2 Environmental Management System

One of Brookhaven National Laboratory's highest priorities is ensuring that its environmental performance measures up to its world-class status in science. Brookhaven Science Associates (BSA), the contractor operating the Laboratory on behalf of DOE, takes environmental stewardship very seriously. As part of BSA's commitment to environmentally responsible operations, they have established the BNL Environmental Management System (EMS). One measure of an effective EMS is recognition of good environmental performance. In 2005, BNL operations led to a DOE Noticeable Practice Award for a conference entitled "Fleet Managers Pollution Prevention Workshop." This workshop, held at BNL, allowed local organizations that manage vehicle fleets to interact and share pollution prevention ideas.

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 2005, an EMS Surveillance Audit determined that BNL remains in conformance with the ISO 14001: 2004 Standard. The Laboratory was the first DOE facility certified to the 2004 Standard.

BNL continued its strong support of the Pollution Prevention Program in 2005. This program seeks ways to eliminate waste and toxic materials and is the preferred approach to resolving environmental issues at the Laboratory. In 2005, pollution prevention projects saved more than $1 million and resulted in the reduction or reuse of approximately 2.8 million pounds of waste. Also in 2005, the BNL Pollution Prevention Council funded 13 new proposals or special projects, investing approximately $101,000. Anticipated annual savings from the projects are estimated at approximately $102,000, for an average payback period of 1.4 years. 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 also 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.

2.1 BNL'S ISO 14001 STANDARD

The ISO 14001 Standard is globally recognized and defines the structure of an organization's EMS for purposes of improving environmental performance. The process-based structure of the ISO 14001 Standard is based on the "Plan-Do-Check-Act" improvement cycle. The standard requires an organiza-

tion to develop an environmental policy, create plans to implement the policy, implement the plans, check progress and take corrective actions, and review the system annually to ensure its continuing suitability, adequacy, and effectiveness. To gain registration to the ISO 14001 Standard, an organization must comply with a set of 17 requirements that are listed and described in Table 2-1.

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. To achieve registration, the Laboratory underwent an independent audit of its EMS to verify that the system conformed to all ISO 14001 requirements and that it was effectively implemented. The certification also requires BNL to undergo annual audits by an accredited registrar to assure that the system is maintained.

In 2005, an EMS Surveillance Audit determined that BNL remains in conformance with the ISO 14001 Standard, which was upgraded in 2004. In its recommendation for continued certification, NSF-International Strategic Registrations, Ltd. highlighted seven examples of BNL's continual improvement, some of which include BNL's improved methods for presenting objectives and targets. The auditors also identified three minor nonconformances and four opportunities for improvement. 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. This policy, issued and signed by the Laboratory director, makes clear BNL's commitments to environmental stewardship, the safety of the public and BNL employees, and the security of the site. To help achieve the goal of providing a healthy and safe work environment, BNL has implemented the OHSAS 18001 (Occupational Health and Safety Assessment Series) specifications to develop a comprehensive Occupational Safety and Health management system. The OHSAS was developed to be compatible with the ISO 14001 Standard to facilitate the integration of environmental and occupational health and safety management systems. The Laboratory is committed to achieving OHSAS registration sitewide by 2006. 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. Within the policy, goals and commitments that focus on compliance, pollution prevention, cleanup, community outreach, and continual improvement include:

- Meet all applicable ESSH laws and BNL Standards Based Management System, Integrated Safety Management, and Integrated Safeguards and Security Management requirements. (The environmental requirements include more than 100 local, state, and federal laws and regulations; DOE Directives; Executive Orders; and numerous operating permits.)
- Integrate hazard prevention/reduction, pollution prevention/waste minimization, resource conservation, security, and compliance into all of our planning and decisionmaking and adopt cost-effective practices that eliminate, minimize, or mitigate environmental impacts and control safety, security, and health risks and vulnerabilities. (This commitment includes conserving natural resources and adhering to the policy known as "E-ALARA" by ensuring that emissions, effluents, and waste generation are As Low As Reasonably Achievable.)
- Strive to conserve resources and minimize or eliminate adverse ESSH effects and risks that may be associated with research and operations, and manage programs in

Table 2-1. Elements of the Environmental Management System (EMS): Implementation of ISO 14001 at BNL.

Environmental Policy	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, the Laboratory has reaffirmed its commitment to compliance, pollution prevention, cleanup, community outreach, and continual improvement.
Environmental Aspects and Impacts	When operations have an environmental aspect, BNL implements the EMS to minimize or eliminate any potential impact. As required by the ISO 14001 Standard, 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 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 ▪ Historical and cultural resources ▪ Environmental noise ▪ Disturbances to endangered species/protected habitats ▪ Soil activation ▪ Historical contamination ▪ Other facility-specific compliance aspects
Legal and Other Requirements	BNL 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.
Objectives, Targets, and Programs	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 were the objectives and targets in FY 2005: ▪ Maintain and improve the EMS ▪ Achieve full compliance with applicable environmental requirements ▪ Invest in specific pollution prevention projects ▪ Improve communications, trust, and relationships with stakeholders on environmental programs ▪ Fully implement the BNL Groundwater Protection Program ▪ Ensure responsible stewardship of natural and historical resources on site ▪ Implement 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. The Laboratory has implemented a Pollution Prevention Program to conserve resources and minimize waste generation. BNL 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.
Resources, Roles, Responsibilities, and Authorities	All employees at the Laboratory 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 BNL employee is required to develop a Roles, Responsibilities, Accountabilities, and Authorities 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.
Competence, Training, and Awareness	Extensive training on EMS requirements has been provided to staff whose responsibilities include environmental protection. The 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.
Communication	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.

(continued on next page)

Table 2-1. Elements of the Environmental Management System (EMS): Implementation of ISO 14001 at BNL.

Documentation	BNL has a comprehensive, 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.
Control of Documents	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.
Operational Control	Operations at the Laboratory are evaluated for the adequacy of current controls to prevent impact to the environment. As needed, additional administrative or engineered controls are identified, and plans for upgrades and improvements are developed and implemented.
Emergency Preparedness and Response	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
Monitoring and Measurement	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, sitewide 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
Evaluation of Compliance	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.
Nonconformity, and Corrective and Preventive Actions	BNL continues to improve processes that identify and correct problems. A Lessons Learned Program to prevent recurrences, a sitewide Self-Assessment Program, and an electronic web-based assessment and action tracking system have been implemented
Control of Records	EMS-related records, including audit and training records, are maintained to ensure integrity, facilitate retrieval, and protect them from loss.
Internal Audit	To periodically verify that the EMS is operating as intended, audits are conducted. These audits, which are part of the sitewide 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.
Management Review	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.

a manner that protects the ecosystem and employee/public health. (This commitment includes continually improving the EMS and the Laboratory's environmental performance by establishing appropriate environmental objectives and performance indicators to guide these efforts and measure progress; maintaining certification by employing proactive measures to prevent problems; and taking corrective actions, as appropriate, if problems do occur.)

- Work with stakeholders to help them address their ESSH needs; maintain a positive, proactive, and constructive relationship with neighbors in the community, regulators, DOE, and other stakeholders;

and openly communicate with stakeholders on our progress and performance (see Section 2.4.2).
- Define, prioritize, and aggressively prevent, correct, and/or clean up existing environmental, security, and occupational safety and health problems. (This commitment encompasses removal or treatment of contamination caused by historical practices; strengthening the BNL Environmental Monitoring Program as discussed in Section 2.4.3 to ensure that controls designed to protect the environment are working; and providing early detection of potential threats to the environment.)

