Chapter 2

Environmental Management System

In 2001, BNL became officially registered to the globally recognized environmental management standard, ISO 14001, affirming the Laboratory's leadership position as the first Long Island-based operation and the first DOE Office of Science facility to achieve this accreditation. The Laboratory's Environmental Management System has an emphasis on compliance assurance, pollution prevention, and community outreach. Under the Environmental Management System, compliance and other environmental considerations are fully integrated into the planning, decision making, and implementation phases of all site activities. Existing industrial and experimental processes on site are regularly evaluated for regulatory compliance and pollution prevention opportunities. In 2001, BNL was recognized with two Pollution Prevention awards from DOE. Pollution prevention projects saved more than $1,385,000 and resulted in the reduction or reuse of approximately 1,955,000 pounds of waste. The Laboratory continues to address legacy issues under the Facility Review Project and the Environmental Restoration Program. A comprehensive program to monitor environmental quality is in place and a Technical Advisory Group was formed in 2001 to address natural resource management issues in the Upton Ecological and Research Reserve. The Laboratory is openly communicating with neighbors, regulators, employees, and other interested parties on environmental issues and progress.

2.1 STEWARDSHIP UNDER BROOKHAVEN SCIENCE ASSOCIATES

During the summer of 2001, under the leadership of Brookhaven Science Associates (BSA), Brookhaven National Laboratory became officially registered to the globally recognized environmental management system, ISO 14001. BNL's registration certificate and the Environmental Stewardship Policy are shown in Figure 2-1. An Environmental Management System (EMS) is a methodology for managing the environmental aspects of an organization's operation in order to:

- Identify how operations can potentially impact the environment
- Define and prioritize what needs protection and how to do it
- Monitor, measure, and communicate what is done and how it is done
- Continually improve environmental protection programs.

An EMS includes planning; establishing responsibilities; instituting procedures, practices, and processes; and dedicating resources to develop, implement, and achieve environmental commitments. The purpose of an EMS is to ensure that programs are managed in an environmentally responsible manner that protects the ecosystem and human health. The ultimate goal is to improve environmental performance and environmental quality.

BNL's EMS is modeled on the International Organization for Standardization (ISO) 14001 Standard, *Environmental Management System–Specification with Guidance for Use* (ISO 1996). ISO 14001 is a consensus standard developed by an international consortium of industry, government, and environmental

Figure 2-1. BNL ISO 14001 Registration Certificate and Environmental Stewardship Policy.

groups. This system has been adopted by not-for-profit organizations such as BNL, as well as by the private sector at companies such as Lucent Technologies, IBM, and Motorola. BNL refers to its EMS as an ISO 14001 "Plus" system, since it has enhanced emphasis on compliance, pollution prevention, and community outreach. BNL's EMS is built on the "Plan, Do, Check, Act" model, and focuses on continual improvement. The EMS can be categorized in the following manner: Environmental Policy, Planning, Implementation, Checking and Corrective Action, and Management Review. These categories cover the 17 elements of the ISO 14001 model. Figure 2-2 shows the relationships among the program elements. This chapter discusses the 17 elements of BNL's EMS and summarizes how BNL implements the requirements of each one. The EMS is integrated with the BNL's other management systems, such as training and emergency preparedness, and is part of the sitewide Integrated Safety Management System.

2.2 ENVIRONMENTAL STEWARDSHIP POLICY

The cornerstone of an EMS is a commitment to environmental protection at the highest levels of the organization. The Environmental Stewardship Policy, issued and signed by the Laboratory Director, is a statement of BNL's intentions and principles regarding overall environmental performance. It provides a framework for planning and action and is included in training programs. The Environmental Stewardship Policy is posted throughout the Laboratory and on the BNL website.

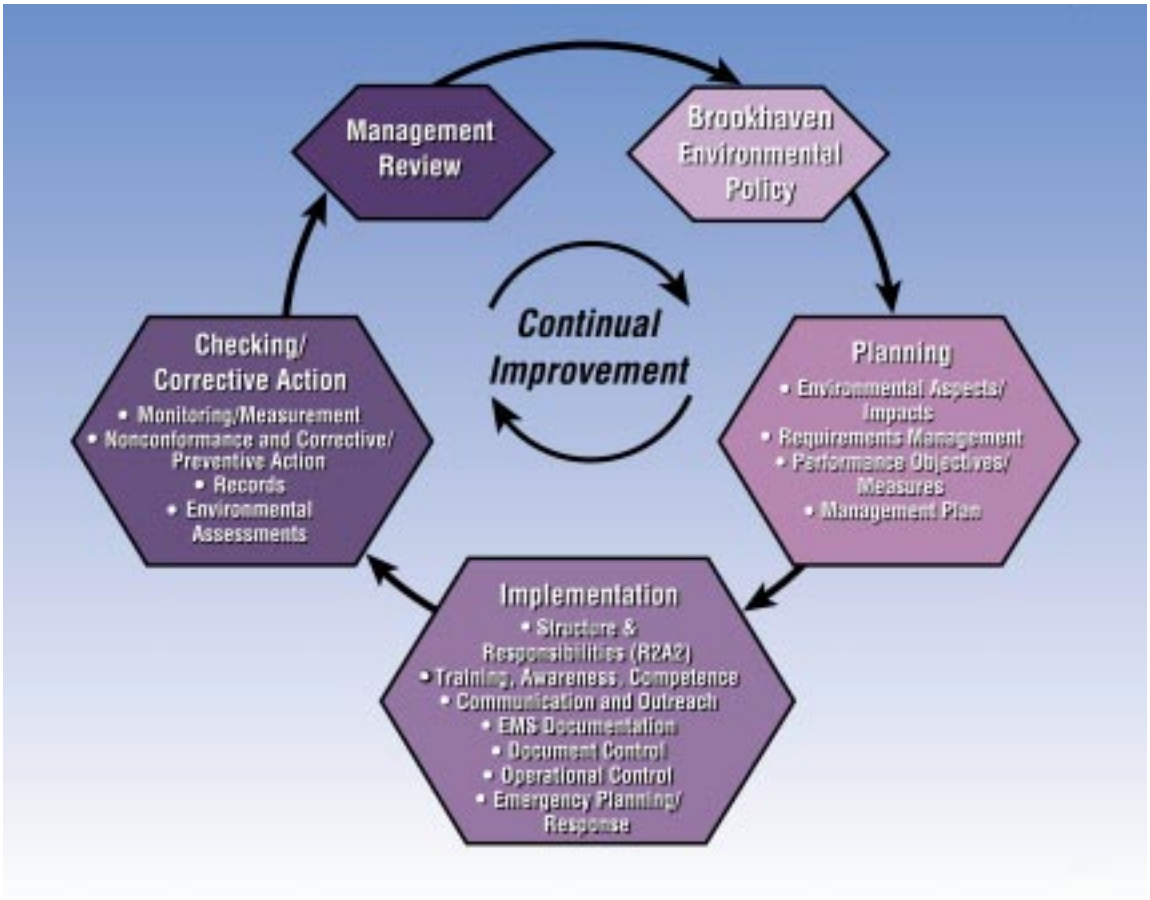

Figure 2-2. Key Elements of the BNL EMS and their Relationship to Each Other.

The Environmental Stewardship Policy contains the following goals and commitments, focusing on compliance, pollution prevention, cleanup, community outreach, and continual improvement:

- Achieve and maintain compliance with applicable environmental requirements. These requirements include over 50 sets of local, state, and federal laws and regulations; 13 DOE Directives; eight Executive Orders; and approximately 65 operating permits (see Chapter 3).
- Integrate pollution prevention/waste minimization, resource conservation, and compliance into BNL activities during planning and decision making. Adopt cost-effective practices that eliminate, minimize, or mitigate environmental impacts. This includes conserving natural resources and ensuring that environmental emissions, effluents, and waste generation are As Low As Reasonably Achievable (a concept known as "Environmental-ALARA," or "E-ALARA," discussed in Chapter 5).
- Define, prioritize, and aggressively correct and clean up existing environmental problems. This commitment encompasses removal or treatment of contamination caused by historical practices. It also includes strengthening the environmental monitoring program to ensure that controls designed to protect the environment are working, and to provide early detection of a potential threat to the environment (see Section 2.5.1).
- Maintain a positive, proactive, and constructive relationship with neighbors in the community, regulators, DOE, and other stakeholders. Openly communicate with stakeholders about program progress and performance (see Section 2.4.3).
- Continually improve the environmental management system and performance. Establish appropriate environmental objectives and performance indicators to guide these efforts and measure our progress. To maintain certification, BNL will employ proactive measures to prevent problems. When problems do occur, the approach is to investigate the root cause and take corrective actions as appropriate.

2.3 PLANNING

2.3.1 Environmental Aspects and Impacts

An environmental aspect is any element of an organization's activities, products, or services that can interact with the environment. As required by the ISO 14001 Standard, BNL evaluates its operations, identifies the aspects of operations that can impact the environment, and determines which of those impacts are significant. Environmental management programs are used to control and manage significant aspects, to prevent or minimize the impacts. Table 2-1 provides a list of BNL's significant environmental aspects. BNL's criteria for significance are based on both actual and perceived impacts of its operations and regulatory requirements. For example, because the Laboratory is situated over a sole source aquifer that provides drinking water, protection of groundwater is a high priority, and possible impact to it is a significant concern. Because of concerns on the part of the surrounding community, radioactivity in any environmental media (air, water, soil) is also deemed a significant aspect. Impacts are reevaluated as necessary to ensure that the significant aspects and potential impacts continue to reflect the concerns of stakeholders and changes in regulatory requirements, and to incorporate new aspects or impacts that have been identified.

2.3.2 Requirements Management

To implement the compliance commitments in the Environmental Stewardship Policy, BNL implemented and continues to improve on a tool called Standards Based Management System (SBMS). SBMS is a web-based system designed to deliver Laboratory-level requirements and guidance to all staff in a user-friendly format. All Labwide procedures reside in this system organized by "Subject Areas."

New or revised requirements (*e.g.*, new regulations) are analyzed to determine their applicability to BNL, and to identify whether actions are required to achieve compliance. This

Table 2-1. BNL's Criteria for Significant Environmental Aspects.

Environmental Aspect	Criteria for Significant Aspects
Regulated Industrial Waste Generation	Any amount of regulated industrial waste generation.
Hazardous Waste Generation	Any amount of hazardous waste generation.
Radioactive Waste Generation	Any amount of radioactive waste generation.
Mixed Waste Generation	Any amount of mixed waste generation.
Regulated Medical Waste Generation	Any amount of regulated medical waste generation.
Atmospheric Discharges	a) Any process that requires a point source air permit or inclusion in the Title V permit as an emission unit, or contributes to a regulated emission point. b) Operations or activities that use engineering controls to reduce hazardous air pollutant or radionuclide emissions. c) Radioactive emissions that require monitoring (continuous or confirmatory) per 40 CFR 61 subpart H of the National Emission Standards for Hazardous Air Pollutants.
Liquid Discharges	a) Radionuclides that are detectable at the point of discharge from the facility. b) Discharges of any of the chemicals listed on the BNL State Pollutant Discharge Elimination System Permit. c) Operations or activities that use engineering controls to reduce the quantity or concentration of pollutant. d) Existence of underground injection control devices.
Storage or Use of Chemicals or Radioactive Materials (potential for accidental release or contamination)	a) Storage or use of chemicals or radioactive materials requiring engineering controls as specified in BNL procedures. b) System configuration requires back-flow prevention in accordance with the BNL procedures. c) Transportation of chemicals or dispersible radioactive materials. d) Storage or use of PCBs as specified in BNL procedures. e) Any underground pipes or ducts that contain chemical and/or radioactive material/contamination. f) Storage or use in quantities capable of resulting in a reportable spill, as defined in BNL procedures.
Water Consumption	a) Total organizational water consumption greater than 650,000 gallons per day. b) Continuous (24 hrs/day), permanent (to continue for the foreseeable future) once-through water use greater than 4 gallons per minute (gpm) that discharges to the sanitary sewer system. c) Daily (8 hrs/day), permanent, once-through water use greater than 10 gpm that discharges to the sanitary sewer system. d) Continuous use greater than 10 gpm, or daily use greater than 15 gpm for a period greater than 60 days that discharge to the sanitary sewer system.
Power Consumption	a) Total organizational power consumption greater than 58 M KWh/yr.
Historical Monuments/ Cultural Resources (groundwater, soil)	a) Any modification to a historically significant structure (e.g., BGRR, Cosmotron building, and World War I foxholes/trenches). b) Proposed modification to known archaeologically significant area(s) or discovery of archaeologically significant material (lithic scatter, bone, foundations, etc.)
Sensitive/Endangered Species and Sensitive Habitats (including Pine Barrens)	a) Potential for habitat destruction, harm or harassment within 850 feet of a critical habitat (*recharge basins, vernal pools, natural and manmade ponds and waterways*). b) Disturbance within 100 feet of a regulated wetland (*that is already not identified as a critical habitat*). c) Disturbance within ½ mile of the Peconic River. d) Activity affecting five or more acres of undeveloped land.
Environmental Noise	a) Exceed ordinance levels [7am-10pm: 55 dba; 10pm-7am: 50 dba (20 min. average)] at property boundary or offsite location.
Historical Contamination (groundwater, soil)	a) Pre-existing contamination (radiological or nonradiological) causing remedial activities resulting in costs in excess of $50,000.
Soil Activation	a) Any soil activation.
Transuranic Waste	a) Generation or potential to generate any radioactive waste stream classified as transuranic waste (i.e., contains greater than 100 nanocuries per gram of trans-uranium isotopes).
Other	a) Other compliance requirement specific to an organization or aspect that could impact the environment (e.g., asbestos research). b) Any historical or legacy issue.

