




BROOKHAVEN NATIONAL LABORATORY  
**Site Environmental Report 2011**  
SUMMARY

A large Southern flying squirrel is shown climbing a tree trunk. The squirrel has grey-brown fur on its back and a white underbelly. It is positioned vertically on the left side of the page, with its head near the bottom and its tail extending upwards. The tree trunk is dark and textured, and the background is a soft-focus green forest.

The photo on the front cover is a Southern flying squirrel (*Glaucomys volans*), a small nocturnal mammal. It is one of two species of flying squirrels found in North America, the other being the larger Northern Flying Squirrel (*G. sabrinus*). It is found in deciduous forests and mixed woodlands in the eastern part of North America, from southeastern Canada to Florida.

Southern flying squirrels have grey brown fur, with a white to cream color underneath. They have large dark eyes and a long flat tail. A furry membrane called a patagium extends between their front and back legs, which they use to glide through the air. The tail is used to stabilize flight and also as an air brake before landing.



Because the Southern flying squirrel is very small, approximately 65 grams, they are very vulnerable to predators on the ground, including snakes, owls, hawks, raccoons, domestic and feral cats, as well as disease. This is why they hunt for food during the night using their keen sense of sight and smell. They

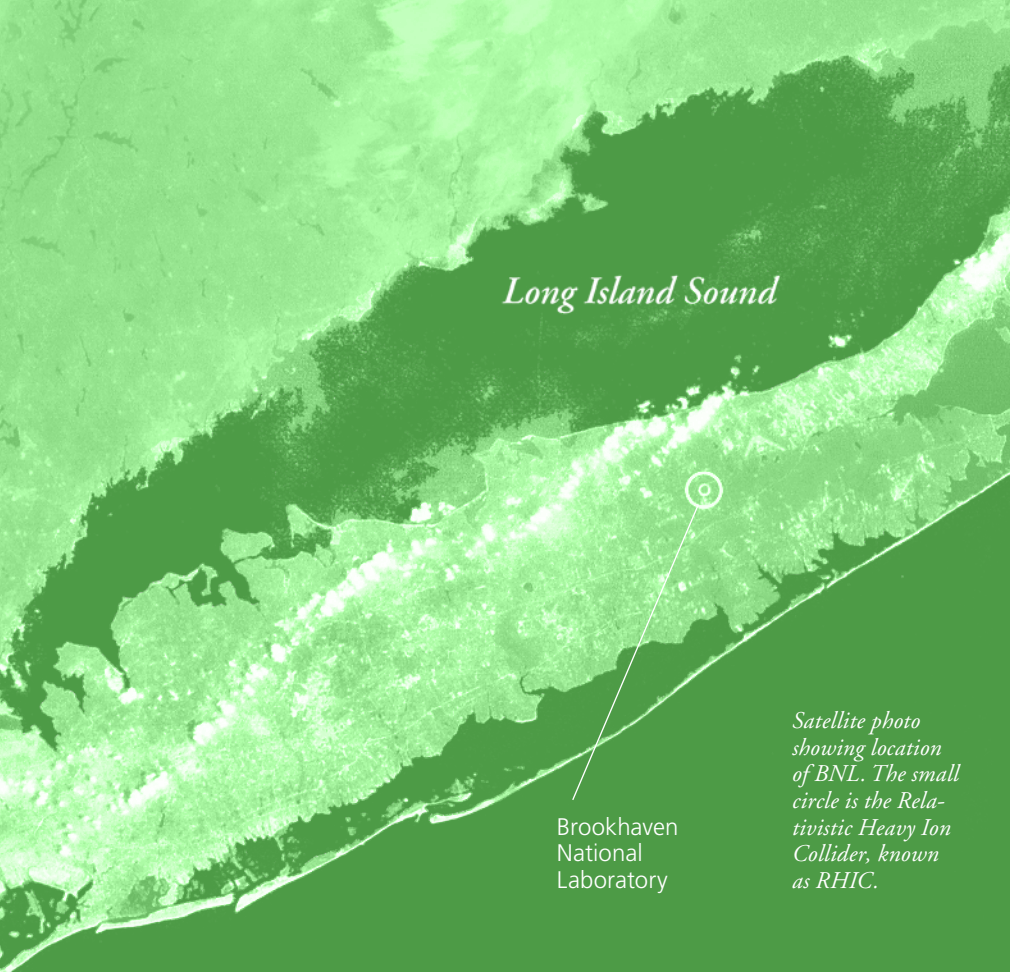
feed on fruit, nuts, seeds, and berries, as well as insects, mushrooms, fungi, carrion, bird eggs, and nestlings and flowers. They store their food for winter consumption in nests in snags and hollow trees.

