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 2011, 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 2011, pollution prevention projects resulted in more than $2.1 million in cost avoidance or savings and resulted in the reduction or reuse of approximately 15.7 million pounds of waste. Also in 2011, the BNL Pollution Prevention Council funded three new proposals or special projects, investing approximately $21,000. Anticipated annual savings from these projects are estimated at approximately $20,300, for an average payback period of approximately 1 year. 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 Environmental Restoration Projects 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 May 2011 (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 and one Opportunity for Improvement. The Minor Nonconformance resulted from misidentified or omitted aspects for the NASA Space Radiation Laboratory. The Opportunity for Improvement was for clarifying that the "core" environmental aspect category of waste generation should include solid wastes such as cardboard, recyclables, food waste, trash, etc. The Minor Nonconformance and Opportunity for Improvement identified are being addressed and 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 2011.

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 2011 (October 1, 2010 through September 30, 2011), 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.

Table 2-1. EO 13514 Goals: Status Summary Table for Fiscal Year (FY) 2011.

DOE Goal	FY 2011 BNL Performance Status	BNL Planned Actions
28 percent Scope 1 and 2 Greenhouse Gas reduction by FY 2020 from a FY 2008 baseline	▪ FY 2008: 205,3542 ▪ FY 2011: 211,183 Percent Change: 6.5 ▪ FY 2011 (adjusted for Hydro): 166,174 Percent Change: 21.3	▪ Hydro power, Long Island Solar Farm R&D PV Array combined heat and power - 200 percent reduction; Renewable Energy Credits to meet renewable energy requirement. ▪ Electrical distribution electricians will receive enhanced training to use a TIF Refrigerant Leak Detector to proactively scan high energy electrical equipment for SF6 leaks during periodic preventative maintenance inspections. ▪ Develop plan modeled after BNL's Refrigerant Management Plan to track repairs of identified SF6 leaks from periodic preventative maintenance inspections and to perform follow-up inspections to confirm that leak repairs are effective.

(continued on next page)

Table 2-1. EO 13514 Goals: Status Summary Table for Fiscal Year (FY) 2011 *(continued).*

DOE Goal	FY 2011 BNL Performance Status	BNL Planned Actions
30 percent energy intensity reduction by FY 2015 from a FY 2003 baseline	▪ FY 2003: 323,780 Btu/GSF ▪ FY 2011: 311,445 Btu/GSF Percent Change: 3.5	Energy Conservation Measures: minimum 30 percent reduction through use of HVAC setback, steam charge-back to users, and lighting upgrades.
Individual buildings or processes metering for 90 percent of electricity by 10/01/2012; 90 percent of steam, natural gas, and chilled water by 10/01/2015, where life-cycle cost effective. BNL may also report on potable and chilled water, as applicable.	BNL exceeds targets for metering.	Advanced steam and water metering to be installed, where appropriate.
Use cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30.	▪ All re-roofing installed in FY 2011 met ASHRAE requirements for cool roofs; however, because they were all existing roofs, none were economically feasible to upgrade to R-30, based on site conditions. ▪ BNL standards and specifications were upgraded to identify the cool roof requirements.	All roofing installed in FY 2012 will meet ASHRAE requirements for cool roofs and will be upgraded to the maximum "R" value that is economically feasible.
7.5 percent of annual electricity consumption from renewable sources by FY 2013 and thereafter; 5 percent by FY 2010-2012.	▪ BNL is currently purchasing renewable energy credits. ▪ The Long Island Solar Farm began operations on 11/01/11 and 40+ million kWh/yr of power will be generated on the Laboratory site; however, none of the power will be consumed by BNL.	▪ Combined heat and power facility and potential use of biomass feasibility study, as well as a wind energy feasibility study. ▪ Continue bio-based fuel for satellite boilers.
10 percent annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline.	Alternative fuel usage as a percent of overall fuel consumption went from 24.2 percent in FY 2010 to 31.6 percent in FY 2011.	▪ Target is 100 percent alternative fuel usage for all alternative fuel vehicles. ▪ Targeting alternative fuel vehicles where high mileage travel is necessary.
2 percent annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline.	Construction activity presented challenges in FY 2001; down 33 percent from FY 2005 baseline.	Evaluating current fleet size and eliminating non alternative fuel vehicles where possible.
75 percent of light duty vehicle purchases must be alternative fuel vehicles by FY 2000 and thereafter; 100 percent beginning in FY 2015.	40.5 percent of Laboratory vehicles are alternative fuel vehicles in FY 2011.	▪ Continue to procure alternative fuel vehicles at a rate determined by budget. ▪ Purchase hybrid vehicles, as appropriate. ▪ Conduct an assessment of alternative fuel vehicle campus.
Reduce fleet inventory by 35 percent within the next 3 years relative to a FY 2005 baseline.	10 percent reduction in FY 2011; goal was 15 percent and waiver was obtained by DOE.	Evaluate and assure correct fleet capacity.
13 percent Scope 3 Greenhouse Gas reduction by FY 2020 from a FY 2008 baseline.	▪ FY 2008: 10,700 ▪ FY 2011: 11,506 Percent Change: 7.5 ▪ Human Resources met with multiple focus groups to identify obstacles to employee participation and manager approval of alternative work schedules. ▪ It is uncertain if Long Island Solar Farm contributes in this category and is being reviewed by the Federal Energy Management Program.	▪ Human Resources to present recommendations to BNL Policy Council based on focus group findings. ▪ Human Resources will expand alternative work schedules and assess airline travel data and options. ▪ A Commuter Challenge will be rolled out in the Spring of 2012. ▪ The Travel Office and the Environmental Protection Division will further define impacts of proposed airline travel reduction options on individual organizations for BNL Policy Council consideration.
15 percent of existing buildings greater than 5,000 gross square feet are compliant with the Guiding Principles of HPSB by FY 2015.	Audit of 26 buildings completed and buildings have been selected to meet the 15 percent requirement.	▪ Plans to meet the 15 percent goal continue on schedule with selected actions on chosen buildings. ▪ Sustainable practices and policies will continue to be implemented.