Source: *Identification of Significant Aspects and Impacts Subject Area, SBMS*

may involve developing or revising documents, operating procedures, or Subject Areas, or implementing administrative controls, providing training, installing engineered controls, or increasing monitoring.

There are Subject Areas on a variety of environmental topics. They are regularly updated by teams of researchers, technical staff, and environmental protection professionals, with input from regulatory agencies. Existing standards for work and research planning and control have been upgraded to ensure that reviews by qualified environmental, safety, and health professionals occur early in the planning process, and that adequate measures to control hazards and risks are incorporated during the design phase. The information provided in the SBMS focuses on what staff need to know to do their work in an environmentally responsible manner and translates requirements into a format and language that are easily understandable. Figure 2-3 lists the environmental protection and other key subject areas that support the EMS.

2.3.3 Performance Objectives and Measures

The Performance Based Management 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 critical outcomes. BNL works 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)
- Commitments (in the Environmental Stewardship Policy, to regulatory agencies, to the public)
- Importance to DOE, the public, and other stakeholders.

Objectives and targets are developed by Fiscal Year (FY). In FY 2001 (October 1, 2000 through September 30, 2001), they included:

- Achieve excellent performance in environmental protection (e.g., minimize permit exceedances and spills and maintain full compliance).
- Complete environmental improvement projects in a timely manner (e.g., EMS, Groundwater, Environmental Restoration, and Environmental Data Management).
- Minimize generation of all wastes.
- Enhance the effectiveness of Laboratory communications and create opportunities for the involvement of stakeholders.

Responsibilities for achieving these expectations are assigned at all relevant levels of the organization, starting with senior management and flowing to the individual level. The following example illustrates this network of responsibilities (also see Figure 2-4).

Under the FY 2001 Operational Excellence *critical outcome,* BNL had an objective to integrate pollution prevention/waste minimization and resource conservation into all planning and decision making. A related *performance objective* was to reduce hazardous, mixed, and low-level radioactive routine waste streams. The *performance measure* was to reduce all three waste streams below FY 2000 levels. At the department level, this could translate into an *organizational goal* to develop and implement an action plan to reduce waste generation. A staff member might have an *individual goal* to learn and comply with the Pollution Prevention and Waste Minimization Subject Area requirements, and to purchase environmentally preferable products.

This approach helps employees understand how their work relates to Laboratory-level performance objectives, so they can align their efforts toward achieving BNL missions. It also ensures that BNL operations are conducted in accordance with the expectations established by DOE and BNL management. Through performance-based management, BSA focuses environmental management improvement initiatives on addressing the priorities of DOE, regulatory agencies, and the community. Specifically, in 2001, emphasis was placed on fully implementing the EMS and obtaining sitewide ISO 14001 registration, improving the

ENVIRONMENTAL PROTECTION SUBJECT AREAS	KEY SUPPORT SUBJECT AREAS
Drinking Water	Calibration
Environmental Assessments	Correspondence and Commitment Tracking
Environmental Evaluation of Industrial Processes and Experimental Research	Community Involvement in Laboratory Decision-Making
Environmental Monitoring	Facility Use Agreements
Groundwater Protection Contingency Plan	Graded Approach for Quality Requirements
Hazardous Waste Management	Hazard Analysis
Identification of Significant Environmental Aspects and Impacts	Integrated Assessment
Liquid Effluents	Internal Controlled Documents
Mixed Waste Management	Investigation of Incidents, Accidents, and Injuries
NEPA and Cultural Resource Evaluation	Lessons Learned
Nonradioactive Airborne Emissions	Nonconformance, Corrective and Preventive Action
Oil/PCB Management	Operational Readiness Evaluation
Pollution Prevention and Waste Minimization	Records Management
Radioactive Airborne Emissions	Requesting SBMS Variances
Radioactive Waste Management	Requirements Management
Regulated Medical Waste Management	Roles, Responsibilities, Accountabilities, and Authorities
Spill Response	Training and Qualification
Storage and Transfer of Hazardous Materials	Emergency Preparedness
Underground Injection Control	

Figure 2-3. Environmental Management System and Supporting Subject Areas in the Standards Based Management System. Labwide requirements are contained in SBMS Subject Areas, available online at <https://sbms.bnl.gov>

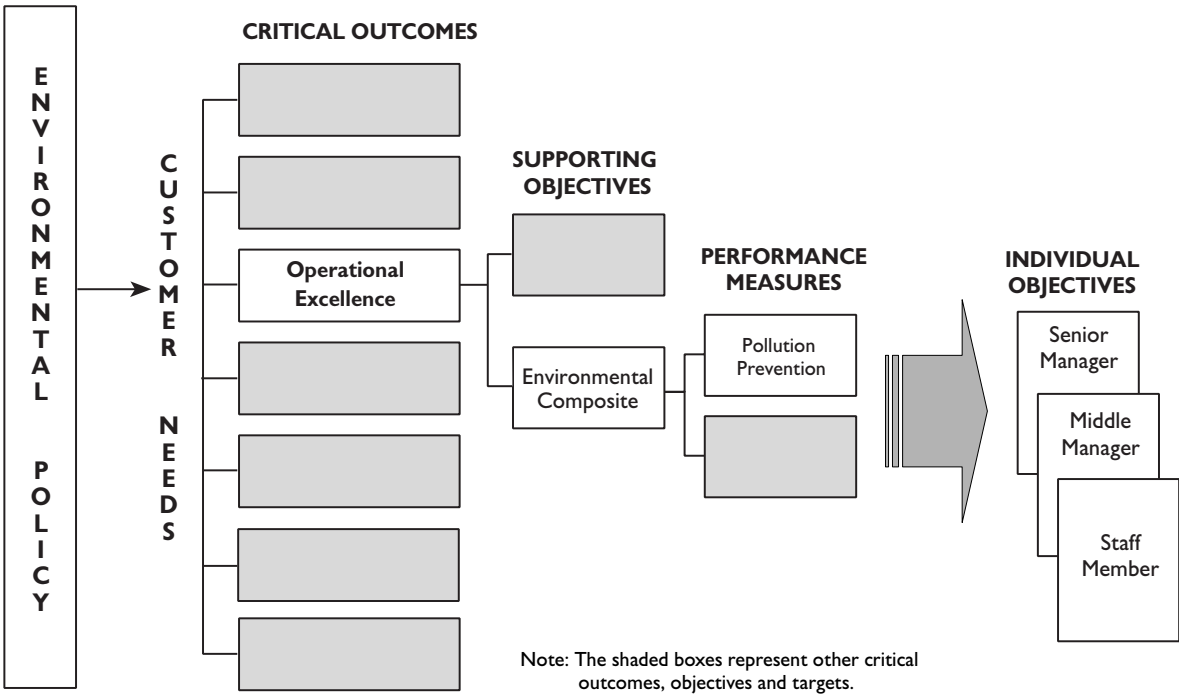

Figure 2-4. Hierarchy of Environmental Objectives at BNL — an Example for Operational Excellence.

Laboratory's groundwater protection program, enhancing the pollution prevention programs, achieving and maintaining compliance, and expediting environmental restoration.

2.3.4 Environmental Management Program

Organizations within BNL develop action plans detailing how they will achieve their objectives and targets and commit the necessary resources to successfully implement both Labwide and facility-specific programs. BNL 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.

BNL has several important Labwide environmental programs developed and funded to further integrate environmental stewardship into all facets of BNL's missions. The key programs are described below.

2.3.4.1 Compliance

BNL has an extensive program to ensure full compliance with all applicable environmental regulatory requirements and permits. Some programs are routine, such as the National Emission Standards for Hazardous Air Pollutants, National Pollutant Discharge Elimination System, and Resource Conservation and Recovery Act compliance programs. Other programs are special projects or initiatives, such as upgrading petroleum and chemical storage tanks 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 discussion of these programs and their status.

2.3.4.2 Groundwater Protection

BNL's Groundwater Protection Management Program is designed to prevent impacts to groundwater and to restore groundwater quality by integrating pollution prevention efforts, monitoring groundwater restoration projects, and communicating on

Bldg. 860 contains offices for technical and professional staff. Staff are responsible for providing support to the Laboratory to facilitate pick-up, storage, and off-site disposal of hazardous, radioactive, and mixed waste.

Hazardous Waste Management

Bldg. 855 is used for the storage of BNL's industrial, hazardous and polychlorinated biphenyl (PCB) solid, liquid, and gaseous wastes. This building was designed and built to provide tertiary containment for stored wastes to prevent environmental contamination should a spill occur. This was accomplished through the use of sealed concrete floors and an impervious liner placed under the building that exceeds regulatory requirements.

Wastes from various research and maintenance activities are typically generated in quantities of five gallons or less. These wastes are stored in containment trays placed on shelves within secondarily contained storage rooms, referred to as lab pack rooms. Wastes stored in these rooms are segregated by hazard class to prevent incompatible materials from reacting.

Some wastes, such as liquid wastes from photographic processing and waste oils, are collected in 55-gallon drums and stored in drum storage bays. These bays provide the space needed to maneuver and inspect larger containers. As in the lab pack rooms, wastes are placed into the drum storage bays by hazard class to segregate incompatible materials. Containment is provided by concrete floors coated with a chemically resistant sealant, which slope toward sealed collection sumps.

Figure 2-5. BNL Waste Management Facility.

Radioactive Waste Management

Bldg. 865 is used for the sorting, repackaging, and temporary storage of solid, low-level radioactive wastes generated by BNL research and maintenance activities. Typical radioactive wastes consist of paper, plastic, glass, and metal. Most radioactive wastes are received at the Waste Management Facility in plastic bags. After receipt, most of these bags are consolidated into metal bins where they may be further consolidated through compaction. Metals, glass, and heavy objects that could puncture a bag are sometimes packaged directly into these bins or other appropriate container.

Prior to shipment off-site, bins containing waste are stored in belowgrade concrete vaults. Bins are inserted into and removed from these vaults via an overhead crane. Only solid radioactive wastes are stored in Bldg. 865.

Mixed Waste Management

Bldg. 870 is used for the storage of mixed wastes. These are wastes that are both hazardous and radioactive. This building is similar in design to the Hazardous Waste Storage Building, Bldg. 855. Most mixed wastes are generated by research activities and are typically in quantities of five gallons or less.

Bldg. 870 is comprised of storage bays that provide secondary containment. Small waste items are stored within containment trays on shelves in the bays. Typical mixed wastes include radioactively contaminated acids and alcohols, mercury-containing apparatus, and lead used in shielding applications. Mixed wastes are stored in this building prior to off-site treatment and disposal.

performance. BNL has also developed a Groundwater Protection Contingency Plan that defines an orderly process for taking corrective actions quickly in response to unexpected monitoring results. Key elements of the groundwater program are the full and timely disclosure of any off-normal circumstances and regular communication on the performance of the program. Chapter 7 provides additional details about the Groundwater Protection Management Program and monitoring results for 2001.

2.3.4.3 Waste Management

The goal of BNL's Waste Management Program is safe and efficient management of waste, from its generation to off-site disposal. The program emphasizes pollution prevention and waste minimization. It ensures that there is a defined pathway and budget for disposing of any waste generated, and also that BNL complies with applicable regulatory and permit requirements. These include DOE Order 435.1 (1999), *Radioactive Waste Management*, and the Resource Conservation and Recovery Act (RCRA) regulations that require disposal of all radioactive and hazardous wastes within one year of receipt by the Waste Management Program. This requirement keeps sites from accumulating excess waste.

BNL's Waste Management Facility has a permit from the New York State Department of Environmental Conservation (NYSDEC): Permit No. 1-422-00032/00102-0, consisting of four operations sites: Buildings 855, 860, 865, and 870. Figure 2-5 illustrates and describes the operations in each of these buildings.

Mixed wastes present a special disposal challenge, as they contain both hazardous and radioactive constituents. In 2001, BNL shipped approximately 1,200 cubic feet of mixed waste off site for treatment and disposal. This waste results from both routine and cleanup operations, and much of it had been in storage for years due to the lack of treatment options. During that time, it was monitored by BNL in accordance with the NYSDEC-approved *BNL Site Treatment Plan* (BNL 1997).

The Water Processing Facility (Building 810/811) is used to manage liquid radioactive wastes. Bulk quantities of radioactive wastewater are stored in tanks at this facility, in permitted tanks for either on-site processing or off-site treatment and disposal.

In addition to the Waste Management and Water Processing Facilities, BNL has nineteen 90-Day Hazardous Waste Accumulation Areas and approximately 200 Hazardous Waste Satellite Accumulation Areas, where small quantities of hazardous waste are managed at or near the point of generation in laboratories and shops. Trained staff, following standard operating procedures, manage these areas.

In 2001, BNL generated the following types and quantities of waste from routine operations:

- Hazardous Waste: 10.1 tons
- Mixed Waste: 55 cubic feet
- Radioactive Waste: 3,488 cubic feet.

These quantities represent significant reductions from previous years, as can be seen in Figures 2-6a through c. These figures represent waste from routine operations only. Routine operations are defined as ongoing industrial and experimental operations. The picture is not complete however, without consideration of wastes generated from "nonroutine" or one-time events and waste generated from environmental restoration activities. Nonroutine waste includes construction and demolition wastes, environmental restoration wastes, legacy waste, lead-painted debris, lead shielding, and PCB waste. Figures 2-6d, 2-6e, and 2-6f show wastes generated under the Environmental Restoration Program. Waste generation from these activities varies significantly from year to year. This is to be expected, based on the progress of the cleanup schedule. As environmental restoration activities move from remedial investigations and feasibility studies to remedial actions, waste generation changes. For example, in 2001, radioactive waste increases can be attributed to soils, debris, and concrete from increased work at the Brookhaven Graphite Research Reactor (BGRR) and the former Hazardous Waste Management Facility. Radioactive waste is expected to continue to significantly exceed mixed and hazardous generation rates, with these waste generation numbers fluctuating from project to project. The purpose of remedial actions is to remove waste or contaminants from the environment. Thus, as the Environmental Restoration Program enters the active cleanup phase, waste volumes from nonroutine operations and remedial actions will continue to rise. The Pollution Prevention Program recognizes this, and will continue to target these waste streams for minimization.

