2 Environmental Management System

One of Brookhaven National Laboratory's (BNL) highest priorities is ensuring that its environmental commitment is as strong as its passion for discovery. The contractor operating the Laboratory on behalf of DOE, Brookhaven Science Associates (BSA), takes environmental stewardship very seriously. As part of its commitment to environmentally responsible operations, BSA has established the BNL Environmental Management System (EMS). One measure of an effective EMS is recognition of good environmental performance. In 2007, BNL was recognized with eight national or regional environmental awards. DOE awarded BNL three Pollution Prevention and Environmental Stewardship Accomplishment Awards for EMS, composting, and recycling efforts. For voluntary efforts in EMS, Performance Track, and the National Partnership for Environmental Priorities program, BNL received the Pollution Prevention Star Award and White House Closing the Circle Award. Further, BNL received its first Silver Level Award for Electronics Recycling from the Office of the Federal Environmental Executive. Finally, the Laboratory received the Environmental Outreach Award from the National Environmental Performance Track Program, and the Long Island Transportation Management Inc. 2007 Commuter Choice Leadership award.

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 EMS registration. Recertification audits of the entire EMS occur every three years. In 2007, an EMS Recertification Audit determined that BNL remains in conformance with the ISO 14001: 2004 Standard.

BNL continued its strong support of the Pollution Prevention Program, which seeks ways to eliminate waste and toxic materials. In 2007, pollution prevention projects resulted in more than $2.9 million in cost avoidance or savings and resulted in the reduction or reuse of approximately 14.6 million pounds of waste. Also in 2007, the BNL Pollution Prevention Council funded six new proposals or special projects, investing approximately $10,000. Anticipated annual savings from the projects are estimated at approximately $38,000, for an average payback period of less than 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 Program and openly communicates with neighbors, regulators, employees, and other interested parties on environmental issues and cleanup progress on site and off 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. The integrated safety processes within the ISMS contributed to BNL achieving ISO 14001 and Occupational Safety and Health 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 ISO14001 structure. 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. To gain registration to the ISO 14001 and OHSAS 18001 standards, an organization must comply with the set of requirements listed and described in Table 2-1. Table 2-1 also defines where these requirements fit into the ISMS structure.

BNL'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 globally recognized environmental standard. BNL was also 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 system is maintained.

In 2007, an EMS and OHSAS Certification Audit determined that BNL remains in conformance with the ISO 14001 and OHSAS 18001 standards. In their recommendation for

Table 2-1. Elements of the Environmental Management System (EMS) and their Relationship to OHSAS 18001 and Integrated Safety Management (ISM) – Review of EMS Implementation at BNL.

ISO 14001 EMS Clause	OHSAS 18001 Clause	ISM Guiding Principle and Core Function
4.2 Environmental policy	4.2 OH&S policy	Core function 1: Define the scope of work Guiding principle 1: Line manager clearly responsible for ES&H
The Environmental, Safety, Security, and Health Policy is a statement of BNL's intentions and principles regarding overall environmental, safety, security, and health performance. It provides a framework for planning and action. In the policy, BNL has reaffirmed its commitment to the environment, safety, security, health, compliance, the community, and continual improvement.		
4.3.1 Environmental aspects	4.3.1 Planning for hazard identification, risk assessment, and risk control	Core function 2: Identify and analyze hazards associated with the work Guiding principle 5: Identify ES&H standards and requirements
When operations have an environmental aspect, BNL implements the EMS to minimize or eliminate any potential impact. The Laboratory evaluates its operations, identifies the aspects of operations that can impact the environment, and determines which of those potential impacts are significant. BNL has determined that the following aspects of its operations are significant and have the potential to affect the environment:		
▪ Waste generation ▪ Atmospheric emissions ▪ Liquid effluents ▪ Storage or use of chemicals and radioactive materials	▪ Natural resource usage — power and water consumption ▪ Work with engineered nanomaterials ▪ Historical and cultural resources ▪ Environmental noise	▪ Disturbances to endangered species/protected habitats ▪ Soil activation ▪ Historical contamination
4.3.2 Legal and other requirements	4.3.2 Legal and other requirements	Core function 2: Identify and analyze hazards associated with the work Guiding principle 5: Identify ES&H standards and requirements
The Laboratory has implemented and continues to improve the Standards Based Management System (SBMS), a BNL web-based system designed to deliver Laboratory-level requirements and guidance to all staff. New or revised requirements (e.g., new regulations) are analyzed to determine their applicability and to identify any actions required to achieve compliance. This may involve developing or revising BNL documents or operating procedures, implementing administrative controls, providing training, installing engineered controls, or increasing monitoring.		

(continued on next page)

Table 2-1. Elements of the Environmental Management System (EMS) and their Relationship to OHSAS 18001 and Integrated Safety Management (ISM) – Review of EMS Implementation at BNL *(continued).*

ISO 14001 EMS Clause	OHSAS 18001 Clause	ISM Guiding Principle and Core Function
4.3.3 Objectives Targets and Programs	4.3.3 Objectives 4.3.4 OH&S management program(s)	Core function 1: Define the scope of work Guiding principle 5: Identify ES&H standards and requirements
The Performance Based Management System is designed to develop, align, balance, and implement the Laboratory's strategic objectives, including environmental objectives. Objectives and targets are developed by fiscal year (FY). The following objectives and targets in FY07 included:		
▪ Continually improving the EMS ▪ Improving compliance in targeted areas ▪ Integrating pollution prevention into work planning	▪ Improving communications, trust, and relationships with stakeholders on environmental programs and issues ▪ Fully implementing the BNL Groundwater Protection Management Program	▪ Ensuring responsible stewardship of natural and historical resources on site ▪ Implementing environmental restoration projects efficiently
Organizations within BNL develop action plans detailing how they will achieve their objectives and targets and commit the necessary resources to successfully implement both Laboratory-wide programs and facility-specific programs. BNL has implemented a Pollution Prevention Program to conserve resources and minimize waste generation. The Laboratory also has a budgeting system designed to ensure that priorities are balanced and that resources essential to the implementation and control of the EMS are provided.		
4.4.1 Resources, roles, responsibilities and authority	4.4.1 Structure and responsibility	Core function 1: Define the scope of work Guiding principle 1: Line manager is clearly responsible for ES&H Guiding principle 2: Clear ES&H roles and responsibilities Guiding principle 4: Balanced priorities
All employees at BNL have specific roles and responsibilities in key areas, including environmental protection. Environmental and waste management technical support personnel assist the line organizations with developing and meeting their environmental responsibilities. Every Laboratory employee is required to develop a Roles, Responsibilities, Accountabilities, and Authorities (R2A2) document signed by the employee, their supervisor, and the supervisor's manager. Specifics on environment, safety, and health performance expectations are included in these documents.		
4.4.2 Competence, training, and awareness	4.4.2 Training, awareness, and competence	Core function 4: Perform work within controls Guiding principle 3: Competence commensurate with responsibilities
Extensive training on EMS requirements has been provided to staff whose responsibilities include environmental protection. BNL's training program includes general environmental awareness for all employees; regulatory compliance training for selected staff; and specific courses for managers, internal assessors, EMS implementation teams, and operations personnel whose work can impact the environment.		
4.4.3 Communication	4.4.3 Consultation and communication	Core function 4: Perform work within controls Core function 5: Provide feedback on adequacy of controls and continue to improve safety management Guiding principle 2: Clear ES&H roles and responsibilities
BNL continues to improve processes for internal and external communications on environmental issues. The Laboratory solicits input from interested parties such as community members, activists, civic organizations, elected officials, and regulators. This is accomplished primarily through the Citizens Advisory Committee and the Brookhaven Executive Roundtable. At the core of the communication and community involvement programs are the Environmental Safety, Security, and Health Policy and the Community Involvement Plan.		
4.4.4 Documentation	4.4.4 Documentation	Core function 2: Identify and analyze hazards associated with the work Guiding principle 6: Hazard controls tailored to work Guiding Principle 7: Operations authorization
BNL has a comprehensive, up-to-date set of Laboratory-wide environmental documents describing the EMS. Using the SBMS, staff can access detailed information on regulatory requirements, Laboratory-wide procedures, and manuals on how to control processes and perform their work in a way that protects the environment. The SBMS has improved the quality, usability, and communication of Laboratory-level requirements.		
4.4.5 Control of documents	4.4.5 Document and data control	Core function 4: Perform work within controls Guiding principle 6: Hazard controls tailored to work
The SBMS includes a comprehensive document control system to ensure effective management of procedures and other requirements documents. When facilities require additional procedures to control their work, document control protocols are implemented to ensure that workers have access to the most current versions of procedures.		

