0	$11	BNL is recycling tyvek through Garment Recovery Systems.
Used motor oil	Energy Recovery	12,680	Industrial Waste	$31,651	$0	$31,651	Used motor oil from the Motor Pool and the on-site gas station is given to Strebel's Laundry Service to fire their boilers. In 2012, they collected 1,585 gallons of oil at no charge to BNL, which avoided the costs for disposal and 31 shipping drums ($50/drum).
Office paper	Recycled	284,120	Industrial Waste	$14,916	$0	$20,599	Cost avoidance based on $105/ton for disposal as trash, plus $40/ton revenue.
Cardboard	Recycled	200,600	Industrial Waste	$10,532	$0	$13,039	Cost avoidance based on $1055/ton for disposal as trash, plus $25/ton revenue.
Electronic waste	Recycled	61,840	Industrial/ Universal Waste	$154,600	$0	$181,795	Cost avoidance based on $105/ton for disposal as trash, plus $900/ton revenue.
Metals	Recycled	555,900	Industrial waste	$29,185	$0	$273,650	Cost avoidance based on $105/ton for disposal as trash, plus $900/ton revenue.
Bottles/cans	Recycled	36,040	Industrial Waste	$1,892	$0	$1,892	Cost avoidance based on $105/ton for disposal as trash.
Construction debris	Recycled	760,580	Industrial Waste	$39,930	$0	$19,775	Cost avoidance based on $52/ton difference for disposal as trash.
	TOTALS	13,082,523		$2,799,961	$45,000	$3,030,079	

* Cost savings of projects funded by the BNL Pollution Prevention Council will be tracked for 3 years.

3,000 gallons of biofuels were used in several applications.

BNL continues to participate in the New York Independent System Operator (NYISO) Special Case Resource (SCR) Program, which is an electric load reduction curtailment program. Through this program, the Laboratory has agreed to reduce electrical demand during critical days throughout the summer when NYISO expects customer demand to meet or exceed the available supply. In return, BNL receives a rebate for each megawatt reduced on each curtailment day. Three curtailment days were required in 2012. BNL continues to keep electric loads at a minimum during the summer by scheduling operations at the Relativistic Heavy Ion Collidar (RHIC) to avoid peak demand periods. This scheduling reduced the electric demand by 25 MW, which allowed the Laboratory to save approximately $2 million in electric costs in 2012, and greatly helps 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 $30.2 million in 2012. The Laboratory will continue to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs. Further, BNL's energy supply now includes approximately 110 million kWh of clean, renewable hydropower.

In 2011, BP Solar completed construction of the Long Island Solar Farm (LISF) on DOE/BNL property. The array is currently the largest solar photovoltaic (PV) array (32 MW) in the Northeast and spans 195 acres with 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 estimated annual output of 44 million kWh will result in an avoidance of approximately 31,000 tons of carbon per year over its 30- to 40-year life span. In fact, the actual output for the first operational year was 54 million kWh, substantially above the estimated annual average value. As an outcome of constructing this large array on site, the Laboratory are developing a solar research program that will look at impacts of climate change on large utility-scale PV systems, as well as research and development for solar power storage and inverter efficiencies. In addition, the Laboratory is in the process of installing approximately 1 MW of solar PV on site for additional research. The Federal Energy Management Program (FEMP) recognizes the importance of the efforts of BNL and the DOE Brookhaven Site Office to host the LISF on site and are providing credit toward BNL's SSP renewable energy goal.

To reduce energy use at non-research facilities, several additional activities also were undertaken by the Energy Management Group in 2012:

