

## Executive Summary

Brookhaven National Laboratory (BNL) prepares an annual Site Environmental Report (SER) in accordance with DOE Order 231.1A, *Environment, Safety and Health Reporting of the U.S. Department of Energy*. The report is written to inform the public, regulators, employees, and other stakeholders of the Laboratory's environmental performance during the calendar year in review. Volume I of the SER summarizes environmental data; environmental management performance; compliance with applicable DOE, federal, state, and local regulations; and performance in restoration and surveillance monitoring programs. BNL has prepared annual SERs since 1971 and has documented nearly all of its environmental history since the Laboratory's inception in 1947.

Volume II of the SER, the *Groundwater Status Report*, also is prepared annually to report on the status of and evaluate the performance of groundwater treatment systems at the Laboratory. Volume II includes detailed technical summaries of groundwater data and its interpretation, and is intended for internal BNL users, regulators, and other technically oriented stakeholders. A brief summary of the information contained in Volume II is included in this volume in Chapter 7, *Groundwater Protection*.

Both reports are available in print and as downloadable files on the BNL web page at <http://www.bnl.gov/ewms/ser/>. An electronic version on compact disc is distributed with each printed report. In addition, a summary of Volume I is prepared each year to provide a general overview of the report, and is distributed with a compact disc containing the-length report.

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BNL is operated and managed for DOE's Office of Science by Brookhaven Science Associates (BSA), a partnership formed by Stony Brook University and Battelle Memorial Institute. For more than 60 years, the Laboratory has played a lead role in the DOE Science and Technology mission and continues to contribute to the DOE missions in Energy Resources, Environmental Quality, and National Security. BNL manages its world-class scientific research with particular sensitivity to environmental issues and community concerns. The Laboratory's motto, "Exploring Life's Mysteries...Protecting its Future," and its Environmental, Safety, Security and Health Policy reflect the commitment of BNL's management to fully integrate environmental stewardship into all facets of its mission and operations.

### **BNL'S INTEGRATED SAFETY MANAGEMENT SYSTEM, ISO 14001, AND OHSAS 18001**

The Laboratory's Integrated Safety Management System (ISMS) integrates management of environment (i.e., environmental protection and pollution prevention), safety, and health issues into all work planning. BNL's ISMS ensures that the Laboratory integrates DOE's five Core Functions and seven Guiding Principles into all work processes. These integrated safety processes contributed to BNL's achievement of registration under both the International Organization for Standardization (ISO) 14001 Standard (for the Laboratory's Environmental Management System) and the Occupational Safety and Health Assessment Series (OHSAS) 18001 standard (for BNL's Safety and Health Program). Both standards require an organiza-

tion to develop a policy, create plans to implement the policy, implement the plans, check progress and take correction actions, and review the system periodically to ensure its continuing suitability, adequacy, and effectiveness.

One of BNL's highest priorities is ensuring that the Laboratory's environmental commitment is as strong as its passion for discovery. In 2001, an Environmental Management System (EMS) was established at BNL to ensure that environmental issues are systematically identified, controlled, and monitored. The EMS also provides mechanisms for responding to changing environmental conditions and requirements, reporting on environmental performance, and reinforcing continual environmental improvement. The cornerstone of the Laboratory's EMS is BNL's Environment, Safety, Security, and Health (ESSH) Policy. This policy makes clear the Laboratory's commitments to environmental stewardship, the safety of its employees, and the security of the site. Specific environmental commitments in the policy include compliance, pollution prevention, conservation, community outreach, and continual improvement. The policy is posted throughout the Laboratory and on the BNL website at <http://www.bnl.gov/ESHQ/ESSH.asp>. It is also included in all training programs for new employees, guests, and contractors.

The Laboratory's EMS was designed to meet the rigorous requirements of the globally recognized ISO 14001 Environmental Management Standard. BNL was the first laboratory under the DOE Office of Science to become officially registered to this standard. Annual independent audits, which are required in order to maintain the registration, are conducted to validate that the Laboratory's EMS is being maintained and to identify evidence of continual improvement. In 2007, an EMS surveillance audit determined that BNL continues to conform to the Standard. During the audit, 24 examples of BNL's continual improvement were highlighted, including the Laboratory's link between institutional- and division-level objectives and targets, "very well done" internal audit records and documentation, and improved management reviews. The auditors identified one minor nonconformance in

"Nonconformity, corrective action and preventative action" and four opportunities for improvement, one each in Emergency Preparedness and Response; Objectives, Targets and Programs; Control of Documents; and Operational Control. A corrective action plan was prepared to track the minor nonconformances to closure.