At BNL, undergraduate student interns began studying the Southern flying squirrel in 2009. These studies utilized live traps to determine the population and diversity of small mammals and flying squirrels in the then proposed site for the Long Island Solar Farm. The information was used to assess any changes in habitat use after the solar array was constructed. Specific tree species used by flying squirrels were also identified. In 2010 and 2011, students continued to use radio-telemetry using radio collars on 15 squirrels to focus on their home range and habitat use. In 2012, an additional 11 squirrels were tracked to continue the research. Results are currently being analyzed and are expected to be published.

The Brookhaven National Laboratory 2010 Site Environmental Report is a public document that is distributed to various U.S. Department of Energy sites, local libraries, and local regulators and stakeholders. The report is available to the general public on the internet at <http://www.bnl.gov/ewms/ser/>. A summary of the report is also available and is accompanied by a compact disk containing the full report. To obtain a copy of the report or summary, please write or call:

Brookhaven National Laboratory  
Environmental Protection Division  
Attention: SER Project Coordinator  
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P.O. Box 5000  
Upton, NY 11973-5000  
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# 2011 SITE ENVIRONMENTAL REPORT SUMMARY



*Long Island Sound*

Brookhaven  
National  
Laboratory

*Satellite photo  
showing location  
of BNL. The small  
circle is the Rela-  
tivistic Heavy Ion  
Collider, known  
as RHIC.*

## PREFACE

Brookhaven National Laboratory (BNL) prepares an annual Site Environmental Report (SER) in accordance with DOE Order 231.1B, Environment, Safety and Health Reporting of the U.S. Department of Energy (DOE). 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. It includes detailed technical summaries of groundwater data and its interpretation, and is intended for internal BNL users, regulators, and other technically oriented stakeholders. In addition, a summary of Volume I is prepared each year to provide a general overview of the report.

Both SER Volumes I and II, as well as this summary, 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 containing the full report is distributed with each printed report.

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## ABOUT BROOKHAVEN NATIONAL LABORATORY

Established in 1947, Brookhaven National Laboratory is a multi-program national laboratory managed for the U.S. Department of Energy by Brookhaven Science Associates (BSA), a partnership formed by Stony Brook University and Battelle Memorial Institute. BSA has been managing and operating the Laboratory under a performance-based contract with DOE since 1998. From 1947 to 1998, BNL was operated by Associated Universities, Incorporated. Prior to 1947, the site operated as Camp Upton, a U.S. Army training camp, which was active from 1917 to 1920 during World War I and from 1940 to 1946 during World War II.

BNL is one of 10 national Laboratories under DOE's Office of Science, which provides most of the Laboratory's research dollars and direction. BNL has a history of outstanding scientific achievements. For over 60 years, Laboratory researchers have successfully worked to envision, construct, and operate large and innovative scientific facilities in pursuit

of research advances in many fields. Programs in place at BNL emphasize continual improvement in environmental, safety, security, and health performance.

BNL's broad mission is to produce excellent science and advanced technology in a safe and environmentally sound manner with the cooperation, support, and involvement of its scientific and local communities. The fundamental elements of the Laboratory's role in support of DOE's strategic missions are the following:

- To conceive, design, construct, and operate complex, leading-edge, user-oriented research facilities in response to the needs of DOE and the international community of users.
- To carry out basic and applied research in long-term, high-risk programs at the frontier of science.
- To develop advanced technologies that address national needs and to transfer them to other organizations and to the commercial sector.
- To disseminate technical knowledge, to educate future



generations of scientists and engineers, to maintain technical capabilities in the nation's workforce, and to encourage scientific awareness in the general public.

BNL is located near the geographical center of Suffolk County, Long Island, New York. The Laboratory's 5,265-acre site is located in Brookhaven Township, approximately 60 miles east of New York City. Nearly one-third of the approximately 1.49 million people who reside in Suffolk County live in Brookhaven Township, the largest township (both in area and population) in Suffolk County.

BNL is one of the five largest high-technology employers on Long Island, with approximately 3,000 employees that include scientists, engineers, technicians, and administrative personnel. More than 75 percent of BNL employees live and shop in Suffolk County. In addition, the Laboratory annually hosts an estimated 4,000 visiting scientists, more than 30 percent of whom are from New York State universities and businesses. The visiting scientists and sometimes their families, as well as visiting students, reside in apartments and dormitories on site or in nearby communities.

BNL strengthens Long Island's position as a center of innovation in energy, the life sciences, and other fields crucial to the growth of New York State's economy. With a budget of over \$691 million, the Laboratory has a significant economic impact on New York State.

A report for fiscal year 2009 showed that the economic output generated by the Laboratory and its visitors during that period amounted to \$704 million and created 5,400 jobs throughout New York State—5,190 of them on Long Island. It is estimated that between 2010 and 2014, the Laboratory will generate, on an average annual basis, \$947 million in economic output and 7,092 jobs throughout the state.

In fiscal year 2011, employee salaries, wages, and fringe benefits accounted for over \$380 million of its total annual budget. Supporting local and state businesses whenever possible, BNL also spent \$375 million on goods and services in fiscal year 2011 (\$75.2 million in New York State).