2.3.4.4 Prevention and Minimization

BNL's environmental stewardship policy includes a commitment to integrate pollution prevention and waste minimization into all planning and decision making. Consistent with this commitment and the requirements of Executive Order 13148 (2000), "Greening the Government Through Leadership in Environmental Management," BNL continued to strengthen the Pollution Prevention Program in 2001.

Recognizing BNL's strong commitment to reducing waste and protecting the environment, in 2001 DOE awarded the Laboratory two prestigious national awards for pollution prevention. BNL won these awards for the "Process Evaluation Project" and "Environmental Management Systems Principles Leading Change." The Process Evaluation Project, completed in May 2000, was a systematic environmental assessment of all waste-generating operations and experiments. This assessment utilized specialized tools called process maps. See Figure 2-7 for a sample map. Approximately 145 industrial operations and 1,800 experiments were evaluated and are reevaluated each year. This process identified more than 260 pollution prevention opportunities. Of these, 97 were determined to be technically feasible with a high probability of successful implementation (*i.e.*, "viable"). Seventy-six of these opportunities were determined to have low cost and were implemented by departments. Twenty-one opportunities were determined to be expensive; proposals were generated for 17 (81 percent) of them, seeking funding from the Pollution Prevention program.

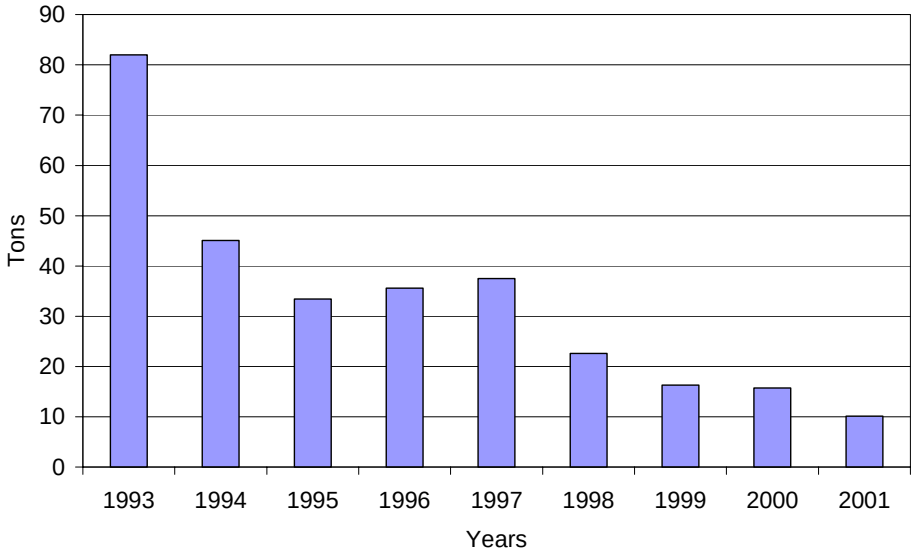

Figure 2-6a. Routine Hazardous Waste Generation, 1993—2001.

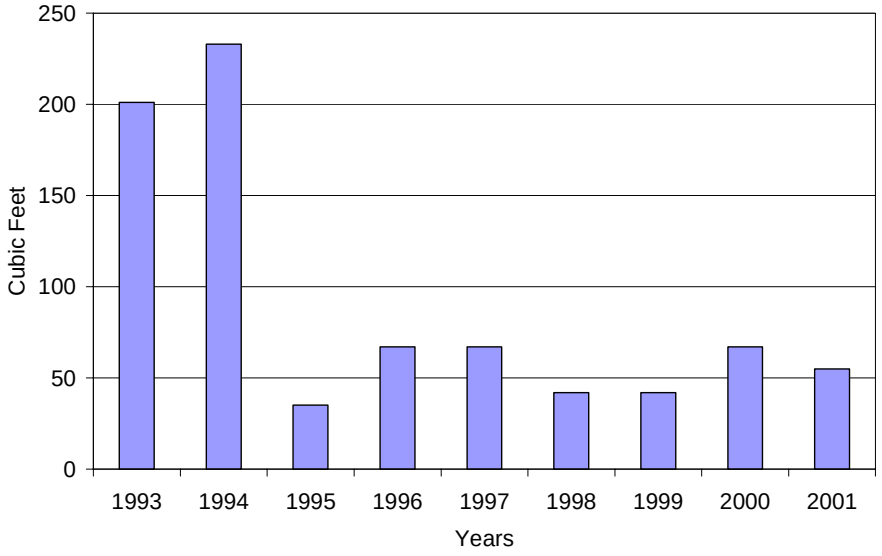

Figure 2-6b. Routine Mixed Waste Generation, 1993—2001.

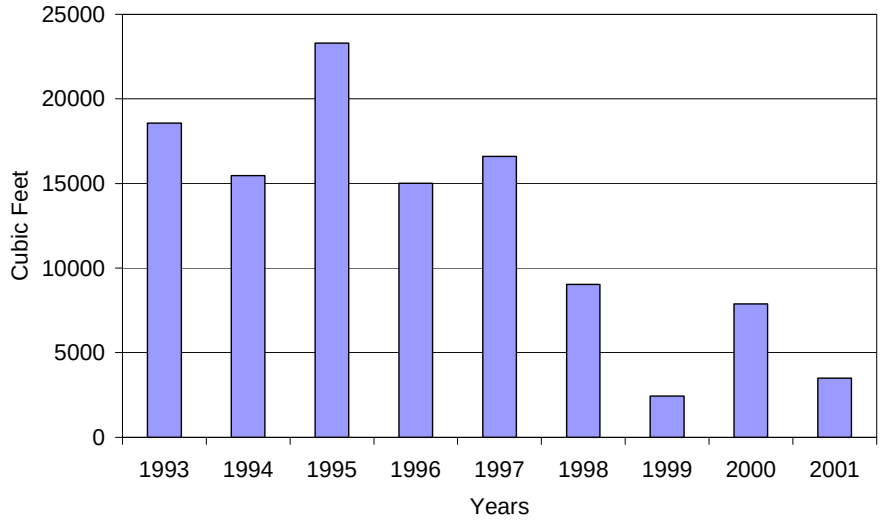

Figure 2-6c. Routine Radioactive Waste Generation, 1993—2001.

Figures 2-6d through 2-6f show the nonroutine waste not included in the totals in Section 2.3.4.3, as well as other hazardous, mixed, and radioactive wastes generated by the Environmental Restoration (ER) Program.

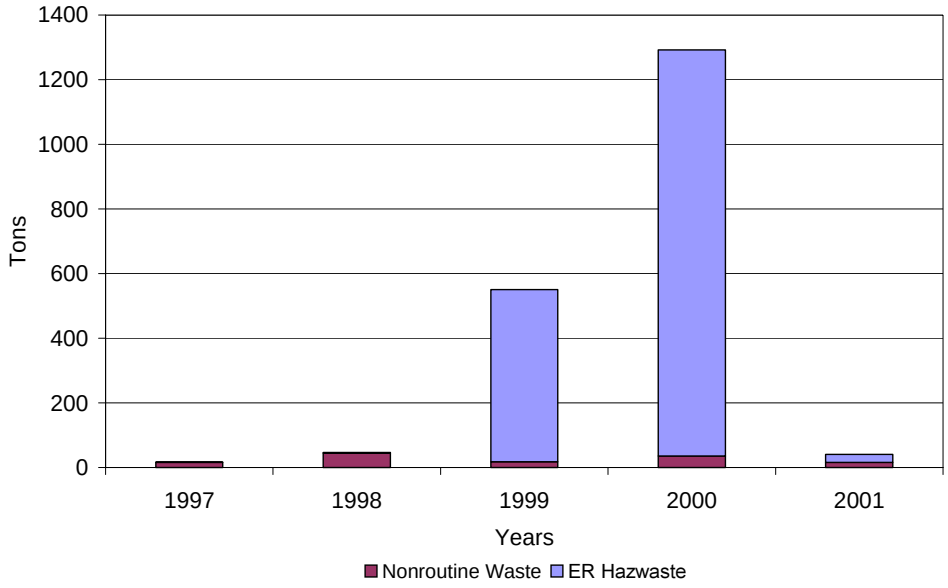

Figure 2-6d. ER and Nonroutine Hazardous Waste Generation 1997—2001.

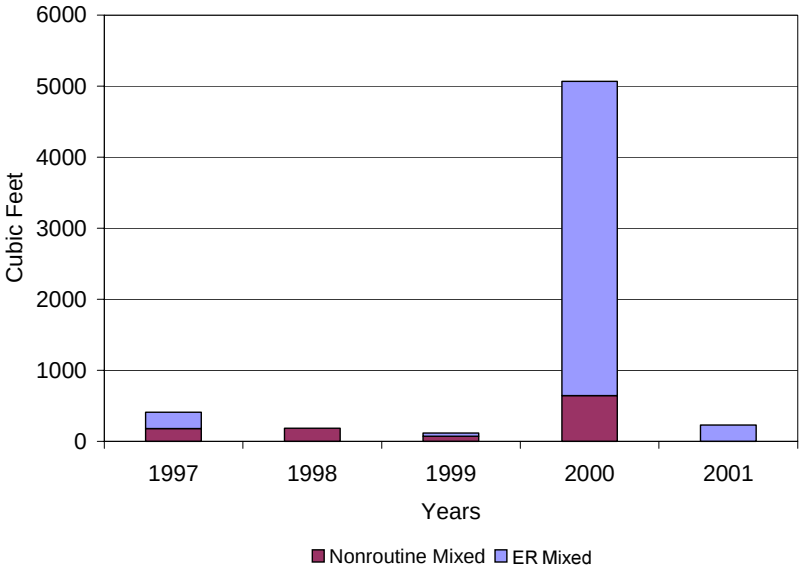

Figure 2-6e. ER and Nonroutine Mixed Waste Generation, 1997—2001.

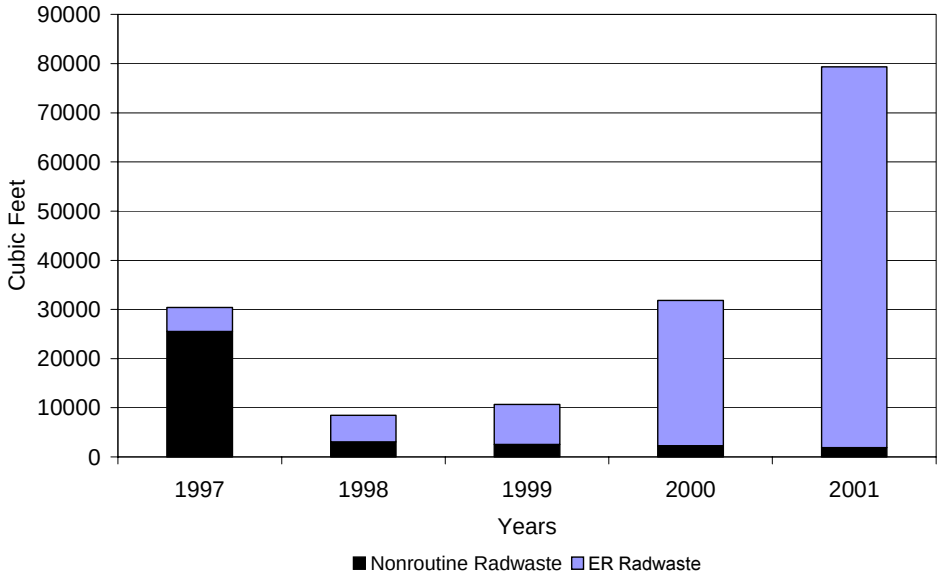

Figure 2-6f. ER and Nonroutine Radioactive Waste Generation, 1997—2001.