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. BNL'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 the significant aspects and potential impacts continue to reflect stakeholder concerns and changes in regulatory requirements. BNL's list of aspects and significance criteria remained unchanged in 2005.

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 SBMS subject areas.

2.3.3 Objectives and Targets

The establishment of environmental objectives and targets is accomplished through BNL's 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. The Laboratory and BSA work 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 FY 2005 (October 1, 2004 through September 30, 2005), BNL's environmental objectives included:

- Maintaining and improving the EMS
- Achieving full compliance with applicable environmental requirements
- Integrating pollution prevention into work planning and expanding participation within the Laboratory
- 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 cultural 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 has developed and funded several important environmental programs to further integrate environmental stewardship into all facets of BNL's missions.

2.3.4.1 Compliance

BNL has an extensive system to help ensure full compliance with all applicable environmental regulatory requirements and permits. Legislated compliance is outlined by the National Emission Standards for Hazardous Air Pollutants (NESHAPs), State Pollutant Discharge Elimination System (SPDES), and Resource Conservation and Recovery Act (RCRA). Other compliance at BNL involves special projects or initiatives, 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 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. BNL 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 the full and timely disclosure of any off-normal occurrences and regular communication on the performance of the program. In 2005, the Laboratory completed construction of the Strontium-90 Groundwater Treatment System, the last major system scheduled for construction. Chapter 7 and the SER Volume II, Groundwater Status Report, provide additional details about this program, its performance, and monitoring results for 2005.

2.3.4.3 Waste Management

As a byproduct of the world-class research it conducts, BNL generates a large range of waste. This includes 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.

BNL's Waste Management Facility (WMF) is responsible for the collection, transportation, storage, and off-site disposal of waste generated at the Laboratory. 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 2005, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 5.9 tons
- Mixed waste: 66 ft^3
- Radioactive waste: 1,402 ft^3

Hazardous and mixed waste amounts from routine operations in 2005 were approximately the same as in 2004 (Figures 2-1a and 2-1b). The radioactive waste quantity for routine operations represents a reduction from previous years, as shown in Figure 2-1c. This reduction is attributed to a limited high-energy nuclear physics fixed-target program in 2005. Waste generated from nonroutine or one-time events and waste 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 historical operations. Waste recovered through restoration and decommissioning activities is managed by the Environmental Restoration (ER) group, with oversight by BNL's Environmental and Waste Management Services Division (EWMSD). In 2005, the EWMSD assumed surveillance and maintenance operations for the Brookhaven Medical Research Reactor (BMRR). Waste generation activity associated with the BMRR is reflected in the nonroutine waste values. Nonroutine waste 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 BNL's cleanup schedule. In 2005, large-scale remedial operations of the Peconic River were completed resulting in the removal of approximately 6,000 tons of non-hazardous sediment. In addition, ER removed the greatest amount of radiological waste in any single year, with the completion of remedial activities at the Former Hazardous Waste Management Facility, Chemical/Glass Holes Project, and Waste Concentration Facility This was a significant achievement for BNL.

2.3.4.4 Pollution Prevention and Minimization

The Laboratory's Pollution Prevention (P2) Program is an essential element for the successful accomplishment of BNL's broad mission. It reflects the national and DOE pollution prevention goals and policies and represents an ongoing effort to make pollution prevention and waste minimization an integral part of the BNL operating philosophy.

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

- Eliminate or reduce emissions, efluents, 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 FY 2005. Nine proposals were funded, in addition to four special projects, for a combined investment of approximately $101,000. The anticipated an-

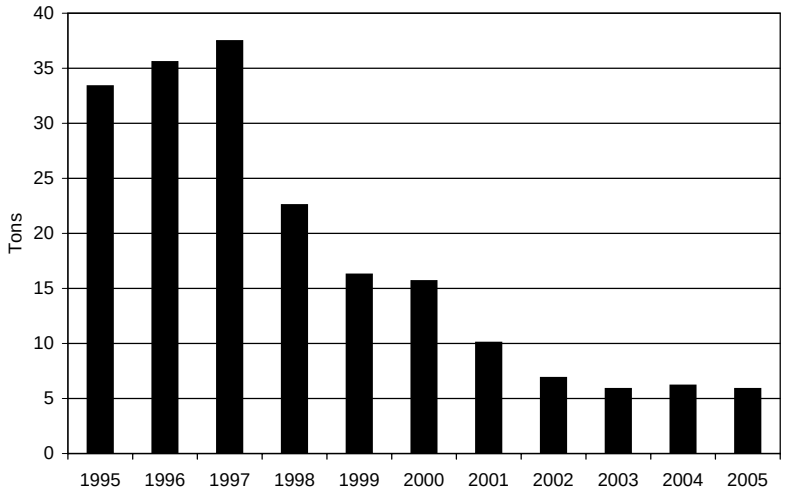

Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1994 – 2005.

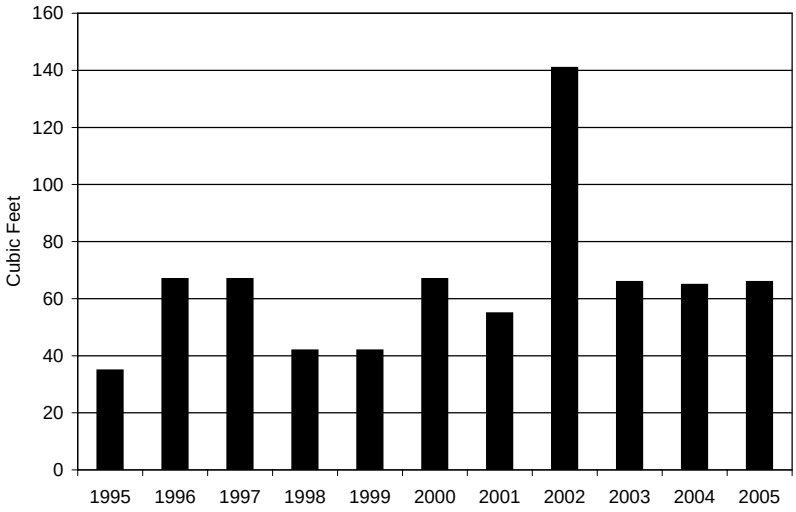

Figure 2-1b. Mixed Waste Generation from Routine Operations, 1994 – 2005.

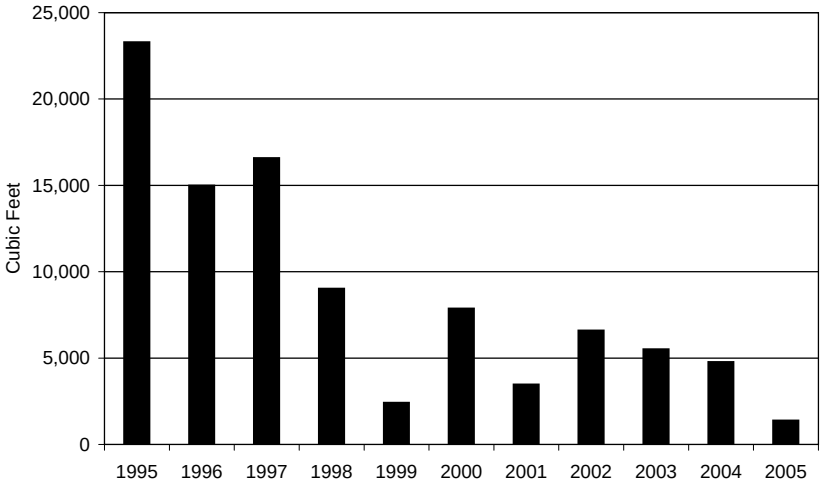

Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1994 – 2005.