- *NYPA Power Contract:* First full year of a 10-year contract that includes 15 MW of renewable, nearly zero GHG of hydropower. This contract is estimated to save in excess of $26 million per year compared to prevailing energy rates, with an option to renew for an additional 5 years. Actual savings for FY 2012 were $30 million.
- *DOE Sustainability Initiative:* Continued to provide substantial support to the Federal/DOE-wide Sustainability Initiative; fostered the creation of a BNL Sustainability Leadership Team, which is developing a formal site-wide sustainability program beyond DOE requirements; participated in one of three subcommittees for DOE on sustainability initiatives; and provided numerous evaluations and estimates on energy use, GHG, renewable energy, and energy-efficiency options.
- *Substantial Progress on Several Initiatives included in BNL's 2012 SSP, including:* new electric and steam meter installations; funding for energy conservation initiatives; new energy-efficient lighting installed in parking lots and offices; the purchase of Renewable Energy Credits (RECs) in meeting the SSP goal; and training various parties on energy conservation initiatives and the set-back.
- *Utility Energy Services Contract:* Major support to DOE/BHSO in developing a UESC, which included a preliminary audit,

Table 2-3. BNL Recycled Program Summary.

Recycled Material	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Mixed paper	209	182	185	193	184	177	151	127	174	186	142
Cardboard	157	176	179	143	135	121	147	152	141	126	100
Bottles/Cans	19	23	22	22.1	27.7	24.4	19.6	23.7	24	22.5	18
Tires	3.5	12.3	11	12.8	32.5	19.9	34.5	15.5	10.1	9.2	10
Construction debris	304	334	367	350	297	287	302	312	416	256	380
Used motor oil (gallons)	1,920	3,920	3,860	4,590	2,780	2,020	1,500	1,568	1,700	1,145	1,585
Metals	48	193	128	559	158	382	460	91	131	84	278
Automotive batteries	6.3	4.6	5	4.6	5.5	2.5	2.7	4	1.6	2.1	2
Printer/Toner cartridges (units)	449	187	105	0	0	0	3,078	1,251	4,132	4,186	4,100
Fluorescent bulbs (units)	25,067	13,611	12,592	7,930	11,740	25,448	36,741	10,223	8,839	20,220	15,727
Blasocut coolant (gallons)	8,180	5,030	6,450	3,890	3,970	2,432	3,340	3,810	4,830	5,660	5,610
Antifreeze (gallons)	0	165	325	0	0	0	0	0	0	0	700
Tritium exit signs (each)	28	181	142	0	0	0	0	0	0	18	0
Smoke detectors (each)	40	0	0	0	0	0	0	0	0	0	0
Road base	2,016	0	2,666	0	0	0	0	0	0	0	0
Electronic reuse	0	0	0	0	0	0	16.3	11.4	12	11.6	3.2
Scrap electronics	0	0	0	6.1	70.3	40.5	48.9	17	16.7	19.9	30.9
Animal Bedding (composted)	0	0	0	0	6.3	19.6	42	41	52	54	43
Tyvek (lbs)	0	0	0	0	0	0	0	84	60	92	105
Metals (building demolition)	8	23	11	6	35	0	0	0	0	0	41
Concrete (building demolition)	891	590	3,000	328	5,505	6175	0	0	4,050	0	3,200
Other construction and debris (building demolition)	790	388	1,200	157	818	0	0	0	0	0	0