(continued on next page)

Table 2-1. Elements of the Environmental Management System (EMS) and their Relationship to OHSAS 18001 and Integrated Safety Management (ISM) – Review of EMS Implementation at BNL *(concluded).*

ISO 14001 EMS Clause	OHSAS 18001 Clause	ISM Guiding Principle and Core Function
4.4.6 Operational control	4.4.6 Operational control	Core function 2: Identify and analyze hazards associated with the work Core function 3: Develop and implement hazard controls Core function 4: Perform work within controls Guiding principle 5: Identify ES&H standards and requirements Guiding principle 6: Hazard controls tailored to work Guiding principle 7: Operations authorization
Operations at BNL are evaluated for the adequacy of current controls to prevent impacts to the environment. As needed, additional administrative or engineered controls are identified, and plans for upgrades and improvements are developed and implemented.		
4.4.7 Emergency preparedness and response	4.4.7 Emergency preparedness and response	Core function 2: Identify and analyze hazards associated with the work Core function 3: Develop and implement hazard controls Guiding principle 6: Hazard controls tailored to work
BNL has an Emergency Preparedness and Response Program and specialized staff to provide timely response to hazardous materials or other environmental emergencies. This program includes procedures for preventing, as well as responding to, emergencies.		
4.5.1 Monitoring and measurement	4.5.1 Performance measurement and monitoring	Core function 5: Provide feedback on adequacy of controls and continue to improve safety
Effluent and emission monitoring helps ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures. BNL has a comprehensive, Laboratory-wide Environmental Monitoring Program. Monitoring results are reported to regulatory agencies and are summarized annually in the Site Environmental Report. In addition, BNL tracks and trends its progress and performance in achieving environmental objectives and performance measures.		
4.4.2 Evaluation of compliance	NA	Core function 5: Provide feedback on adequacy of controls and continue to improve safety
Specific environmental legislation and regulations are evaluated and assessed on a program- or facility-specific basis. BNL has established a documented procedure for periodically evaluating its compliance with relevant environmental regulations. This procedure is often integrated in an organization's environmental, safety, and health inspection process, which is performed in a prioritized fashion by a team of experts including one on environmental regulatory issues. Periodically, the environmental support organizations will perform a regulatory assessment in a particular topical area to verify the compliance status of multiple organizations throughout the Laboratory. Lastly, external regulatory agencies and/or technical experts may conduct independent audits of compliance.		
4.5.3 Nonconformance, corrective action, and preventative action	4.5.2 Accidents, incidents, non-conformances, and corrective and preventative action	Core function 5: Provide feedback on adequacy of controls and continue to improve safety
BNL continues to improve processes that identify and correct problems. A Lessons Learned Program to prevent recurrences, a Laboratory-wide Self-Assessment Program, and an electronic web-based assessment and action tracking system have been implemented.		
4.5.2 Control of records	4.5.3 Records and records management	Core function 2: Identify and analyze hazards associated with the work Guiding principle 6: Hazard controls tailored to work Guiding principle 7: Operations authorization
EMS-related records, including audit and training records, are maintained to ensure integrity, facilitate retrieval, and protect them from loss.		
4.5.5 Internal audit	4.5.4 Audit	Core function 5: Provide feedback on adequacy of controls and continue to improve safety
To periodically verify that the EMS is operating as intended, audits are conducted. These audits, which are part of the Laboratory-wide Self-Assessment Program, are designed to ensure that any nonconformance to the ISO 14001 Standard is identified and addressed. An independent accredited registrar also conducts ISO 14001 registration audits. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and periodic audits.		
4.6 Management review	4.6 Management review	Core function 5: Provide feedback on adequacy of controls and continue to improve safety Guiding principle 1: Line manager clearly responsible for ES&H
In addition to audits, a management review process has been established to involve top management in the overall assessment of environmental performance, the EMS, and progress toward achieving environmental goals. This review also identifies, as necessary, the need for changes to, and continual improvement of, the EMS.		

continued certification, auditors from NSF-International Strategic Registrations, Ltd. highlighted 24 examples of BNL's continual improvement, some of which include the Laboratory's link between institutional- and division-level objectives and targets, "very well done" internal audit records and documentation, and improved management reviews. The auditors also identified one EMS minor nonconformance in "Nonconformity, corrective action and preventative action" and four EMS opportunities for improvement, one each in Emergency Preparedness and Response; Objectives, Targets and Programs; Control of Documents; and Operational Control. A corrective action plan was prepared to track the minor nonconformances 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 interact with 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.

In 2007, BNL focused on work with engineered nanomaterials, following the completion of a new Center for Functional Nanomaterial Research. In September 2005, a DOE Policy (456.1) had been released establishing a framework by which all DOE labs would work safely with engineered nanomaterials. In response, BNL has worked in conjunction with other DOE Nanoscale Science Research Centers (NSRCs) to develop a consensus document, "Approach to Nanomaterial ESH," that establishes the best available controls for worker and environmental protection. The document uses the precautionary principal to manage the uncertain risk associated with engineered nanomaterials. The Laboratory has since performed an extensive review of its work with engineered nanomaterials to ensure that the controls identified in the document have been implemented. The procedure requires rigorous environmental controls to prevent the release of engineered nanomaterials to the environment. BNL added work with engineered nanomaterials to its list of significant environmental aspects in 2007 and continues to inform the community on its management efforts.

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.

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. Annually, BSA works closely with DOE to clearly define expectations and performance measures. Factors for selecting environmental priorities include:

- 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 FY07 (October 1, 2006 through September 30, 2007), BNL's environmental objectives included:

- Continually improving the EMS
- Improving compliance in targeted areas
- Integrating pollution prevention into work planning
- Improving communications, trust, and relationships with stakeholders on environmental programs and issues
- Fully implementing the BNL Groundwater Protection Management Program
- Ensuring responsible stewardship of natural and historical resources on site
- Implementing environmental restoration projects efficiently

2.3.4 Environmental Management Programs

Each organization within BNL develops an action plan detailing how they will achieve their environmental objectives and targets and 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 waste. 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 2007.

2.3.4.3 Waste Management

As a byproduct of the world-class research it conducts, BNL generates a large range of wastes. These wastes include materials common to many businesses and industries, such as 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.

Collecting, storing, transporting, and disposing of waste generated at the Laboratory is the responsibility of BNL's Waste Management Facility (WMF). 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, regulated by RCRA; a mixed-waste building for material that is both hazardous and radioactive; and a reclamation building for radioactive material. 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. In 2007, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 4.1 tons
- Mixed waste: 31 ft^3
- Radioactive waste: 6,796 ft^3

Hazardous waste from routine operations in 2007 remained fairly steady with respect to 2006 generation rates, as shown in Figure 2-1a. The increase in mixed waste generation, as shown in 2-1b, is attributed to activities within the Collider-Accelerator Department. As shown in Figure 2-1c, the radioactive waste quantity for routine operations also increased, but remained below quantities typically generated in previous years. This increase is attributed to increased funding and resulting operations within the high-energy nuclear physics program. Wastes generated from nonroutine or one-time events and wastes generated from environmental restoration activities are not included in the figures.

Routine operations are defined as ongoing industrial and experimental operations. BNL is currently cleaning up facilities and areas containing radioactive and chemical contamination resulting from long-past operations. Waste recovered through restoration and decommissioning activities is managed by the Environmental Restoration (ER) Project, with assistance from BNL's Environmental and Waste Management Services Division (EWMSD).