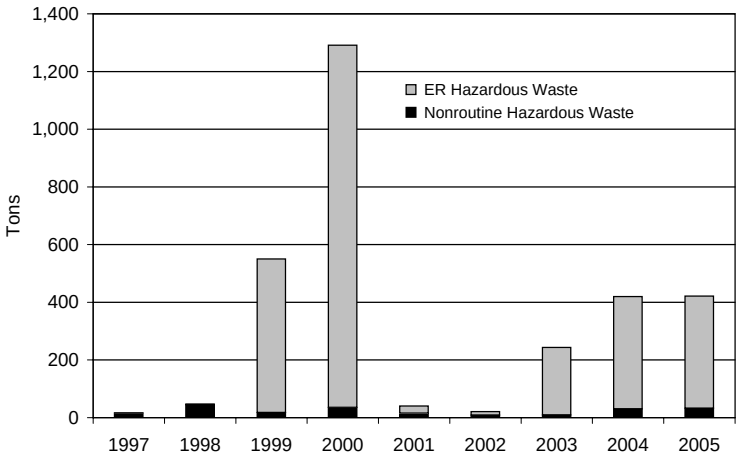

Figure 2-1d.
Hazardous Waste Generation from ER and Nonroutine Operations, 1997 – 2005.

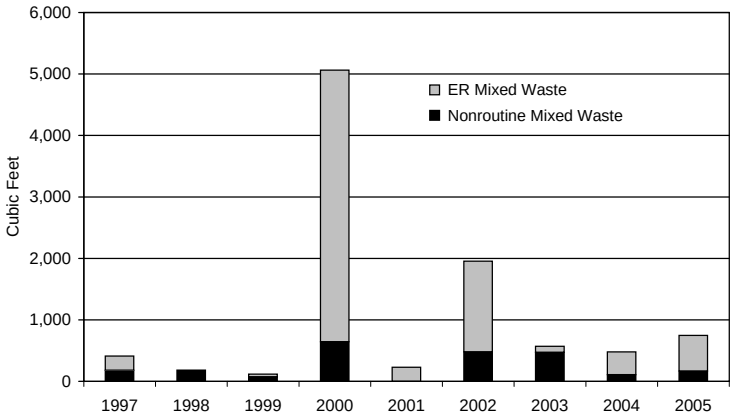

Figure 2-1e.
Mixed Waste Generation from ER and Nonroutine Operations, 1997 – 2005.

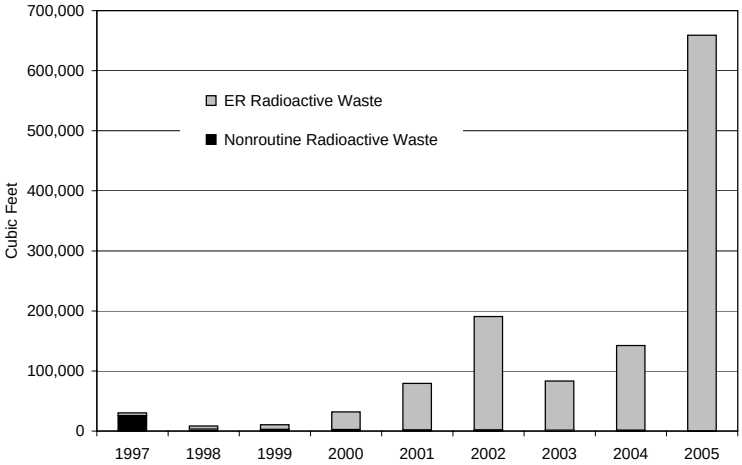

Figure 2-1f.
Radioactive Waste Generation from ER and Nonroutine Operations, 1997 – 2005.

nual savings from these projects is estimated at $102,000, for an average payback period of 1.4 years. The four special projects were jointly funded with other BNL divisions and significantly limited future environmental and worker safety risks.

The efforts of 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.

Examples of some of BNL's 2005 P2 accomplishments include:

- Since 2002, the hydraulic lift bays in the motor pool have been using a biobased hydraulic oil as part of a P2-funded initiative, after an underground hydraulic line leaked petroleum-based oil, which required excavation and remediation. During 2005, a leak involving biobased oil developed in one of the underground hydraulic lines of an adjacent bay. Samples were collected and the impacted soil was found to be as much as 10 feet below grade (yet well above groundwater levels). The authorizing regulatory agencies approved a plan to allow the oil to biodegrade in place. The underground pipes were abandoned and replaced with aboveground piping. The permission to use biodegradation and "abandonment in place" saved the Laboratory approximately $20,000 in excavation, manpower, and waste management costs.
- Several jointly funded P2 projects greatly decreased both environmental and safety risks to the Laboratory. These projects included:
  - Removing the PCB rectifier and transformer from Building 901
  - Dismantling the Animal Bedding Facility Disposal System in Building 490
  - Demolishing and removing the Building 208 Hopper
  - Installing oil/water separators for the Vehicle Wash Facility at Building 649
  - The Collider Accelerator Department submitted a P2 proposal for an aerosol can disposal system. The disposal system punctures aerosol cans and collects the contents, allowing the cans to be recycled as scrap metal and avoiding the generation of hazardous waste. Due to the success of this disposal system, seven additional systems were purchased and distributed throughout the Laboratory.

Table 2-2 describes the P2 projects implemented through 2005 and indicates the number of pounds of materials reduced, reused, or recycled and the estimated cost benefit of each project. Also included in the table are additional recycling and waste reduction projects.

Implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has significantly reduced both waste volumes and management costs. In 2005, these efforts resulted in more than $1 million in cost avoidance or savings and approximately 2.8 million pounds of materials being reduced, recycled, or reused.

BNL also has an active and successful solid waste recycling program, which involves all employees. In 2005, BNL collected more than 190 tons of office paper for recycling. Cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, printer and toner cartridges, 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 2005.

2.3.4.5 Water Conservation

BNL has a strong water conservation program in place that 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 cool-