Notes:
Units = tons, except where noted

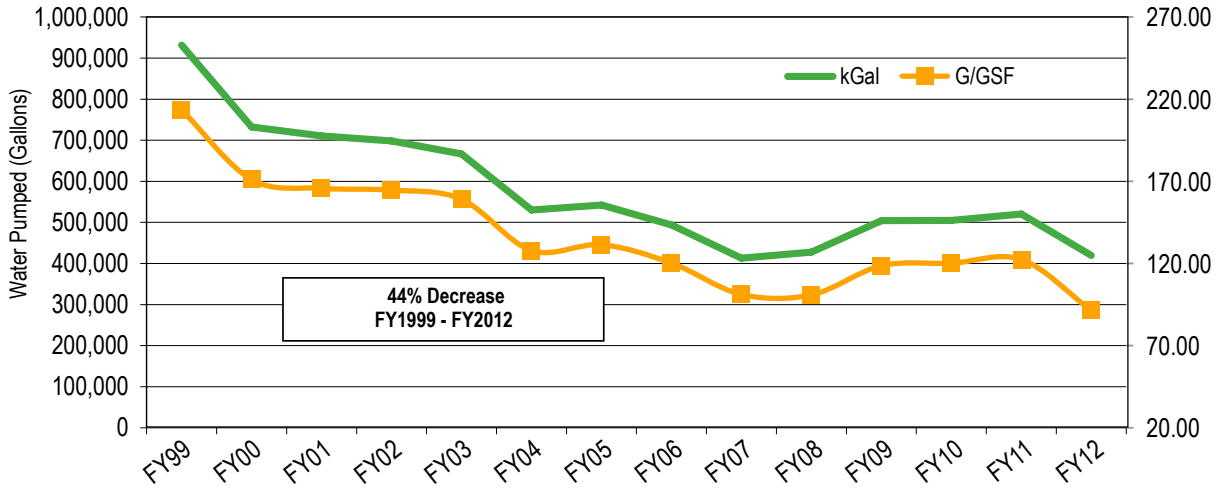

Figure 2-2. Annual Potable Water Use, 1999-2012.

completion of a follow-on Investment Grade Audit (IGA), and major progress towards development of the UESC contract terms and requirements. The first phase of the UESC, which includes energy-efficient lighting, new building controls and commissioning, and an energy-efficient chiller project, are expected to be initiated in late 2013.

- *Energy Conservation:* Evaluated several projects for energy conservation opportunities that were submitted by Laboratory employees, and continued development of an Energy Dashboard.
- *High Performance Sustainability Buildings (HPSB):* Completed evaluations of 24 buildings and developed plans and budgets to implement various energy and water conservation projects to achieve compliance in the EPA Portfolio Manager program. Construction contracts were awarded to complete various HPSB initiatives in various buildings.
- *Renewable Energy:* Provided project support to BHSO for the LISF Project, including presentations, hosting tours, and assisting operating personnel.
- *Central Chilled Water Facility (CCWF)-Phase II:* The CCWF Phase-II project was completed in 2011 and is now providing chilled water to BNL buildings and processes such as the National Synchrotron Light Source (NSLS) and the data center, using modern energy-efficient chillers.
- *Natural Gas Purchase Contract:* This contract is estimated to save $6 million compared to oil and $600k compared to purchasing directly from National Grid.
- *Energy Savings:* 25 MW of demand was rescheduled to avoid coinciding with the utility summer peak, saving over 2 million dollars in electricity charges. In addition, work continued in the replacement of aging, inefficient T-40 fluorescent lighting fixtures with new, efficient T-8 and T-5 units (two to three hundred fixtures are typically replaced annually), saving tens of thousands of kWhs and reducing costs by several thousand dollars.

Due to continued conservation efforts, overall facilities energy usage for FY 2012 was approximately 7.3 percent less than in FY 2003, saving $720,000. In addition, approximately 24,000 gasoline gallon equivalents (gge) of natural gas were used in place of gasoline for the Laboratory's vehicle fleet.

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 (EISA) of 2007, requires federal agencies to apply energy conservation measures and to improve federal building design to reduce energy consumption per square foot. Current goals are to reduce energy consumption per square foot, relative to 2003, by 2 percent per year from FY 2006 – FY 2015. Further, EO 13514 and associated orders have set even more stringent requirements, including increased use of renewable energy and reductions in transportation fuels that go significantly beyond the previous goal of a 30 percent reduction by FY 2005, compared to FY 1985. As shown in Figure 2-3, BNL's energy use per square foot in 2012 was 30 percent less than in FY 1985 and 4 percent less than in FY 2003. It is important to note that energy use for buildings and facilities at the Laboratory is largely weather dependent.