In 2007, EWMSD continued surveillance and maintenance operations for the Brookhaven Medical Research Reactor (BMRR) and began working on removing some of the equipment and components from the former Hot Laundry and Decontamination Facility in Building 650. Waste generation activity associated with the BMRR and the Decontamination Facility is reflected in the nonroutine waste values. Nonroutine waste typically includes construction and demolition waste, environmental restoration waste, legacy waste, lead-painted debris, lead shielding, and polychlorinated biphenyl (PCB) waste. Figures 2-1d through 2-1f show wastes generated under the ER Program, as well as nonroutine operations. Waste generation from these activities has varied significantly from year to year. This was expected, as environmental restoration activities moved from remedial investigations and feasibility studies to remedial actions, which have changed annually based on the progress of the Laboratory's cleanup schedule. Nonroutine hazardous waste generation increased in 2007 due to activities to remove lead from the former skeet range.

2.3.4.4 Pollution Prevention and 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

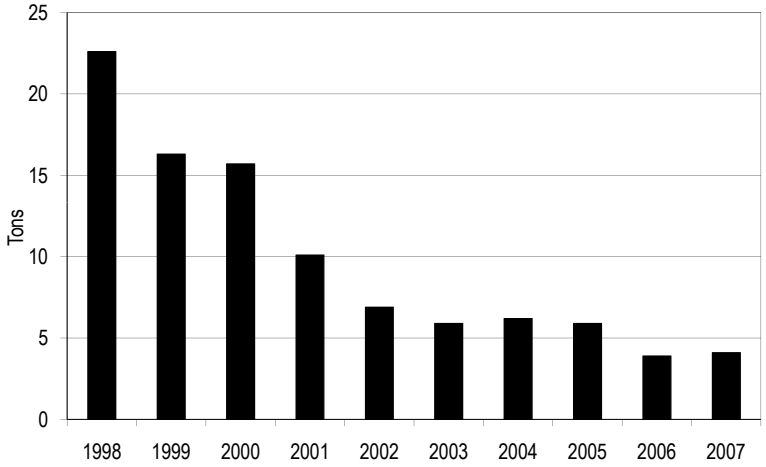

Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1998 – 2007.

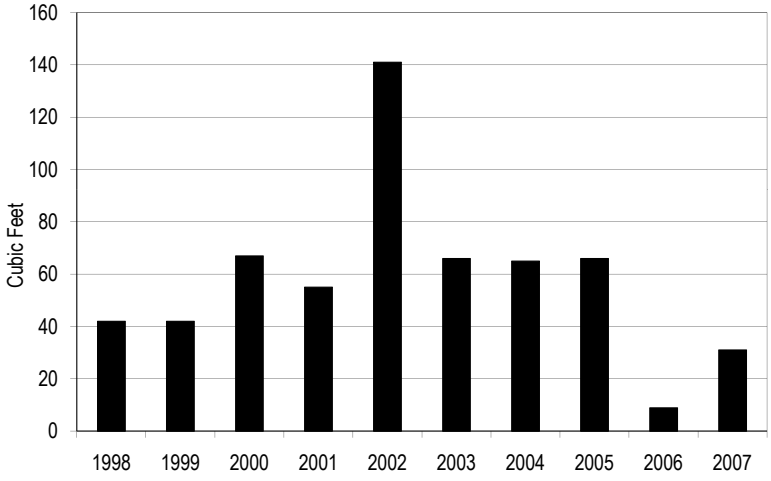

Figure 2-1b. Mixed Waste Generation from Routine Operations, 1998 – 2007.

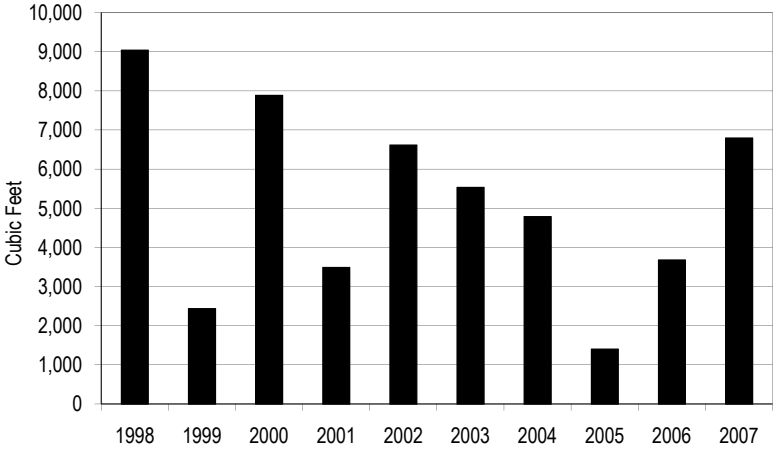

Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1998 – 2007.

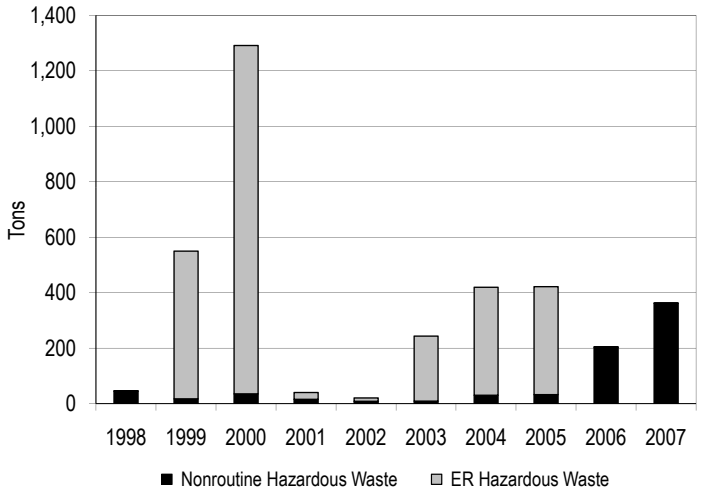

Figure 2-1d. Hazardous Waste Generation from ER and Nonroutine Operations, 1998 – 2007.

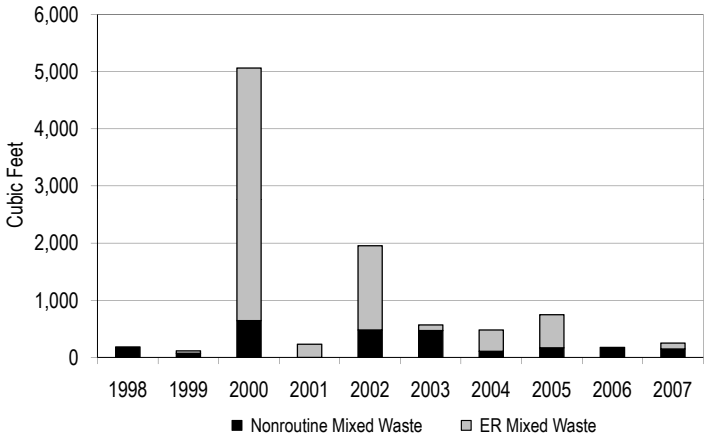

Figure 2-1e. Mixed Waste Generation from ER and Nonroutine Operations, 1998 – 2007.

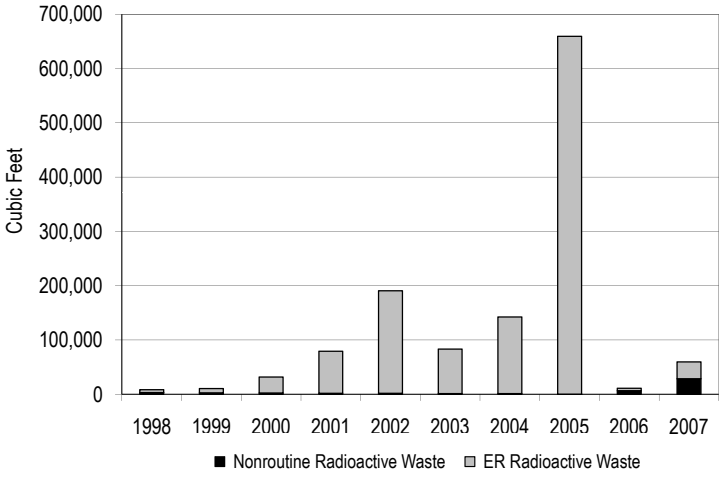

Figure 2-1f. Radioactive Waste Generation from ER and Nonroutine Operations, 1998 – 2007.

prevention goals and policies, and represents an ongoing effort to make pollution prevention and waste minimization an integral part of the Laboratory's operating philosophy.