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2005	Waste Type	Potential Cost for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Aerosol Can Disposal System	Recycling	66	Hazardous Waste	$991	$1,700	$991	Allows spent aerosol cans to be recycled scrap metal rather than sent to Waste Management Division as hazardous waste.
Formaldetox	Source Reduction	128	Industrial Waste - Lab Pack	$2,120	$1,040	$2,120	Neutralizes nonhazardous para-formaldehyde, bleach, and rat blood.
Replacement of IO Mercury Thermometers	Substitution	20	Mercury	$2,350	$250	$2,350	Approximately 20 lbs of mercury-containing thermometers were removed from 10 laboratories during 2005. Savings are based on the cost of one mercury spill and cleanup.
Replacement of PO Mercury Thermometers	Substitution	30	Mercury	$2,350	$450	$2,350	Approximately 30 lbs of mercury-containing thermometers were removed from Physics laboratories during 2005. Savings are based on the cost of one mercury spill and cleanup.
Photon Counting Spectroflurometer	Substitution	54	2 ft^3 of Mixed Waste and 1000 Man-hours	$10,540	$46,350	$25,540	Eliminated the need for radioactive assays and the subsequent generated radioactive waste. Cost savings include 1,000 man-hours and savings on material costs.
Replacement of Mercury Utility Devices	Substitution	120	Mercury		$12,000	$2,350	Approximately 120 lbs of mercury-containing devices were removed from utility devices during 2005. Savings are based on the cost of one mercury spill and cleanup.
Animal Bedding Conveying System Dismantling*	Recycling	2,000	250 ft^3 of Low-Level Radioactive Waste	$38,974	$5,000	$38,974	Multi-year/multiple department-funded initiative that will eliminate low-level radioactive waste and provide a safer work environment in the Medical Department.
PCB Transformer Carcuss Removal	Removal	4,000	High-Level Risk to the Laboratory		$6,251	$6,000	Final stage of a multi-year/multiple department-funded initiative to eliminate electrical components which were PCB contaminated.
Recovery of CFC R-113 from Building 511 Chiller	Substitution	490	Class 1 Ozone Depleting Substances (ODS)	$4,250	$500	$3,750	Recovery and reuse by another DOE facility of 490 lbs of R-113 (a Class 1 ODS).
Halogen 1211 Fire Extinguisher Substitution*	Substitution	1,700	Halogenated Ozone Depleting Substances (ODS)		$10,000	$6,250	Halogen 1211 removed from service and replaced with non-ozone depleting substances.

(continued on next page)

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2005	Waste Type	Potential Cost for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
EP Grounds Vehicle Wash*	Waste Minimization	8,000	Oils/Grease to Soils	$16,000	$3,000	$16,000	Multi-year/multiple department-funded initiative that will eliminate the potential of oil and grease being released to soil.
208 Hopper Demolition	Recycling	12,000	Legacy Waste and Safety Risk to Laboratory	$12,000	$8,100	$4,000	Multiple department-funded initiative that eliminated a potential legacy waste and a severe safety concern.
Laboratory-Wide Earth Day Mercury Disposal Amnesty	Removal	30	Mercury		$6,000	$2,350	Approximately 30 lbs of mercury-containing waste were removed from use during this 2005 amnesty program. Savings are based on the cost of one mercury spill and cleanup.
Automotive Waste	Substitution	510	Hazardous Waste	$1,061	$0	$1,000	In 2004, solvent-based brake cleaners were replaced, reducing the hazards associated with their use and disposal.
Mercury Utility Devices	Substitution	60	Mercury	$1,750	$0	$1,750	Approximately 60 lbs of mercury-containing devices were removed from Buildings 463 and 490 in 2004. Savings are based on the cost of one mercury spill and cleanup in 2004.
PCB Oils	Retrofill	1,200	Hazardous Waste	$2,850	$0	$2,850	Approximately 150 gal of PCB-laden oil were removed from the ATF Klystron in 2004. Savings are based on the cost of one PCB spill and cleanup.
Organic Solvents	Substitution	678	Hazardous Waste	$1,410	$0	$26,000	Life Sciences purchased a Microwave Peptide Synthesizer in 2004 to significantly reduce the amount of hazardous wastes generated. Saves approximately 1,000 work hours/year (reflected in cost savings).
Organic Solvents	Purification/ Reuse	480	Hazardous Waste	$998	$0	$10,915	The implementation of the BES solvent purification system in 2004 replaces the need to purchase new solvent.
Cooling Water	Reuse	80,000	Deionized water	$0	$0	$10,000	A closed-cycle water recycling system for the Building 480 melt spinner was purchased in 2004. This saves a minimium of 10,000 gal of ultra-pure water and extends the life expentancy of equipment worth $100,000.
PCB Oils	Removal	3,110	Hazardous Waste	$6,469	$0	$2,850	In 2004, approximately 300 gal of pure PCB oil were drained from the transformer and rectifier in Building 901 (former PET Facility). Also removed were 30 PCB capacators and 11 PCB transformers. Savings are based on the cost of one PCB spill and cleanup.
Mercury Utility Devices	Substitution	40	Mercury	$2,350	$0	$2,350	The Occupational Medical Center replaced mercury-containing equipment with non mercury-containing equipment in 2004. Savings are based on the cost of one mercury spill and cleanup.
Radioactive Waste	Source Reduction	1,500	Radioactive Waste	$6,000	$0	$6,000	A sorting table was purchased in 2003 for the Waste Yard to sort clean waste from radioactive waste.

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2005	Waste Type	Potential Cost for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Radioactive Emissions	Emission Reduction	0	Radioactive Emissions			$0	A shroud was installed over the 16-inch diameter shaft in the Hot Cell of the 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.
Radioactive Waste generated through wet chemistry	Waste Minimization	30	Mixed Waste and Liquid Radioactive Waste	$17,600	$0	$22,500	The purchase of a Kinetic Phosphorescence Analyzer (KPA) system for uranium analysis eliminated mixed waste generation in this chemistry laboratory, reduced the volume of liquid waste by 90 percent, reduced the amount of radioactive material handled by 90 percent, minimized exposure to uranium by laboratory personnel, and decreased labor time 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 was purchased to reduce volume of radioactive waste.
Radioactive and Mixed Wastes from radio-labeled chemicals	Waste Minimization	112	Mixed Waste	$27,690	$0	$27,690	A microplate scintillation counter was purchased to to reduce mixed waste generation.
Pump Oil	Substitution	51	Hazardous Waste and Industrial Waste	$3,520	$0	$3,520	Oil-displacement pumps were replaced with dry pumps for both laboratory and aircraft missions.
Photographic Waste	Substitution	3,840	Hazardous Waste and Industrial Waste	$7,600	$0	$16,489	A photographic processor reduced the amount of chemicals used and waste generated by up to 80 percent.
Electrophoretic Mini-Gels	Microscale Chemical Use	2,200	Hazardous Waste - Lab Pack	$10,576	$0	$10,576	This system minimizes silver waste from silver-staining electrophoretic mini-gels. Savings reflect avoided waste disposal costs and lower material purchase costs ($6,000).
Hydraulic Oil	Product Substitution	3,000	Industrial Waste	$26,000	$0	$26,000	Hydraulic lift bays in the Motor Pool Shop were retrofitted to vegetable-based hydraulic oil in 2002. During 2005, an underground hydraulic pipe leak occured. The hydraulics were re-piped above ground and the oil was allowed to biodegrade in place.