The Laboratory's strong Pollution Prevention (P2) Program is an essential element for the successful implementation of BNL's EMS. The P2 Program reflects the national and DOE pollution prevention goals and policies, and represents an ongoing effort to make pollution prevention and waste minimization an integral part of the Laboratory's operating philosophy. Pollution prevention and waste reduction goals have been incorporated as performance measures into the DOE contract with BSA and into BNL's ESSH Policy. The overall goal of the P2 Program is to create a systems approach that integrates pollution prevention and waste minimization, resource conservation, recycling, and affirmative procurement into all planning and decision making. In January 2007, Executive Order 13423 was signed, establishing federal requirements for: energy efficiency and conservation, renewable energy, fleet management, electronic stewardship, water conservation, toxic chemical use reduction, recycling, sustainable buildings, and purchasing environmentally preferred products. Although most of these requirements have already been incorporated within the Laboratory's P2 program, the new order will direct its future course. Six P2 proposals, submitted by employees to BNL's P2 Council, were funded in 2007, for a combined investment of approximately \$10,000. The anticipated annual savings from these projects is estimated at \$38,000, for an average payback period of less than one year. Initiatives to reduce, recycle, and reuse 14.6 million pounds of industrial, sanitary, hazardous, and radiological waste through the P2 program saved over \$2.9 million in 2007.

BNL was accepted into the EPA's Performance Track (PTrack) Program in 2004. This program recognizes top environmental performance among participating U.S. facilities of all types and is considered the "gold standard" for facility-based environmental performance. The

program requires that facilities commit to several improvement goals for a 3-year period and report on the progress of these goals annually. In 2007, the Laboratory completed its first set of goals under the PTrack Program:

- BNL's land and habitat conservation was significantly increased. A total of 42 acres of land was recovered, surpassing the original goal to recover 30 acres.
- The Laboratory continued its efforts to reduce radioactive air emissions from the Brookhaven Linac Isotope Producer (BLIP). In total, emissions were reduced by 34 percent, surpassing the original goal of 30 percent.
- BNL surpassed its original goal to remove more than 30 tons of ozone-depleting substances (ODS) by eliminating 35.5 tons of Class I ODS from 2003 through 2006.
- The Laboratory did not achieve its original goal of an 80 percent reduction in mercury inventory because the original inventory of mercury in storage was overestimated. By the end of 2006, 47 percent of the mercury inventory had been disposed. BNL continued to eliminate sources of mercury in 2007, achieving a 60 percent reduction by the end of the year.

In April 2007, BNL reapplied for continued membership to the PTrack program. Four new goals were established: energy reduction, transportation energy reduction, toxic release reductions, and establishing an electronics procurement program.

Chapter 2 of this report describes the elements and implementation of BNL's EMS in further detail.

#### **BNL'S ENVIRONMENTAL MANAGEMENT PROGRAM**

BNL's Environmental Management Program consists of several Laboratory-wide and facility-specific environmental monitoring and surveillance programs. These programs identify potential pathways of public and environmental exposure and evaluate the impacts BNL activities may have on the environment. An overview of the Laboratory's environmental programs and a summary of performance for 2007 follows:

#### ***Compliance Monitoring Program***

BNL has an extensive program in place to ensure compliance with all applicable environmental regulatory and permit requirements. The Laboratory must comply with more than 100 sets of federal, state, and local environmental regulations, numerous site-specific permits, equivalency permits for the operation of 14 groundwater remediation systems, and several other binding agreements. In 2007, BNL complied with the majority of these requirements, and instances of noncompliance were reported to regulatory agencies and corrected expeditiously.

Ten external environmental audits were conducted in 2007. The New York State Department of Environmental Conservation (NYSDEC) conducted inspections of air compliance at the Central Steam Facility (CSF), several outfalls at the Sewage Treatment Plant (STP) regulated by the State Pollutant Discharge Elimination System (SPDES), BNL's Major Petroleum Facility (MPF), and chemical bulk storage facilities. The Suffolk County Department of Health Services (SCDHS) conducted inspections of the BNL potable water supply, a quarterly inspection of the STP, and several SPDES-regulated outfalls. No formal notices of violation or enforcement actions were issued as a result of these inspections.