(continued on next page)

Table 2-1. EO 13514 Goals: Status Summary Table for Fiscal Year (FY) 2011 *(concluded).*

DOE Goal	FY 2011 BNL Performance Status	BNL Planned Actions
All new construction, major renovations, and alterations of buildings greater than 5,000 gross square feet must comply with the Guiding Principles and where work exceeds $5 million, and each are LEED® -NC Gold certified or equivalent.	Construction of the Interdisciplinary Science Building I (ISB I) and Research Science Labs II (RSL II) began in FY 2011.	▪ No new building projects, major renovations, or alterations of buildings exceeding 5,000 gross square feet are expected to begin in FY 2012. ▪ FY 2017: ISB II ▪ FY 2020: ISB II ▪ FY 2021: Central Computing ▪ FY 2021: RSL II ▪ FY to be determined: Renovate Building 462.
26 percent water intensity reduction by FY 2020 from a FY 2007 baseline.	▪ Water use up 26 percent since 2007 due to increased cooling needs. ▪ BNL focused heavily on water conservation prior to FY 2007; water use is down since 1999.	▪ Continue to practice cost-effective water conservation. ▪ Implement the groundwater recharge project, which will replenish over 70 percent of BNL's water usage.
20 percent water consumption reduction of industrial, landscaping, and agricultural water by FY 2020 from a FY 2010 baseline.	No landscaping or agricultural water usage in FY 2011.	No actions are planned.
Divert at least 50 percent of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015.	▪ FY 2011 diversion was 48 percent. ▪ Composting programs are active for animal bedding and cafeteria organic matter. ▪ Chemical Management System has been enhanced.	▪ Evaluate Pollution Prevention Tracking and Reporting System and establish metrics. ▪ Inspect waste streams from different locations to assess recycling efforts. ▪ Work with janitorial staff to increase recycling awareness. ▪ Appraise contractor compliance with reporting recycling activities. ▪ Maintain and continuously improve chemical inventory system and chemical redistribution program. ▪ Evaluate Emergency Planning and Community Right-to-Know Act reports, chemical management system, ozone-depleting substances, and greenhouse gas inventories to identify chemicals of concern and potential opportunities for pollution prevention. ▪ Establish policy for unrestricted release of materials.
Divert at least 50 percent of construction and demolition materials and debris by FY 2015.	95 percent of construction and demolition materials are recycled.	Start a pallet recycling program.
Procurements to meet sustainability requirements and include sustainable acquisition clause (95 percent each year)	▪ Requirements for Sustainable Acquisition have been incorporated into all Procurement and Property Management Terms and Conditions. ▪ Based on BNL's Pollution Prevention Tracking and Reporting System database, BNL has had a policy in place to procure Electronic Product Environmental Assessment Tool (EPEAT)-certified systems for a number of years; when the systems come from the vendor, the Energy Star settings are already in place.	Purchase Energy Star-rated desktop and laptop computers and monitors, where feasible.
All data centers are metered to measure the monthly Power Utilization Efficiency (100 percent by FY 2015).	Significant progress made and additional metering in process.	Review meter data.
Maximum annual weighted average Power Utilization Efficiency of 1.4 by FY 2015.	Current maximum annual weighted average Power Utilization Efficiency is 1.8.	▪ Completion of data center study will focus on obtaining Power Utilization Efficiency of < 1.4. ▪ Finalize report by 12/2011. ▪ Develop funding strategy, as required, based on final report.
Electronic Stewardship: 100 percent of eligible personal computers, laptops, and monitors with power management actively implemented and in use by FY2012.	LANDesk Management Suite deployed across all Windows systems in BNLs site-wide authentication domain.	Although initial installation exceeds requirements, BNL will evaluate the feasibility of extending the desktop computer power management policy currently in place.

- 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 continuing to dispose of excess facilities, materials, and chemicals, and to support 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 2011.

2.3.4.3 Waste Management

As a byproduct of the world-class research it conducts, BNL generates a 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 three staging areas: a facility for hazardous waste (Building 855), regulated by RCRA; a mixed-waste building for material that is both hazardous and radioactive (Building 870); and a reclamation building for radioactive material (Building 865). The RCRA and mixed-waste buildings are managed under a permit issued by the New York State Department

of Environmental Conservation (NYSDEC). These buildings are used for short-term storage of waste before it is packaged or consolidated for off-site shipment to permitted treatment and disposal facilities. 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. To effect the closure of the mixed waste building, the Laboratory has submitted a closure report to NYSDEC, which includes the required sampling and analytical results to document that operations at that facility have not impacted the environment. When approved, BNL will submit a permit modification request to NYSDEC to remove the building from the Laboratory's NYSDEC RCRA Permit.

In 2011, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 4.7 tons
- Mixed waste: 22 ft^3
- Radioactive waste: 2,574 ft^3

Hazardous waste from routine operations in 2011 was basically unchanged from 2010 generation rates, as shown in Figure 2-1a. Mixed waste generation decreased slightly, as shown in Figure 2-1b, and can be attributed primarily to fluctuations in operations and material substitutions. As shown in Figure 2-1c, the radioactive waste quantity for routine operations decreased significantly. This is primarily attributed to decreases in radioactive liquid generation. The primary contributor to this waste stream remains the Collider Accelerator

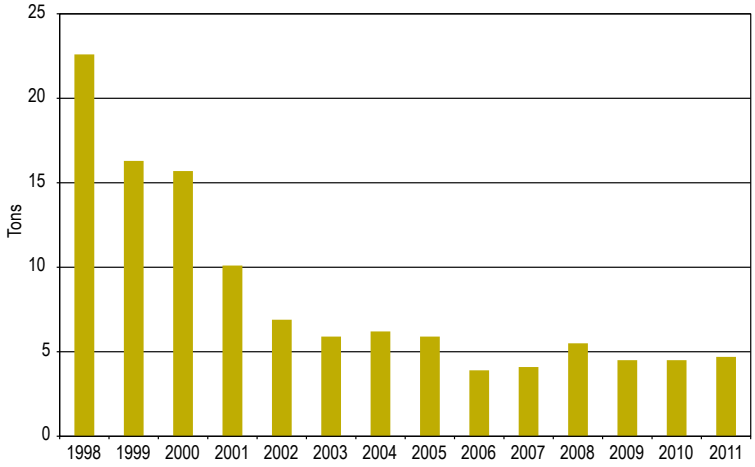

Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1998 – 2011.