In January 2007, Executive Order 13423 was signed, establishing federal requirements for: energy efficiency and conservation, renewable energy, fleet management, electronic stewardship, water conservation, toxic chemical use reduction, recycling, sustainable buildings, and purchasing environmentally preferred products. These requirements will direct the future of BNL's P2 program and, as discussed below, most have already been incorporated within its program.

Pollution prevention and waste reduction goals have been incorporated into the DOE contract with BSA, into BNL's ESSH Policy, and into the Performance Evaluation Management Plan associated with the Laboratory's operating contract with BSA. 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" (i.e., uphold the E-ALARA policy)
- 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
- Identify funding mechanisms for evaluating and implementing P2 opportunities
- Implement P2 projects
- Improve employee and community awareness of P2 goals, plans, and progress

Nineteen P2 proposals were submitted to the BNL P2 Council for funding in fiscal year 2007. Six proposals were funded, for a combined investment of slightly less than $10,000. The anticipated annual savings from these projects is estimated at $38,218, for an average payback period of less than 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 2007 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 opportuni-

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled or Conserved in 2007	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details*
Aerosol can disposal system	Recycling	528	Hazardous waste	$12,000	$0	$12,000	Empty aerosol cans can now 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.
Portable closed-head drum mixer	Neutralization	1,600	Hazardous waste	$7,644	$1,450	$6,194	The National Synchrotron Light Source (NSLS) bought a closed drum mixer to neutralize Rydlyme, used to descale cooling pipes.
Relocation of hazardous storage sheds	Reuse	3,200	Industrial waste	$0	$500	$26,500	Recycled two hazardous storage material sheds for reuse in Plant Engineering. Relocation cost $550, but avoided the purchase of new sheds.
Formaldetox	Source reduction	8	Non-hazardous waste (neutralized approximately 1 gallon)	$25	$0	$25	Neutralizes nonhazardous para-formaldehyde, chlorix, bleach, and rat blood.
HPLC solvent recycler	Reuse	110	Hazardous waste	$2,500	$0	$6,755	Allows reuse of approximately 50 liters of solvent and saves approximately 50 labor hours.
Propane cylinder de-valver	Recycling	50	Hazardous waste	$3,750	$0	$3,750	The Collider Accelerator Division (CA-D) bought a propane cylinder de-valver to avoid sending cylinders to a disposal vendor at $75 each; instead they are now recycled as scrap.

(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 2007	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details*
Fluorescently labeled oligonucleotides	Waste minimization	3,144	Radiological waste (396 ft^3); Mixed waste (35 galllons); Hazardous Waste (108 gallons)	$67,600	$0	$67,600	This project was cost-shared with Biology. The process avoids the use of radioactivity, thus avoiding radiological waste generation.
Electronic recycling	Recycling	140,600	E-waste	N/A	$2,300	N/A	BNL e-waste was formerly collected by a scrap metal dealer, but the recycling process was questionable. The Laboratory has now partnered with a government-based e-waste recycler and now pays shipping fees only.
Building demolition recycling	Recycling	12,350,000	Industrial waste	$561,925	$32,000	$529,925	On-site demolition products (steel and concrete) are segregated, recycled, and reused.
System One parts cleaner	Substitution	640	Hazardous waste	$10,000	$0	$10,000	Plant Engineering bought a System One parts washer to re-distill dirty solvent, eliminating the need for a vendor such as Safety Kleen. Removed grit and sludge are mixed with the waste oil.
Photon-counting spectrofluorimeter	Substitution	54	Mixed waste (2 ft^3)	$16,000	$0	$66,000	Eliminated the need for radioactive assays and thus their radioactive waste. Savings include 1,000 work-hours plus savings on material costs.
Replacement of mercury utility devices	Substitution	40	Mercury	$2,350	$4,000	$2,350	Approximately 36 lb of mercury-containing devices were removed from utility devices during 2007. Savings are based on the cost of one mercury spill and cleanup.
Animal bedding conveying system	Composing		Low-level Radiological Waste (76 yds^3)	$570,456	$0	$570,456	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.
Plant Engineering grounds vehicle wash system	Waste minimization	8,000	Oils/grease to soils	$16,000	$3,000	$13,000	This multi-year, multi-department project was completed in 2007 and eliminates the potential of oil and grease being released to soil.
Organic solvents	Substitution	678	Hazardous waste	$1,694	$0	$26,000	Life Sciences bought a Microwave Peptide Synthesizer in 2004 to significantly reduce the hazardous wastes generated. Saves ~1,000 work-hours/year (reflected in cost savings).
Organic solvents	Purification/reuse	44	Hazardous waste	$110	$0	$3,510	The primary savings of the BES solvent purification system are in not purchasing new solvent and labor savings from not running the stills.

(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 2007	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details*
Cooling water	Reuse	63,400	Deionized water	$0	$0	$7,925	A closed-cycle water recycling system for the Building 480 melt spinner saved 7,925 gallons of ultra-pure water and extends the life expectancy of equipment worth $100,000.
Mercury utility devices	Substitution	37	Mercury	$2,300	$0	$2,300	Plant Engineering replaced mercury-containing utility devices with mercury-free equipment in 2007. Savings are based on the cost of one mercury spill and cleanup.
Radioactive emissions	Emission reduction	0	Radioactive emissions	$0	$0	$0	A shroud was installed over the 16-inch diameter shaft in the Hot Cell of the Brookhaven Linac Isotope Producer (BLIP), isolating cooling water from the rapidly moving air of the exhaust system and allowing radiological decay within the water system. Slowing the diffusion into the hot cell air will effectively reduce gaseous emissions into the exhaust stack, as these radionuclides have very short half lives. The shroud/enclosure has been instrumental in reducing short-lived radioactive gaseous emissions. Beyond the environmental benefits associated with the project and due to the efficiency of the enclosure in reducing emissions, the facility has been able to stay below the emissions level that would require additional regulatory burdens.
Radioactive waste generated through wet chemistry	Waste minimization	30	Mixed waste/ Liquid radioative waste	$17,600	$0	$22,500	The use of a Kinetic Phosphorescence Analyzer (KPA) system for uranium analysis eliminated mixed waste generation in a chemistry lab, reduced 90 percent of the volume of liquid waste, reduced 90 percent of radioactive material handled, minimized exposure to uranium by Laboratory personnel, and decreased labor costs by 75 percent.
Radioactive waste from labeled chemicals	Waste minimization/ volume reduction	0	Solid radioactive waste	$2,168	$0	$2,168	A vial crusher for glass vials, pipettes, and other glassware reduces the volume of rad waste.
Radioactive and mixed wastes from radio-labeled chemicals	Waste minimization	112	Mixed waste	$27,690	$0	$27,690	Use of a microplate scintillation counter generates less mixed waste.
Electrophoretic Mini-Gels	Microscale chemical use	2,200	Hazardous waste - lab pack	$11,500	$0	$11,500	Minimizing silver waste from silver-staining electrophoretic mini-gels saves waste disposal costs and lowers material purchase costs ($6,000).