The Laboratory took immediate corrective actions to address three conditions identified during the NYSDEC inspection of the MPF. The corrective actions included: the submittal of design specifications/plans for the replacement of the secondary containment system for tanks 5 and 6, repair of a malfunctioning alarm system, and the need for an additional cover stone on several secondary containment systems to prevent liner damage. In addition, an inspection of BNL's diesel tank farm and underground gasoline storage facilities identified three conditions that needed corrective action. They included: application of the proper color coding for an underground storage tank, inspections and repair of two high-level alarms at the diesel tank farm, and noting both the design and working capabilities of each tank at the diesel tank farm. All conditions were corrected in 2007.

Two issues that required corrective action were identified during an inspection by NYSDEC of BNL's chemical bulk storage facilities. These included: peeling and blistering paint observed on a tank, and tank labels that did not include the working capacity of each tank. The issues were corrected in accordance with the NYSDEC directive.

Compliance monitoring in 2007 showed that emissions of nitrogen oxides, carbon monoxide, and sulfur dioxide from the CSF were all within permit limits. Opacity excursions were noted in the first and second quarters of 2007. The first excursions were due to soot blowing operations, which are performed to maintain boiler efficiency. The excursions were determined to be isolated events after an extended idle period which allowed excess soot to accumulate while nominal volumes of oil were burned to keep the boiler warm. Opacity excursions noted in the second quarter were caused by a mechanical malfunction of the calibration shutter in the transmissometer optical head assembly, which was subsequently replaced.

Approximately 1,168 pounds of ozone-depleting refrigerants were recovered from refrigeration equipment for recycling on site or made available for use by other DOE facilities or federal agencies. These reductions included the removal of forty-seven 17-pound Halon 1211 portable fire extinguishers as excess property due to changes in operations or through replacement.

Monitoring of the potable water supply showed that all drinking water quality requirements were met. Groundwater monitoring at the MPF continued to demonstrate that current oil storage and transfer operations are not affecting groundwater quality. With the exception of four minor permit excursions at the STP, liquid effluents discharged to surface water and groundwater met all applicable SPDES permit requirements. The four SPDES permit limit excursions reported were for nitrogen. Abnormally low flow conditions and decreased nutrients in the waste have been identified as the most likely causes of the increased nitrogen levels. Enzymes are now added at the plant to enhance denitrification of the effluent by the biological organisms during treatment.

The Laboratory continues to reduce the number and severity of spills on site. In 2007, the total number of spills was reduced by 22 percent, from 27 spills in 2006 to 21 spills in 2007. Twelve spills were 5 gallons or less, but were reportable because they reached the soil. The remaining nine spills were small-volume releases either to containment areas or to other impermeable surfaces. All releases were cleaned up or addressed to the satisfaction of NYSDEC. Measures employed to help reduce spills include: replacing petroleum-based lubricants and fluids with vegetable-based products, installing stainless steel-reinforced hydraulic lines on various pieces of equipment, and training staff in proper spill-response techniques.

Chapter 3 of this report describes BNL's Compliance Program and status in further detail.

### *Air Quality Program*

BNL monitors radioactive emissions at three facilities on site to ensure compliance with the requirements of the Clean Air Act (CAA). During 2007, Laboratory facilities released a total of 2,536 curies of radioactive gases. EPA regulations require continuous monitoring of all sources that have the potential to deliver an annual radiation dose greater than 0.1 mrem to a member of the public; all other facilities capable of delivering any radiation dose require periodic confirmatory sampling. Although the dose to the public is less than 0.1 mrem and monitoring is not required by EPA, the BLIP is continuously monitored. Oxygen-15 (half-life: 122 seconds) and carbon-11 (half-life: 20.48 minutes) emitted from the BLIP constituted more than 99.9 percent of radiological air emissions on site in 2007. The combined emissions were approximately 43 percent lower than in 2006, primarily due to operation at lower power levels in 2007.

Monitoring was also conducted at one other active facility, the Target Processing Laboratory (TPL), and one inactive facility, the High Flux Beam Reactor (HFBR). Releases from the TPL in 2007 continued to be very small (0.038  $\mu$ Ci). Tritium releases from the HFBR in 2007 continued a downward trend, as emissions dropped to 1.33Ci compared to releases in 2006 of 4.03 Ci.

The Laboratory conducts ambient radiological air monitoring to verify local air quality and assess possible environmental and health impacts from BNL operations. Air monitoring stations around the perimeter of the site measure tritium and gross alpha and beta airborne activity. Results for 2007 continued to demonstrate that on-site radiological air quality was consistent with off-site measurements and with results from locations in New York State that are not located near radiological facilities.