2.3.4.7 Natural and Cultural Resource Management Programs

BNL continues to enhance its Natural Resource Management Program in cooperation with the Foundation for Ecological Research in the Northeast (FERN) and the Upton Ecological and Research Reserve. The Laboratory also continues to enhance its Cultural Resource Management Program. A BNL Cultural Resource Management Plan has been developed to identify and manage properties that are determined to be eligible or potentially 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

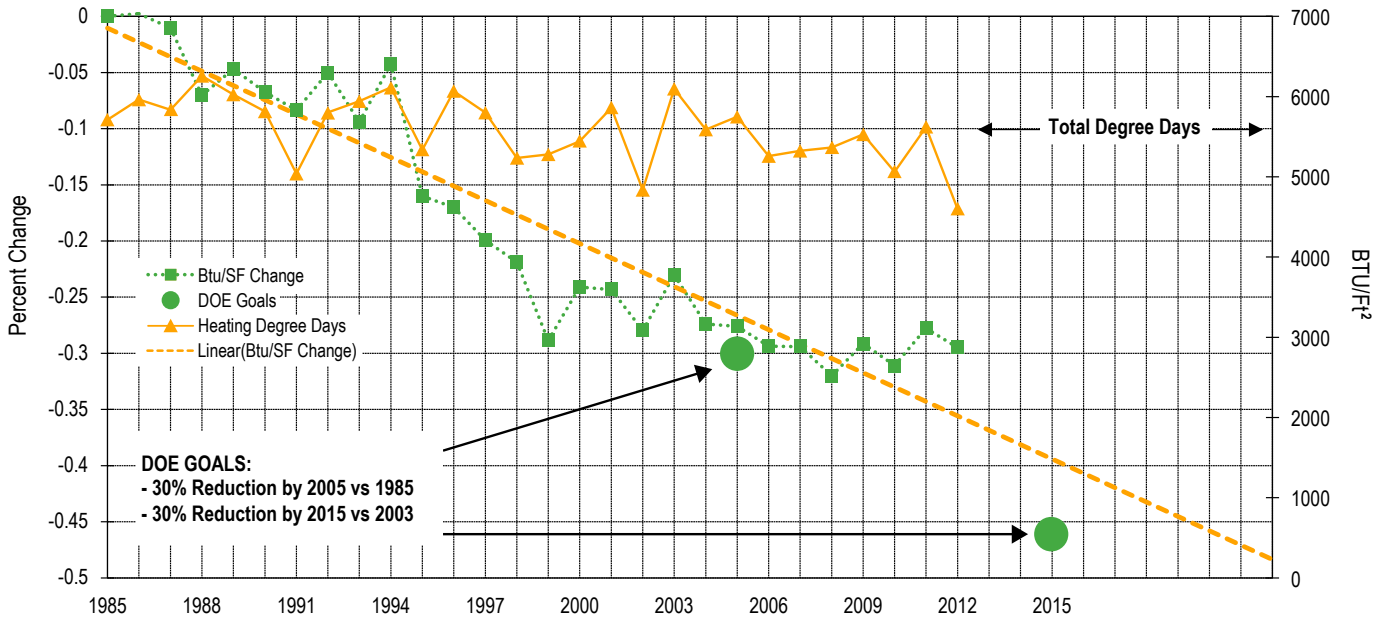

Figure 2-3. BNL Building Energy Performance (BTU/FT² Change % vs. Baseline Years).

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 Interagency 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 2012, significant work was performed for the BGRR and BNL's groundwater treatment systems. The BGRR ROD required the removal of the graphite pile and the biological shield, as well as the installation of a water infiltration control and monitoring system. Following removal of the 700-ton graphite pile in 2010, removal of the BGRR biological shield commenced and was completed in May 2012. This work was funded, in part, through the American Recovery and Reinvestment Act of 2009 (ARRA). The biological shield roof was removed and special torch-cutting tools, as well as a large excavator, were deployed to remove the biological shield steel and reinforced concrete walls. An Explanation of Significant Differences (ESD) to the BGRR ROD describes and justifies one instance where the completed end state is different than described

in the ROD. The BGRR ROD anticipated removal of the biological shield walls from the top of the bioshield to its base, which is 3 feet below the floor level. Per the ESD, the portion of the biological shield below the floor level was not removed and was left in place (this portion of the biological shield contains activation products). In July 2012, transition of the long-term surveillance and maintenance (S&M) program for the BGRR to the Environmental Protection Division (EPD) was completed.

All near-term activities identified in the HFBR ROD have been completed, except for the demolition of the HFBR stack. In accordance with the ROD, demolition of the stack will be completed prior to 2020. In May 2012, transition of the long-term S&M program for the HFBR Stack and Grounds and the Waste Loading Area to EPD was completed.