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2005	Waste Type	Potential Cost for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Sewage Sludge	Volume Reduction	122,570	Radioactive Waste	$232,080	$0	$226,480	Disposal of radioactive Sewage Treatment Plant liquid waste would cost $15.16/gal. Instead, the waste is dried using rolloffs, absorbent, and lime realizing a 96 percent volume reduction. The waste is then shipped to a disposal facility in drums or rail cars.
Film and other radioisotopic imaging	Substitution	300	Hazardous Waste and Industrial Waste	$22,000	$0	$22,000	Replacement of film-based autoradiography and other radioisotopic imaging with a Phosphor Imager reduced hazardous waste generation by 200 lbs and industrial waste generation by 100 lbs. Additional projected savings are in annual supply costs and labor reduction.
Digital Imaging System	Substitution	282	Hazardous Waste, Radioactive Waste, and Industrial Waste	$25,000	$0	$25,000	Reduction of hazardous (134 lbs), radioactive (80 lbs), and industrial (68 lbs) waste with installation of a digital imaging system. Additional projected savings are in annual supply costs and labor reduction.
Fluorescence-Based Assay	Substitution	200	Mixed Waste	$30,550	$0	$30,550	Development of a fluorescence-based assay for the DNA-dependent protein kinase (DNA-PKcs), replacing the 32P assay.
Lead Acid Batteries	Recycled	9,200	Hazardous Waste	$19,136	$0	$19,136	Estimate 40 lbs/battery and avoided disposal costs as hazardous waste.
Ion Exchange Wastewater	Source Reduction	1250	Hazardous and Sanitary Wastewater	$2,600	$100	$2,500	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. There is a small annual cost for replacement supplies.
Smoke Detectors	Source Reduction	513	Mixed Waste	$112,039	$10,650	$101,389	In 2005, 171 Americium smoke detectors were removed from service, returned to the manufacturer, and replaced with non-rad detectors. This ongoing project reduces the risk of americium being released to the environment and avoids eventual disposal as mixed waste.
Cooling Water	Reuse	6,800	Radioactive Waste	$16,266	$0	$16,266	Approximately 850 gal (6,800 lbs) of cooling water were reused in the main magnet cooling water system, avoiding disposal as radioactive waste water.
Short Half-life Waste	Decay in Storage	25	Radioactive Waste	$2,308	$0	$2,308	Short half-life isotopes, particularly phosphorus-32 and phosphorus-33, are frequently used in Life Sciences Department experiments. In 2005, wastes from these operations (6 ft^3) were managed in accordance with BNL decay-in-storage requirements, rendering the wastes eligible for volumetric release.

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2005	Waste Type	Potential Cost for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Lubricating Oil	Energy Recovery	4,000	Industrial Waste	$8,320	$500	$8,000	In 2005, approximately 4,000 lbs (500 gal) of lubricating oils were collected, tested for suitable use as waste oil fuel, and used for energy production at the Central Steam Facility. Avoided disposal cost was $8,000. Cost of testing ($500) was offset by fuel use savings ($1.00/gal).
Cooling Tower Chemicals	Source Reduction	6,375	Industrial Waste	$15,000	$0	$15,000	In 2001, ozone water treatment units were installed on cooling towers at two RHIC experiments to provide biological control of cooling water. These systems eliminate the need for water treatment chemicals (typically toxic biocides), save labor, and reduce analytical costs for monitoring cooling tower blowdown.
Blasocut Machining Coolant	Recycled/ Reused	31,120	Industrial Waste	$68,630	$0	$75,030	Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it Laboratory-wide. In 2005, 3,890 gal (31,120 lbs) of Blasocut lubricant were recycled. Recycling involves aeration, centrifuge, and filtration. This avoids cost of disposal as industrial waste, plus an avoided cost of the procurement of 8 drums of concentrate ($800/drum) and 78 drums for waste ($50/drum).
Used Motor Oil	Energy Recovery	34,560	Industrial Waste	$75,785	$0	$83,370	Used motor oil from the motor pool and the on-site gas station is picked up by Strebel's Laundry Service free-of-charge and used to fire their waste oil dryers. In 2005, 4,320 gal of oil were picked up, avoiding cost for disposal and 87 drums for shipping ($50/drum).
Office Paper	Recycling	388,000	Sanitary Waste	$19,400	$0	$19,400	Estimate $100/ton for disposal as trash.
Cardboard	Recycling	314,000	Sanitary Waste	$15,700	$0	$15,700	Estimate $100/ton for disposal as trash.
Scrap Metal	Recycling	1,122,000	Sanitary Waste	$56,100	$0	$56,100	Estimate $100/ton for disposal as trash.
Bottles/Cans	Recycling	42,000	Sanitary Waste	$2,100	$0	$2,100	Estimate $100/ton for disposal as trash.
Construction Debris	Recycling	578,000	Sanitary Waste	$13,005	$0	$13,005	Estimate $45/ton for avoiding disposal as trash.
	TOTAL	2,786,644		$943,584	$111,891	$1,018,966	

* Cost savings of projects funded by the BNL Pollution Prevention Council are tracked for three years.

Table 2-3. BNL Recycling Program Summary.

Recycled Material	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Mixed paper	220	106	196	204	370	336	246	209	182	185	193
Cardboard	85	101	103	97	124	132	127	157	176	179	143
Bottles/Cans	11	15	21	22	21	20	29	19	23	22	22.1
Tires	11	17	18.6	11.5	15.2	0	0	3.5	12.3	11	12.8
Construction debris	627	837	799	527	352	243	289	304	334	367	350
Used motor oil (gallons)	3,350	4,275	4,600	3,810	3,570	3,295	3,335	1,920	3,920	3,860	4,590
Metals	153	158	266	64	47	534	38	48	193	128	559
Lead	–	–	4.4	3.7	0.7	2.5	0	0	–	5	0
Automotive batteries	0.72	6.8	4.3	2.1	1.1	2.2	4.8	6.3	4.6	5	4.6
Printer/Toner cartridges (units)	–	–	–	1,480/175	1,575/510	–	363	449	187	105	0
Fluorescent bulbs (units)	–	13,664	12,846	867	25,291	5,874	17,112	25,067	13,611	12,592	7,930
Blasocut coolant (gallons)	–	–	–	–	3,575	7,500	10,660	8,180	5,030	6,450	3890
Antifreeze (gallons)	–	55	276	448	145	110	200	0	165	325	0
Tritium exit signs (each)	–	–	–	–	–	185	190	28	181	142	0
Smoke detectors	–	–	–	–	–	–	171	40	0	0	0
Road base	–	–	–	–	–	–	–	2,016	0	2,666	0
Scrap electronics	–	–	–	–	–	–	–	–	–	–	6.1

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

ing towers. The goal is to reduce the consumption of potable water and reduce the possible impact of clean water discharges on Sewage Treatment Plant operations. Figure 2-2 shows the 10-year trend of water consumption. As of 2005, BNL has used less than half as much water as was used in 1996—over 700 million gallons less.

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 (2003a).

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 2005, the Laboratory used approximately 289 million kilowatt hours (kWh) of electricity, 4.4 million gallons of fuel oil, 40 thousand gallons of propane, and 40 thousand ft^3 of natural gas. Fuel oil and natural gas produce steam at the Central Steam Facility (CSF). Due to market conditions, fuel oil was predominately used in 2005, resulting in a cost savings of approximately $1,144,000. See additional information on natural gas and fuel oil use in Chapter 4.

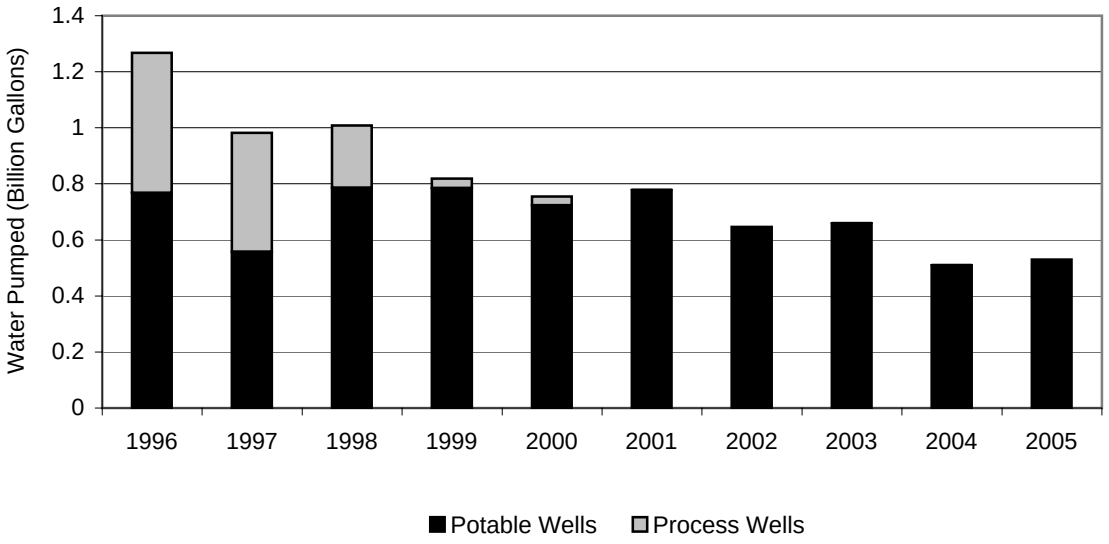

Figure 2-2. BNL Water Consumption Trend.