Various state and federal regulations governing nonradiological releases require facilities to conduct periodic or continuous emission monitoring to demonstrate compliance with emission limits. The CSF is the only BNL facility that requires monitoring. Two of the four boilers at the CSF, specifically 6 and 7, are equipped with continuous emission monitors to measure opacity and nitrogen oxide (NO<sub>x</sub>) emissions. In 2007, there were no exceedances of the NO<sub>x</sub> emission standards for either boiler. Opacity levels cannot exceed 20 percent, except for one 6-minute period per hour of not more than 27 percent opacity. During the first quarter of 2007, all of the Boiler 6 opacity measurements that exceeded the opacity limit occurred during the first soot blowing cycle after a long idle period, during which the boiler was only warmed with nominal volumes of oil. Second quarter Boiler 6 opacity exceedances were the result of a calibration shutter malfunction. Opacity deviations ceased when the transmissometer optical head assembly was replaced. Changes in the sequence of the soot blowing cycle for Boiler 6 that were made in August 2005 have proven effective in eliminating most opacity exceedances due to soot blowing. Similar changes made to the soot blowing cycle on Boiler 7, after the installation of a new soot blowing controller in March 2006, have also been successful in eliminating soot blowing opacity exceedances from this boiler.

Because natural gas prices were lower than residual fuel oil prices from May through November 2007, BNL used natural gas for most heating and cooling needs during these months. As a result, annual facility emissions of particulate matter, nitrogen oxides, and sulfur dioxide

were considerably lower than in years when residual fuel oil was predominantly used.

Chapter 4 of this report describes BNL's Air Quality Program and monitoring data in further detail.

### *Water Quality Surveillance Program*

BNL discharges treated wastewater into the headwaters of the Peconic River via the STP, and non-contact cooling water and storm water runoff to groundwater via recharge basins. Some wastewater may contain very low levels of radiological, organic, or inorganic contaminants. Monitoring, pollution prevention, and careful operation of treatment facilities ensure that these discharges comply with all applicable requirements and that the public, employees, and the environment are protected.

To assess the potential impact of discharges on the water quality of the Peconic River, surface water monitoring is conducted at several locations upstream and downstream of the STP point-source discharge. The Carmans River, located to the west of BNL, is monitored as a geographical control location for comparative purposes, as it is not affected by Laboratory operations. In 2007, the average gross alpha and beta activity levels in the STP discharge were well below drinking water standards (DWS). While the frequency of detectable levels of tritium declined in 2007, the average concentration was slightly higher than in 2006, resulting in an increase in releases to the Peconic River. The maximum concentration released was approximately 9.2 percent of the drinking water standard and was only detected in the effluent. The average concentration was 57.4 pCi/L, which is less than 20 percent of the minimum detection limit (MDL). Throughout 2007, tritium was never detected in the influent to the STP, only the effluent. The only explanation for this observation is that tritium released to the STP in late 2006 continued to be released in early January. An investigation to ascertain the tritium source did not reveal any single source of high-concentration tritium, but did identify several low-concentration sources. The low-concentration releases are expected to continue, as facilities such as the HFBR and Brookhaven

Medical Research Reactor (BMRR) are placed into routine surveillance mode and piping and tank systems are drained and dried out. The STP effluent continued to show no detection of cesium-137 (Cs-137), strontium-90 (Sr-90), or other gamma-emitting nuclides attributable to BNL operations. Acetone was the only volatile organic compound (VOC) detected in the STP effluent at concentrations at or near the detection limit. The maximum concentration detected was 4.2 ug/L, which is less than 15 percent of the generic limit of 50 ug/L imposed by NYSDEC. Nitrogen as nitrate was confirmed in the STP effluent through the environmental surveillance monitoring program at concentrations that exceeded the SPDES permit limits.

On-site recharge basins are used for the discharge of “clean” wastewater streams, including once-through cooling water, storm water runoff, and cooling tower blow-down, and are suitable for direct replenishment of the groundwater aquifer. Radiological analyses in 2007 showed that the low levels of gross alpha and beta activity detected in most of the basins were attributable to naturally occurring radionuclides, such as potassium-40, and not to BNL operations. Tritium was detected in a single sample collected at Basin HT-W at very low levels (430 pCi/L). Considering the low level of detection and analytical method uncertainties, positive identification of tritium in the sample was questionable.