*Aerial photograph of the BNL site.*

## BNL FACILITIES AND OPERATIONS

Most of the Laboratory's principal facilities are located near the center of the site. The developed area is approximately 1,850 acres:

- 500 acres originally developed by the Army (as part of Camp Upton) and still used for offices and other operational buildings
- 200 acres occupied by large, specialized research facilities
- 550 acres used for outlying facilities, such as the Sewage Treatment Plant, research agricultural fields, housing facilities, and fire breaks
- 400 acres of roads, parking lots, and connecting areas
- 200 acres occupied by the Long Island Solar Farm
- Approximately 3,400 acres, which is mostly wooded and represents the native pine barrens ecosystem.

The major scientific facilities at BNL are briefly described below. All of the research and support facilities must undergo periodic environmental reviews as part of BNL's Environmental Management Program.

## MAJOR SCIENTIFIC FACILITIES AT BNL

- **Alternating Gradient Synchrotron (AGS).** The AGS is a particle accelerator used to propel protons and heavy ions, such as gold or iron, to high energies for physics research. The Linear Accelerator (Linac) serves as a proton injector for the AGS Booster.
- **AGS Booster.** The AGS Booster is a circular accelerator used for physics research and radiobiology studies. It receives either a proton beam from the Linac or heavy ions from the Tandem Van de Graaff and accelerates these before injecting them into the AGS ring for further acceleration. The Booster also serves as the energetic heavy ion source for the NASA Space Radiation Laboratory, which is used to simulate the harsh cosmic and solar radiation environment found in space.
- **Center for Functional Nanomaterials (CFN).** The CFN provides state-of-the-art capabilities for the fabrication and study of nanoscale materials, with an emphasis on atomic-level tailoring to achieve desired properties and functions. The overarching scientific theme of the CFN is the development and understanding of nanoscale materials that address the nations' challenges in energy security.
- **Linear Accelerator (Linac) and Brookhaven Linac Isotope Producer (BLIP).** The Linac provides beams of polarized protons for the AGS and RHIC. The beam is also used to produce radioisotopes for research and medical imaging at the BLIP. The BLIP is one of the nation's key production facilities for radioisotopes, which are crucial to clinical nuclear medicine. The BLIP also supports research on new diagnostic and therapeutic radiopharmaceuticals.
- **National Synchrotron Light Source (NSLS).** The NSLS uses a linear accelerator and booster synchrotron as an injection system for two electron storage rings that provide intense light spanning the electromagnetic spectrum from the infrared through x-rays. The properties of this light and the 80 specially designed experimental stations, called beamlines, allow scientists to perform a large variety of experiments.
- **National Synchrotron Light Source II (NSLS-II).** The NSLS-II facility, currently under construction and scheduled to start operating in 2015, will provide sophisticated new tools that will allow scientists to see materials at the scale of a nanometer, or one billionth of a meter—a capability not available at any other light source in the world. Working at the nanoscale, researchers will focus on some of the nation's most important scientific challenges, including developing materials for clean and affordable energy production, molecular electronics, and high-temperature superconductors.
- **Relativistic Heavy Ion Collider (RHIC).** The RHIC is a world-class scientific research facility. The RHIC accelerator drives two intersecting beams of heavy ions or protons head-on to form subatomic collisions. What physicists learn from these collisions may help us understand more about why the physical world works the way it does, from the smallest subatomic particles, to the largest stars.
- **Tandem Van de Graaff and Cyclotrons.** The Tandem Van de Graaff accelerators are used to bombard materials with ions for manufacturing and testing purposes, and to supply RHIC with heavy ions. The cyclotrons are used for the production of radiotracers for use in Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) studies.



*Aerial photograph of the Long Island Solar Farm.*

Construction of the Long Island Solar Farm (LISF) on DOE/BNL property began in 2010 and was completed in the fall of 2011. Privately owned by BP Solar and MetLife, it is currently the largest solar photovoltaic (PV) array in the Northeast United States and spans nearly 200 acres at the southeast end of the Laboratory property. The irregular layout, as seen in the photo above, was designed to minimize environmental issues (i.e., wetland areas, threatened and endangered species, groundwater, etc.) and to avoid development within the Core Preservation Area of the Long Island Pine Barrens.

BNL worked extensively with BP Solar, the Long Island Power Authority (LIPA), the State of New York, and other organizations to evaluate the site and develop the project, with LIPA purchasing the output through a 20-year Power Purchase Contract.

Construction of a second array on site — the Northeast Solar Energy Research Center (NSERC) — is expected to be completed in the summer of 2013. This research array will be a DOE-owned user facility and will provide BNL and industrial partners with the ability to test new solar system technologies, including electrical inverters, storage devices, solar modules, and other technologies.

Additional information regarding the LISF can be found at <http://www.bnl.gov/GARS/SET/LISF.php> and under Energy Management and Conservation on Page 10 of this summary.