BNL is a participant in the Long Island Power Authority's (LIPA) Peak Load Reduction Curtailment Program. Through this program, the Laboratory has agreed to reduce electrical demand during critical days throughout the summer when LIPA expects customer demand to meet or exceed the company's available supply. In return, BNL receives a rebate for each megawatt reduced on each critical day. In 2005, participation in this program produced a rebate of $4,000 even though LIPA did not need to call a critical day in 2005. The Laboratory's participation is significant to LIPA: BNL's portion represents more than 10 percent of the 95+ MW load-curtailment program total, making the Laboratory one of the larger program contributors. BNL also agreed to keep electric loads at a minimum during the summer, in part by curtailing operations at the Relativistic Heavy Ion Collider (RHIC). This scheduling allowed the Laboratory to save more than $2 million in electric costs.

BNL also maintains a contract with New York Power Authority (NYPA) that resulted in an overall cost avoidance of $16 million in 2005. Participation in NYPA's 2005 load curtailment effort produced savings of over $2 million. BNL will continue to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs.

In 2005, a project to install a solar heating system for the BNL swimming pool was initiated. This small project is a first step toward meeting the Laboratory's energy needs with renewable sources. Also in 2005, several other energy related accomplishments included:

- Several activities were undertaken to reduce energy use at non-research facilities (e.g., replacement of inefficient chiller, demand control, lighting upgrades, etc.).
- Obtained the Energy Star designation for the DOE Brookhaven Site Office. To qualify, a building must meet specific standards for thermal comfort, indoor air quality, and lighting. In addition, a building must be in the top 25 percent for energy performance of similar existing buildings of its type and size.
- BNL is evaluating several buildings on site to determine if they meet the qualification criteria of use, size, and metering for Energy Star Buildings consideration as well as Leadership in Energy and Environmental Design (LEED) certification, the recognized standard for measuring building sustainability. The LEED "green" building rating system is designed to promote design and construction practices that increase profitability while reducing negative environmental impacts and improving occupant health and well-being. The Laboratory's Research

Support Building and the Center for Functional Nanomaterials, both under construction, were registered for LEED certification.
- BNL participated in LIPA's Peak Load Reduction Curtailment Program during the summer, as previously discussed. This was the 17th consecutive year of participation.
- Nearly 34,000 gge (gas 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 FY2006 – FY2015. These are very aggressive goals, and go significantly beyond the previously set goals of the 30 percent reduction by 2005 compared to 1985. BNL's energy use per square foot in 2005 was 27.6 percent less than in 1985 (see Figure 2-3) and 6 percent less than 2003. It is important to note that energy use for buildings and facilities at BNL 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 U.S. Fish & Wildlife Service, the Upton Ecological and Research Reserve Technical Advisory Group, and the Foundation for Ecological Research in the Northeast. 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. For more information about these programs, see Chapter 6.

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 (see http://www.epa.gov/superfund/sites/npl/ny.htm).

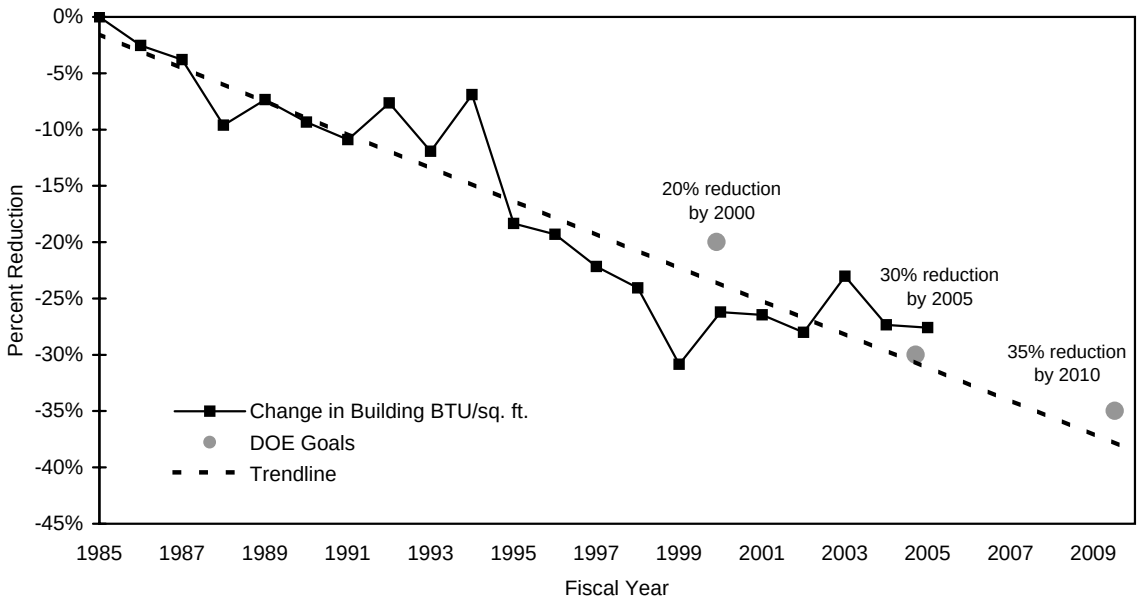

Figure 2-3. BNL Building Energy Performance, 1985 – 2010.

Each step of the CERCLA cleanup process is reviewed and approved by DOE, EPA, and NYSDEC, under an Interagency Agreement contract. This agreement was formalized in 1992. 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 list and evaluate Remedial Action alternatives and present the proposed best alternative
- Issue a Record of Decision (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

Significant progress was made in environmental restoration in 2005, highlighted by the completion of remedial activities at the Peconic River, Former Hazardous Waste Management Facility, and Waste Concentration Facility. Construction of the Strontium-90 Groundwater Treatment System, the last major groundwater treatment system scheduled for construction, was also completed. In addition, the final record of decision for the end state of the BGRR was completed. The success of the accomplishments was recognized with a celebration attended by community and political stakeholders, and marked a turning point for BNL into its planned operation, maintenance, and monitoring program. 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. The 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 program currently has approximately 400 members nationwide.

The PTrack Program requires that sites commit to several improvement goals for a 3-year period and report on the progress of these goals annually. Below is a brief description of the goals and the progress for 2005.