The productive operation and maintenance (O&M) of the Laboratory's 14 groundwater treatment systems removed approximately 239 pounds of solvents and 1.9 mCi of Sr-90 from the sole source aquifer in 2012. Since the operation of the first treatment system in 1996, a cumulative total of approximately 6,948 pounds of solvents and 27.5 mCi of Sr-90 have been removed from the groundwater.

Other work performed in 2012 included the start-up of a new treatment system to address trichlorofluoromethane (Freon-11) contamination in groundwater downgradient of Building 452, a site maintenance facility. An ESD to the OU III ROD was issued in July 2012 to document this change to the OU III remedy. In addition, a new extraction well was installed to address deeper VOC contamination at the OU III south boundary.

Post-cleanup monitoring of Peconic River surface water, sediment, and wetland vegetation continued, and the results were reported in the Annual Peconic River Monitoring Report (see Chapter 6). Monitoring and re-vegetation was performed at three Peconic wetland areas that were remediated in 2011. As a result, the conditions identified in the 2010 State Equivalency Permit were met. Invasive species monitoring will continue for these areas through 2014 to satisfy federal requirements.

The groundwater systems operate in accordance with the O&M manuals, while the Peconic and surface soil cleanup areas are monitored via the Soil and Peconic River S&M Plan. 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 OU 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. Employees are required to develop and sign their own Roles, Responsibilities, Accountabilities, and Authorities (R2A2) document, which must also be signed by two levels of supervision. BSA has clearly defined expectations for management and staff which must be included in this 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 EMS commitment to communication and community involvement, the Community, Education, Government and Public Affairs (CEGPA) Directorate develops best-in-class communications, science education, government relations, and community involvement programs that advance the science and science education missions of the Laboratory. CEGPA contributes to public understanding of science and 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. CEGPA also works to maintain relationships with BNL employees, key stakeholders, neighbors, elected officials, regulators, and other community members 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, CEGPA's Community Relations Office participates in or conducts on- and off-site meetings which include discussions, presentations, roundtables, and workshops. Community 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.

2.4.2.1 Communication Forums

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

- 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 composed of 27 member organizations and individuals representing civic, education, employee, community, environmental, and health interests. The CAC sets its own agenda in cooperation with the Laboratory and meets monthly. The CAC is one of the primary ways the Laboratory keeps the community informed. Meetings are open to the public and are announced in the monthly community e-newsletter, *LabLink*, on the BNL homepage calendar, and on the Community Relations website. 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 keep them up-to-date on project status and to provide feedback and input, as well as opportunities to discuss emerging environmental findings.
- The Community Relations Office website is used to host links to the CAC webpage, which contains meeting agendas and past meeting presentations and minutes, and also hosts links to important documents and announcements for public meeting dates. Community Relations also manages several outreach programs that provide opportunities for stakeholders to become familiar with the Laboratory's facilities and research projects, as well as new initiatives. 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 who conduct 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 2,350 visitors in 2012.

– *The Speakers' Bureau:* Speakers are provided for educational institutions and community organizations, such as Rotary Clubs, civic organizations, and professional societies, to update them on Laboratory research and operations accomplishments, including environmental stewardship.

– *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 2012, more than 5,400 visitors participated in the program.

The Laboratory participates in various outreach events throughout the year that include BNL's Earth Day celebration, off-site fairs and festivals, and workshops and conferences such as the Long Island Earth Summit, the Long Island Green Infrastructure Conference, Long Island Regional Economic Development Council, and the Suffolk County Planning Federation Conference. Brown bag lunch meetings, held periodically, cover topics of interest to employees, including project status 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 both electronic and print weekly employee newsletters – Brookhaven This Week and The Brookhaven Digest – that are geared toward employees with email access and those who do not have direct access to a computer. Also, 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 at *http://lists.bnl.gov/mailman/listinfo/bnl-announce-1*.