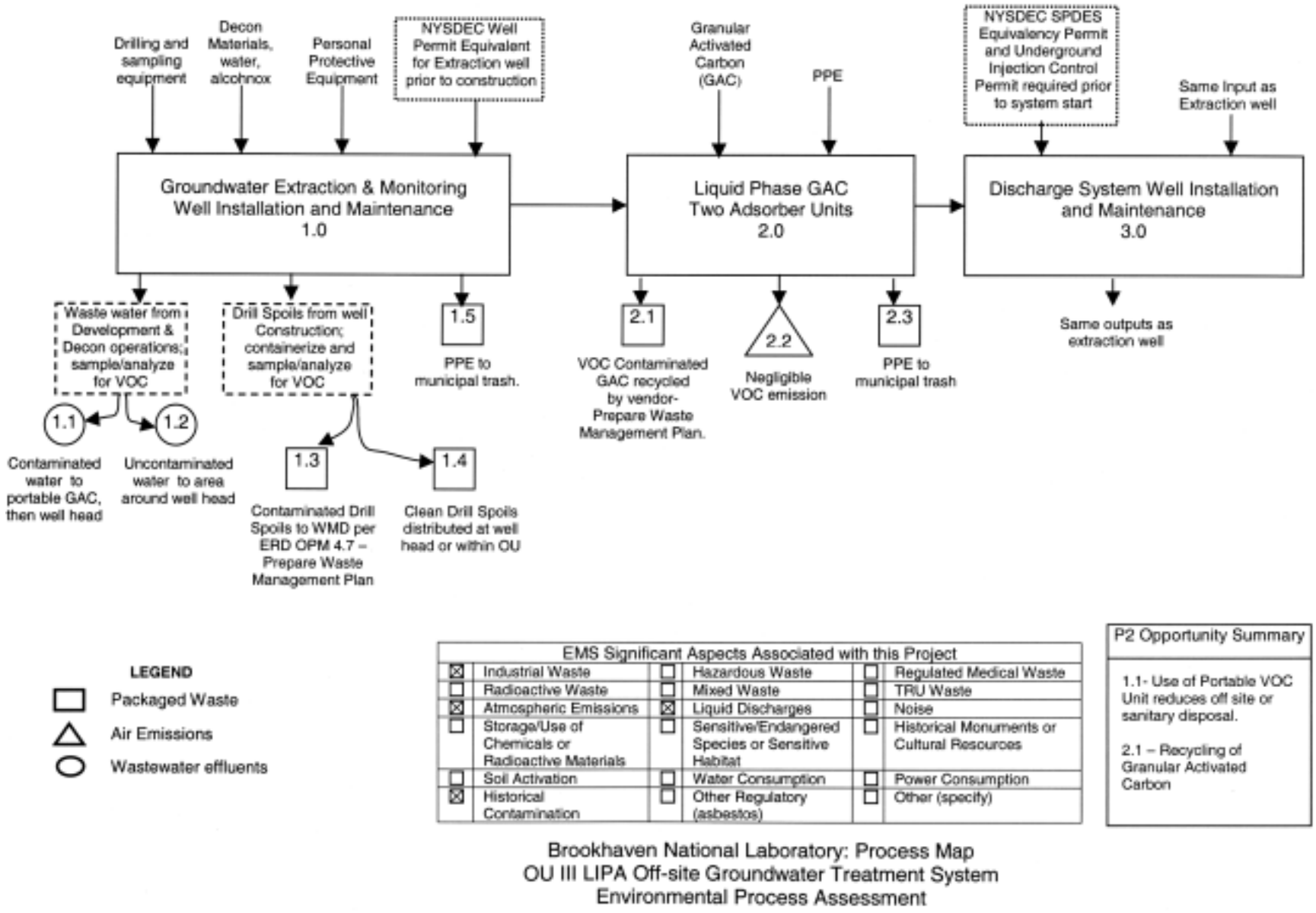

Figure 2-7. Process Map Example.

BNL has evaluated approximately 2,000 industrial and research processes on site and produced process maps like this one showing inputs, outputs, and regulatory requirements. This project received a DOE Pollution Prevention Award in 2001.

The EMS Principles Leading Change award was for the ongoing effort to fully integrate environmental stewardship into all facets of BNL's operations. In addition to the DOE awards, EPA Region II also recommended both projects for inclusion in President Clinton's Library of Accomplishments. A third project, "Preparing for High Flux Beam Reactor Facility Stabilization," was selected as a runner-up in the DOE national awards. This project sought alternative uses for equipment and supplies that were once part of the former HFBR; recycling these materials saved the Laboratory more than $300,000.

The BNL Pollution Prevention Program reflects national and DOE pollution prevention goals and policies, and represents an ongoing effort to make pollution prevention and waste minimization an integral part of the BNL operating philosophy. Key elements of the Pollution Prevention Program include the following:

- Eliminate or reduce wastes, effluents, and emissions at the source where possible, and ensure that environmental effluents, emissions, and wastes are As Low As Reasonably Achievable (E-ALARA).
- Procure environmentally preferable products (also known as "affirmative procurement").
- Conserve natural resources and energy.
- Reuse and recycle materials.
- Achieve or exceed BNL/DOE waste minimization, pollution prevention, recycling, and affirmative procurement goals.
- Comply with applicable requirements (*e.g.*, New York State Hazardous Waste Reduction Goal, Executive Orders).
- Reduce waste management costs.
- Identify funding mechanisms for evaluating and implementing pollution prevention opportunities.
- Implement pollution prevention projects.
- Improve employee and community outreach and awareness of pollution prevention goals, plans, and progress.

The EMS provides a mechanism for expanded awareness and employee involvement in the Pollution Prevention Program, and for systematically evaluating and implementing value-added pollution prevention opportunities at the Laboratory. In particular, pollution prevention planning has been incorporated into the BNL work planning processes such as the experimental safety reviews, facility design reviews, and routine work planning. This is consistent with the principles of integrated safety management and the approach is beginning to produce excellent results. The increasing number of pollution prevention project proposals submitted by scientific research staff, up nearly 300 percent since 1999, demonstrates the success of this system.

The sustained efforts of the BNL pollution prevention and recycling programs have achieved significant reductions in waste generated by routine operations. From 1993 through 2001, BNL reduced hazardous waste generation by 85 percent, mixed waste by 81 percent, and radioactive waste by 72 percent.

Implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has significantly reduced both waste volumes and management costs. In 2001 alone, these efforts resulted in nearly $1,386,000 in cost savings and approximately 1,955,000 pounds of materials being reduced, recycled, or reused. Table 2-2 describes the projects that were implemented in 2001 and includes the number of pounds of materials reduced, reused, or recycled and the estimated cost benefit of each project.

BNL also has an active and successful solid waste recycling program. The recycling program involves all employees. Office staff collect paper in designated containers in their workspace. Custodial staff collect and consolidate recycled paper to central locations, where it is shipped to the recycling facility. In 2001, BNL collected 246 tons of paper for recycling. In addition to paper, the recycling program collects many other kinds of materials, including cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, printer and toner cartridges, fluorescent light bulbs, machine coolant, and antifreeze. In 2001, BNL expanded

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2001	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Photographic waste	Segregation	2,320	Hazardous Waste	$4,640	$0	$4,640	Photography and Graphic Arts Division implemented a pollution prevention project that segregates hazardous fixer from nonhazardous developer. This reduced the hazardous waste stream by approximately 2,320 lbs, avoiding hazardous waste disposal costs of approximately $4,640.
Photographic waste from X-ray film processor	Source Reduction	765	Hazardous Waste	$8,415	$5,200	$4,800	The X-ray film processor at the clinic was replaced with a more efficient processor, reducing hazardous waste generation by 90 gallons/year. This avoids the cost of disposal of $8,415 (765 lbs at $11/lb) and saves $1,585 from reduced labor. The project cost $5,200.
Photoresist waste	Source Reduction	500	Hazardous Waste	$5,500	$0	$5,500	A fully aqueous developer solution was installed in the printed circuit laboratory for processing dry film photoresist. The system replaced a solvent-based process that formerly generated approximately 500 lbs of hazardous waste annually. Waste avoidance costs are estimated at $5,500 (500 lbs at $11/lb).
Heavy metal solutions from crystallography experiments	Source Reduction	10,200	Hazardous Waste	$112,200	$3,500	$114,700	This project, funded by the pollution prevention council, installed a xenon pressure cell to allow preparation of samples for protein crystallography without the use of toxic heavy metal solutions. The project should eliminate 1,200 gallons of heavy metal hazardous waste (10,200 lbs) and avoid disposal costs of $112,200 ($11/lb). Additionally, approximate $6,000 savings is estimated from reduced labor and handling. The project cost $3,500.
Lead	Recycled	550	Hazardous Waste	$6,050	$0	$6,050	Approximately 550 lbs of lead bricks were collected by the Instrumentation Division for recycling. Waste disposal cost avoided is estimated at $6,050 (550 lbs at $11/lb).
Lead acid batteries	Recycled	9,600	Hazardous Waste	$105,600	$0	$105,600	Estimate 40 lbs./battery and avoided disposal costs as hazardous waste at $11/lb.
Ion exchange wastewater	Source Reduction	1,250	Hazardous and Sanitary Wastewater	$2,000	$100	$1,900	Prefilters were added to the deionization system to polish make up water entering the ion exchange system. This extended the useful life of the ion exchange resins, requiring less frequent regeneration. The regeneration process generates hazardous and sanitary wastewaters. The project is estimated to have eliminated 40 gallons of hazardous waste and 200 gallons of sanitary wastewater. Approximately $2,000 in disposal costs are avoided annually.

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2001	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Tritium Exit Signs	Source Reduction	800	Mixed Waste	$99,750	$20,000	$79,750	Removed 190 tritium exit signs from service and returned to the manufacturer . Replaced with energy efficient light emitting diode (LED) signs. Project reduced risk of tritium gas release and avoided disposal as mixed waste. Savings from avoided disposal costs estimated at $99,750 (475 ft^3 at $210/$ft^3$), less $20,000 implementation cost for total savings of $79,750.
Chromotography waste	Source Reduction	782	Mixed Waste	$164,220	$30,000	$134,220	This project constructed a preparative-scale supercritical fluid chromatograph suitable for PET radiotracer purification. This system utilizes an alternate solvent (supercritical CO_2) system that allows radiotracer purification to be carried out in an organic-free environment. Using supercritical CO_2 as a solvent for tracer purification eliminates a huge organic waste stream. Conventional high-pressure liquid chromatography purification generates about 200 mL of organic waste. This project has been an enormous success in minimizing organic waste. Waste disposal cost avoidance is estimated at $164,220 (782 lbs mixed waste at $210/lb). The project cost $30,000.
Shield Block (concrete)	Reuse	100,000	Radioactive Waste	$27,833	$0	$27,833	In excess of 100,000 lbs of shield block was reused on site by the Collider Accelerator Department as shielding for beamlines. This avoided disposal costs of approximately $27,833 (estimate 1,113 ft^3 at $25/$ft^3$).
Cooling Water	Reuse	153,000	Radioactive Waste	$144,000	$0	$144,000	Approximately 18,000 gallons (153,000 lbs) of cooling water was reused in the main magnet cooling water system, avoiding disposal as radioactive waste water at a cost of $8/gallon.
Short half-life waste	Decay in Storage	3,950	Radioactive Waste	$1,575	$0	$1,575	Short half-life isotopes, particularly phosphorus-32 and phosphorus-33, are frequently used in life sciences experiments. Wastes generated from these operations were managed in accordance with BNL decay-in-storage requirements, rendering the wastes eligible for volumetric release. Waste disposal cost avoided is estimated at $1,575 (63 ft^3 at $25/$ft^3$).

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2001	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Filters	Decay in Storage	1,920	Radioactive Waste	$9,312	$0	$9,312	Filters from the air handlers in the Linear Accelerator facility become contaminated with beryllium-7, a short-lived isotope eligible for decay. The filters were allowed to decay for over ten half-lives in accordance with the decay-in-storage requirements. They were surveyed and released as undetectable for disposal as industrial waste. This avoided disposal costs estimated at $9,312.
Antifreeze	Recycled	1,700	Industrial Waste	$3,400	$0	$5,600	Avoided disposal cost of $3,400 (1,700 lbs at $2/lb for bulk waste), plus material savings of $2,200.
Oily waste water	Source Reduction	6,240	Industrial Waste	$12,480	$17,300	$2,980	This project, funded by the pollution prevention council, installed automatic oil-water separators on compressor blowdown stations. These units capture the oily discharge and save significant labor hours compared to the previous system. Waste disposal cost avoidance is estimated at $12,480 (6,240 lbs at $2/lb) and labor savings is estimated at $7800/yr. The project cost $17,300.
Lubricating oil	Energy Recovery	54,400	Industrial Waste	$108,800	$500	$108,300	Approximately 6,800 gallons of lubricating oils were collected, tested for suitable for use as waste oil fuel, and used for energy production at the Central Steam Facility. This avoided waste disposal costs estimated at $108,800. Cost of analysis is estimated at $500.
Cooling tower chemicals	Source Reduction	6,375	Industrial Waste	$0	$0	$15,000	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. Savings are estimated at $15,000/yr.
Measuring and test instrumentation	Reuse	2,000	Industrial Waste	$22,000	$0	$82,000	As part of the HFBR facility stabilization project, staff transferred approximately $60,000 worth of measuring and test equipment to five other departments at BNL. Avoided disposal costs are estimated at $22,000 (2,000 lbs at $11/lb).
Heavy machinery	Reuse	12,000	Industrial Waste	$24,000	$0	$174,000	As part of the HFBR facility stabilization project, staff transferred approximately $150,000 worth of heavy equipment (lathes, milling machines, etc.) to the Magnet Division at BNL. Avoided disposal costs are estimated at $24,000 (12,000 lbs at $2/lb).

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

Waste Description	Type of Project	Pounds Reduced, Reused, Recycled, or Conserved in 2001	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Pressure equipment	Reuse	1,000	Industrial Waste	$11,000	$0	$51,000	As part of the HFBR facility stabilization project, staff transferred approximately $40,000 worth of pressure guages, pressure regulators, thermometers, and o-rings to the Collider Accelerator Department at BNL. Avoided disposal costs are estimated at $11,000 (1,000 lbs at $11/lb).
Hydraulic oil	Source Reduction	6,000	Industrial Waste	$12,000	$15,000	$30,000	This project, funded by the pollution prevention council, replaced hydraulic lines on heavy equipment with steel braided lines and replaced the petroleum-based hydraulic oils with bio-based vegetable oils. Hydraulic line breaks were responsible for a significant number of reportable spills and costly response and cleanup. This project reduced the frequency of spills and resulting response and cleanup costs. The vegetable-based oil is biodegradable and subject to fewer reporting requirements. Avoided disposal costs are estimated at $12,000 (6,000 lbs at $2/lb) and savings from reduced response and cleanup costs are estimated at $33,000. The cost of implementation was $15,000.
Blasocut machining coolant	Recycled/Reused	85,280	Industrial Waste	$170,560	$0	$187,610	Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it labwide. 10,660 gallons (85,280 lbs) of Blasocut lubricant were recycled in 2001. Recycling involves aeration, centrifuge, and filtration. Avoids cost of disposal as industrial waste ($2/lb for bulk waste), plus an avoided cost of procurement of 8 drums of concentrate ($800/drum) and 213 drums for waste ($50/drum) for a total savings of $187,610. Cost of recycle is estimated to be the same as cost of procurement and preparation of proper dilution for use.
Used motor oil	Recycled	23,345	Industrial Waste	$46,690	$0	$46,690	Estimate avoided disposal cost of $46,690 (23,345 lbs at $2/lb bulk waste).
Office paper	Recycled	492,000	Sanitary Waste	$19,680	$0	$19,680	Estimate $80/ton for disposal as trash.
Cardboard	Recycled	254,000	Sanitary Waste	$10,160	$0	$10,160	Estimate $80/ton for disposal as trash.
Scrap metal	Recycled	88,000	Sanitary Waste	$3,520	$0	$3,520	Estimate $80/ton for disposal as trash.
Bottles/cans	Recycled	58,600	Sanitary Waste	$2,344	$0	$2,344	Estimate $80/ton for disposal as trash.
Construction debris	Recycled	578,000	Sanitary Waste	$7,225	$0	$7,225	Estimate $25/ton for disposal as trash.
	TOTALS	**1,954,577**		**$1,144,954**	**$91,600**	**$1,385,989**	

Table 2-3. Recycling Program Summary.