(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 2007	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details*
Sewage sludge	Volume reduction	18,450	Radioactive waste	$1,249,500	$47,738	$1,201,762	Disposal of 110,000 gallons of radioactive Sewage Treatment Plant liquid waste by a contractor would cost $1,249,500. Instead, waste from the anaerobic sludge digester was dried on the drying tables (96 percent reduction), mixed with absorbent and lime, and shipped in (21) 55-gallon drums to a disposal facility.
Film and other radioisotopic imaging	Substitution	300	Hazardous waste/Industrial waste	$22,000	$0	$22,000	Replacement of film-based autoradiography and other radioisotopic imaging with a Phosphor Imager reduced waste generation by 200 lb of hazardous waste and 100 lb of industrial waste. Additional projected savings are in annual supply costs and labor reduction.
Lead acid batteries	Recycled	5,000	Universal waste	$15,925	$0	$15,925	Avoids hazardous waste disposal costs for approximately 40 lb of lead per battery.
Ion exchange wastewater	Source reduction	1250	Hazardous and sanitary wastewater	$3,125	$0	$3,125	Prefilters, added to the deionization system, polish makeup water entering the ion exchange system. This extends the useful life of the ion exchange resins, requiring less frequent regeneration. The regeneration process generates hazardous and sanitary waste.
Short half-life waste	Decay in storage	490	Radioactive waste	$37,631	$0	$37,631	Short half-life isotopes, particularly iodine-125 and phosphorus-32, are often used in life sciences experiments. In 2007, wastes from these operations (21.5 ft^3 and 133 lbs of liquid) were managed in accordance with BNL decay-in-storage requirements, rendering the wastes eligible for volumetric release.
Cooling Tower chemicals	Source reduction	9,563	Industrial waste	$22,500	$0	$22,500	Ozone water treatment units were installed on cooling towers at SEM, the National Space Radiation Laboratory (NSRL), and the RHIC Reseach Facility, 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.

(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 2007	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details*
Blasocut machining coolant	Recycled/ Reused	19,456	Industrial waste	$50,078	$0	$54,078	Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it Laboratory-wide. In 2007, 2,432 gallons (19,456 lb) of Blasocut lubricant were recycled. Recycling involves aeration, centrifuge, and filtration. This avoids cost of disposal as industrial waste plus an avoided cost of buying 5 drums of concentrate ($800/drum) and 49 empty drums for shipping ($50/drum).
Used motor oil	Energy recovery	16,160	Industrial waste	$41,902	$0	$41,902	Used motor oil from the motor pool and the on-site gas station is given to Strebel's Laundry Service, for use in their boilers. In 2007, they collected 2,020 gallons of oil at no charge to BNL, which thus avoided the costs for disposal and 41 shipping drums ($50/drum).
Office paper	Recycled	354,000	Industrial waste	$18,762	$0	$18,762	Cost avoidance based on $106/ton for disposal as trash.
Cardboard	Recycled	242,000	Industrial waste	$12,826	$0	$12,826	Cost avoidance based on $106/ton for disposal as trash.
Scrap metal	Recycled	764,000	Industrial waste	$97,792	$0	$97,792	Cost avoidance based on $106/ton for disposal as trash, plus $150/ton revenue.
Bottles/cans	Recycled	48,800	Industrial waste	$2,586	$0	$2,586	Cost avoidance based on $106/ton for disposal as trash.
Construction debris	Recycled	574,000	Industrial waste	$12,915	$0	$12,915	Cost avoidance based on $45/ton difference for disposal as trash.
	TOTALS	14,627,944		$2,920,855	$90,988	$2,961,952	

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

ties, recycling programs, and conservation initiatives has significantly reduced both waste volumes and management costs. In 2007, these efforts resulted in more than $2.9 million in cost avoidance or savings and approximately 14.6 million pounds of materials being reduced, recycled, or reused.

The Laboratory also has an active and successful solid waste recycling program, which involves all employees. In 2007, BNL collected more than 175 tons of office paper for recycling. Cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, electronic scrap, fluorescent light bulbs, drill press machine coolant, and antifreeze were also recycled. Table 2-3 shows the total number of tons (or units) of the materials recycled in 2007.

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. The goal is to reduce the consumption of potable water and reduce the possible impact of clean water discharges on

Table 2-3. BNL Recycled Program Summary.

Recycled Material	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Mixed paper	106	196	204	370	336	246	209	182	185	193	184	177
Cardboard	101	103	97	124	132	127	157	176	179	143	135	121
Bottles/Cans	15	21	22	21	20	29	19	23	22	22.1	27.7	24.4
Tires	17	18.6	11.5	15.2	0	0	3.5	12.3	11	12.8	32.5	19.9
Construction debris	837	799	527	352	243	289	304	334	367	350	297	287
Used motor oil (gallons)	4,275	4,600	3,810	3,570	3,295	3,335	1,920	3,920	3,860	4,590	2,780	2020
Metals	158	266	64	47	534	38	48	193	128	559	158	382
Lead	–	4.4	3.7	0.7	2.5	0	0	–	5	0	0	0
Automotive batteries	6.8	4.3	2.1	1.1	2.2	4.8	6.3	4.6	5	4.6	5.5	2.5
Printer/Toner cartridges (units)	–	–	1,480/175	1,575/510	–	363	449	187	105	0	0	0
Fluorescent bulbs (units)	13,664	12,846	867	25,291	5,874	17,112	25,067	13,611	12,592	7,930	11,740	25,448
Blasocut coolant (gallons)	–	–	–	3,575	7,500	10,660	8,180	5,030	6,450	3890	3,970	2,432
Antifreeze (gallons)	55	276	448	145	110	200	0	165	325	0	0	0
Tritium exit signs (each)	–	–	–	–	185	190	28	181	142	0	0	0
Smoke detectors	–	–	–	–	–	171	40	0	0	0	0	0
Road base	–	–	–	–	–	–	2,016	0	2,666	0	0	0
Scrap electronics	–	–	–	–	–	–	–	–	–	6.1	70.3	40.5
Animal Bedding (composted)	–	–	–	–	–	–	–	–	–	–	6.3	19.6
Metals (building demolition)	–	–	–	–	–	–	8	23	11	6	35	–
Concrete (building demolition)	–	–	–	–	–	–	891	590	3,000	328	5505	6175
Other construction and debris (building demolition)	–	–	–	–	–	–	790	388	1,200	157	818	–

Notes:
All units are tons unless otherwise noted.
– Denotes not recycled in that year or data not available.

Sewage Treatment Plant (STP) operations. Figure 2-2 shows the 10-year trend of water consumption. In 2007, BNL reduced its water use by more than 11 percent, compared to the previous year. In each of the past 4 years, the water consumption total was less than 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 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 goals in DOE Order 430.2B and the Secretary's Transformational Energy Action Management (TEAM) initiative.

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 2007, the Laboratory used approximately 233 million kilowatt hours (kWh) of electricity, 3 million gallons of fuel oil, 36 thousand gallons of propane, and 163 million ft^3 of natural gas. Fuel oil and

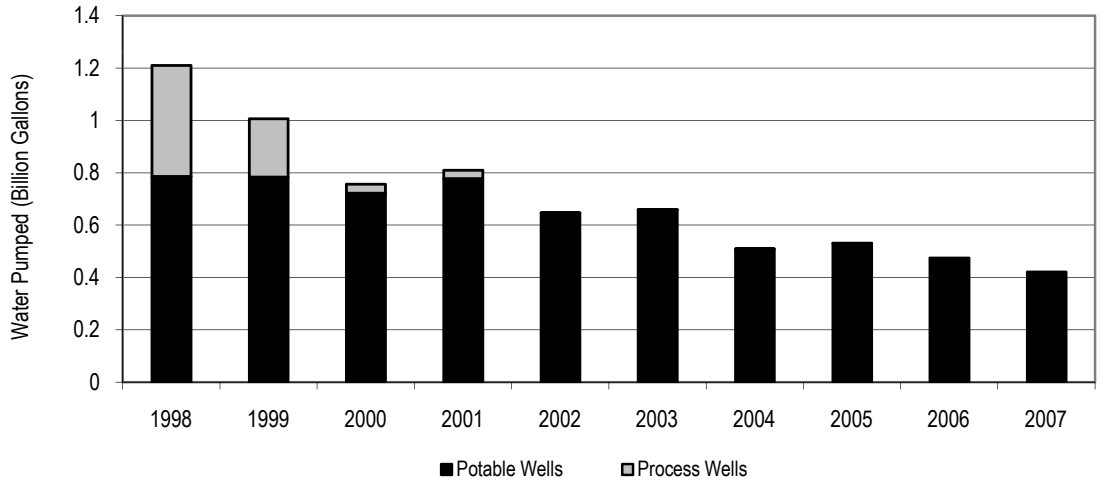

Figure 2-2. BNL Water Consumption Trend, 1998–2007.

natural gas produce steam at the Central Steam Facility (CSF). Due to market conditions, fuel oil and natural gas were used whenever each respective fuel was least expensive. Additional information on natural gas and fuel oil use can be found in Chapter 4.