- *Increase BNL's land and habitat conservation.* To date, the Laboratory has recovered a total of 26 acres of land, including 10 acres restored to native vegetation in 2005. This was accomplished by recovering areas where World War II structures had been demolished, and identifying additional acreage to be placed in "no mow" situations, to enable the gradual recovery to native forest vegetation. Additionally, BNL environmental biologists identified a 15-acre plot to be treated with prescribed fire to improve the health of the forest. The prescription for the burn was approved and all preparations were completed. However, due to poor weather conditions, the burn could not be carried out as scheduled. The prescription will be attempted again in 2006.
- *Reduce Radioactive Air Emissions*. In 2005, the Laboratory made significant progress in achieving a PTrack commitment to reduce radioactive air emissions from the Brookhaven Linac Isotope Producer (BLIP) 30 percent by 2006. Construction and testing of a Lucite enclosure was completed in 2005. The objective of the enclosure was to minimize evaporative and gaseous losses from the beam interactions with the target cooling water. A performance test was conducted in March 2005 to evaluate the enclosure's effectiveness. The emissions data confirmed that the overall reduction in emissions ranged between 29 and 35 percent under normal operating conditions.

Table 2-4. Summary of BNL 2005 Environmental Restoration Activities.

Project	Description	Environmental Restoration Program Actions
Soil Projects	OU I OU II OU VII	▪ Mobilized contractor and completed the soil remediation at the former Hazardous Waste Management Facility. ▪ Mobilized the contractor and completed the underground storage tank removal and soil remediation at the Waste Concentration Facility. ▪ Submitted the Operable Unit (OU) I Soils and OU V Long-Term Monitoring and Maintenance Plan to the regulators for review.
Groundwater Projects	OU III	▪ Began operations of an on-site strontium-90 (Sr-90) groundwater treatment system for the Brookhaven Graphite Research Reactor (BGRR)/Waste Concentration Facility groundwater plume. This is the last of the treatment systems to be constructed. ▪ Continued operations of all groundwater treatment systems on and off site that treat volatile organic compounds (VOCs) and Sr-90. ▪ Three groundwater treatment systems began pulse pumping due to low VOC concentrations in the groundwater near the pumping wells. Two systems remained in standby mode. ▪ Performed two applications of the oxidizer potassium permanganate to degrade VOC contamination at the Building 96 groundwater plume. The regulators approved a Petition for Shutdown of the fourth Building 96 groundwater treatment system extraction well. The well was placed on standby in June; however, it was restarted in October due to a rebound in VOC concentrations. Alternative remediation methods may be evaluated. ▪ Continued monitoring of the High Flux Beam Reactor (HFBR) tritium plume. ▪ An Explanation of Significant Differences (ESD) to the OU III Record of Decision (ROD) was signed by DOE and the regulators. The ESD selected active treatment of the Magothy aquifer VOC contamination, changes to the overall cleanup timeframe for the Sr-90 plumes, and documented the need for no further action for Building 96 anomalies. ▪ Began preparation of a Focused Feasibility Study for submittal to the regulators in 2006. ▪ During 2005, 1.8 billion gallons of groundwater were treated and 472 pounds of VOCs were removed. Since the first groundwater treatment system started operating in December 1996, approximately 5,280 pounds of VOCs have been removed from more than 10.1 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 2004 Groundwater Status Report. ▪ Collected and analyzed 2,282 groundwater samples from 739 monitoring wells. ▪ Updated the Environmental Monitoring Plan. ▪ Submitted the draft sitewide Five-Year Review Report to the regulators for review.
Peconic River	OU V	▪ Completed the Phase 1 on-site remediation of the Peconic River. ▪ DOE and EPA signed the ROD. ▪ Completed the Phase 2 off-site remediation of the Peconic River. ▪ Began long-term post-cleanup monitoring.
Reactors	BGRR	▪ DOE and EPA signed the ROD. ▪ Completed the partial removal of the belowground-duct primary liner. ▪ Completed the removal of the BGRR canal. ▪ Completed the remediation of accessible pockets of deep soil contamination.
	HFBR	▪ Continued long-term surveillance and maintenance activities. ▪ Continued legacy waste disposal.
	BMRR	▪ The surveillance and maintenance activities at the Brookhaven Medical Research Reactor (BMRR) was transitioned from the Environmental Restoration Group to to Environmental and Waste Management Services Division in 2005. ▪ Continued surveillance and maintenance activities at the BMRR. ▪ Disposed of 12 plates (Janus Plates) of low-enriched uranium. ▪ Removed and disposed of approximately 2,000 gallons of tritiated primary coolant water.

- *Reduce BNL's use of ozone-depleting substances (ODS), specifically Class I ODS.* In 2005, BNL continued its commitment to reduce the amount of ODS used at the Laboratory. The 2003 baseline inventory of Class I ODS was revised by BNL in 2005 to include Halon 1211. In 2003, there were 455 portable extinguishers on site, containing 7,707 pounds of Halon 1211; another 50 pounds of Halon 1211 were held in stock to replenish discharged extinguishers.

  Because Halon 1211 has an ozone depletion potential of 3.0, the 2003 baseline inventory was increased to 147,717 pounds of CFC-11 equivalent. By the end of 2005, BNL had reduced its ODS inventory by approximately 65,000 pounds (32.5 tons), exceeding the original proposed reduction of 30 tons. BNL will continue to reduce its reliance on Class I and II ODS in 2006.

  ODS reduction activities in 2005 also included: the recovery/reclamation of residual refrigerant from two chillers, one containing 490 pounds of CFC-113 and one containing 800 pounds of CFC-11, and the removal of 125 Halon 1211 portable extinguishers from service.

  BNL's long-term goal is to replace all of the Halon 1211 portable extinguishers by the end of 2010 with ABC dry-chemical or with clean agent FE-36 extinguishers.
- *Reduce BNL's hazardous materials use.* BNL continued to revise its baseline inventory of mercury and mercury-containing devices in 2005 as new devices were located or identified. The total inventory subject to this commitment in 2005 was 499 pounds. Of the 499 pounds, 194 pounds were determined to be essential and 305 pounds nonessential. By the end of 2005, BNL had removed and recycled approximately 185 pounds of elemental mercury from the nonessential inventory, resulting in a remaining total inventory of 314 pounds. The removed devices included: 87 pounds of elemental mercury from a mercury vacuum pump, more than 450 mercury bulb thermometers, and numerous mercury-wetted relays—some with up to 0.5 pounds of mercury each.

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 a Roles, Responsibilities, Accountabilities, and Authorities document signed by the employee, his or her supervisor, and the supervisor's manager. 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 the BNL's science and operations, including environmental stewardship and restoration activities, and to incorporate community input in the Laboratory's decision making.

BNL staff participate in on- and off-site meetings, which include discussions, talks, presentations, roundtables, workshops, canvassing, tours, 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 with BNL and DOE. These meetings enable Laboratory and DOE representatives to update local, state, and federal elected officials and regulatory agencies regarding BNL's environmental and operational issues, as well as scientific discoveries and initiatives. The Community Advisory Council (CAC), established by BNL in 1998, advises the Laboratory Director on issues related to the Laboratory that are of importance to the community. The CAC is composed of approximately 30 member organizations representing business, civic, education, employee, community, and environmental and health organizations. The CAC meets monthly in sessions 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 the Laboratory gain a better understanding of local community concerns. The Speakers' Bureau provides speakers for educational and other organizations interested in BNL, and the Volunteers in Partnership Program supports employee volunteer efforts for charitable organizations. The Laboratory's Summer Sunday tours enable BNL to educate the public by featuring different facilities and program areas each week. In addition, the Laboratory hosts various events annually in celebration of Earth Day.