## ADDITIONAL FACILITIES AND OPERATIONS AT BNL

- **Central Chilled Water Plant.** This plant provides chilled water sitewide for air conditioning and process refrigeration via underground piping. The plant has a large refrigeration capacity and reduces the need for local refrigeration plants and air conditioning.
- **Central Steam Facility (CSF).** This facility provides high-pressure steam for facility and process heating sitewide. Either natural gas or fuel oil can be used to produce the steam, which is conveyed to other facilities through underground piping. Condensate is collected and returned to the CSF for reuse, to conserve water and energy.
- **Fire Station.** The Fire Station houses six response vehicles. The BNL Fire Rescue Group provides on-site fire suppression, emergency medical services, hazardous material response, salvage, and property protection.
- **Major Petroleum Facility (MPF).** This facility provides reserve fuel for the CSF during times of peak operation. With a total capacity of 2.3 million gallons, the MPF primarily stores No. 6 fuel oil. The 1997 conversion of CSF boilers to burn natural gas as well as oil has significantly reduced the Laboratory's reliance on oil as a sole fuel source when other fuels are more economical.
- **Sewage Treatment Plant (STP).** This plant treats sanitary and certain process wastewater from BNL facilities prior to discharge into the Peconic River, similar to the operations of a municipal sewage treatment plant. The plant has a design capacity of 3 million gallons per day. Effluent is monitored and controlled under a permit issued by the New York State Department of Environmental Conservation (NYSDEC).
- **Waste Management Facility (WMF).** This facility is a state-of-the-art complex for managing the wastes generated from BNL's research and operations activities. The facility was built with advanced environmental protection systems and features, and began operation in December 1997.
- **Water Treatment Plant (WTP).** The potable water treatment plant has a capacity of 5 million gallons per day. Potable water is obtained from five on-site wells. Three wells located along the western boundary of the site are treated at the WTP with a lime-softening process to remove naturally occurring iron and by the addition of sodium hypochlorite for bacterial control. The plant is also equipped with dual air-stripping towers to ensure that volatile organic compounds (VOCs) are at or below New York State drinking water standards. Two wells located along the eastern section of the developed site are treated by the addition of sodium hydroxide to increase the pH of the water to make it less corrosive, and by the addition of sodium hypochlorite to control bacteria.

## RESEARCH AND DISCOVERIES AT BNL

The Laboratory is one of the nation's—and the world's—leading research institutions. Seven Nobel Prize-winning discoveries have been made at BNL (<http://www.bnl.gov/bnlweb/history/nobel/>). Brookhaven scientists have made many discoveries, developments, inventions, and innovations.

Some examples for environmental research at BNL are shown below. Further information regarding all research conducted at the Laboratory can be found at [http://www.bnl.gov/bnlweb/research\\_list.asp](http://www.bnl.gov/bnlweb/research_list.asp).

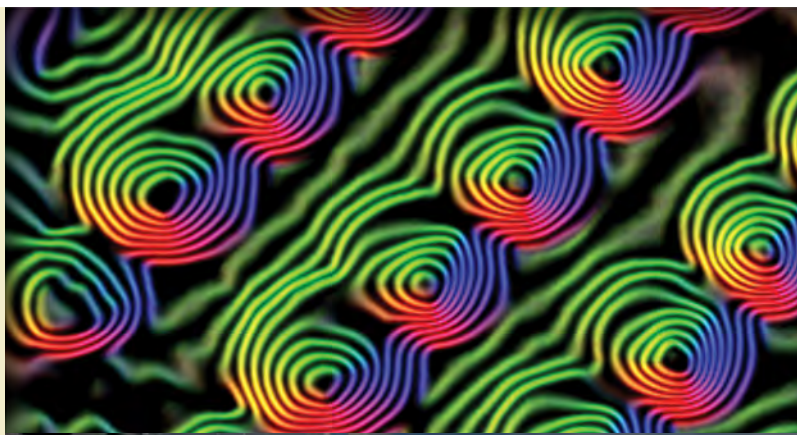
### SCIENTIFIC DISCOVERIES AND RESEARCH IN ENVIRONMENTAL SCIENCES

- Response of plants and trees to radiation exposure
- Metal hydrides for better hydrogen storage in fuel cells
- Building and studying of demonstration houses with alternative-energy and energy-saving features
- Invention of better, cleaner, more efficient oil burners and devices to aid clean and efficient oil burning
- Development of chemically inert tracers and detectors to track the environmental impact of power plants
- Better, safer, more convenient natural gas storage options for alternative-fuel vehicles
- Facilities that allow studies of environmental technologies and phenomena: polymers used to clean up oil spills, examination of sandstone porosity for more efficient oil-field exploration, and the effect of cosmic radiation on tissue
- Large-scale studies of the effect of increased carbon dioxide on ecosystems
- Oceanographic studies of plankton populations to gauge ocean health and climate change potential and research into the cause of mysterious "brown tide" algae blooms
- Harnessing natural bacteria to clean up environmental pollution and purify crude oil
- Studies of air pollution, including smog and particulates
- Computer models of atmospheric radiation (important for climate change), groundwater movement, and energy use impact in developing nations
- New techniques for encapsulating hazardous waste for storage and disposal, including glass, plastic and concrete