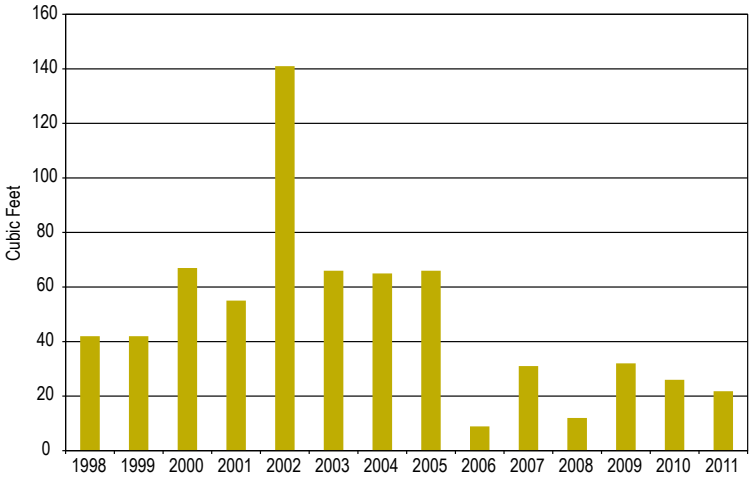

Figure 2-1b. Mixed Waste Generation from Routine Operations, 1998 – 2011.

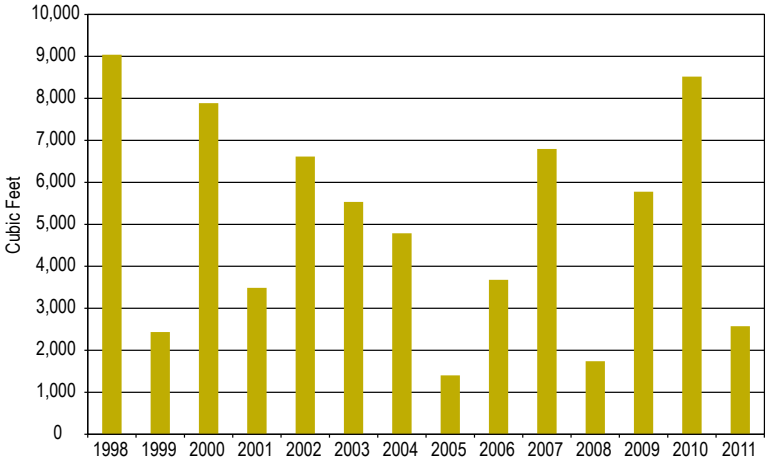

Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1998 – 2011.

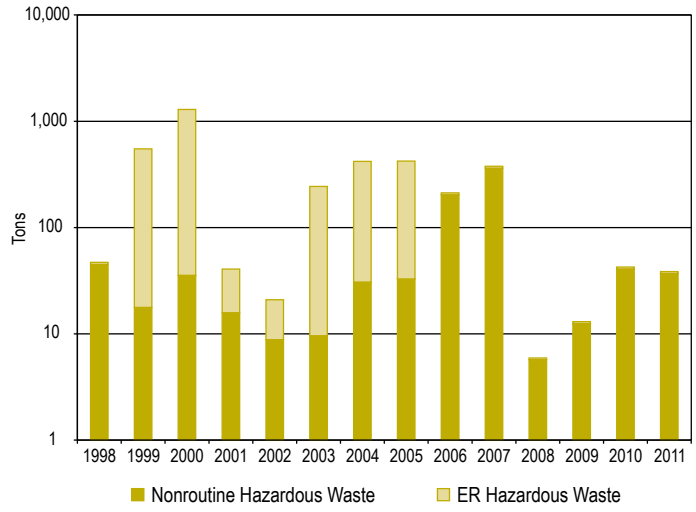

Figure 2-1d. Hazardous Waste Generation from ER and Nonroutine Operations, 1998 – 2011.

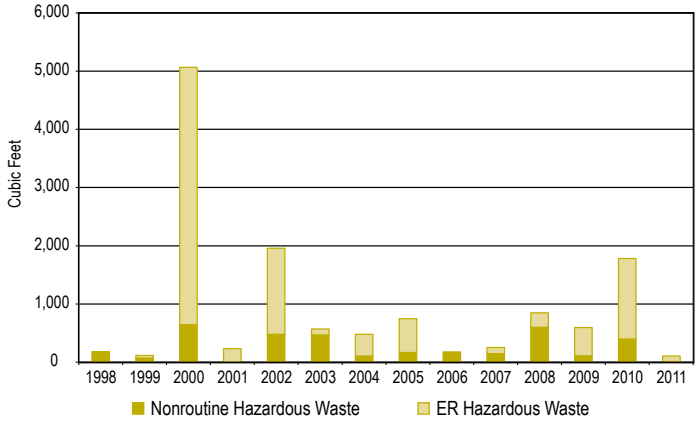

Figure 2-1e. Mixed Waste Generation from ER and Nonroutine Operations, 1998 – 2011.

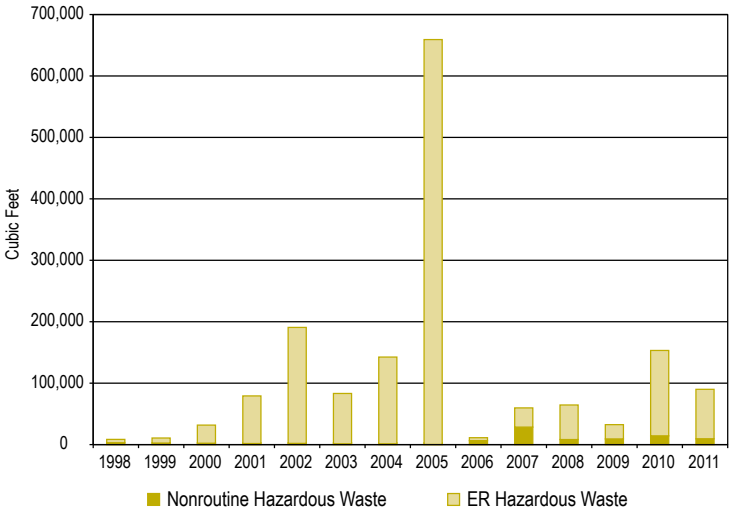

Figure 2-1f. Radioactive Waste Generation from ER and Nonroutine Operations, 1998 – 2011.