Recycled Material	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Mixed paper	155	136	197	220	106	196	204	370	336	246
Cardboard	21	81	164	85	101	103	97	124	132	127
Bottles/cans	12	12	18	11	15	21	22	21	20	29
Tires	9	21	7	11	17	18.6	11.5	15.2	0	0
Construction debris	809	495	495	627	837	799	527	352	243	289
Used motor oil (gallons)	-	-	4,000	3,350	4,275	4,600	3,810	3,570	3,295	3,335
Metals	201	210	33	153	158	266	64	47	534	38
Lead	-	-	-	-	-	4.4	3.7	0.7	2.5	0
Automotive batteries	-	5	0.81	0.72	6.8	4.3	2.1	1.1	2.2	4.8
Printer/toner cartridges (units)	-	-	-	-	-	-	1,480/175	1,575/510	n/a	363
Fluorescent bulbs (units)	-	-	-	-	13,664	12,846	867	25,291	5,874	17,112
Blasocut coolant (gallons)	-	-	-	-	-	-	-	3,575	7,500	10,660
Antifreeze (gallons)	-	-	-	-	55	276	448	145	110	200
Tritium Exit signs (each)	-	-	-	-	-	-	-	-	185	190
Smoke detectors	-	-	-	-	-	-	-	-	-	171

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

the recycling program to include smoke detectors, which are shipped back to the manufacturer. Table 2-3 shows the total number of tons (or units) of these materials recycled in 2001 and the trends since 1992.

BNL has operated a rideshare program since 1995. BNL is planning on integrating its program with Long Island Transportation Management to provide a larger pool of participants. The Laboratory offers a guaranteed ride service that can be used by program participants. Some BNL groups encourage the use of flexible work schedules with extended hours, which eliminates one to two days of travel every two weeks.

In the summer of 2001, Cornell Cooperative Extension (CCE) of Suffolk County conducted an assessment of BNL's Integrated Pest Management Program (Sanok, 2001). CCE found that the Laboratory's current pest management program constitutes a fully Integrated Pest Management control strategy due to BNL's limited use of chemicals in all areas. CCE commended BNL for taking a proactive approach and agreed to assist with additional training, information on pest management issues, and a written procedure for addressing the many concerns associated with this issue. BNL's environmental stewardship supports these efforts to maintain an attractive and productive facility while minimizing the health and environmental risks. Additionally, with the exception of hydroseeding to reestablish damaged landscape, lawn areas are not watered, fertilized, or treated with pesticides. This reduces the need for mowing, which in turn reduces air emissions from mowers and tractors and the potential for oil spills. When areas other than lawns are identified for revegetation, they are planted with grasses, wildflowers, or trees native to the Northeast, when available and appropriate.

2.3.4.5 Water Conservation

BNL has a strong water conservation program and has achieved dramatic reductions in water usage since the mid 1990s. The Laboratory continuously evaluates water conservation as part of facility upgrades or new

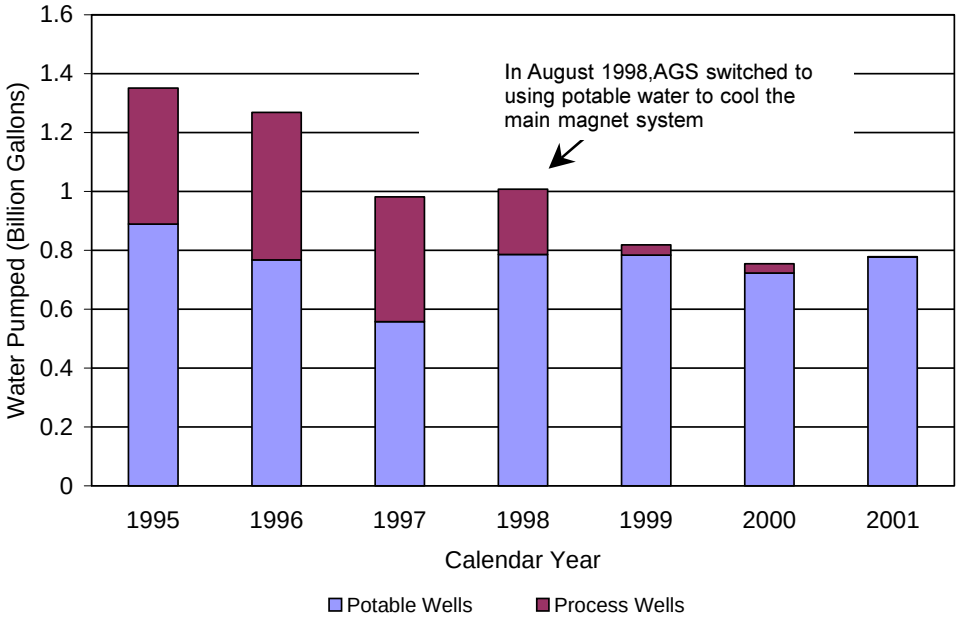

Figure 2-8. Water Consumption Trend.

construction initiatives. These efforts include more efficient and expanded use of chilled water for the heating, ventilation, and air conditioning system, and reuse of once-through cooling water for other systems such as cooling towers. The goal is to reduce the consumption of potable water and reduce the impacts of clean water discharges on Sewage Treatment Plant operations. Figure 2-8 shows the seven-year trend of water consumption. The total annual reduction since 1995 is 600,000,000 gallons.

2.3.4.6 Energy Management and Conservation

BNL's Energy Management Group has been in place since 1979. This group works to reduce BNL's energy use and costs by identifying cost-effective energy efficiency projects, monitoring energy use and utility bills, and assisting in obtaining the least expensive energy sources possible. This group is responsible for the development, implementation, and coordination of BNL's Energy Management Plan.

BNL 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. Fuel and natural gas are used to produce steam at the Central Steam Facility. In 2001, BNL used 290,806,524 kWh of electricity, 4,104,968 gallons of fuel oil and propane, and 851,300 cubic feet of natural gas. Natural gas use started in FY 1997 and is reducing the need for fuel oil. Use of natural gas (instead of fuel oil) reduced emissions, saved energy, and lowered costs. (See additional information on fuel use in Chapter 4.) BNL is a participant in the Long Island Power Authority's (LIPA) Peak Load Reduction Curtailment 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 for each critical day.

In 2001, several energy-related projects and initiatives were completed. These include completion of a new compressed natural gas vehicle fueling facility for BNL vehicles, completion of a natural gas contract that will save more than $1.7 million over three years (more than $300,000 was saved in FY2001), fuel purchasing strategies that saved $592,000, and the connection of the Chemistry Building to the central chilled water, eliminating the need for two large, out-dated chloroflourocarbon chillers. BNL also received $940,000 for new energy conservation projects, ranging from LED

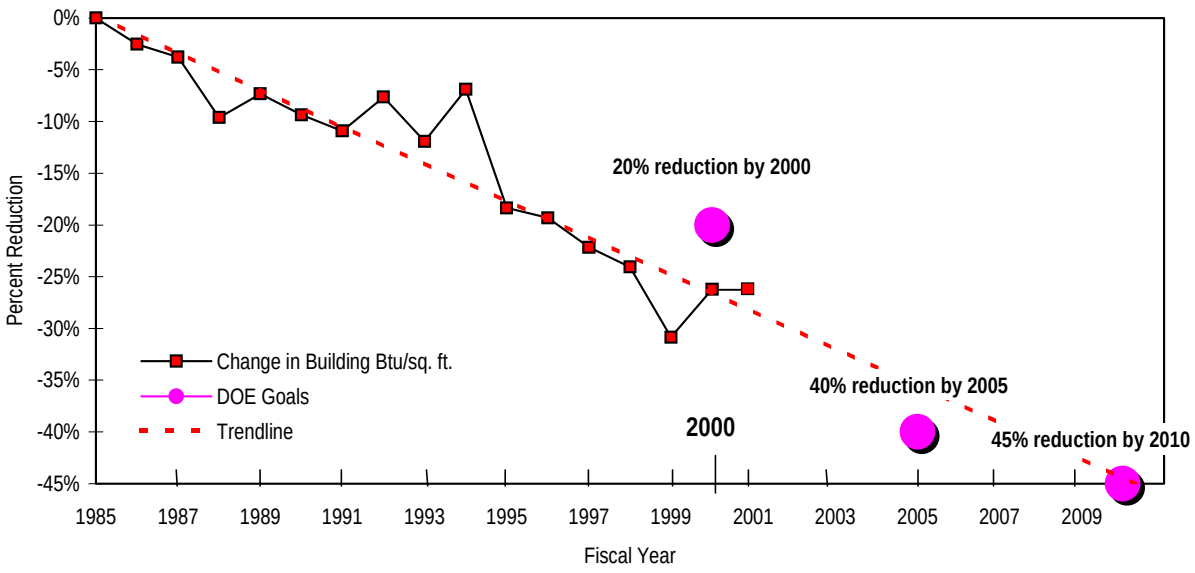

Figure 2-9. Building Energy Performance Since 1985.

lighting to a solar heating system for the swimming pool.

The National Energy Conservation Policy Act, as amended by the Federal Energy Management Improvement Act of 1988 and the Energy Policy Act of 1992, requires federal agencies to apply energy conservation measures and improve federal building design to reduce energy consumption per square foot. Current goals are to reduce energy consumption per square foot, relative to 1985, by 20 percent in 2000, 40 percent by 2005, and 45 percent by 2010. BNL energy use per square foot in 2001 is 26 percent less than in 1985 (see graph in Figure 2-9). However, it is becoming increasingly difficult to find economically attractive energy projects. Energy use in 2001 was similar to 2000. The measure of Btu/ft^2 (shown in Figure 2-9) does not take weather into account. When the Btu/ft^2 per degree-day (adjusted for weather) is calculated, there is actually an 8.4 percent drop from 2000 to 2001. BNL's Energy Management Group assisted with a demonstration and test of microturbines at the Laboratory in 2001. In cooperation with Keyspan Energy and the Energy Sciences and Technology Department and with financial assistance from the Federal Energy Management Program, two microturbines were installed at the Laboratory as part of DOE's strategic effort to develop alternatives to large-scale power plants. Overall annual energy savings for FY2001 were $15,000,000. BNL continues to seek out alternative energy to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs.

2.3.4.7 Natural and Cultural Resource Management

The Laboratory continues to develop, enhance, and implement its natural resource program, building on a foundation established by the Wildlife Management Plan. Over the past year, BNL has begun to develop a cultural resource program 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 two programs, refer to 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 on December 11, 1980. As part of CERCLA, EPA established the National Priorities List (NPL), which is a list of sites nationwide where cleanup of past

contamination is required. BNL is listed on the NPL with 32 other Long Island sites (16 in Suffolk County—see http://www.epa.gov/superfund/sites/npl/ny.htm). Most of the contamination at BNL is associated with past accidental spills and outmoded practices for handling, storing, and disposing of chemical and radiological material.

BNL follows the CERCLA process (Figure 2-10), which includes the following steps:

- Conduct a Preliminary Assessment (review of historical documents, interviews with employees, site reconnaissance).
- Conduct a Site Inspection, which often includes sampling.
- 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 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.

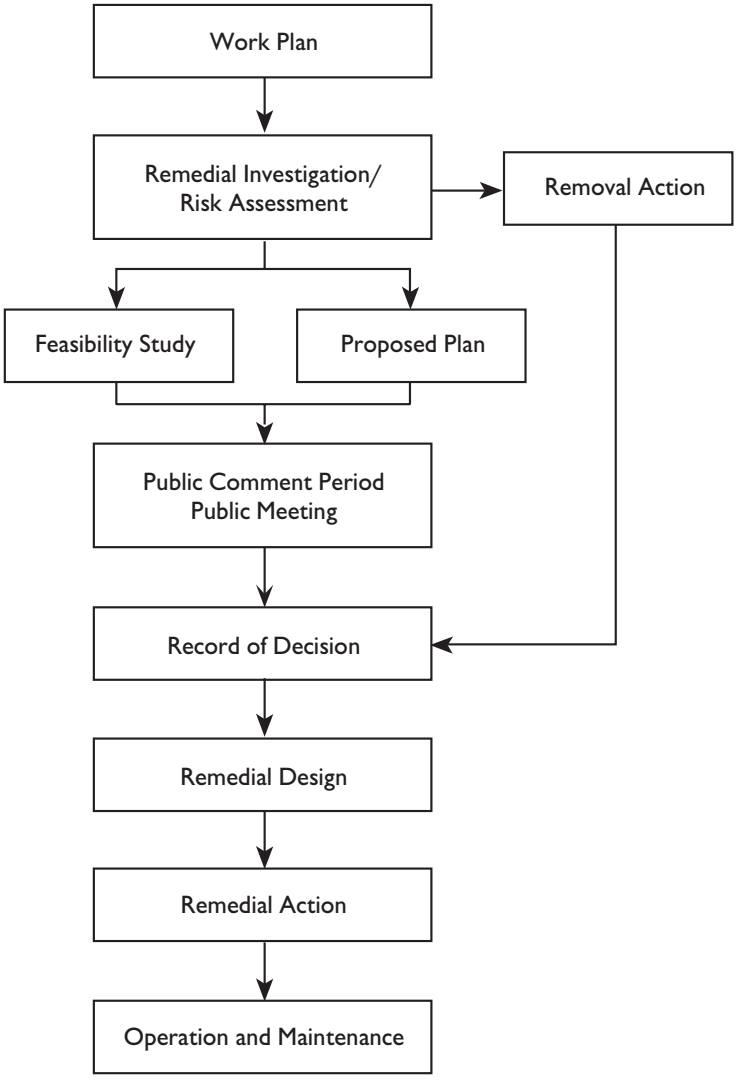

Figure 2-10. CERCLA Process.