*BNL's energy research will draw on our considerable scientific expertise and leverage our world-class facilities to help reduce the carbon footprint of our energy economy.*

*Nanomaterials research at BNL seeks to refine materials used in electricity generation — like photovoltaics.*

*BNL is well-suited to address some of the most challenging scientific questions related to achieving a sustainable future.*



# Environmental, Safety, Security, and Health Policy

## Brookhaven National Laboratory

*This document is a statement of BNL's ESSH policy. BNL is a world leader in scientific research and strives to demonstrate excellence in protecting people, property, and the environment.*

*I expect every employee, contractor, and guest to take personal responsibility for adhering to the following principles:*

### ENVIRONMENT

We protect the environment, conserve resources, and prevent pollution.

### SAFETY

We maintain a safe workplace and we plan our work and perform it safely. We take responsibility for the safety of ourselves, coworkers, and guests.

### SECURITY

We protect people, property, information, computing systems, and facilities.

### HEALTH

We protect human health within our boundaries and in the surrounding community.

### COMPLIANCE

We achieve and maintain compliance with applicable ESSH requirements.

### COMMUNITY

We maintain open, proactive, and constructive relationships with our employees, neighbors, regulators, DOE, and our other stakeholders.

### CONTINUAL IMPROVEMENT

We continually improve ESSH performance.

*In addition to my annual review of BNL's progress on ESSH goals and adherence to this policy, I invite all interested parties to provide me with input on our performance relative to this policy, and the policy itself.*

Signed: September 6, 2006  
Sam Aronson, Director

## BNL'S ENVIRONMENTAL MANAGEMENT SYSTEM

An Environmental Management System (EMS) was established at BNL in 2001 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 and health of its employees, and the security of the site. Specific environmental commitments in the policy include compliance, pollution prevention, conservation, community outreach, and continued improvement in ESSH performance. 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. Certification requires the Laboratory to undergo annual audits by an accredited registrar to assure that the systems are maintained and to identify evidence of continual improvement. In 2011, an EMS surveillance audit determined that BNL remains in conformance with the ISO 14000 standard.

Signed in 2009, Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance, sets sustainability goals for federal agencies and focuses on making improvements in environmental, energy, and economic performance. It requires federal agencies to set a greenhouse gas emissions reduction target, increase energy efficiency, reduce fleet petroleum consumption, conserve water, reduce waste, support sustainable communities, and leverage federal purchasing power to promote environmentally responsible products and technologies. Each governmental facility is required to have a Site Sustainability Plan (SSP) in place detailing the strategy for achieving these long-term goals and to provide an annual status. The requirements influence the future of BNL's EMS program and have been incorporated into BNL's SSP.



## 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 2011 follows. A complete discussion for each program can be found in the full report on compact disk in the back of this summary booklet.

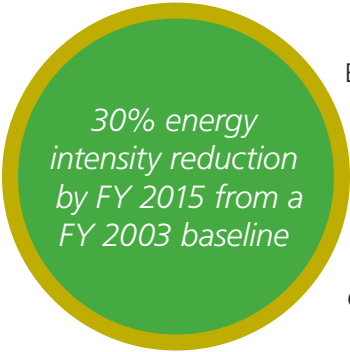
### POLLUTION PREVENTION PROGRAM

The Laboratory's strong Pollution Prevention (P2) Program is an essential element for the successful implementation of BNL's Environmental Management System. 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. 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.

An important function of the P2 program is to provide funding to implement pollution prevention projects within the Laboratory. In 2011, three of 13 P2 proposals, submitted by employees to BNL's P2 Council, were funded, for a combined investment of approximately \$21,000. The anticipated annual savings from these projects is estimated at \$20,300, for an average payback period of approximately 1 year. Initiatives to reduce, recycle, and reuse 15.7 million pounds of industrial, sanitary, hazardous, and radiological waste through the P2 program resulted in more than \$2.1 million in cost avoidance or savings in 2011.

The Laboratory also has an active and successful solid waste recycling program, which involves all employees. In 2011, BNL collected approximately 186 tons of office paper for recycling. Cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, electronic scrap, fluorescent light bulbs, and drill press/machining coolant were also recycled.

### ENERGY MANAGEMENT AND CONSERVATION



*30% energy  
intensity reduction  
by FY 2015 from a  
FY 2003 baseline*

Even though BNL anticipates growth in the number of staff and facilities, it is expected that our efforts to reduce energy usage will still allow us to meet or exceed the goal by FY 2015.