Department (CAD), which generated less material from beamline maintenance in 2011. 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 2011, BNL's EPD continued to reduce the inventory of legacy waste materials through laboratory cleanouts. Restoration and decommissioning activities included the continued removal of High Flux Beam Reactor (HFBR) and BGRR components. 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 was expected, as various remedial actions were 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

Twelve P2 proposals were submitted to the BNL P2 Council for funding in FY 2011. Three proposals were funded, for a combined investment of approximately $21,000. The anticipated annual savings from these projects is estimated at $20,300, for an average payback period of approximately 1 year. 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 2011, 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 2011, these efforts resulted in more than $2.1 million in cost avoidance or savings and approximately 15.7 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 2011, BNL collected approximately 186 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 2011.

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.

The 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 12-year trend of water consumption. Total water consumption for 2011 was approximately 14 million gallons less than in 2010. 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 1998 total — a reduction of nearly a half-billion gallons per year.

2.3.4.6 Energy Management and Conservation

Since 1979, the Laboratory's Energy Management Group has been working to reduce energy use and costs by identifying and implementing

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2011	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details *
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.
LED lighting in Building 490 Conference Room	Energy Conservation	N/A	Greenhouse Gas / Energy Conservation/ Manpower	$2,940	$4,000	$3,710	Forty 65-watt incandecent bulbs were replaced with LED bulbs; savings of $1,190 per year in energy costs and $2,520 per year manpower costs.
Sewage sludge	Publicly Owned Treatment Works (POTW)	3,000	Low-level Radiological Waste	$500,000	$35,000	$465,000	Rad constituents were eliminated from within the Sewage Treatment Facility; the sludge is now sent to a POTW.
Alkaline batteries	Recycling	174	Industrial Waste	$10	$0	$10	Two hundred pounds of alkaline batteries were collected and sent for recycling.
Bio-diesel tank	Alternative Fuels	0	Greenhouse Gas / Energy Conservation	$0	$0	$0	Per DOE Order, BNL is utilizing different alternative fuels to operate maintainance vehicles.
Motion sensors for 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.
Aerosol can disposal system	Recycling	528	Hazardous Waste	$42,708	$0	$42,708	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 recycling	Electronic Recycling	39,880	Electronic Waste	$99,700	$0	$117,238	After an extensive audit review, BNL's electronic waste (e-waste) is now collected by the Laboratory's metals recycler, which gurantees that all e-wate is recycled in the most environmentally friendly manor.
Electronic Reuse	Reuse	23,287	Electronic Waste	$58,218	$0	$58,218	The Laboratory tracks electronic equipment and takes a reuse credit for transfer of equipment to another user.

(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 2011	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details *
Building demolition recycling	Recycling	14,000,000	Industrial Waste	$540,190	$32,000	$508,190	On-site demolition products (steel and concrete) are segregated, recycled, and reused.
System One parts cleaner	Substitution	1,280	Hazardous Waste	$10,677	$0	$10,677	Central Fabrications and Motor Pool each purchased a System One parts washer to re-distill dirty solvent, eliminating the need for a vendor. Removed grit and sludge are mixed with the waste oil.
Animal bedding conveying system	Composting	74,000	Low-level Radiological Waste	$780,192	$0	$780,192	Animal bedding material is no longer sent to sanitary landfill; it is now conveyed to a dumpster that is emptied or composted at the stump dump.
Lead acid batteries	Recycled	4,200	Universal Waste	$29,896	$0	$29,896	Avoids hazardous waste disposal costs for approximately 40 lbs. of lead per battery.
Short half-life waste - CA	Decay in Storage	142	Radioactive Waste	$48,848	$0	$48,848	During 2011, 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.
Short half-life waste - MO	Decay in Storage	40	Radioactive Waste	$1,640	$0	$1,640	During 2011, 5 gallons of low-level radioactive waste were managed as Regulated Medical Waste in accordance with BNL decay-in-storage requirements, rendering the wastes eligible for volumetric release.
Cooling Tower chemicals	Source Reduction	4,000	Industrial Waste	$9,000	$0	$9,000	Ozone water treatment units were installed on cooling towers at the National Space Radiation Laboratory 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.
Blasocut machining coolant	Recycled/ Reused	45,280	Industrial Waste	$110,580	$0	$120,180	Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it Laboratory-wide. In 2011, 5,660 gal. (45,280 lb.) of Blasocut lubricant were recycled. Recycling involves aeration, centrifuge, and filtration.

(continued on next page)

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2011	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details *
Fluorescent bulbs	Recycled	20,220	Universal Waste	$143,926	$20,000	$123,926	Fluorescent bulbs are collected and sent to a recycling facility under the Universal Waste exemption rule.
Tyvek	Recycled	92	Industrial Waste	$4	$0	$11	BNL is recycling tyvek through Garment Recovery Systems.
Used motor oil	Energy Recovery	11,320	Industrial Waste	$28,130	$0	$28,130	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 2011, they collected 1,415 gallons of oil at no charge to BNL, which avoided the costs for disposal and 29 shipping drums ($50/drum).
Office paper	Recycled	372,000	Industrial Waste	$17,670	$0	$25,110	Cost avoidance based on $95/ton for disposal as trash.
Cardboard	Recycled	252,000	Industrial Waste	$11,970	$0	$15,750	Cost avoidance based on $95/ton for disposal as trash, plus $30/ton revenue.
Electronic Waste	Recycled	39,800	Industrial Waste	$1,891	$0	$19,393	Cost avoidance based on $95/ton for disposal as trash, plus $200/ton revenue.
Metals	Recycled	241,400	Industrial Waste	$11,467	$0	$117,626	Cost avoidance based on $95/ton for disposal as trash, plus $200/ton revenue.
Bottles/cans	Recycled	45,000	Industrial Waste	$2,138	$0	$2,138	Cost avoidance based on $95/ton for disposal as trash.
Construction debris	Recycled	512,000	Industrial Waste	$14,080	$0	$11,520	Cost avoidance based on $45/ton difference for disposal as trash.
	TOTALS	15,687,283		$1,972,933	$52,000	$2,086,216	

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

Table 2-3. BNL Recycled Program Summary.