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 requested in 2007, in part due to mild weather. However, mere participation in this program produced a rebate of $55,000. The Laboratory continues to keep electric loads at a minimum during the summer, by scheduling operations at RHIC to avoid peak demand periods. This scheduling allowed BNL to save nearly $4 million in electric costs in 2007 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 $20.4 million in 2007. The Laboratory will continue to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs. In 2007, the Laboratory purchased a portion of "green energy" for the newly constructed Research Support Building, avoiding 265,000 lbs of CO_2. In addition, biofuels were used in several applications.

In 2007, a solar heating system for the BNL swimming pool began operation. This small project was the first step toward meeting the Laboratory's energy needs with renewable sources. To reduce energy use at non-research facilities, other activities also were undertaken in 2007. These activities included:

- The process was begun for a site-wide Energy Savings Performance Contract (ESPC) audit that will strive to reduce energy usage throughout the Laboratory. This is still in the preliminary evaluation stage, but BNL anticipates significant energy savings from this effort.
- 25 MW of demand was rescheduled to avoid coinciding with the utility summer peak, saving several million dollars in electricity charges.
- $30,000 in Federal Energy Management Program funding was obtained to demonstrate a solar hot water combination system at the Brookhaven Center.
- Work continued in the replacment 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

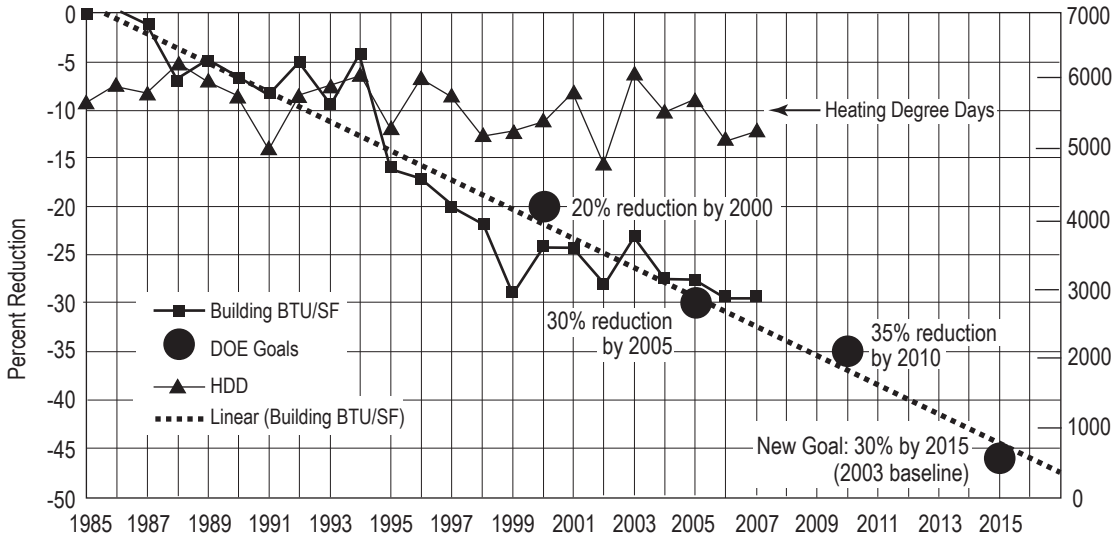

Figure 2-3. BNL Building Energy Performance, 1998–2010.

of kWhs and reducing costs by several thousand dollars.

- Due to aggressive conservation in various buildings, BNL's overall facilities energy usage for FY07 was approximately 8.3 percent less than in FY05, saving over $1.2 million.
- Water consumption for FY07 was 53 million gallons less than in FY06, saving approximately $20,000 in operational costs.
- Efficient fuel purchasing strategies (buying and storing oil and burning the least expensive fuel) saved $420,000, compared to purchasing only oil as it is consumed.
- The Laboratory's Research Support Building was completed and received a Leadership in Energy and Environmental Design (LEED) silver certification.
- The Center for Functional Nanomaterials was completed, and is also expected to receive LEED silver certification.
- Nearly 25,000 gge (gasoline gallon equivalents) 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, 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 FY06 – FY15. In 2007, an Executive Order increased the target reduction to 3 percent per year, which is a 30 percent reduction by the end of FY2015. Further, DOE Order 430.2B and the Secretary's TEAM initiative have set even more stringent requirements, including renewable energy and transportation fuels that go significantly beyond the previous goal of a 30 percent reduction by 2005, compared to 1985. BNL's energy use per square foot in 2007 was 29.4 percent less than in 1985 (see Figure 2-3) and 8.3 percent less than 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) contract. This agreement was formalized in 1992. Although not a formal signatory of the IAG, the Suffolk County Department of Health Services (SCDHS) also plays a key role in the review process. Most of the contamination at the Laboratory is associated with past accidental spills and outmoded practices for handling, storing, and disposing of chemical and radiological material.

BNL follows the CERCLA process, which includes the following steps:

- Conduct a Remedial Investigation to characterize the nature and extent of contamination and assess the associated risks
- Prepare a Feasibility Study and Proposed Plan to identify and evaluate remedial action alternatives and present the proposed 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 2007, work planning continued for the Brookhaven Graphite Research Reactor (BGRR) decommissioning project. In accordance with the requirements of 10 CFR 830, BNL completed the development of the Documented Safety Analysis (DSA), which was approved by DOE. The DSA is a critical document for the BGRR pile removal. Other progress related to the BGRR project included finalizing the Remedial Design/Remedial Action (RD/RA) Work Plan for the graphite pile removal, the development and regulatory review of the RD/RA Work Plans for removal of the biological shield and installation of an engineered cap.

Progress associated with the High Flux Beam Reactor (HFBR) decommissioning project in 2007 included: finalization of the HFBR Feasibility Study describing remedial alternatives and presenting a comparative analysis of the alternatives; working with regulators to finalize the Proposed Remedial Action Plan (PRAP); and preparations for the commencement of the public comment period for the PRAP, including two information sessions and a public meeting.

A final Action Memorandum was issued for the removal action involving the cleanup of the Waste Loading Area (WLA). The WLA is an area along the eastern boundary of the former Hazardous Waste Management Facility (HWMF). The remediation of this area (approximately two acres) was transferred to the HFBR project scope in 2005. Cleanup of the WLA using the dose-based cleanup goal and methodology specified for the former HWMF in the Operable Unit I ROD began in 2007.

The productive operation and maintenance (O&M) of the Laboratory's groundwater treatment systems removed approximately 200 pounds of solvents and 5 mCi of Strontium-90 (Sr-90) from the sole source aquifer in 2007. Since the operation of the first treatment system in 1996, a cumulative total of approximately 5,900 pounds of solvents and 17 mCi of Sr-90 have been cleaned-up. Other progress included the installation of four additional extraction wells to supplement the existing 57 wells to ensure that all cleanup objectives will be met. Post-cleanup monitoring of the Peconic River surface water, sediment, fish, and wetland vegetation continued with the issuance of an Annual Monitoring Report. 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. An annual

evaluation of these controls is submitted to the regulators.

Following the resolution of public comments, a ROD was signed for the g-2 Tritium Source Area and Groundwater Plume, the Brookhaven Linac Isotope Producer (BLIP), and the Former Underground Storage Tanks area. Table 2-4 provides a description of each operable unit and a summary of environmental restoration actions taken. See Chapter 7 and SER Volume II, Groundwater Status Report, for further details.

2.3.4.9 EPA Performance Track Program

BNL was accepted into the EPA's Performance Track (PTrack) Program in 2004. This program recognizes top environmental performance among participating U.S. facilities of all types, sizes, and complexity, both public and private. It is considered the "gold standard" for facility-based environmental performance—a standard that participating members strive to attain as they "meet or exceed their performance commitment." Under this program, partners provide leadership in many areas, including preventing pollution at its source. The PTrack Program requires that sites commit to several improvement goals for a 3-year period and report on the progress of the goals annually. In 2007, BNL completed its first set of goals under the PTrack program. Below are brief descriptions of the goals and their progress.