At each step, EPA distinguishes between sites that do or do not require further action, based on potential threat to human health and the environment. An expedited cleanup action, called a *Removal Action*, can also be conducted. This requires an *Engineering Evaluation/Cost Analysis*, which evaluates and recommends specific cleanup actions. The selected action is then documented in an *Action Memorandum*, the equivalent of a Record of Decision.

The goal of BNL's Environmental Restoration Program is to complete onsite cleanup activities and install all groundwater treatment systems by 2006 or earlier. The Laboratory has made substantial progress in characterizing and removing sources of contamination (*e.g.*, underground tanks) and in treating or removing the groundwater and soil contamination that are the result of past disposal practices. The Environmental Restoration Program has also worked to advance the decontamination and decommissioning of the former BGRR and the stabilization of the HFBR.

Historical facility records and sampling have been used to determine where contamination might be present on the site today. These areas were geographically grouped into Operable Units (OU). For a fuller description, see *Areas of Concern at BNL, Upton, New York – A Reference Handbook* (BNL 1998a). A map of

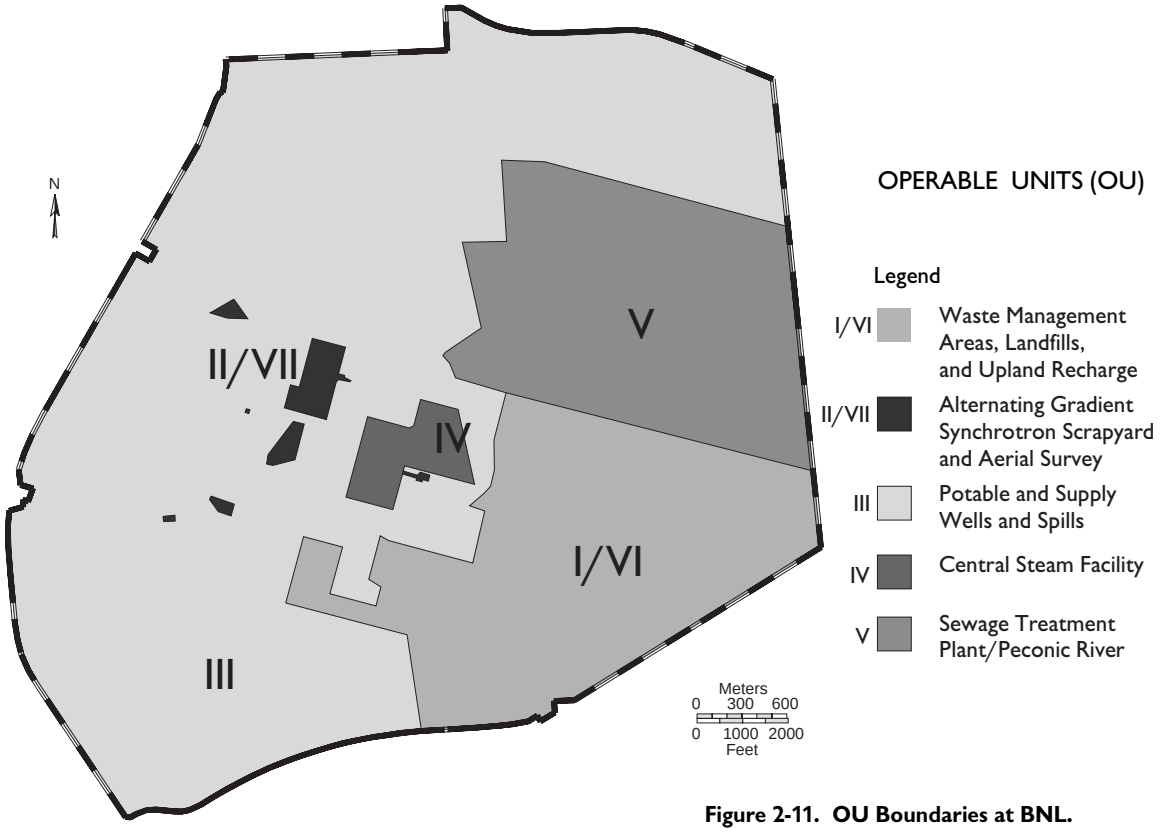

Figure 2-11. OU Boundaries at BNL.

the OUs is shown in Figure 2-11. Table 2-4 provides a description of each OU (I through VII) and a summary of environmental restoration actions taken during 2001 (also see Figures 2-12a through 2-12f). Significant progress was made in environmental restoration in 2001. The cleanup implementation has been organized into four classes of projects: soils, groundwater, Peconic River, and reactors. These are detailed in Table 2-4.

2.3.4.9 The Facility Review Project

The Facility Review Project was a comprehensive examination of all site facilities, existing or demolished, to identify any past or current activities with the potential to degrade the environment. During this project, BNL reviewed the entire operating history of the site and more than 900 systems, facilities, and operations including tanks, pipes, sumps, cesspools, storage areas, historical discharges, and current and past operating practices. Twenty-eight individuals from fifteen other DOE facilities provided high-level technical and management support during the review. A final report was issued on October 7, 1998 (BNL 1998b).

The report identified 75 issues as having the highest priority, due to their potential to contaminate groundwater above drinking water standards. Seventy-six percent of these issues were dispositioned by December of 2001. Additionally, more than 1,675 issues that had the potential to impact the environment were identified as needing further evaluation. These were further subdivided into operational and legacy issues. In March 2000 the *Facility Review Disposition Project Plan* (BNL 2000a) was approved. This three-year project provides the mechanisms needed to rank risk, to schedule, and to resolve the issues identified during the Facility Review Project of 1997. BNL continues to work closely with Suffolk County Department of Health Services on these issues, using a shared database to track progress. See Table 2-5 for a breakdown of the number of issues and their status. Overall, 68 percent of all issues were dispositioned by the end of 2001. The goal is to resolve all of these issues by the end of 2002.

Table 2-4. Hierarchy of Environmental Objectives at BNL.

Cleanup Project	Operable Unit/Description	Environmental Restoration Program Actions in 2001
Soil Projects	OU I OU II OUVII	• Boneyard project legacy waste transported to ATG for processing (1.1 million pounds). • Size reduction of Boneyard project yard components/ debris and subsequent transport to Envirocare of Utah for disposal(42,500 ft^3). • Completed remediation and restoration of the Landscape Soils (AOC 16). · Approximately 1,500 yd^3 of soil from the Chemical Holes remediation was transported to Envirocare of Utah for disposal. • Removal Action Work Plans for the Bldg. 811 underground storage tanks and soils, and Bldg. 650 sump outfall were submitted to regulators. • *Phase 1 Landfill 5-Year Review Report* was submitted to regulators. • Final design for radiologically contaminated soils was submitted to regulators.
Groundwater Projects	OU III	• Completed construction and began routine operations of on-site groundwater treatment system at Middle Road for volatile organic compounds (VOCs). • Began construction of on-site groundwater treatment system for VOCs at western south boundary. • Completed the low-flow pumping of tritiated groundwater along Temple Place, and prepared evaluation. • Continued installation of temporary and permanent monitoring wells for the HFBR tritium plume. • Identified high concentration of tritium in the groundwater from the g-2 activated soil, and installed several Geoprobes and monitoring wells. An Engineering Evaluation and Cost Analysis was prepared for regulator review. (This is not included under any specific OU at this time but it is an AOC). • During 2001, 1,032,684,000 gallons of groundwater were treated and 600 pounds of VOCs were removed. Since the first groundwater treatment system started operating in December 1996, approximately 2,900 pounds of VOCs have been removed from more than 4 billion gallons of groundwater. • Conducted pre-design characterization by installating temporary and permanent monitoring wells for five planned off-site groundwater treatment systems south of BNL in East Yaphank and Manorville. • Continued characterization of the Magothy Aquifer.
	OU IV	• A petition for system shut-down was submitted and approved by the regulators for the OU IV air sparge and soil vapor extraction soil and groundwater treatment system. The system was placed on stand-by in August. • Continued groundwater monitoring. • Completed interim remedy monitoring for the Bldg. 650 Sump and Sump Outfall.
	OU VI	• EPA and DEC approved the Record of Decision. • Continued monitoring the ethylene dibromide plume. • Conducted pre-design characterization consisting of installation of temporary and permanent monitoring wells for the planned off-site groundwater treatment system south of BNL in Manorville.
	Groundwater Monitoring	• Completed the *BNL 2000 Groundwater Status Report.* • Collected and analyzed 2,389 groundwater samples from 594 monitoring wells. • Completed a comprehensive data quality objective assessment of the groundwater monitoring program. • Issued the Environmental Monitoring Plan, 2001 Update.
Peconic River	OU V	• Record of Decision signed for the Sewage Treatment Plant. • Technology fact sheets distributed and Peconic River fact sheets updated.
Reactors	BGRR·	• The Below Ground Duct Cooler was removed. The cooler waste will be sent to Envirocare of Utah in 2002. •· The Above Ground Duct was removed. Sections of concrete duct were size reduced to meet transportation and disposal site criteria. Shipping of the duct sections to Envirocare of Utah began in August. The final disposal of duct sections is scheduled to finish during the first quarter of 2002. • An Engineering Evaluation and Cost Analysis (EE/CA) was developed and issued for the BGRR Canal. Work began on the decontamination, soil remediation, and removal of belowground piping and equipment associated with the Canal. • The Below Ground Duct and associated soils were characterized in accordance with an approved Sampling and Analysis Plan. The characterization data will be analyzed as part of the overall

Table 2-4. Hierarchy of Environmental Objectives at BNL *(concluded)*.

Cleanup Project	Operable Unit/Description	Environmental Restoration Program Actions in 2001
Reactors	HFBR	BGRR risk assessment and end-state determination. • Approximately 250 tons of oiled sand at the site of the former FA310 Tank, a 250,000-gallon holdup tank, were removed and sent off site for disposal as industrial waste. Following demolition of the concrete pits and foundation ring, clean soil was back-filled, graded and hydro-seeded, returning the area to a grassy, gently rolling slope. • A radiological and hazardous material characterization of the HFBR and ancillary support buildings was completed. • The Ra-Be source was moved to the HFBR from the basement of Bldg. 703. • A final inspection by Suffolk County of the HFBR facility concluded that the facility is in full compliance with the provisions of Article 12 of the Sanitary Code.

a. Middle Road Groundwater Treatment System began operations in October 2001.

b. OU IV Air Sparge Soil Vapor Extraction System received approval for system "shutdown" from the regulators in January 2001. It pumped on and off during the year and was turned off in August 2001.

c. Removal of the contaminated BGRR Canal north concrete pad area.

d. Plant Engineering rigging personnel loading an Above Ground Duct section onto a truck for transport to a disposal facility.

e. Above Ground Duct section 4-1 cuts are complete and being prepared for separation. Saw House being moved away from saw cut 4-4.

f. Workers remove cooling coils from the Below Ground Duct.

Figure 2-12. Environmental Restoration Actions Taken during 2001.

Table 2-5. Category, Risk Rank, Number, and Status of Issues Identified in the Facility Review Project, as of December 31, 2001.

Category	Rank: Type of Issue	Number	Dispositioned	
75 High-Priority Issues	High Priority: Potential to impact groundwater above drinking water standards	75	57	(76%)
1,175 Operational Issues (responsible organization still exists) needing further evaluation	Rank 1-3: Potential to impact groundwater, but not above drinking water standards	176	145	(82%)
	Rank 4-6: Lower priority, requiring engineering controls or documentation	999	595	(60%)
500 Legacy Issues (responsible organization does not exist) needing further evaluation	Rank 1-3: Potential to impact groundwater, but not above drinking water standards	212	161	(48%)
	Rank 4-6: Lower priority, requiring engineering controls or documentation	288	230	(80%)
Total		**1,750**	**1,188**	**(68%)**

2.4 IMPLEMENTATION

2.4.1 Structure and Responsibility

All employees at BNL have clearly defined roles and responsibilities in key areas including environmental protection. 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.

One key to the success of BSA's approach to environmental stewardship has been leadership. At Laboratory meetings and in memorandums, the Director continues to reaffirm his personal commitment to environmental protection and his expectation that all staff participate in this way of doing business. The Deputy Director for Operations manages the Environment, Safety, Health & Quality Directorate and leads environmental protection efforts. He is responsible for coordinating the EMS within BNL and reporting on performance to senior management, utilizing the staff of the Environmental Services Division to accomplish this task.

BSA also more clearly defined expectations for staff and management. In the past, as is often the case, responsibility for environment, safety, and health had been relegated to support organizations. Now, under the BSA performance based management model, senior management has communicated their expectation that all line managers take full responsibility for environment, safety, and health performance, and that line managers and staff be held accountable. Environmental and waste management technical support personnel assist the line organizations with their environmental responsibilities. The Environmental Compliance Representative program, initiated in 1998, continues to be well received and 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 in place (see Section 2.4.2), thus ensuring that all personnel are aware of their environmental responsibilities.