Recycled Material	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Mixed paper	209	182	185	193	184	177	151	127	174	186
Cardboard	157	176	179	143	135	121	147	152	141	126
Bottles/Cans	19	23	22	22.1	27.7	24.4	19.6	23.7	24	22.5
Tires	3.5	12.3	11	12.8	32.5	19.9	34.5	15.5	10.1	9.2
Construction debris	304	334	367	350	297	287	302	312	416	256
Used motor oil (gallons)	1,920	3,920	3,860	4,590	2,780	2,020	1,500	1,568	1,700	1,145
Metals	48	193	128	559	158	382	460	91	131	84
Lead	0	0	5	0	0	0	0	0	0	36.7
Automotive batteries	6.3	4.6	5	4.6	5.5	2.5	2.7	4	1.6	2.1
Printer/Toner cartridges (units)	449	187	105	0	0	0	3,078	1,251	4,132	4,186
Fluorescent bulbs (units)	25,067	13,611	12,592	7,930	11,740	25,448	36,741	10,223	8,839	20,220
Blasocut coolant (gallons)	8,180	5,030	6,450	3,890	3,970	2,432	3,340	3,810	4,830	5,660
Antifreeze (gallons)	0	165	325	0	0	0	0	0	0	0
Tritium exit signs (each)	28	181	142	0	0	0	0	0	0	18
Smoke detectors (each)	40	0	0	0	0	0	0	0	0	0
Road base	2,016	0	2,666	0	0	0	0	0	0	0
Electronic reuse	0	0	0	0	0	0	16.3	11.4	12	11.6
Scrap electronics	0	0	0	6.1	70.3	40.5	48.9	17	16.7	19.9
Animal Bedding (composted)	0	0	0	0	6.3	19.6	42	41	52	54
Tyvek (lbs)	0	0	0	0	0	0	0	84	60	92
Metals (building demolition)	8	23	11	6	35	0	0	0	0	0
Concrete (building demolition)	891	590	3,000	328	5,505	6,175	0	0	4,050	0
Other construction and debris (building demolition)	790	388	1,200	157	818	0	0	0	0	0

Notes:
All units are tons unless otherwise noted.

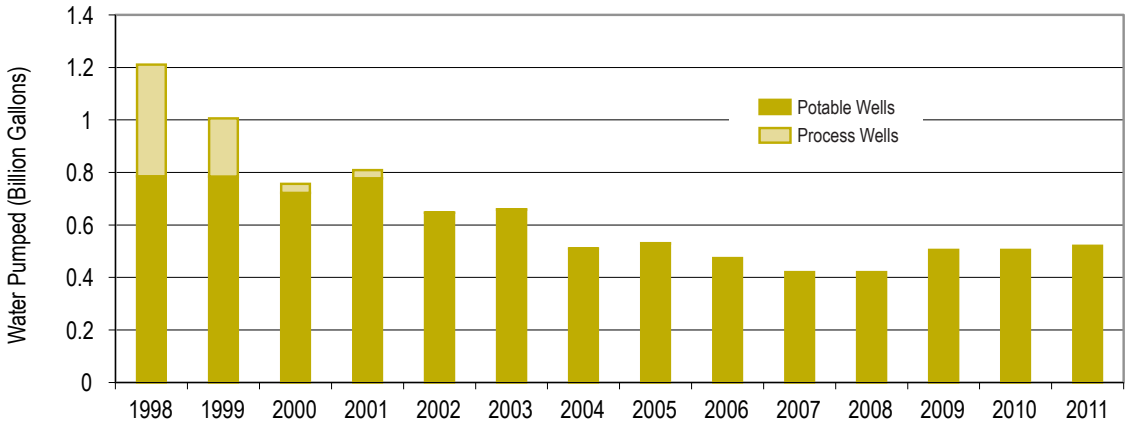

Figure 2-2. BNL Water Consumption Trend, 1998–2011.

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, Departmental Sustainability; 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 2011, the Laboratory used approximately 271 million kilowatt hours (kWh) of electricity, 170,000 gallons of fuel oil, 21,000 gallons of propane, and 647 million ft^3 of natural gas. Fuel oil and natural gas produce steam at the Central Steam Facility (CSF). Responding to market conditions, fuel oil and natural gas were used whenever each respective fuel was least expensive. However, wherever 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 3,000 gallons of biofuels were used in several applications.

BNL is a participant 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. No curtailment days were required in 2011, but the Laboratory participated in some test exercises. Limited participation in this program produced a rebate of $34,000. 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 2011, 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 $24.5 million in 2011. The Laboratory will continue to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs.

Also 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. As an outcome of constructing this large array on site, BP Solar and 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 will install 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:

- NYPA Power Contract: Received final approval for 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.

- DOE Sustainability Initiative: Provided 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 2011 SSP, including: new electric and steam meter installations; implementation of a temperature set-back policy; funding for energy conservation initiatives; new energy-efficient lighting installed in parking lots and offices; purchase of Renewable Energy Credits (RECs) in meeting the SSP goal; continued development of a steam recharge program; training various parties on energy conservation initiatives and the set-back policy; and development of an Energy Services Company (ESCo) for BNL's Utility Energy Services Contract (UESC).
- Utility Energy Services Contract: Major support to DOE/BHSO in developing a UESC, which included a preliminary audit and significant progress towards completing a follow-on Investment Grade Audit (IGA). 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 2012. A UESC process was started and a preliminary energy audit is underway.
- 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.
- Renewable Energy: Provided project support to BHSO for the LISF Project, including: various evaluations; project plans; work permits; digging permits; general work coordination; presentations; hosted tours and escorted engineering and construction personnel; and provided project management for the Building 30 Renewable Energy demonstration project, which is on line and operating.
- 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 National Synchrotron Light Source (NSLS) and the data center, using modern energy-efficient chillers.
- Natural Gas Purchase Contract: This project is estimated to save $2.7 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.
- BNL PV Research Array: Provided conceptual design for BNL 1 MW research array.

Due to continued conservation efforts, overall facilities energy usage for FY 2011 was approximately 4 percent less than in FY 2003, saving over $1 million. The increase in energy intensity compared to 2010 was due in part to weather, as well as increased activity on site associated with several major construction projects. 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 2011 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 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 Labo-