Community members who have questions or comments can submit them via the "Contact Us" form found on the Community Relations Office website at *www.bnl.gov/community/contact.asp.* Community members can also subscribe to the monthly e-newsletter, *LabLink*, found on the Community Relations webpage at *www.bnl.gov/lablink. LabLink* keeps the community informed about happenings at BNL, explains the science behind Laboratory research, and invites subscribers to educational and cultural events.

2.4.2.2 Community Involvement in Cleanup Projects

In 2012, BNL shared information with stakeholders on several environmental projects:

- *Brookhaven Graphite Research Reactor (BGRR):* Work on the dismantlement of the BGRR continued into 2012. Because of challenges removing the concrete bioshield, changes were made to the Work Plan and an ESD ROD was prepared. In January, presentations on the work plan change, which called for leaving a portion of the concrete floor in place, were provided to the CAC and BER. Additionally, the CAC was given updates on the equipment removal and waste shipments, and on water found in the deep pit from dust suppression activities associated with demolition of the bioshield. The CAC was also given a close-out report from the DOE project manager and were notified when the ESD was finalized. A Notice of Availability announcing the ESD was published in July 2012.
- *Operable Unit III Explanation of Significant Differences (ESD):* Following the 2011 discovery of Freon-11 in a monitoring well in the vicinity of Building 452 during

Table 2-4. Summary of BNL 2012 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	▪ Continued operation of 10 groundwater treatment systems that remove volatile organic compounds (VOCs) and two systems that remove strontium-90 (Sr-90). ▪ Began operation of a new treatment system to address trichlorofluoromethane (Freon-11) contamination in groundwater downgradient of Building 452, a site maintenance facility. An Explanation of Significant Differences (ESD) to the OU III Record of Decision (ROD) was issued in July 2012 to document this change to the OU III remedy. Began operation of a new extraction well to address deeper VOC contamination at the OU III south boundary. ▪ 239 pounds of VOCs and 1.9 mCi of Sr-90 were removed during the treatment of 1.5 billion gallons of groundwater. Since the first groundwater treatment system started operating in December 1996, approximately 6,948 pounds of VOCs and 27.5 mCi of Sr-90 have been removed, while treating over 19 billion gallons of groundwater. ▪ Collected and analyzed approximately 1,561 sets of groundwater samples from 662 monitoring wells. ▪ Installed several temporary wells and collected multiple samples from each location. ▪ Continued monitoring and operation of the High Flux Beam Reactor (HFBR) tritium pump and recharge system. ▪ Continued post-closure groundwater monitoring at the former Carbon Tetrachloride groundwater treatment system and OU IV. ▪ Continued monitoring the g-2 tritium plume using temporary and permanent monitoring wells.
Peconic River	OU V	▪ Performed seventh year of long-term post-cleanup monitoring of Peconic River surface water and sediment. ▪ Fish collection is now performed every other year. ▪ Performed monitoring and maintenance of the three excavated sediment locations within the Peconic River; this satisfied the State equivalency permit conditions.
Reactors	Brookhaven Graphite Research Reactor (BGRR)	▪ Completed removal and off-site disposal of the bioshield. An ESD for the BGRR ROD was issued to document a change to the completed end state. ▪ Completed transition of the BGRR long-term surveillance and maintenance program to the Environmental Protection Division (EPD).
	High Flux Beam Reactor (HFBR)	▪ Completed transition of the HFBR Stack and Grounds and Waste Loading Area long-term surveillance and maintenance program to EPD.
	Stack (Building 705)	▪ Removed stack silencers and shipped to disposal.
	Brookhaven Medical Research Reactor (BMRR) (Project managed by EPD)	▪ Continued surveillance and maintenance activities.
Buildings 810/811	Radiological Liquid Processing Facility (Project managed by EPD)	▪ Performed routine surveillance and maintenance of the facility. ▪ EPD removed and shipped the last of the 20,000-gal tanks from the facility to disposal. ▪ EPD emptied and decontaminated Building 810 for use as a propylene glycol recycling facility.
Building 801	Inactive Radiological Liquid Holdup Facility (Project managed by EPD)	▪ Performed routine surveillance and maintenance of the facility.
Building 650	Inactive Radiological Decon Facility (Project managed by EPD)	▪ Performed routine surveillance and maintenance of the facility.

routine sampling, further characterization was conducted and a change to the groundwater remedy for the Operable Unit (OU) III ROD was proposed. An ESD was prepared that outlined the addition of Freon-11 to the list of volatile organic compounds (VOCs) to be remediated under CERCLA and the Building 452 area was designated as Area of Concern (AOC) 32. The CAC and BER received presentations and updates on the construction of the groundwater treatment system and the ESD. The ESD was published in Long Island's *Newsday* on April 7, 2012.