Table 2-4. Summary of BNL 2007 Environmental Restoration Activities.

Project	Description	Environmental Restoration Program Actions
Soil Projects	Operable Unit (OU) I OU II OU VII	▪ Performed monitoring and maintenance of institutional controls for cleanup areas. An annual evaluation of compliance with the controls was submitted to the regulators. ▪ Initiated remediation of radiologically-contaminated soil at the Waste Loading area, including rail shipments for disposal.
Groundwater Projects	OU III	▪ Continued operations of 14 groundwater treatment systems that treat volatile organic compounds (VOCs) and strontium-90 (Sr-90). ▪ Four groundwater treatment systems continued pulse pumping due to low VOC concentrations in the groundwater near the pumping wells. ▪ One groundwater treatment system and 11 individual extraction wells were placed in standby mode. ▪ Due to the detection of hexavalent chromium above the standard in a localized area at the Building 96 VOC plume, a design modification for one of the pumping wells was submitted to regulators for treatment of chromium using ion exchange resin. A State Pollutant Discharge Elimination System (SPDES) Equivalency Permit for the planned discharge of the treated effluent was issued by the New York State Department of Environmental Conservation (NYSDEC). Preparation of an alternative evaluation to address the high level of VOCs in the silt zone was initiated. One Building 96 groundwater treatment system extraction well was placed back into service. ▪ Continued monitoring of the High Flux Beam Reactor (HFBR) tritium plume. As a result of triggering the contingency at Weaver Drive in late 2006 with a detection of tritium above the 20,000 pCi/L drinking water standard, a fourth groundwater extraction well was installed and began operation in late 2007. ▪ Based on preliminary groundwater modeling of recent Sr-90 concentrations in the Waste Concentration Facility (WCF) plume, it was determined that several additional extraction wells will be necessary in order to achieve the cleanup goals. ▪ Installed and began operation of two additional extraction wells for the Sr-90 Chemical Holes plume, and one additional extraction well for the Airport plume. ▪ Following concurrence from NYSDEC, the Record of Decision (ROD) for the g-2 Tritium Groundwater Plume, the Brookhaven LINAC Isotope Producer (BLIP), and former Underground Storage Tanks Proposed Remedial Action Plan was signed by DOE and EPA. ▪ During 2007, 1.2 billion gallons of groundwater were treated and 198 pounds of VOCs were removed. Since the first groundwater treatment system started operating in December 1996, approximately 5,900 pounds of VOCs have been removed from more than 12.8 billion gallons of groundwater.
	OU IV	▪ Continued groundwater monitoring.
	OU VI	▪ Continued operation of a groundwater treatment system to treat ethylene dibromide that has migrated beyond BNL property in Manorville.
	Groundwater Monitoring	▪ Completed the BNL 2007 Groundwater Status Report. ▪ Collected and analyzed 2,289 groundwater samples from 850 monitoring wells. ▪ Updated the Environmental Monitoring Plan.

(continued on next page)

Table 2-4. Summary of BNL 2007 Environmental Restoration Activities *(concluded).*

Project	Description	Environmental Restoration Program Actions
Peconic River	OU V	▪ Performed second year of long-term post-cleanup monitoring of Peconic River surface water, sediment, fish, and wetland vegetation (including phragmities removal). ▪ Issued Final 2006 Peconic River Monitoring Report and submitted the draft 2007 report to regulators for review.
Reactors	Brookhaven Graphite Research Reactor (BGRR)	▪ Completed Graphite Pile inspections. ▪ Detailed Planning for Graphite Pile and Bioshield removal. ▪ Documented Safety Analysis and Technical Safety Requirements approved by DOE. ▪ Completed Building 701 preparatory work including: overhaul of overhead crane; high-bay ventilation system modification; and perimeter fencing installation. ▪ Awarded contract for Graphite Pile and BioShield removal in December 2007.
	High Flux Beam Reactor (HFBR)	▪ Continued long-term surveillance and maintenance activities. ▪ Installed Building 750 leak detection system. ▪ Removed combustible material from reactor building in accordance with Fire Hazards Analysis recommendations. ▪ Developed revised Nuclear Safety Basis documentation and submitted to DOE. ▪ Commenced remediation of the Waste Loading area. ▪ Commenced detailed planning for the removal and disposal of the control rod blades and beam plugs.
	Brookhaven Medical Research Reactor (BMRR) (Project managed by the BNL Environmental and Waste Management Services Division)	▪ Continued surveillance and maintenance activities at the BMRR. ▪ Planned for the removal of the resin vessels from the primary coolant water purification system.
Buildings 810/811	Radiological Liquid Processing Facility	▪ Removed and disposed of two inactive above-ground 25,000-gal radioactive liquid storage tanks.
Building 801	Inactive Radiological Liquid Holdup Facility	▪ Removed piping containing mercury from outlet of two inactive radiological liquid holdup tanks.
Building 650	Inactive Radiological Decon Facility	▪ Removed lead melter, contaminated glove boxes, contaminated water in drains, and contaminated HVAC ductwork. Pumped standing water and scraped contaminated sludge from the floor of the basement.

- *Increase BNL's land and habitat conservation.* BNL surpassed its original goal of 30 acres and recovered a total of 42 acres of land, including 15 acres recovered during a prescribed burn conducted in October 2006. Prescribed burns improve the health of the forest and allow for forest re-growth by removing dead vegetation, eliminating underbrush and leaf litter, and opening the forest floor to new growth. The Laboratory will continue its stewardship efforts by returning lands to their native states as opportunities arise, minimizing use of non-native vegetation in landscaping, and managing on-site wildlife.
- *Reduce Radioactive Air Emissions*. BNL continued to evaluate and reduce, where possible, radioactive air emissions from the BLIP. In total, emissions were reduced by 34 percent, surpassing the original goal of 30 percent. These efforts included construction of a Lucite enclosure to retain evaporative losses from the target facility. In 2007, a barometric damper was installed to reduce the pressure differential across the target enclosure, which also reduces evaporative emissions. The effectiveness of this change will continue to be assessed.
- *Reduce BNL's use of ozone-depleting substances (ODS), specifically Class I ODS.* BNL surpassed its original goal by more than 5.5 tons of ODS by eliminating 35.5 tons of Class I ODS from 2003 through 2006. The Laboratory will continue to remove Class I and II refrigerants as obsolete A/C and refrigeration systems are replaced.
- *Reduce BNL's hazardous materials use.* BNL did not achieve its original goal of an 80 percent reduction in mercury inventory, primarily because the estimate of the amount of mercury in storage was high. By the end of 2006, 47 percent of the mercury

inventory had been disposed. In 2007, the Laboratory continued to eliminate unneeded sources of mercury and achieved a 60 percent reduction by the end of the year. BNL will continue to remove and dispose of mercury, especially elemental mercury, as opportunities arise and as older projects close.

In April 2007, BNL reapplied for continued membership to the PTrack program. Four new goals were established and accepted: energy reduction, transportation energy reduction, reductions in toxic releases through effective biosolids management, and establishing an electronics procurement program focused on purchasing computers that are registered under the Electronic Procurement Environmental Assessment Tool.

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 their own Roles, Responsibilities, Accountabilities, and Authorities (R2A2) document to sign and 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 management 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 in the Laboratory's decision making.

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

2.4.2.1 Communication Forums

To facilitate effective dialogue between BNL 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 regulatory agencies on environmental and operational issues, as well as on scientific discoveries and initiatives.
- The Community Advisory Council (CAC), established by BNL in 1998, advises the Laboratory Director on issues related to the Laboratory that are important to the community. The CAC is composed of approximately 30 member organizations representing business, civic, education, employee, community, environmental, and health organizations. The CAC meets monthly in sessions that are open to the public, and sets its own agenda in cooperation with the Laboratory.
- BNL's Envoy Program educates employee volunteers regarding Laboratory issues and provides a link to local community organizations. Feedback shared by envoys helps BNL gain a better understanding of local community concerns.