#### *DOE Sustainability Goal*

Since 1979, the Laboratory's Energy Management Group has been working to reduce energy use and costs by identifying and implementing cost-effective, energy-efficient projects; monitoring energy use and utility bills; and assisting in obtaining the least expensive energy sources possible. The group is responsible for developing, implementing, and coordinating BNL's Energy Management Plan and assisting DOE in meeting the energy and sustainability goals in Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance; DOE Order 436.1, Environmental Protection Program; and the Secretary's Transformational Energy Action Management (TEAM) initiatives.

The Laboratory has more than 4 million square feet of building space, and many BNL scientific experiments use particle beams generated and accelerated by electricity. In 2011, the Laboratory used approximately 271 million



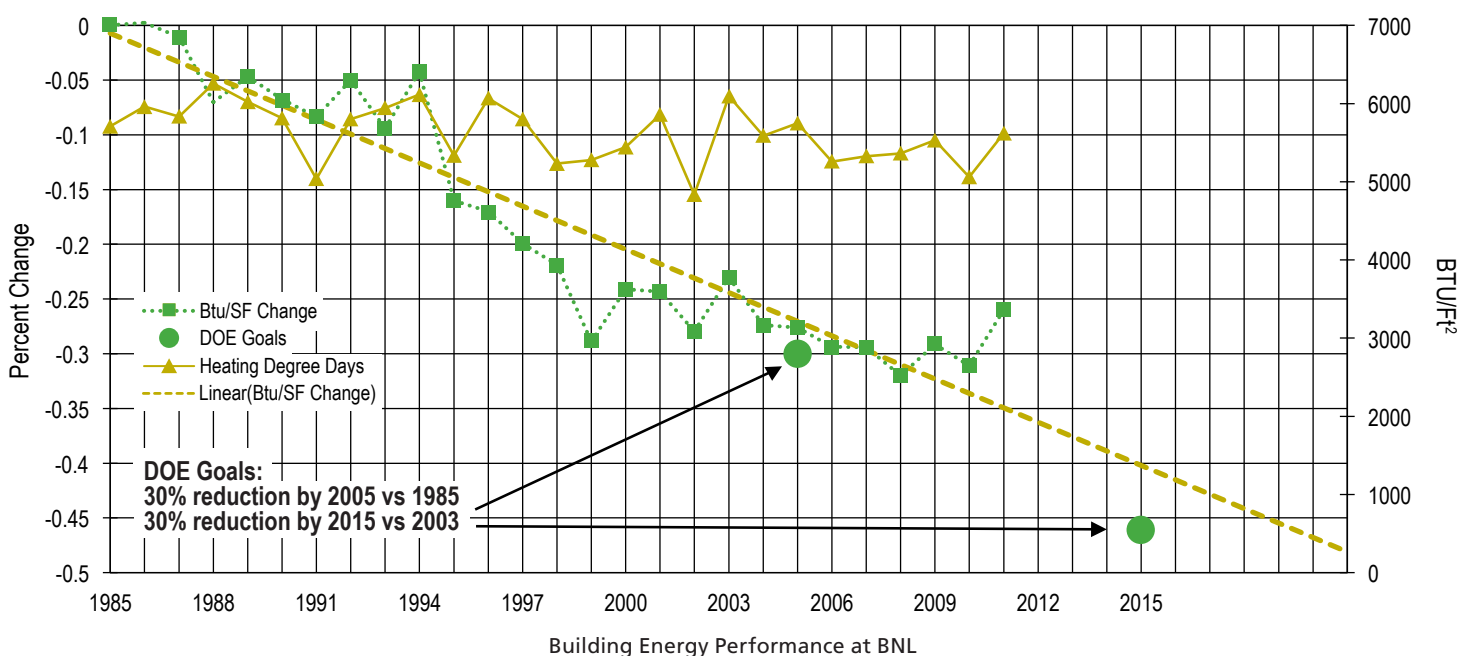
kilowatt hours (kWh) of electricity. Overall facilities energy usage for FY 2011 was approximately 4 percent less compared to FY 2003, saving BNL over \$1 million. The increase in energy intensity compared to 2010 was due in part to weather, as well as increased activity on site associated with several major construction projects.

The Laboratory is a participant in the New York Independent System Operator (NYISO) Special Case Resource (SCR) Program, which is an electric load reduction curtailment program. Through this program, BNL has agreed to reduce electrical demand during critical days throughout the summer when NYISO expects customer demand to meet or exceed the available supply. In return, the Laboratory receives a rebate for each megawatt (MW) reduced on each curtailment day. No curtailment days were required in 2011, but the Laboratory participated in some test exercises, which produced a rebate of \$34,000. BNL also maintains a contract with the New York Power Authority (NYPA) that resulted in an overall cost avoidance of \$24.5 million in 2011.

BNL continues to keep electric loads at a minimum during the summer by scheduling operations at the Laboratory's Relativistic Heavy Ion Collider (RHIC) to avoid peak demand periods. This scheduling reduced the electric demand by 25 MW, which allowed BNL to save approximately \$2 million in electric costs in 2011, and greatly helps maintain the reliability of the Long Island Power Authority (LIPA) electric system to meet all of its users' needs.