In 2007, nonradiological analyses of the recharge basins showed low concentrations of VOCs, including disinfection byproducts generated by the use of chlorine for the control of bacteria and algae in cooling water systems. Acetone was also detected above the MDL for most recharge basins. Due to the common use of acetone in analytical laboratories and the finding of acetone in the contract analytical laboratory control samples, positive identification is suspect. Lead was detected in two samples and was likely due to the presence of suspended particulate in the samples. Remediation of the CSF outfall for lead contamination was completed and the site was restored in 2007 at a MDL of 0.2 ug/L.

Along the Peconic River, several locations are monitored for radiological and nonradiologi-

cal parameters to access overall water quality. Radiological data from Peconic River surface water sampling in 2007 showed very low concentrations of gross alpha and gross beta activity. The average concentrations from off-site and control locations were indistinguishable from BNL on-site levels, and all detected levels were below the applicable DWS. No gamma-emitting radionuclides attributable to Laboratory operations were detected either upstream or downstream of the STP. Tritium was detected in a single water sample collected downstream of the STP discharge in May, although the detection is questionable due to the fact that tritium was not detected in the STP discharge during this period. Aluminum, copper, iron, and zinc were present at some locations both upstream and downstream of the STP point-source discharge at concentrations that exceeded the NYS Ambient Water Quality Standards. Mercury was not detected in any water samples in 2007.

Chapter 5 of this report describes BNL’s Water Quality Surveillance Program and monitoring data in further detail.

### ***Natural and Cultural Resource Management Program***

The BNL Natural Resource Management Program was designed to promote stewardship of the natural resources found on site and to integrate natural resource management and protection with the Laboratory’s scientific mission. The goals of the program include protecting and monitoring the ecosystem, conducting research, and communicating with the public, stakeholders, and staff members regarding environmental issues. Precautions are taken to protect and enhance habitats and natural resources at BNL. Activities to eliminate or minimize negative effects on sensitive or critical species (such as the eastern tiger salamander, eastern hognose snake, and banded sunfish) are incorporated into procedures or into specific program or project plans. Restoration efforts continue to remove pollutant sources that could contaminate habitats. In some cases, habitats are enhanced to improve survival or increase populations. The Laboratory also monitors and manages other wildlife populations, such as white-tailed deer and wild turkey.

BNL conducts routine monitoring of flora and fauna to assess the impact, if any, of past and present activities on the Laboratory's natural resources. Generally, deer sampled on site contain higher concentrations of Cs-137 than deer sampled from more than 1 mile off site. This is most likely because on-site deer consume small amounts of contaminated soil and graze on vegetation growing in soil where elevated Cs-137 levels are known to exist. The maximum on-site concentration in 2007 was 17 times lower than the highest level reported in 2006, and is much lower than the highest level ever reported (1996). The low levels in samples taken in 2007 indicate the effectiveness of cleanup actions across the site. The New York State Department of Health (NYSDOH) has reviewed the potential public health risk associated with the low levels of Cs-137 in on-site deer and determined that neither hunting restrictions or formal health advisories are warranted. Testing of deer bones for Sr-90 indicated background levels. Sr-90 is present in the environment at background levels as a result of worldwide fallout from nuclear weapons testing. BNL will continue to test for Sr-90 in bone to develop baseline information.

In an effort to restore fish populations, the Laboratory suspended most on-site fish sampling in 2001. The reluctance to sample fish continued in 2006, due to impacts of the Peconic River cleanup project and drought conditions in 2005. In 2006, four fish were sampled on site; although due to the size of the fish, only metals analyses could be performed. Routine annual on-site sampling of fish resumed in 2007. Cs-137 was detected at low levels in all samples from the Peconic River system and appears to be declining compared with historic values. The cleanup of both on-and off-site portions of the Peconic River in 2004 and 2005 removed approximately 88 percent of Cs-137 in the sediment that was co-located with mercury. Natural decay and the removal of this contamination are expected to result in further decreases.

Non-radiological analysis of fish continued in 2007. Due to their small size, fish taken on site were analyzed for mercury only, due to its known health effects. The mercury in on-site samples ranged from 0.13 mg/kg in a brown

bullhead to 1.35 mg/kg in a pumpkinseed. This compares to a range of 0.46 mg/kg to 0.62 mg/kg in fish taken in 2006. The larger range in the 2007 on-site data is due to a larger sample size and larger range in fish. Off-site Peconic River samples ranged from less than the MDL in a brown bullhead to 1.04 mg/kg in a large-mouth bass. Mercury levels were less than the 1.0 mg/kg consumption standard set by the U.S. Food and Drug Administration in all but a few fish. The average of all fish from the Peconic River was 0.32 mg/kg, which is slightly above the U.S. EPA criterion for freshwaters. Low levels of pesticides were also detected in off-site fish samples, but did not exceed any standards and do not pose any health impact to humans or animals that might consume the fish. PCBs have been found in fish and sediment at BNL and periodically at other locations in the Peconic River. However, the cleanup of the Peconic River, which was completed in 2005, removed most PCBs within the sediments. PCB testing will be discontinued in fish samples in 2008 except for fish taken on site to continue to document the effectiveness of the Peconic River cleanup.