- The Speakers' Bureau provides speakers for educational and other organizations interested in the Laboratory.
- BNLs Summer Sunday tours enable the Laboratory to educate the public by featuring different facilities and program areas.
- The Laboratory participates in various annual events, such as a week-long celebration in honor of Earth Day, the Heckscher State Park Spring Festival, and the Longwood Fair.
- Lunchtime tours are held once a month and offer employees the opportunity to learn about activities outside the scope of their jobs.
- The Laboratory's research, history, and natural environment, as well as cleanup projects, have all been topics covered under BNL's lunchtime talks. Periodically, bag lunch meetings are held with employees on specific topics of interest or concern, such as health benefits or wildlife management.
- BNL issues press releases; publishes *Laboratory Link*, a bi-monthly update on BNL science and events; and *the Bulletin*, a weekly employee newsletter.
- 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 update service at http://lists.bnl.gov/mailman/listinfo/bnl-announce-1.

2.4.2.2 Community Involvement in Cleanup Projects

In 2007, BNL stakeholders were updated on the progress of the environmental cleanup projects through presentations given at the monthly CAC and BER meetings, including:

- A presentation on the Laboratory's Annual Groundwater Report provided the CAC with information on the communication processes related to groundwater remediation, the protection and monitoring of the groundwater, the operational status of treatment systems, the progress toward achieving cleanup goals, and proposed actions in response to monitoring data.
- The 2006 monitoring report on the Peconic River (OU V) was shared with the CAC in two detailed presentations. The presentations included data on sediment, surface water, fish, and wetlands sampling. It also included information on sampling, data evaluation, data transmission, and implementation of follow-up actions.
- As a follow-up to the comments provided in 2006 by the CAC on the Proposed Remedial Action Plan for the g-2 Tritium Source area and plume, the Laboratory briefed the CAC on how their comments and those received from other stakeholders were incorporated into the ROD.
- The CAC was updated periodically on the development of possible remedies for the decommissioning of the HFBR in an effort to provide them with up-to-date information when the final Proposed Remedial Action Plan was released.
- A presentation on the activities at the BGRR was given to the CAC. Work plans and schedules for removal of the pile, and preparatory activities including overhauling the overhead crane, removal of physical interferences, and identifying remote equipment, were discussed. A detailed description of an inspection of the pile and its findings was also provided.

Working closely with elected officials, regulatory agency representatives, community members, and employees, DOE and BNL openly shared information and provided 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 what impact activities have on the environment, and ensures compliance with environmental per-

mit 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 450.1, Environmental Protection Program, BNL prepares an Environmental Monitoring Plan, Triennial Update (BNL 2007), 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 2007 there were 8,632 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

Table 2-5. Summary of BNL 2007 Sampling Program Sorted by Media.

Environmental Media	No. of Sampling Events*	Purpose
Groundwater	2,049 ER 256 ES/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	43 ES 181 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)	439	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, samples can not be collected. See Chapters 3 and 5 for further detail.
Precipitation	16	Precipitation samples are collected from two locations to determine if radioactive emissions have impacted rainfall, and to monitor worldwide fallout from nuclear testing. The data are also used, along with wind speed, wind direction, temperature, and atmospheric stability to help model atmospheric transport and diffusion of radionuclides. See Chapter 4 for further detail.
Air – Tritium	381	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	459 ES/C 53 NYSDOH	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. Samples are also collected for the New York State Department of Health Services (NYSDOH) as part of their program to assess radiological air concentrations statewide. See Chapter 4 for further detail.
Air – Charcoal	53	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. See Chapter 4 for further detail.
Fauna	144	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.

(*continued on next page*)

Table 2-5. Summary of BNL 2007 Sampling Program Sorted by Media *(concluded).*

Environmental Media	No. of Sampling Events*	Purpose
Flora	13	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	78	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	312	Samples are collected periodically from potable water fixtures and dispensers, manholes, spills, to assess process waters, and to assess sanitary discharges.
Groundwater Treatment Systems and Remediation Monitoring	2027	Samples are collected from groundwater treatment systems and as long-term monitoring after remediation completion under the Comprehensive Environmental Response, Compensation, and Liability Act program. The Laboratory has 14 operating groundwater treatment systems. See Chapter 7 for details.
Vehicle Monitor Checks	248	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)	244	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	546	Flowcharts are exchanged weekly as part of BNL's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	110	Tests are performed on select petroleum storage facility monitoring wells to determine if floating petroleum products are present. The number of wells and frequency of testing is determined by NYSDEC licensing requirements (e.g., Major Petroleum Facility), NYSDEC spill response requirements (e.g., Motor Pool area), or other facility-specific sampling and analysis plans.
Radiological Monitor Checks	661	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)	248	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	**8632**	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2007), as well as samples collected to monitor Environmental Restoration projects, air and water treatment system processes, and by the Environmental and Waste Management Services 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 sampling event is the collection of samples from a single georeferenced location. Multiple samples for different analyses (i.e., tritium, gross alpha, gross beta, and volatile organic compounds) can be collected during a single sample event.

C = Compliance
ER = Environmental Restoration
ES = Environmental Surveillance

Pollution Act, Safe Drinking Water Act, and the New York State equivalents. Included in compliance monitoring are the following:

- *Air emissions monitoring* is conducted at reactors, accelerators, and other radiological emission sources, as well as the 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 ER 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 also performed in accordance with permit requirements. Specifically, monitoring of groundwater is required under the Major Petroleum Facility License for the CSF and the RCRA permit for the WMF. Extensive groundwater monitoring is also conducted under the Long Term Response Actions Program, as required under the RODs for many of the OUs or Areas of Concern (see Chapter 7 and SER Volume II, Groundwater Status Report, for details). Additionally, to ensure that the Laboratory maintains a safe drinking water supply, BNL's potable water supply is monitored as required by the SDWA, which is administered by the 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 and RCRA.

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 450.1, 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 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 unprecedented 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 regain and 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. The Laboratory continues to pursue other ways to communicate timely data in a more user-friendly, visual manner.

BNL's EMS is viewed as exemplary within DOE. Due to external recognition of the Laboratory's knowledge and unique experience implementing the EMS program, several DOE facilities and private universities have invited BNL to extend its outreach activities and 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. Audits and EMS management reviews have noted the following improvements made since BSA began managing BNL:

- The EMS has been strengthened, integrated with other Laboratory management systems, and formalized.
- Line ownership for environmental stewardship has been established, key roles and responsibilities have been identified and clarified, and expectations have been made explicit.
- A comprehensive environmental training program has been implemented.
- From the process evaluation project, BNL has improved its understanding of environmental aspects, waste streams, and applicable requirements.
- There is much greater formality with regard to control of EMS documents, manuals, and procedures. Procedures and requirements have been updated, and environmental management programs have been improved.
- The Laboratory has been very successful in achieving its environmental goals. There have been successes in ISO 14001 registration and recertification, compliance improvements (e.g., facility modifications, implementation of SBMS, enhanced operational controls), and increased environmental knowledge and awareness on the part of management, employees, contractors, and visitors.
- Communication on environmental issues has improved, occurs at the highest levels of management, and reporting is more formal. Managers are better informed about environmental aspects, issues, and performance.
- Core EMS teams representing many organizations have been formed. A consensus process is used to develop the system, improving acceptance and support.
- There has been strong implementation of the EMS throughout the organizations, and cultural change has been notable.

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," 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. 2003b. *Natural Resource Management Plan for Brookhaven National Laboratory*. BNL-71870-2003. Brookhaven National Laboratory, Upton, NY.

BNL. 2003c. *Wildland Fire Management Plan for Brookhaven National Laboratory*. BNL-71629-2003. Brookhaven National Laboratory, Upton, NY.

BNL. 2006. *BNL Environmental Monitoring Plan 2006, Triennial Update.* Brookhaven National Laboratory, Upton, NY.

DOE Order 450.1. 2003. *Environmental Protection Program*. U.S. Department of Energy, Washington, DC. Jan. 15. 2003.

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.

Intentionally Left Blank