BNL used 90,000 gallons of fuel oil, 20,000 gallons of propane, and 657 million ft<sup>3</sup> of natural gas for site needs, and approximately 24,000 gasoline equivalents of natural gas (for the Laboratory's vehicle fleet) in 2011. Responding to market conditions, fuel oil and natural gas were used whenever each respective fuel was least expensive. However, wherever possible, BNL will purchase natural gas over oil in order to help reduce greenhouse gas emissions.

The Laboratory continues to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs wherever possible.





*Long Island Solar Farm at BNL*

*Solar power helps eliminate carbon dioxide, the chief greenhouse gas responsible for global warming and climate change.*

- The 164,000 solar panels that make up the Long Island Solar Farm at BNL provide LIPA with up to 32 MW of alternating current electricity, generating enough clean solar energy to power as many as 4,500 homes.
- The estimated annual output of 44 million kWh will result in an avoidance of approximately 31,000 tons of carbon per year over its 30- to 40-year life span.
- The Northeast Solar Energy Research Center (when completed) will generate approximately 700 kWh to 1 MW of electricity at full power, which will be distributed to BNL's electrical network for use.

## **WATER CONSERVATION PROGRAM**

BNL's Water Conservation Program has achieved dramatic reductions in water use since the mid 1990s. The Laboratory continually evaluates water conservation as part of facility upgrades or new construction initiatives. These efforts include more efficient and expanded use of chilled water for cooling and heating/ventilation and air conditioning (HVAC) systems, and reuse of once-through cooling water for other systems, such as cooling towers. Through an annual program at the Laboratory, approximately \$50K per year is allocated to replace existing conventional plumbing fixtures with low-flow devices.

The Laboratory's goal is to reduce the consumption of potable water on site and to reduce the possible impact of clean water discharges from BNL's Sewage Treatment Plant operations. Total water consumption for 2011 was approximately 14 million gallons less than in 2010. The decrease can be attributed to water conservation efforts and less water used for cooling.



*BNL Water Storage Tower*



*Aerial photograph of the Waste Management Facility*

## WASTE MANAGEMENT PROGRAM

As a byproduct of the world-class research it conducts, BNL generates a large range of wastes. These wastes include materials common to many businesses and industries, such as office wastes (e.g., paper, plastic, etc.), aerosol cans, batteries, paints, and oils. However, the Laboratory's unique scientific activities also generate waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, and mixed waste.

BNL's Waste Management Facility handles the collection, storing, transporting, and the disposal of waste generated at the Laboratory. This modern facility was designed for handling hazardous, industrial, radioactive, and mixed waste and is comprised of three staging areas: a facility for hazardous waste, regulated by the Resource Conservation and Recovery Act (RCRA); a mixed-waste building for material that is both hazardous and radioactive; and a reclamation building for radioactive material. The RCRA and mixed-waste buildings are managed under a permit issued by the New York State Department of Environmental Conservation (NYSDEC). These buildings are used for short-term storage of waste before it is packaged or consolidated for off-site shipment to permitted treatment and disposal facilities. Due to the relatively small quantities and infrequent generation of mixed waste, BNL has reduced its waste storage footprint by consolidating hazardous and mixed wastes into its RCRA waste building.

Hazardous waste from routine operations in 2011 was basically unchanged from 2010 generation rates. Mixed waste generation decreased slightly in 2011 and can be attributed primarily to fluctuations in operations and material substitutions. Radioactive waste quantity for routine operations decreased significantly and is primarily attributed to decreases in radioactive liquid generation.

Wastes generated by remediation projects, decommissioning activities, or one-time events (e.g., lab cleanout) are considered non-routine. In 2011, BNL continued to reduce the inventory of legacy waste materials through lab cleanouts. Restoration and decommissioning activities included the removal of the High Flux Beam Reactor and Brookhaven Graphite Research Reactor components. Other non-routine wastes included disposal of lead contaminated debris, lead shielding, and polychlorinated biphenyl (PCB) wastes.



*Headwaters of the Peconic River*

## 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, 15 equivalency permits for the operation of 13 groundwater remediation systems, and several other binding agreements. In 2011, the Laboratory complied with the majority of these requirements, and instances of noncompliance were reported to regulatory agencies and corrected expeditiously.

Under the Clean Air Act (CAA), which is administered by the Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC), the objectives are to improve or maintain regional ambient air quality through operational and engineering controls on stationary or mobile sources of air pollution. Both conventional and hazardous air pollutants are regulated under the CAA.

BNL's Central Steam Facility utilizes four boilers that are subject to NYSDEC regulations. In 2011, emission testing of the boilers showed that nitrogen oxides, carbon monoxide, and sulfur dioxide were all within permit limits. Opacity excursions only occurred during boiler testing periods.