Annual sampling of sediment, vegetation, and freshwater in the Peconic River and a control location on the Carmans River was conducted in 2007. Low levels of Cs-137 were documented in sediment and vegetation. On- and off-site aquatic vegetation and sediments contained low levels of Cs-137, metals, pesticides, and PCBs, in amounts that were consistent with levels detected in previous years.

Under the Peconic River remediation project, sediment from the Peconic River was remediated to remove mercury and associated contaminants from the river. This project was completed in the summer of 2005. Sampling results for 2007 showed that 97 percent of samples analyzed at 16 on-site locations and 14 off-site locations met the cleanup goal of 2.0 mg/kg. One sample exceeded the goal in June and two samples exceeded the goal in August. Further evaluation will include additional sediment and surface water sampling in 2008.

Water column sampling for mercury and methylmercury was performed at 20 Peconic River sampling locations and one reference

location on the Connetquot River in 2007. Concentrations of mercury were less than the respective 2003 Peconic River pre-cleanup concentrations. Mercury samples collected from the Peconic River upstream and downstream of the STP effluent indicate that concentrations are higher upstream of the STP. Methylmercury concentrations detected in June 2007 were generally higher than the June 2003 Peconic River pre-cleanup concentrations, and August 2007 concentrations were lower than values detected in August 2003. Methylmercury samples collected from the STP effluent indicate that the STP is not a significant contributing source.

Wetland monitoring results showed that vegetation restoration along the Peconic River was at 92 percent over 64 monitoring transects with less than 1 percent coverage of invasive species. Monitoring of invasive species will continue until 2008, at which time BNL will evaluate all wetland restoration and invasive species surveys and control operations since the completion of the Peconic River cleanup in 2005.

BNL sponsors a variety of educational and outreach activities involving natural resources. These programs are designed to help participants understand the ecosystem and to foster interest in science. Wildlife programs are conducted at BNL in collaboration with DOE, local agencies, colleges, and high schools. Ecological research is also conducted on site to update the current natural resource inventory, gain a better understanding of the ecosystem, and guide management planning. In 2007, the Environmental and Waste Management Services Division (EWMSD) hosted 16 interns and one faculty member who worked on a variety of projects including: surveying dragonflies and damselflies, radio tracking turtles, analyzing the water chemistry of coastal plain ponds, investigating turtle and amphibian diseases, investigating the loss of the southern leopard frog on Long Island, genetics of resident gray and red fox at BNL, and population health of the banded sunfish. The Foundation for Ecological Research in the Northeast (FERN) hosted two undergraduate interns who assisted in the development of Freshwater Wetland Health Monitoring Protocols. The monitoring protocols are available on

the FERN website at [www.fern-li.org](http://www.fern-li.org).

The goal of BNL's Cultural Resource Management Program (CRMP) is to ensure the proper stewardship of BNL and DOE historic resources. Additional goals include maintaining compliance with various historic preservation and archaeological laws and regulations, and ensuring the availability of resources to Laboratory personnel and the public for research and interpretation. Cultural resource management activities performed in 2007 include: identifying additional equipment artifacts associated with the HFBR and the BGRR, and electronically scanning the diary of a World War I soldier for website posting. Outreach activities consisted of providing presentations on Laboratory cultural resources and tours of the WWI trenches to several small groups, and participating in local fairs.

Chapter 6 of this report describes BNL's natural and cultural resources in further detail.

#### ***Groundwater Protection Management Program***

BNL's extensive groundwater monitoring well network is used to evaluate progress in restoring groundwater quality, to comply with regulatory permit requirements, to monitor active research and support facilities, and to assess the quality of groundwater that enters and exits the site. The Laboratory monitors research and support facilities where there is a potential for environmental impact, as well as areas where past waste handling practices or accidental spills have already degraded groundwater quality. In 2007, the Laboratory collected groundwater samples from 850 on- and off-site monitoring wells during 2,289 individual sampling events.