In addition to the projects outlined above, stakeholders were updated on the progress of other environmental cleanup projects, additional initiatives, and health and safety issues via mailings and briefings and presentations given at CAC and BER meetings. These topics included:

- *Wastewater Treatment Modification Project:* As part on an ongoing State Pollutant Discharge Elimination System (SPDES) project that began in 2009 where BNL proposed to eliminate the discharge of its Sewage Treatment Plant effluent to the Peconic River and instead process wastewater through groundwater recharge basins, the CAC and BER received several updates on the design and construction status of this project.
- *The 2010 Site Environmental Report:* In January 2012, an overview of BNL's EMS ISO 14001 and OHSAS 18001 recertification, the Laboratory's Pollution Prevention program, waste generation, and energy management and conservation was provided. Information on compliance status, inspections, assessments, water monitoring, radiological and non-radiological air quality, and dose assessments was also presented.
- Following the detection of VOCs at deeper levels than anticipated and the 2010 CERCLA Five-Year Review recommendation that an additional extraction well be added to the OU III Southern Boundary groundwater treatment system, an update was given on the installation of the well and its impact on the ROD cleanup objectives for the Upper Glacial Aquifer.
- *The 2011 Site Environmental Report:* In October 2012, the CAC received a presentation on the Laboratory's environmental impact for the previous year. Updates on the Lab's EMS and opportunities for its improvement (outcomes of the annual assessment) and pollution prevention projects implemented during the year were provided. Statistics on waste generation, energy management and conservation, water quality, and air quality were also discussed.

Working closely with the community, employees, elected officials, and regulatory agency representatives, DOE and BNL continue to openly share information on issues, projects, and programs and welcome all input and feedback offered.

2.4.3 Monitoring and Measurement

The Laboratory monitors effluents and emissions to ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures. BNL's Environmental Monitoring
Program 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 monitoring program is reviewed and revised, as necessary or on an annual basis, 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 required under DOE Order 436.1, Departmental Sustainability, BNL prepares an Environmental Monitoring Plan, which outlines annual sampling goals by media and frequency. 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.

As shown in Table 2-5, in 2012 there were 7,800 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 monitoring data 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, accelerators, and other radiological emission sources, as well as the Central Steam Facility (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 authority. See Chapters 3 and 4 for details.
- *Wastewater monitoring* is performed at the point of discharge to ensure that the effluent

Table 2-5. Summary of BNL 2012 Sampling Program Sorted by Media.

Environmental Media	No. of Sampling Events(a)	Purpose
Groundwater	1,816 (b) 277 ES/C (c)	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, Groundwater Status Report for further detail.
On-Site Recharge Basins	128	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	47 ES 184 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)	388	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	16	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	363	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	498 ES/C 53 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.
Air – Charcoal	52	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. See Chapter 4 for further detail.

(continued on next page)