To keep employees and the community informed about the Laboratory's research, activities, and issues, including those related to the environment, BNL issues press releases; publishes *Laboratory Link*, a monthly update on BNL science and events; *the Bulletin*, a weekly employee newsletter; and *discover Brookhaven*, BNL's quarterly science magazine. The Laboratory maintains an informative website at http://www.bnl.gov, where these publications are posted, as well as information about BNL's science and operations, past and present. 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 2005, significant progress was made toward completing several cleanup projects of importance to BNL stakeholders, as a result of their involvement in the decision making.

- A decision among DOE, EPA, and NYSDEC to remove more than 90 percent of the mercury and PCBs in the Peconic River sediment, both on and off site, was reached following extensive public participation. The plan included appropriate methods to clean up the river, measures for protecting environmentally sensitive areas of the river and sensitive species within the river, and measures for reestablishing river vegetation after the cleanup. Final cleanup plans incorporated much of the community's input on each of these issues, and all comments and concerns were responded to and made a part of the written public record.
- DOE, EPA, and NYSDEC agreed on a cleanup plan for the Brookhaven Graphite Research Reactor (BGRR). The plan includes the removal of the reactor pile and contaminated biological shield, accessible pockets of contaminated soil, and the fuel canal structure. The goal is to eliminate more than 99 percent of the radioactive contamination found in the complex. A long-term monitoring program will also be implemented. Stakeholders, including the CAC and a working group of community members, provided substantial input in the final decisions of the cleanup plan.
- Following extensive review by regulators and the public, a final decision was reached regarding the cleanup of strontium-90 (Sr-90) in groundwater on site and contamination in off-site portions of the Magothy aquifer. The primary concern of the community was adequate protection of human health and the environment, given

the length of time required for the cleanup process. The final document formalizing the decision was revised to include wording, suggested by community members, that requires DOE to continue searching for more effective and efficient cleanup methods, and to keep the community informed of the results through regular reviews and published reports.

The cleanup plans reached in 2005 put in place the systems to ensure the completion of high-priority environmental restoration projects on and around the Laboratory site, as required by a 1992 agreement among DOE, EPA, and NYSDEC. Working closely with elected officials, regulatory agency representatives, and community members, DOE and BNL openly shared information, extensively solicited input, and immediately provided feedback on how and when that input was used. To acknowledge these achievements, a community-wide cleanup celebration was held at the Laboratory in the fall of 2005.

2.4.3 Monitoring and Measurement

Effluents and emissions are monitored 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 permit requirements. The monitoring program is reviewed and revised, as necessary or on an annual basis, to reflect changes in permit requirements, changes in facility-specific monitoring activities, or the need to increase or decrease monitoring based on a review of previous analytical results.

As required under DOE Order 450.1, Environmental Protection Program, BNL prepares an Environmental Monitoring Plan, Triennial Update (BNL 2003e), which outlines annual sampling goals by media and frequency. The plan uses the EPA Data Quality Objective approach for documenting the decisions assoc-iated with the monitoring program. In addition to the required triennial update, an annual electronic update is also prepared.

In 2005, there were 9,307 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges under the Environmental Monitoring Program, as shown in Table 2-5. Specific sampling programs for the various media are described further in Chapters 3 through 8.

There are three components to the Environmental Monitoring Program: compliance, restoration, and surveillance monitoring.

2.4.3.1 Compliance Monitoring

Compliance monitoring is conducted to ensure that wastewater effluents, air emissions, and groundwater monitoring data comply with regulatory and permit limits issued under the federal Clean Air Act, Clean Water Act, Oil Pollution Act, 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 BNL'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.

Table 2-5. Summary of BNL 2005 Sampling Program Sorted by Media.

Environmental Media	No. of Sampling Events*	Purpose
Groundwater	2,282 ER 503 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.
On-Site Recharge Basins	72	Recharge basins used for wastewater and stormwater disposal are monitored in accordance with discharge permit requirements and for environmental surveillance purposes. See discussion in Chapter 5.
Potable Water	41 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 discussion in Chapters 3 and 7.
Sewage Treatment Plant (STP)	453	The STP influent and effluent and several upstream and downstream Peconic River stations are monitored routinely for organic, inorganic, and radiological parameters to assess BNL impacts. The number of samples taken depends on flow. For example, samples are scheduled for collection at Station HQ monthly, but if there is no flow, no sample can be collected. See discussion in Chapters 3 and 5.
Precipitation	8	Precipitation samples are collected from two locations to determine if radioactive emissions have impacted rainfall, and to monitor worldwide fallout from nuclear testing. The data are also used, along with wind speed, wind direction, temperature, and atmospheric stability to help model atmospheric transport and diffusion of radionuclides. See discussion in Chapter 4.
Air – Tritium	305	Silica gel cartridges are used to collect atmospheric moisture for subsequent tritium analysis. These data are used to assess environmental tritium levels. See discussion in Chapter 4.
Air – Particulate	461 ES/C 52 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 discussion in Chapter 4.
Air – Charcoal	53	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. See discussion in Chapter 4.
Fauna	65	Fish, deer, and small mammals are monitored to assess impacts on wildlife associated with past or current BNL operations. See discussion in Chapter 6.
Flora	12	Vegetation is sampled to assess possible uptake of contaminants by plants and fauna, since the primary pathway from soil contamination to fauna is via ingestion. See discussion in Chapter 6.
Soils	207	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	431	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	2,032	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 had 14 operating groundwater treatment systems in 2005. See discussion in Chapter 7.
Vehicle Monitor Checks	250	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)	237	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 Sewage Treatment Plant (STP), recharge basins, and four process discharge sub-outfalls to the STP.
Flow Charts	555	Flowcharts are exchanged weekly as part of the Laboratory's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	101	This test is performed on select petroleum storage facility monitoring wells to determine if floating petroleum products are present. The number of wells and frequency of this 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.

(continued on next page)

Table 2-5. Summary of BNL 2005 Sampling Program Sorted by Media *(concluded)*.

Environmental Media	No. of Sampling Events*	Purpose
Radiological Monitor Checks	689	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)	317	To ensure that the concentrations of contaminants reported in the Site Environmental Report are accurate, additional samples are collected. These samples detect if contaminants are introduced during sampling, transportation, or analysis of the samples. QA/QC samples are also sent to the contract analytical laboratories to ensure their processes give valid, reproducible results.
Total number of sampling events	9,307	This number includes all samples identified in the Environmental Monitoring Plan, 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

- *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 ER Program, as required under the Records of Decision 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 viable potable water supply, groundwater is monitored as required by SCDHS.

2.4.3.2 Restoration Monitoring

Restoration monitoring is performed to determine the overall impact of past operations, to delineate the real extent of contamination, and to ensure that Removal Actions are effective and remedial systems are performing as designed under CERCLA 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. Followup monitoring of groundwater is conducted in accordance with a Record of Decision with regulatory agencies.

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 that 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. BNL 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 programs such as the Facility Review Disposition Project, 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 BNL's compliance status, and pollution prevention projects have reduced costs, minimized waste generation, and reused and recycled significant quantities of materials.

The Laboratory is openly communicating with neighbors, regulators, employees, and other interested parties on environmental issues

and progress. To regain and maintain stakeholder trust, BNL 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. BNL continues to pursue other mechanisms to communicate data in a more user friendly, visual, and timely 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. BNL'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 the Laboratory:

- The EMS has been strengthened, integrated with other BNL 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.
- BNL 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," and reflects BNL's desire to balance world-class research with environmentally responsible operations.

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