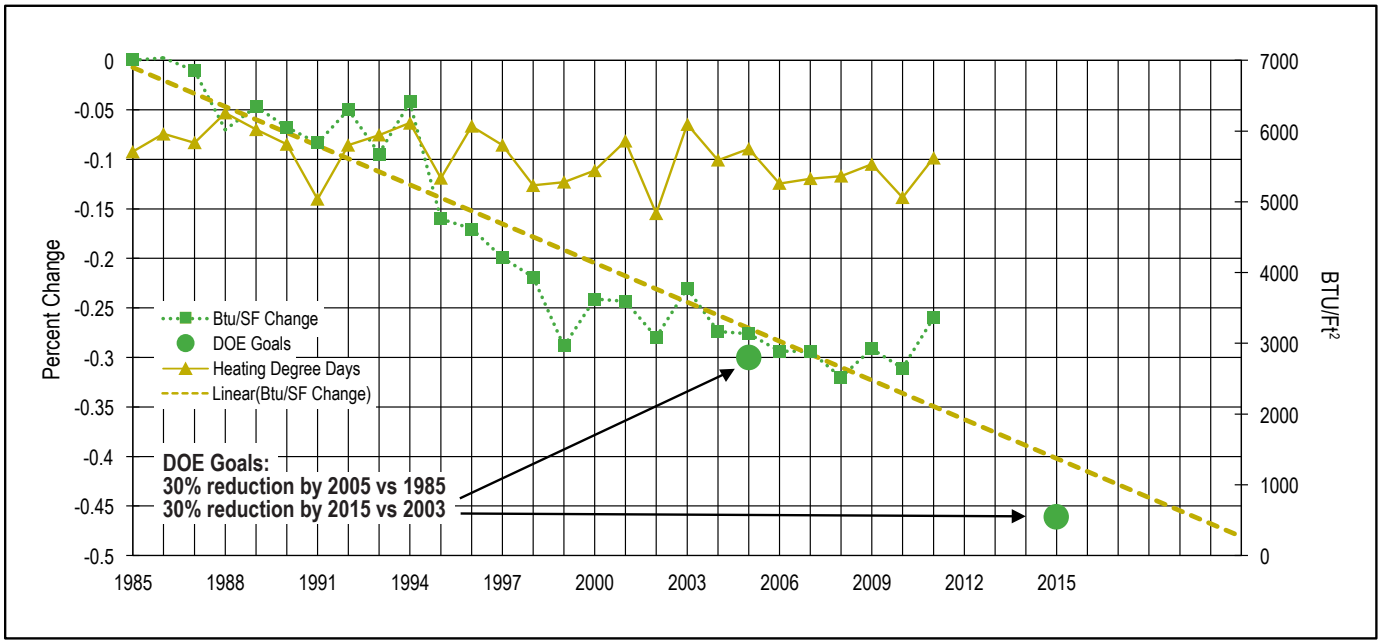

Figure 2-3. BNL Building Energy Performance (BTU/FT² Change % vs. Baseline Years).

ratory 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 best 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 2011, significant work was performed for the BGRR, HFBR, 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 continued through 2011. 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. The removal work will be complete in May 2012. Installation of the water infiltration control system (engineered cap) began in December 2010 and was completed in May 2011. The cap consists of a 40-mil high density polyethylene (HDPE) geomembrane, a sand protection layer, geotextile, and asphalt. The cap also included the installation of two concrete pads adjacent to the Building 701 east and west roll-up doors.

As a result of funding made available through ARRA, near-term activities identified in the HFBR ROD were completed in 2011. These include dismantling the fan house buildings and removal of the stack silencer baffles. The ROD requires that these near-term actions be completed no later than 2020. In accordance with the ROD, the demolition of the HFBR stack will be completed prior to 2020.

The productive operation and maintenance (O&M) of the Laboratory's groundwater treatment systems removed approximately 156 pounds of solvents and 2.9 mCi of strontium-90 (Sr-90) from the sole source aquifer in 2011. Since the operation of the first treatment system in 1996, a cumulative total of approximately 6,708 pounds of solvents and 26 mCi of Sr-90 have been removed from the groundwater.

Other work performed in 2011 included the start-up of four additional extraction wells serving the Brookhaven Graphite Research Reactor/Waste Concentration Facility Groundwater Treatment System to remediate the downgradient high concentration area of Sr-90. A new Area of Concern (AOC 32) was proposed to the regulators as a result of the identification of the refrigerant Freon-11 (trichlorofluoromethane) in groundwater downgradient of Building 452, a site maintenance facility. Due to the high concentrations, an additional groundwater treatment system was constructed in 2011 to address this plume. To formally document this action in a ROD, an Explanation of Significant Differences (ESD) to the Operable Unit (OU) III ROD will be prepared for submittal to the regulators. The ESD is expected to be approved and finalized by July 2012.

Post-cleanup monitoring of Peconic River surface water, sediment, fish, and wetland vegetation continued, and the results were reported in the Annual Peconic River Monitoring Report (see Chapter 6.) Sediment remediation of three small areas of the Peconic River with continued elevated concentrations of mercury was completed in February 2011. This was followed by revegetation of the restored areas in the summer of 2011. Continued monitoring of the restored wetland areas will be conducted in accordance with the 2010 Equivalency Permit.

The groundwater systems operate in accordance with the O&M manuals, while the Peconic and surface soil cleanup areas are monitored via the OU I Soils and OU V Long-Term Monitoring and Maintenance 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. In addition to the annual evaluation, a second comprehensive Five-Year Review Report was reviewed and approved by the regulators. The review evaluated the protectiveness of the various remedies implemented on site, and the report was made available on the BNL website in December 2011.

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

Communication and community involvement are commitments under BNL's EMS. The Laboratory maintains relationships with its employees, key stakeholders, neighbors, elected officials, regulators, and other community members. The goals are to provide an understanding of BNL's science and operations, including environmental stewardship and restoration activities, and to incorporate community input into the Laboratory's decision making.

BNL staff participates in or conducts: on- and off-site meetings, which include discussions, talks, presentations, and roundtables; workshops; local civic association meetings; canvassing surrounding neighborhoods; Laboratory tours; and informal information sessions and formal public meetings held during public comment periods for environmental projects.

2.4.2.1 Communication Forums

To facilitate 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 the Laboratory Director and members of the Laboratory's management team, primarily on environmental, health, and safety issues related to BNL that are of importance to the community. The CAC is composed of approximately 25 member organizations and individuals representing business, 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. Meeting

Table 2-4. Summary of BNL 2011 Environmental Restoration Activities.