Table 2-5. Summary of BNL 2012 Sampling Program Sorted by Media *(concluded).*

Environmental Media	No. of Sampling Events(a)	Purpose
Fauna	63	Fish and deer are monitored to assess impacts on wildlife associated with past or current BNL operations. See Chapter 6 for further detail.
Flora	27	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	50	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	482	Samples are collected periodically from potable water fixtures and dispensers, manholes, spills, to assess process waters, and to assess sanitary discharges.
Groundwater Treatment Systems and Remediation Monitoring	1,019	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 14 operating groundwater treatment systems. See discussion in Chapter 7.
Vehicle Monitor Checks	216	Materials leaving the Laboratory pass through the on-site vehicle monitor that detects if radioactive materials are present. Any radioactive material discovered is properly disposed of through the Waste Management Program. The vehicle monitor is checked on a daily basis.
State Pollutant Discharge Elimination System (SPDES)	423	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	609	Flowcharts are exchanged weekly as part of BNL's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	110	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	744	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)	235	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
Total number of sampling events	**7,800**	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2009), 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.
(b) Includes 28 temporary wells; many of which are used to collect multiple samples at different depth intervals.
(c) Includes 50 temporary wells, many of which are used to collect multiple samples at different depth intervals.
C = Compliance
ER = Environmental Restoration (CERCLA)
ES = Environmental Surveillance

complies with release limits in the Laboratory's SPDES permits. Twenty-four point-source discharges are monitored under the BNL program: 12 under the Environmental Restoration Program and 12 under the SPDES permit. As required by permit conditions, samples are collected daily, weekly, monthly, or quarterly and monitored for organic, inorganic, and radiological parameters. Monthly reports that provide analytical results and an assessment of compliance for that reporting period are filed with the permitting agency. 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 and the RCRA permit for the Waste Management Facility. 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

Restoration monitoring is performed to determine the overall impact of past operations, to delineate the real extent of contamination, and to ensure that Removal Actions are effective and remedial systems are performing as designed under CERCLA.

This program typically involves collecting soil and groundwater samples to determine the lateral and vertical extent of the contaminated area. Samples are analyzed for organic, inorganic, and radiological contaminants, and the analytical results are compared with guidance, standards, cleanup goals, or background concentrations. Areas where impacts have been confirmed are fully characterized and, if necessary, remediated to mitigate continuing impacts. Follow-up monitoring of groundwater is conducted in accordance with a ROD with the regulatory agencies (see Chapter 7 and SER Volume II, Groundwater Status Report, for details).

2.4.3.3 Surveillance Monitoring

Pursuant to DOE Order 436.1, surveillance monitoring is performed in addition to compliance monitoring, to assess potential environmental impacts that could result from routine facility operations. The BNL Surveillance Monitoring Program involves collecting samples of ambient air, surface water, groundwater, flora, fauna, and precipitation. Samples are analyzed for organic, inorganic, and radiological contaminants. Additionally, data collected using thermoluminescent dosimeters (devices to measure radiation exposure) strategically positioned on and off site are routinely reviewed under this program. Control samples (also called background or reference samples) are collected on and off 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 media-specific 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, audits are conducted as part of BNL's Self-Assessment Program. The audits are designed to ensure that any nonconformance to the ISO 14001 Standard is identified and addressed. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and focused compliance audits. BNL's Self-Assessment Program consists of several processes:

- *Self-assessment* is the systematic evaluation of internal processes and performance. The approach for the environmental self-assessment program includes evaluating programs and processes within organizations that

have environmental aspects. Conformance to the Laboratory's EMS requirements is verified, progress toward achieving environmental objectives is monitored, operations are inspected to verify compliance with regulatory requirements, and the overall effectiveness of the EMS is evaluated. BNL environmental staff routinely participate in these assessments. Laboratory management conducts assessments to evaluate BNL environmental performance from a programmatic perspective, to determine if there are Laboratory-wide issues that require attention, and to facilitate the identification and communication of "best management" practices used in one part of the Laboratory that could improve performance in other parts. BNL management also 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.

- *Independent assessments* are 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. 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 also conducted to identify the root causes of problems, as well as identify corrective actions and lessons learned.

The Laboratory's Self-Assessment Program is augmented by programmatic, external audits conducted by DOE. BSA staff and subcontractors also perform periodic independent reviews. An independent third party conducts ISO 14001 registration audits of BNL's EMS. The Laboratory is also 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 ongoing 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 infor-mation 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. Audits have consistently observed a high level of management involvement, commitment, and support for environmental protection and the EMS.

For more than 50 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. The Laboratory's environmental motto, which was generated in an employee suggestion contest, is "Exploring Earth's Mysteries … Protecting Its Future," and reflects the Laboratory's desire to balance world-class research with environmentally responsible operations.

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