2.4.2 Staff Training and Awareness

Extensive training on EMS requirements has been provided to staff whose responsibilities involve environmental protection. In total, approximately 14,000 hours of environmental training were provided between 1998 and 2001.

- All permanent employees and visiting scientists with the potential to impact the environment are required to take a computer-based training course developed by BNL to provide a basic level of environmental awareness. The course discusses the EMS, reviews basic environmental requirements, and describes the impacts of non-

compliance. Contractors and visiting scientists complete a modified training program covering the key points of BNL's environmental program as part of the required site orientation.
- Staff whose work could directly impact the environment are given job-specific training focused on implementing processes and controls to minimize environmental impacts.
- To support the Laboratory's Assessment Program (see Section 2.5.4), BNL continues to train select individuals to perform EMS internal audits.

2.4.3 Communication and Community Involvement

When BSA was awarded the contract to manage BNL in 1998, they made a commitment to establish an effective partnership between DOE, the Laboratory, and a full range of community members to address issues that affect quality of life in the community. At the core of the communication and community involvement programs are the Environmental Stewardship Policy and the Community Involvement Policy and Plan (available at http://www.bnl.gov/community/).

As discussed in Section 2.2, the Environmental Stewardship Policy contains a commitment to maintain a positive, proactive, and constructive relationship with the community and regulators, and to promote open communication on environmental performance. The Community Involvement Policy and Plan was written with input from both internal and external stakeholders, and documents BSA's efforts to ensure that the public will be kept informed of issues; that the Laboratory will actively seek and consider input from regulators, stakeholders, and the general public; and that opportunities will continue to be provided for an open, two-way exchange of information, knowledge, and perspectives.

The Laboratory continues efforts to improve working relationships with regulatory agencies by sharing information and by working to resolve issues on plans, priorities, and corrective actions of importance to the regulators. The Laboratory meets regularly with regulators from the New York State Department of Environmental Conservation, the U.S. Environmental Protection Agency Region II, and the Suffolk County Department of Health Services. Suffolk County inspectors have a permanent office on site.

Another forum for communication is the Brookhaven Executive Roundtable, which was established by DOE in August 1997. The Roundtable includes staff from the offices of local, state, and federal elected officials, regulatory agencies, and representatives from DOE and the Laboratory.

In addition, the Community Advisory Council was established in September 1998. The Council, which serves in an advisory capacity to the Laboratory Director, consists of representatives from more than 30 varied stakeholder groups, including civic, business, union, health, education, employee, and environmental organizations. At monthly meetings, both the Roundtable and the Council are given frequent updates on Laboratory activities, environmental issues, and progress. Feedback and recommendations are considered in the Laboratory's decision-making processes.

The Council closely followed and gave feedback to the Laboratory on remediation activities, including groundwater issues; the BGRR; and plans for cleaning up portions of the Peconic River, including a recommendation to conduct pilot programs to attempt to minimize impacts to the Peconic River wetlands. A report on the DOE Assessment on Distribution of Cancer Among Former and Current BNL Workers was given by the DOE Office of Health Studies and the Director of the New York State Cancer Registry, which stated that the distribution among the BNL cohort was not substantially different from that which was expected, including no overall excess in radiosensitive solid cancers (Schymura 2001). The Council was also briefed on the *Historical Emissions Report 1947–1961* (Meinhold & Meinhold 2001), the Sewage Treatment Plant discharges, sanitary sewer modifications and upgrades, the Upton Ecological and Research Reserve, the Landtrek Project, and the 2001 Earth Day activities, as well as presentations by Science Chairs and researchers. Finally, the

Council hosted a series of six forums on "Energy and the Environment" which were open to the public.

Stakeholders are provided with many other opportunities to learn about and provide input on issues of importance to them—from working groups to roundtables to one-on-one interactions with managers and subject matter experts. Input is actively sought to help the Laboratory make better decisions that take the community's values and perspectives into account. Public outreach activities include briefings to local civic and community groups; meetings and presentations to local, state, and federal regulators and elected officials; and regular interactions with the business and educational communities. The Correspondence and Commitment Tracking System is used to track and ensure response to communications from external interested parties. Laboratory Envoys, who are well educated about BNL and its issues, regularly interact with individuals and groups in the community, gathering feedback, and responding to concerns.

In 2001, BNL hosted more than 25,000 visitors, including students and community members who participated in Summer Sunday, open houses, science museum visits, high school, college and community tours. The Laboratory also maintains an informative website, www.bnl.gov; issues press releases; publishes the *Brookhaven Bulletin* (a weekly employee newsletter), c*leanupdate* (a periodic newsletter on environmental cleanup), *Laboratory Link* (a monthly brief on research activities), and e-mail updates to keep the public and employees informed about a wide variety of Laboratory activities and issues, including environmental issues. Section 6.8 in Chapter 6 discusses additional outreach activities associated with the natural resources program.

BNL was selected as the "Organization of the Year" in 2001 by the nonprofit organization, International Association for Public Participation. BNL was recognized for integrating public participation into its operations, ensuring that stakeholders are kept informed and have a voice in decisions and issues that may affect them.

In 2001, BNL celebrated the thirty-first anniversary of Earth Day with a variety of activities involving BNL staff and the community, including environmental awards, an art contest, a four-mile race, environmental displays, and an on-site Office Swap (reuse of office products) (see Figure 2-13). Brookhaven Science Associates, contributed corporate funds in support of these events as part of a commitment to environmental stewardship.

Another innovative program that BNL continues to work on is the LandTrek project, which is an extension of the BNL Environmental Information Management System. The BNL LandTrek project, developed with support from DOE's Oakland office, provides environmental monitoring data to the public and BNL staff and managers over the Internet. The website was created based on community and staff input and continues to be updated as new data become available. Access is restricted, due to security issues. Password access may be obtained by visiting the website at http://webeims.b459.bnl.gov/website/bnl/ and requesting a password. Additional information about the LandTrek project can be found at http://www.bnl.gov/esd/landtrek.htm. BNL continues to expand the LandTrek website by providing additional data on BNL facilities and environmental media.

2.4.4 EMS Documentation

BNL has a comprehensive, up-to-date set of Laboratory-wide environmental documents describing its EMS program. A web-based system, known as the Standards Based Management System (discussed in Section 2.3.2), provides access to regulatory requirements and Laboratory-wide procedures and manuals that tell staff how to control processes and perform work at BNL in a way that protects the environment. SBMS has improved the quality, usability, and communication of Laboratory-level requirements.

The core elements of the EMS are described and regularly updated in the ISO 14001 Plus Environmental Management System Manual. This document can be found at https://sbms.bnl.gov/program/pd02/pd02d011.htm.

a

b

c

a. Laboratory Director gets ready to start 4-mile Earth Day run through the Long Island Pine Barrens.

b. Runners start 4-mile Earth Day race.

c. Runners reach the finish line after completing the 4-mile Earth Day race.

d. Scientists display environmental research work, such as bio-fuel (a vegetable-based home heating fuel).

e. Kids get ready to begin the half-mile Fun Run for Earth Week.

d

e

Figure 2-13. Earth Day 2001.

2.4.5 Document Control

The SBMS (discussed in Section 2.3.2) contains a comprehensive document control system to ensure effective management of procedures and other system documents. When facilities require additional procedures to control their work, document control protocols are implemented to ensure that workers have access to the current versions of procedures. Figure 2-14 shows the document hierarchy, including document inputs, and Figure 2-15 provides a flowchart of the document control process within SBMS.

2.4.6 Operational Control

Operations at the Laboratory are evaluated for the adequacy of current controls to prevent impacts to the environment through the use of Process Evaluations (see Figure 2-7 for an example), work planning and control, and

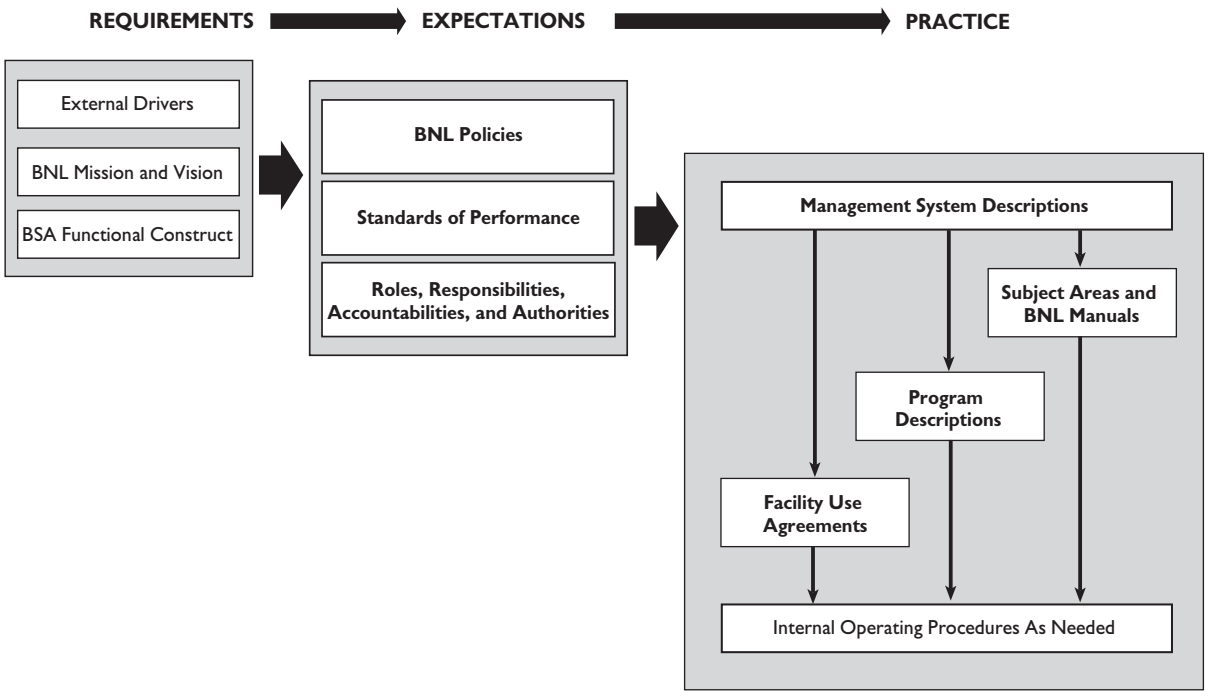

Figure 2-14. Standards Based Management System (SBMS) Hierarchy.

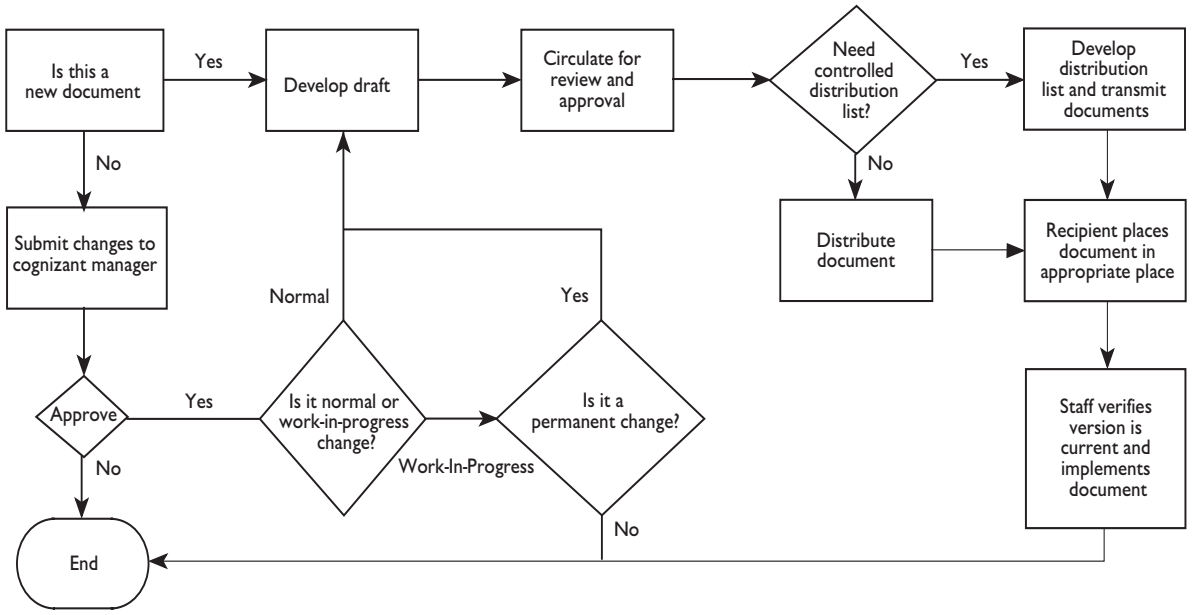

Figure 2-15. Flowchart of Document Control in the SBMS.

experimental design review. As needed, additional administrative or engineered controls are identified and plans for upgrades and improvements are developed and implemented. An example of an engineered control is the capping of the accelerator beam stops to prevent rainwater from reaching the activated soils and potentially contaminating the groundwater (Figure 2-16). Key operational control procedures are documented either in the SBMS or in facility-specific internal standard operating procedures and work instructions.

2.4.7 Emergency Preparedness and Response

BNL has an emergency preparedness and response program and specialized staff to provide timely response to hazardous material spills or other environmental emergencies. This program includes procedures for preventing, as well as responding to, emergencies. For more information on BNL's emergency preparedness, view the webpage http://www.bnl.gov/emergencyservices/.