Project	Description	Environmental Restoration Actions
Soil Projects	Operable Unit (OU) I/II/III/VII (CERCLA)	▪ Completed and posted the approved final Five-Year Review for all projects to the BNL website. ▪ Performed monitoring and maintenance of institutional controls for cleanup areas.
Groundwater Projects	OU III (CERCLA)	▪ Continued operation of 10 groundwater treatment systems that remove volatile organic compounds (VOCs) and two systems that remove strontium-90 (Sr-90). ▪ 156 pounds of VOCs and 2.9 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 6,708 pounds of VOCs and 26 mCi of Sr-90 have been removed, while treating over 19 billion gallons of groundwater. ▪ Collected and analyzed approximately 1,500 sets of groundwater samples from 662 monitoring wells. ▪ Installed 28 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 Operable Unit (OU) IV. ▪ Began operation of four additional Sr-90 extraction wells that are necessary to achieve cleanup goals. ▪ Continued monitoring the g-2 tritium plume using temporary and permanent monitoring wells. ▪ A new Area of Concern (AOC 32) was proposed to the regulators as a result of the identification of the refrigerant Freon-11(trichlorofluoromethane) in groundwater downgradient of Building 452, a site maintenance facility. The plume was characterized using 41 temporary wells. Due to the high concentrations of Freon-11 in the groundwater, a new groundwater treatment system was constructed. To formally document this action, an Explanation of Significant Differences to the OU III ROD will be prepared for submittal to the regulators in 2012.
Peconic River	OU V (CERCLA)	▪ Performed sixth year of long-term post-cleanup monitoring of Peconic River surface water, sediment, and fish. ▪ Performed revegetation of the excavated sediment locations within the Peconic River. ▪ Monitoring and maintenance of these wetland areas will continue in accordance with the equivalency permit.
Reactors	Brookhaven Graphite Research Reactor (BGRR) (CERCLA)	▪ Installed engineered cap. ▪ Removed inner steel and concrete of Bioshield. ▪ Shipped generated waste to disposal.
	High Flux Beam Reactor (HFBR) (CERCLA)	▪ Continued surveillance and maintenance activities.
	Stack (Building 705) (CERCLA)	▪ Continued surveillance and maintenance activities. ▪ Removed stack silencers and shipped to disposal.
	Brookhaven Medical Research Reactor (BMRR) (Non-CERCLA)	▪ Continued surveillance and maintenance activities.
Buildings 810/811	Radiological Liquid Processing Facility (Non-CERCLA)	▪ Performed routine surveillance and maintenance of the facility. ▪ Removed and shipped the last of the 20,000-gal tanks from the facility to disposal. ▪ Emptied and decontaminated Building 810 for use as a propylene glycol recycling facility.

(continued on next page)

Table 2-4. Summary of BNL 2011 Environmental Restoration Activities *(concluded).*

Project	Description	Environmental Restoration Actions
Building 801	Inactive Radiological Liquid Holdup Facility (Non-CERCLA)	▪ Performed routine surveillance and maintenance of the facility.
Building 650	Inactive Radiological Decon Facility (Non-CERCLA)	▪ Performed routine surveillance and maintenance of the facility.

schedules and agendas are published on the Community Relations website and in our monthly e-newsletter, *Lab Link*, and are open to the public. An opportunity for comments from the public is provided at each meeting. Organizations interested in participating on the CAC are encouraged to attend meetings and voice their interest in becoming a member.

- Bi-weekly phone calls with federal, state, and local regulators keep them up-to-date on project status and 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 cleanup documents and announcements for public meeting dates. Local elected officials and their staff are provided with up-to-the-minute information and updates on environmental issues and research breakthroughs by the State & Local Government Affairs manager. As a result, a number of tours and events are held, such as the 2011 February State of the Lab announcement, which brought many visitors to BNL for the first time.
- The Community Relations Office 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*: This program offers the opportunity for college, university, professional, and community groups to learn about BNL. 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.
  - *The Speakers' Bureau*: This program provides speakers for educational and other organizations, such as Rotary Clubs, civic organizations, professional societies, and other groups, to update the community about Laboratory research and operations accomplishments, including environmental stewardship.
  - *Summer Sundays*: This program enables the public to visit BNL science facilities, experience hands-on activities, and learn about research projects and environmental stewardship activities.
- The Laboratory participates in various annual events, such as BNL's week-long celebration in honor of Earth Day, off-site Earth Day fairs and festivals, and the William Floyd Summit Night Out.
- Brown bag lunch meetings, held periodically, cover topics of interest to employees, including project status updates, newly proposed initiatives, wildlife management concerns, and benefits information.
- Lunchtime tours are held once a month and offer employees the opportunity to learn

about the Laboratory's science facilities, program areas, and activities outside the scope of their daily jobs.

- BNL's Media and Communications and Internal Communications Offices issue press releases and publishes *The Bulletin*, a weekly employee newsletter. 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 http://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 questions and comments may be submitted via the "Contact Us" form found on the Community Relations Office website at http://www.bnl.gov/community/.

2.4.2.2 Community Involvement in Cleanup Projects

In 2011, BNL shared updates with stakeholders on several ongoing projects and provided information on a proposed addition to a ROD to be documented by an ESD. The projects and ESD included:

- *American Recovery and Reinvestment Act projects*: Work on two ARRA projects continued in 2011, including the ongoing dismantlement of the BGRR and the demolition of the HFBR stack. Progress on the removal of the BGRR bioshield was slower than expected, due to the unanticipated strength of the concrete walls. As a result, the work was reassessed and a larger excavator was brought in with greater capability to increase demolition speed. All work and waste removal is now expected to be completed by June 2012. Due to inclement weather during the 2010/2011 winter, demolition of the HFBR stack was delayed. A reevaluation of the work methodology further delayed the project start. As a result, it was determined that work would proceed to remove the stack silencers and the demolition of the stack would be deferred until 2020, as originality agreed to in the HFBR ROD. The CAC and BER received periodic updates on these projects throughout the year.
- *OU III ESD*: In April, Freon-11 was discovered in one of the monitoring wells during routine sampling of the Building 96 groundwater treatment system. A thorough investigation and characterization of the new contamination was completed and a groundwater treatment system plan was developed. The location, near Building 452 in the center of the BNL site, was designated as a new Area of Concern (AOC 32) and completing an ESD was proposed to document the restoration activities. Presentations on this finding and remediation plans were presented to the CAC, BER, and regulators.
- *Environmental Assessment for Wastewater Treatment Modifications*: In July, a Notice of Availability for the completed Environmental Assessment (EA) for the Proposed Waste Water Treatment Modifications for Improved Effluent Compliance at BNL and a Finding of No Significant Impact (FONSI) were published in the Long Island Newsday. The EA is part of the ongoing SPDES project to meet new standards for wastewater discharges to the Peconic River that began in 2009. BNL proposed to eliminate discharge to the river and instead process its wastewater through groundwater recharge basins. The CAC and BER received presentations on this project, and also received notice of the completed EA.
- *Site-wide Five-Year Review*: In December, a Notice of Availability (NOA) was published by DOE announcing the completion of the Five-Year Review for BNL as required under CERCLA. Stakeholders, including the CAC and BER, were notified of the announcement and documents were made available in the three BNL repositories and on the BNL website. In addition, the CAC and BER were provided with presentations on the groundwater and Peconic River

findings, as well as recommendations contained in the report prior to finalization and publishing of the NOA.