Under the environmental surveillance program, 10 active research and support facilities were monitored during 2007. Although no new impacts to groundwater quality have been discovered since 2001, groundwater quality continues to be impacted from past releases at two facilities: the former g-2 experiment within the Alternating Gradient Synchrotron (AGS) facility, and the Upton service station facility. Tritium continues to be detected at concentrations above the 20,000 pCi/L DWS in wells monitoring the g-2 source area. Although tritium concentrations have shown a steady decline over the past

4 years, monitoring data suggest that the continued release of tritium from the source area is due to residual tritium being flushed out of the unsaturated zone close to the water table by natural water table fluctuations. The amount of tritium entering the groundwater is expected to decrease over time, due to this flushing mechanism and by natural radioactive decay. Tritium levels in the groundwater at the BLIP were less than the 20,000 pCi/L DWS during all of 2007. In early 2007, a Record of Decision (ROD) was signed by DOE and EPA for the g-2 and BLIP tritium source areas. The ROD requires continued routine inspection and maintenance of the impermeable caps at the source area, groundwater surveillance of the source areas, and monitoring the g-2 tritium plume until it attenuates to less than the 20,000 pCi/L DWS. VOCs associated with historical petroleum and solvent spills continue to be detected in the groundwater at concentrations above the applicable DWS at the Upton service station facility. These low levels of VOCs are expected to decrease over time by means of natural attenuation.

The primary mission of the Laboratory's Long Term Response Actions (LTRA) program is to operate and maintain groundwater treatment systems and prevent additional groundwater contamination from migrating off site. BNL continues to make significant progress in restoring groundwater on site. During 2007, 198 pounds of VOCs and approximately 5.2 mCi of Sr-90 were removed from the groundwater, and more than 1.2 billion gallons of treated groundwater were returned to the aquifer. Data from the groundwater monitoring networks and treatment systems is monitored and analyzed on a continuous basis. During 2007, it was determined that two groundwater treatment systems, the Chemical Holes Sr-90 System and the Airport System, required modifications in the form of additional extraction wells to ensure the complete capture of the plumes and the ability to achieve the cleanup goals. In addition, based on the triggering of an OU III ROD contingency, the HFBR Pump and Recharge System was reactivated and enhanced with an additional extraction well. The Laboratory's groundwater cleanup goals include minimizing plume growth

and reducing contaminant concentrations in the Upper Glacial aquifer to below Maximum Contaminant Level (MCL) standards by 2030. For the Chemical/Animal Holes area, MCLs must be reached by 2040. VOC levels in the Magothy aquifer must meet MCLs by 2065. For the Sr-90 plumes associated with the BGRR/WCF, MCLs must be reached by 2070. The cleanup objectives will be met by a combination of active treatment and natural attenuation. The LTRA program uses an extensive network of monitoring wells to track the progress that the groundwater treatment systems are making toward plume remediation.

Chapter 7 of this report provides an overview of this program, and the SER Volume II, Groundwater Status Report, provides a detailed description, data, and maps relating to all groundwater monitoring performed in 2007.

#### ***Radiological Dose Assessment Program***

BNL routinely assesses its operations to ensure that any potential radiological dose to members of the public, BNL workers, and the environment is "As Low As Reasonably Achievable" (ALARA). The potential radiological dose is calculated as the largest possible dose to a hypothetical Maximally Exposed Individual (MEI) at the BNL site boundary. For dose assessment purposes, the pathways include direct radiation exposure, inhalation, ingestion, immersion, and skin absorption. Radiological dose assessments at the Laboratory have consistently shown that the "effective dose equivalent" from operations is well below the EPA and DOE regulatory dose limits for the public and the environment. The dose impact from all BNL activities in 2007 was found to be insignificantly above natural background radiation levels.

To measure direct radiation from Laboratory operations, 49 thermoluminescent dosimeters (TLDs) are placed on site and 15 TLDs are placed in surrounding communities. In 2007, the average doses from all TLDs showed there was no additional contribution to dose from BNL operations above natural background radiation. The annual on-site external dose from all potential sources, including cosmic and terrestrial radiation, was  $70 \pm 12$  mrem ( $700 \pm 120$

μSv), and the annual off-site external dose was  $64 \pm 10$  mrem ( $640 \pm 100$  μSv). Both on- and off-site dose measurements include the contribution from natural terrestrial and cosmic background radiation.