2.5 CHECKING AND CORRECTIVE ACTION

2.5.1 Monitoring and Measurement

One key element of BNL's Performance Based Management Program is routine and systematic assessment processes. The Laboratory's Assessment Program was established to monitor progress toward achieving high-priority improvements, as well as routine expectations such as compliance with environmental regulations. Areas for improvement are identified and tracked to completion. See Section 2.5.4 for further details on BNL's assessment programs.

Effluent and emissions 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. This program identifies potential pathways for exposure of the public and the environment, as well as evaluating what impact BNL activities may be having on the environment. It also ensures compliance with environmental permit requirements.

The monitoring program is reviewed and revised, as necessary, 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 the review of previous analytical results. As required under DOE Order 5400.1 (1988), BNL's *Environmental Monitoring Plan, Triennial Update* (BNL 2000c) outlines annual sampling goals by specific media and frequency. The 2000 plan also specifies the data quality objectives associated with the monitoring program.

There were a total of 5,578 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges in 2001 under the Environmental Monitoring Program, as shown in Table 2-6. This does not include samples taken to characterize wastes for disposal purposes or nonroutine samples collected in support of restoration characterization activities. Specific sampling programs for the various media are described further in Chapters 3 through 7.

Figure 2-16. Gunnite Cap Installed Over g-2 Area Prevents Rainwater from Reaching the Activated Soils and Potentially Contaminating the Groundwater.

Table 2-6. Summary of BNL Sampling Program Sorted by Media.

Environmental Media	Total # of Sampling Events*	Purpose
Groundwater	2,739	To evaluate impacts of past and present operations on groundwater quality, under the Environmental Restoration, Environmental Surveillance, and Compliance programs.
On-site Recharge Basins	186	Recharge basins used for wastewater and stormwater disposal are monitored in accordance with discharge permit requirements and for environmental surveillance purposes.
Potable Water	136	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 and for environmental surveillance purposes.
Sewage Treatment Plant	866	The STP influent and effluent and several downstream Peconic River stations are monitored routinely for organic, inorganic, and radiological parameters to assess BNL impacts on the estuary. The number of samples taken depends on flow—*e.g.*, samples are scheduled for collection at Station HQ three times per week, 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 and direction, temperature, and atmospheric stability, to help model atmospheric transport and diffusion of radionuclides.
Air - Tritium	373	Silica gel cartridges are used to collect atmospheric moisture for subsequent tritium analysis. These data are used to assess tritium levels downwind of the reactors. Due to several years of nondetectable measurements, and the shutdown of the HFBR, monitoring was reduced from weekly to monthly in several areas of the site in 1999. See discussion in Chapters 4 and 8.
Air - Particulate	490	Gamma analysis is performed on samples of particulate matter collected from air samples. The purpose is determine whether there has been impact from BNL operations.
Air - Charcoal	87	Charcoal samples are used to assess for radioiodines, which could be released in reactor emissions.
Fauna	98	Fish, deer, and small mammals are monitored to assess impacts on wildlife associated with past (or current) BNL operations.
Flora	60	Since the primary pathway from soils to fauna is via ingestion, vegetation is sampled to assess uptake of contaminants by plants and hence to fauna. This number includes 33 samples taken of farm produce.
Soils	387	Soil samples are collected from adjacent farms and other local areas to confirm that Laboratory emissions have no impact on surrounding areas. Soil samples are also collected in conjunction with Environmental Restoration investigative work.
Miscellaneous	148	Samples are collected periodically from manholes and other locations to assess compliance with regulatory requirements. This number includes samples taken by the ESD field sampling team for Plant Engineering (*e.g.*, collected during sewer line cleanouts).
Total Number of Sampling Events in 2001	**5,578**	This number includes all the samples identified in the EMP (BNL 2000b) plus samples collected by the ESD field sampling team as special requests. The number does not include samples collected to monitor Environmental Restoration air and water treatment system processes, or samples taken by the Waste Management Division, waste generators or Environmental Compliance Representatives for waste characterization purposes.

* In one sampling event, multiple samples may be collected from a single location. For example, a separate sample for tritium, gross alpha and beta, and VOCs may be collected from a groundwater monitoring well during one event.

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

2.5.1.1 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 Central Steam Facility. Real-time, continuous emission monitoring equipment is installed and maintained at these facilities or periodically samples are collected and analyzed to ensure compliance with regulatory requirements. Analytical data are routinely reported to the permitting authority. See Section 3.5 of Chapter 3 for details.
- **Wastewater discharge monitoring** is performed at the point of discharge to ensure that the effluent complies with release limits in BNL's State Pollutant Discharge Elimination System (SPDES) permits. Sixteen point-source discharges are monitored under the BNL program: four under the Environmental Restoration Program and twelve under the State Pollutant Discharge Elimination System permit. As required by permit conditions, samples are collected daily, weekly, monthly, or quarterly and monitored for organics, inorganics, or radiological parameters. Monthly reports that provide analytical results and an assessment of compliance for that reporting period are filed with the permitting agency. See Section 3.6 of Chapter 3 for details.
- **Groundwater monitoring** is also performed in accordance with permit requirements. Specifically, monitoring of groundwater is required under the Major Petroleum Facility License for the Central Steam Facility, and the Resource Conservation and Recovery Act permit for the Waste Management Facility. Extensive groundwater monitoring is also conducted under the Environmental Restoration program as required under the Records of Decision for many of the Operable Units or Areas of Concern (see Chapter 7 for details). Additionally, to ensure that the Laboratory maintains a viable potable water supply, groundwater is monitored as required by the New York State Department of Health. See Chapter 3 for details on potable water supply monitoring programs and results.

2.5.1.2 Restoration Monitoring

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

This program typically includes the collection of soil and groundwater samples in order to determine the lateral and vertical extent of the contaminated area. Samples are analyzed for organics, inorganics, and radiological contaminants, and the analytical results are compared with guidance, standards, or background concentrations. Areas where impacts have been confirmed are fully characterized and, if necessary, remediated to mitigate continual impacts. Followup monitoring of groundwater is conducted in accordance with a Record of Decision.

2.5.1.3 Surveillance Monitoring

Surveillance monitoring is conducted to further monitor what impact, if any, BNL operations have on the environment (pursuant to DOE Order 5400.1). The focus of the environmental surveillance program is to assess potential environmental impacts that result from routine facility operations. This program includes the collection of ambient air, surface water, groundwater, flora, fauna, and precipitation samples. Samples are analyzed for radiological, organic, and inorganic contaminants. Additionally, routine reviews of data collected by thermoluminescent dosimeters

(devices to measure radiation exposure) that are placed on site and off site are performed under this program.

Control samples (also called background or reference samples) are also collected on and off the site to compare BNL results to areas that could not have been impacted 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 remainder of this *Site Environmental 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.

2.5.2 Nonconformance, Corrective, and Preventive Action

BNL continues to improve processes to identify and correct problems. This includes implementation of a Lessons Learned program to prevent recurrences, a robust Self-Assessment Program and an electronic web-based assessment and action tracking system.

2.5.3 Records

EMS-related records, including audit and training records, are maintained to ensure integrity, facilitate retrieval, and to protect them from loss. BNL maintains a records retention schedule on the SBMS.

2.5.4 EMS Assessments

To periodically verify that the EMS is operating as intended, audits are conducted. These audits are part of the sitewide self-assessment program and are designed to ensure that any nonconformance to the ISO 14001 Standard is identified and addressed. An independent, accredited registrar also conducts the ISO 14001 registration audits annually. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and focused compliance audits. BNL's 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 ISO 14001 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. Environmental experts routinely participate in these assessments. Management also conducts assessments to evaluate Laboratory environmental performance from a programmatic perspective, to determine if there are Labwide 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. Laboratory management also routinely evaluates progress on key environmental improvement projects. BNL periodically teams with the local DOE office to perform assessments in order to facilitate the efficiency of assessment activities and ensure that the approach to performing the assessments meets DOE expectations.
- **Independent assessments** are performed by staff who do not have line responsibility for the work processes. 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, corrective actions, and lessons learned.

The Laboratory's Assessment Program is augmented by programmatic, *external audits* conducted by DOE. Staff from the offices of

Battelle Memorial Institute and BSA subcontractors also perform periodic independent reviews. As noted above, an independent third party conducts ISO 14001 registration audits of the environmental management system. NSF conducted the ISO 14001 registration for BNL June 18–22, 2001, and found eight minor nonconformances and five opportunities for improvement. Corrective action reports were prepared for each minor nonconformance, and were accepted by the auditor. All corrective actions were completed.

BNL is also subject to extensive oversight by external regulatory agencies (see Chapter 3). Results of all assessment activities related to environmental performance are included, as appropriate, throughout this report.

2.6 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 Environmental Management System, and progress toward achieving environmental goals. This review identifies, as necessary, the need for changes to, and continual improvement of, the EMS.

2.7 ENVIRONMENTAL STEWARDSHIP AT BNL TODAY

BNL now has an unprecedented knowledge of its potential environmental vulnerabilities and current operations due to programs such as the Facility Review project, process evaluations, the work planning and control system, groundwater protection, environmental restoration, and information management systems that were designed to improve the Laboratory's environmental systems and performance. Compliance assurance programs are improving BNL's compliance status. 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 issues and progress. BNL must continue to deliver on commitments and demonstrate real improvements in environmental performance in order to regain and maintain the stakeholders' trust. This annual *Site Environmental Report* is an important communication mechanism, as it summarizes BNL's environmental programs and performance for the 2001 calendar year. Additional information about BNL's environmental programs is available on BNL's website at <www.bnl.gov>. Environmental project plans, status reports, procedures, and more are accessible to the general public at http://www.bnl.gov/esd/. The Laboratory is pursuing other mechanisms to communicate data in a more user friendly, visual, and timely manner, such as the BNL Landtrek project, which is viewed as a model in the DOE complex.

BNL's Environmental Management System includes a commitment to continual improvement. The Laboratory fulfills this commitment by establishing performance goals, developing action plans to achieve these goals, and periodically assessing performance. These processes are implemented within the context of the broader, Labwide efforts to improve the management systems.

The existing BNL Environmental Management System is viewed as exemplary in the DOE complex. BNL is the first Office of Science national laboratory to obtain third-party registration to ISO 14001, a globally recognized environmental standard. Due to external recognition of BNL's knowledge and unique experience implementing the ISO 14001 EMS program, several DOE facilities and private universities have invited BNL to extend its outreach activities and share its experiences, lessons learned, and successes. As noted above, BNL's environmental programs and projects have been recognized with regional and national 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.
- BNL has an improved understanding of environmental aspects, waste streams, and applicable requirements from the process evaluations.
- 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 environmental goals and Critical Outcomes. There have been successes in ISO 14001 registration, compliance improvements (*e.g.*, facility modifications, implementation of SBMS, enhanced operational controls), and increased environmental knowledge and awareness on the part of management, employees, and visiting scientists.
- Communications on environmental issues have improved, occur at the highest levels of management, and reporting is more formal. Managers are better informed about aspects, issues, and performance.
- Core EMS teams representing many organizations have been formed, and the consensus process used to develop the system has improved buy-in.
- There has been strong penetration of the EMS throughout organizations, and cultural change has been sweeping.

For over 50 years, the unique, leading-edge research facilities at BNL have made many innovative scientific contributions possible. Today, BNL continues its research mission while paying much closer attention to 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." This reflects BNL's desire to balance world-class research with environmentally responsible operations.

REFERENCES

BNL. 1997. *Brookhaven National Laboratory Site Treatment Plan.* Brookhaven National Laboratory, Upton, NY. January 1997.

BNL. 1998a. *Areas of Concern at Brookhaven National Laboratory, Upton, New York–A Reference Handbook.* Brookhaven National Laboratory, Upton, NY. June 1998.

BNL. 1998b. *BNL Facility Review Final Report, Review of Potential Environmental Release Points.* Brookhaven National Laboratory, Upton, NY. October 7, 1998.

BNL. 1999. *Site Environmental Report for Calendar Year 1997.* BNL-52553. Brookhaven National Laboratory, Upton, NY. February 1999.

BNL. 2000a. *Facility Review Disposition Project Plan.* Brookhaven National Laboratory, Upton, NY. March 2000.

BNL. 2000b. *Final Report, EPA Phase II Process Evaluation Project.* Brookhaven National Laboratory, Upton, NY. June 2000.

BNL. 2000c. *BNL Environmental Monitoring Plan 2000, Triennial Update.* BNL-52584. Brookhaven National Laboratory, Upton, NY. March 31, 2000.

DOE Order 430.2. 1996. *In-House Energy Management.* U.S. Department of Energy, Washington, D.C. June 13, 1996 (expired June 13, 2000).

DOE Order 435.1. 1999. *Radioactive Waste Management.* U. S. Department of Energy, Washington, D.C. July 7, 1999.

DOE Order 5400.1. 1988. *General Environmental Protection Program.* U.S. Department of Energy, Washington, D.C. Change 1: 6-29-90.

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

Executive Order 13148. *Greening of the Government Through Leadership in Environmental Management.* April 22, 2000.

ISO. 1996. *ISO 14001, Environmental Management Systems - Specification with Guidance for Use.* First Edition. International Organization for Standardization. Geneva, Switzerland. September 1, 1996.

Meinhold, C.B. and A.F. Meinhold. 2001. *Radiological Emissions and Environmental Monitoring for Brookhaven National Laboratory, 1947-1961.* DOE Contract No. DE-AC02-98CH10866. Brookhaven National Laboratory, Upton, N.Y. May 2001.

Sanok, William J. 2001. "Integrated Pest Management Assessment – Brookhaven National Laboratory." Cornell Cooperative Extension of Suffolk County. August 2001.

Schymura, Maria J., Ph.D. 2001. "Assessing Cancer Risk among Former and Current Brookhaven National Laboratory Workers." New York State Cancer Registry, New York State Department of Health. April, 2001.

EXPLORING EARTH'S MYSTERIES
...PROTECTING ITS FUTURE