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

- The ERPs FY 2010 Performance report to the CAC provided an overview of its annual planning process and objectives and targets. Information on environmental and safety performance included statistics on reportable spills, Occupational Safety & Health Administration (OSHA) lost work day cases, and pollution prevention initiatives.
- The 2010 Annual Groundwater Report provided an overview of the groundwater plumes and specific information on the protection, monitoring of groundwater, and the remediation process, including the operational status of treatment systems, progress toward achieving cleanup goals, and recommended or proposed actions in response to monitoring data. The update also covered information and recommendations on groundwater included in the sitewide Five-Year Review.
- A presentation on 2010 Peconic River monitoring included highlights on data for sediment, surface water, and fish sampling, including three locations that received further remediation in 2010 and recommendations made in the Five-Year Review for reduced frequency sampling.
- A contamination incident that occurred in September 2011 was reported to stakeholders and the CAC. The incident involved a sealed source used to test radiation monitors that had failed. The source developed a leak and, as a result, contamination was found in several locations where the source was used. The locations were identified and decontaminated. The incident was analyzed, all sources on site were leak-tested, and corrective and preventive actions were developed.
- Each October, natural resource management staff at BNL work with NYSDEC to development a prescription for a prescribed fire to be conducted during the annual New York Wildfire & Incident Management Academy held at the Laboratory. Stakeholders north and east of the Laboratory are notified that a prescribed fire may occur during the Academy.
- BNL's natural resources were the topic of a CAC presentation, which provided a history of natural resource management at the Laboratory, as well as information and updates on the status of threatened and endangered species and their habitat, management of invasive species, deer management, fire management, forest health, and bird surveys. Information on the study of the impacts of the LISF and of removing the Sewage Treatment Plant discharge from the Peconic River were also provided.

In addition to the projects noted above, the CAC continues to express an interest in energy research conducted at BNL. In 2011, they received the following presentations: Reducing Greenhouse Gas Emissions in NYS, BNL's 10-Year Strategic Plan, Nanotechnology for the Energy Challenge, Overview of BNL's Solar Research Plans, Moving Discoveries to the Market Place, BNL's Master Plan, and the DOE-sponsored Employee Examination & Compensation Programs.

Working closely with the community, employees, elected officials, and regulatory agency representatives, DOE and BNL continue to openly share information on issues and projects and provide feedback on how that input was used.

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 2011 there were 9,776 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

Table 2-5. Summary of BNL 2011 Sampling Programs Sorted by Media.

Environmental Media	No. of Sampling Events(a)	Purpose
Groundwater	1,837 (b) 636 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	71	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	51 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)	194	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	30	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	296	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	511 ES/C 47 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	101	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 2011 Sampling Programs Sorted by Media *(concluded).*

Environmental Media	No. of Sampling Events(a)	Purpose
Fauna	345	Fish, deer, and small mammals are monitored to assess impacts on wildlife associated with past or current BNL operations. See Chapter 6 for further detail.
Flora	14	Vegetation is sampled to assess possible uptake of contaminants by plants and fauna, since the primary pathway from soil contamination to fauna is via ingestion. See Chapter 6 for further detail.
Soils	153	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	832	Samples are collected periodically from potable water fixtures and dispensers, manholes, and spills, to assess process waters and sanitary discharges.
Groundwater Treatment Systems and Remediation Monitoring	1,838	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 13 operating groundwater treatment systems. See discussion in Chapter 7.
Vehicle Monitor Checks	244	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)	477	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	656	Flowcharts are exchanged weekly as part of BNL's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	114	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	756	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)	389	To ensure that the concentrations of contaminants reported in the Site Environmental Report are accurate, additional samples are collected. These samples detect if contaminants are introduced during sampling, transportation, or analysis of the samples. QA/QC samples are also sent to the contract analytical laboratories to ensure their processes give valid, reproducible results.
Total number of sampling events	**9,776**	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2010), 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

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 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 information about the Laboratory's environmental programs is available on BNL's website at http://www.bnl.gov.

Due to external recognition of the Laboratory's knowledge and unique experience implementing the EMS program, BNL is often asked to share its experiences, lessons learned, and successes. The Laboratory's environmental programs and projects have been recognized with international, national, and regional awards. 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.

REFERENCES AND BIBLIOGRAPHY

BNL. 2005. *Community Involvement Policy and Plan*. Brookhaven National Laboratory, Upton, NY.

BNL. 2003a. *BNL Energy Management Plan*. Brookhaven National Laboratory, Upton, NY.

BNL. 2011. *Natural Resource Management Plan for Brookhaven National Laboratory*. BNL-96320-2011. Brookhaven National Laboratory, Upton, NY.

BNL. 2009. *Wildland Fire Management Plan for Brookhaven National Laboratory*. BNL-82418-2009. Brookhaven National Laboratory, Upton, NY.

BNL. 2012. *Environmental Monitoring Plan 2012 Update*. Brookhaven National Laboratory, Upton, NY.

DOE Order 436.1, 2011. *Departmental Sustainability*. U.S. Department of Energy, Washington, DC. May 2, 2011.

Executive Order 13514, 2009. *Federal Leadership in Environmental, Energy, and Economic Performance*. US Department of Energy, Washington, DC. October 5, 2009.

Executive Order 13423, 2009. *Strengthening Federal Environmental, Energy and Transportation Management*. U.S. Department of Energy, Washington, DC. February 17, 2009.

Executive Order 13148, 2000. *Greening of the Government through Leadership in Environmental Management*. US Department of Energy, Washington, DC. April 21, 2000.

EPA/DOE. 1998. *Memorandum of Agreement by and between the Environmental Protection Agency and the United States Department of Energy*. March 23, 1998.

ISO. 2004. ISO 14001, *Environmental Management Systems – Specification with Guidance for Use*. First Edition. International Organization for Standardization. Geneva, Switzerland.