The effective dose to the MEI from air emissions was  $5.96E-2$  mrem ( $0.60$  μSv). The ingestion pathway dose was estimated as  $3.02$  mrem ( $30$  μSv) from consumption of deer meat and  $0.08$  mrem ( $0.7$  μSv) from consumption of fish caught in the vicinity of the Laboratory. The total annual dose to the MEI from all pathways was estimated as  $3.16$  mrem ( $32$  μSv). The dose from the air inhalation pathway attributable to BNL operations was less than 1 percent of EPA's annual regulatory dose limit of  $10$  mrem ( $100$  μSv), and the total dose was less than 4 percent of DOE's annual dose limit of  $100$  mrem ( $1,000$  μSv) from all pathways. Doses to aquatic and terrestrial biota were also evaluated and found to be well below the regulatory limits.

As a part of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) review process at BNL, any source that has the potential to emit radioactive materials is evaluated for regulatory compliance. In 2007, two NESHAPs compliance reviews were performed: research using radiotracers in Room 9-830 in the Medical Department and remediation activities at the waste loading dock. Both assessments showed no significant dose impacts from these activities.

Chapter 8 of this report describes the BNL Radiological Dose Assessment Program and monitoring data in further detail.

### ***Quality Assurance Program***

The multilayered components of the BNL Quality Assurance (QA) Program ensure that all analytical data reported in this document are reliable and of high quality, and that all environmental monitoring data meet quality assurance and quality control objectives. Samples are collected and analyzed in accordance with EPA methods and standard operating procedures that are designed to ensure samples are representative and the resulting data are reliable and defensible. Quality control in the analytical laboratories is maintained through daily instru-

ment calibrations, efficiency and background checks, and testing for precision and accuracy. Data are verified and validated as required by project-specific quality objectives before being used to support decision making.

In 2007, the Laboratory used five off-site contract analytical laboratories to analyze environmental samples: General Engineering Lab (GEL), H2M Lab, Test American (TA), Chemtex Lab, and Brooks Rand. All analytical laboratories were certified by New York State for the tests they performed for BNL, and were subject to oversight that included state and national performance evaluation (PE) testing, review of QA programs, and audits.

Four of the contract analytical laboratories (GEL, TA, H2M, and Brooks Rand) participated in several national and state PE testing programs in 2007. The fifth contractor, Chemtex Laboratory, did not participate in PE testing because there is no testing program for the specific analytes Chemtex analyzed. Each of the participating laboratories took part in at least one testing program, and several laboratories participated in multiple programs. Results of the tests provide information on the quality of a laboratory's analytical capabilities. The testing was conducted by Environmental Resource Associates (ERA), the National Voluntary Laboratory Accreditation Program (NVLAP), the voluntary Mixed Analyte Performance Evaluation Program (MAPEP), and the NYSDOH Environmental Laboratory Accreditation Program (ELAP).

As part of DOE's Integrated Contract Procurement Team Program, TA and GEL were audited during 2007. During the audits, errors are categorized into Priority I and Priority II findings. Priority I status indicates a problem that can result in unusable data or a finding that the contract analytical laboratory cannot adequately perform services for DOE. Priority II status indicates problems that do not result in unusable data and do not indicate that the contract analytical laboratory cannot adequately perform services for DOE.

In 2007, there were no Priority I findings for GEL. TA had two Priority I findings. The results of the TA audit included two Priority I findings (one radiological and one waste man-

agement) and 18 Priority II findings: 11 radiological, 2 QA management system findings, 1 waste management finding, 3 inorganic findings, and 1 Laboratory Information Management System (LIMS) finding. The two Priority I findings against their radiological analysis and waste management departments indicated that the Technical Director of the radiochemistry department did not have the appropriate education/and or technical background and that the implementation of the radiation protection program had systematic failures and a lack of accountability of the radiological inventory. Based on these findings, it was necessary to suspend sending samples for radiological analyses until the TA facility successfully closed these issues with DOE. In July 2007, DOE issued a letter stating that a re-audit of the facility resulted in the closing of the Priority I findings

and BNL was authorized to ship BNL samples to TA. The results of the GEL audit included 13 Priority II findings: two quality assurance management system findings, three organic findings, three inorganic findings, four radiological findings, and one waste management finding. Corrective action plans were submitted to DOE by both contract analytical laboratories to document that procedures were put in place to correct these findings. Based on the audits, the analytical data met DOE's criteria for acceptable status.

Based on the data reviews, data validations, and results of the independent PE assessments, the chemical and radiological results reported in this 2007 SER are of acceptable quality.

Chapter 9 of this report describes the BNL Quality Assurance/Quality Control Program in further detail.