Halon portable fire extinguishers at the Laboratory continue to be removed and replaced by dry-chemical or clean agent units as they are encountered. The existing supply of Halon in storage will be transferred to the Department of Defense Ozone Depleting Substances Reserve in 2012. Also in 2011, 394 pounds of ozone-depleting substances were recovered and recycled from refrigeration equipment that was serviced.

In 2011, the Laboratory notified the EPA Region II office regarding the removal of materials containing asbestos. During the year, 2,750 linear feet of pipe insulation, 39,365 square feet of siding material, and 150 cubic yards of asbestos-containing debris were removed and disposed of according to EPA requirements.

The disposal of wastewater generated by BNL operations is regulated under the Clean Water Act (CWA) as implemented by NYSDEC and under DOE Order 458.1, Radiation Protection of the Public and the Environment. The goals of

the CWA are to achieve a level of water quality that promotes the propagation of fish, shellfish, and wildlife; to provide waters suitable for recreational purposes; and to eliminate the discharge of pollutants into surface waters. NYSDEC has issued a State Pollutant Discharge Elimination System (SPDES) permit to BNL to regulate wastewater effluents at the Laboratory. Each month, BNL prepares a Discharge Monitoring Report that describes monitoring results, evaluates compliance with permit limitations, and identifies corrective measures taken to address any permit excursion.

Most of the liquid effluents discharged to surface water and groundwater met applicable SPDES permit requirements; however, six minor excursions above permit limits were reported in 2011. Three occurred at the Laboratory's Sewage Treatment Plant (two for iron and one for total nitrogen load) and three pH excursions were recorded for discharges to recharge basins on site. The permit excursions were reported to NYSDEC and the Suffolk County Department of Health Services (SCDHS). Groundwater monitoring at BNL's Major Petroleum Facility continues to demonstrate that current oil storage and transfer operations are not affecting groundwater quality.

Federal, state, and local regulations are in place to address the management of storage facilities containing chemicals, petroleum, and other hazardous materials. The regulations include specifications for the design of storage facilities, requirements for written plans relating to unplanned releases, and requirements for reporting releases that do occur. Efforts to reduce the number and minimize the severity of spills on site continued in 2011. There were 18 reportable spills of petroleum products, antifreeze, or chemicals in 2011. While the total number of spills increased by three from 2010, the severity of releases were minor and cleaned up to the satisfaction of NYSDEC.

A number of federal, state, and local agencies oversee BNL activities. In addition to external audits and oversight, the Laboratory has a comprehensive self-assessment program in place to review operations. In 2011, the Laboratory participated in 10 environmental inspections or reviews by external regulatory agencies. These inspections included BNL's Sewage Treatment Plant operations, waste water discharges to regulated outfalls and recharge basins, hazardous waste management facilities, and BNL's potable water system; there were no significant instances of noncompliance.

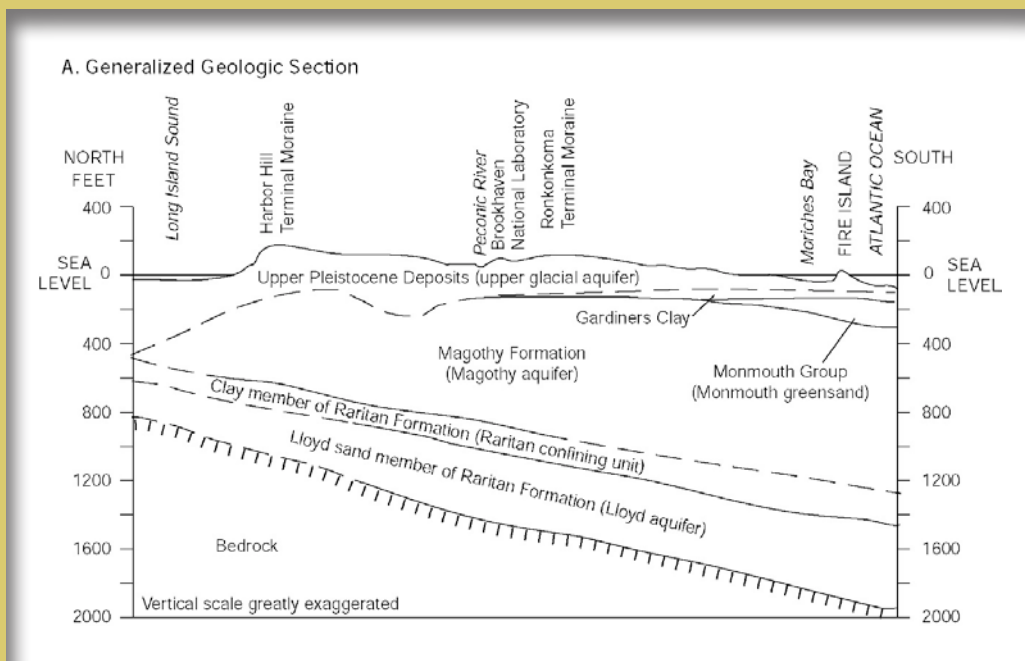
## LONG ISLAND'S 'SOLE SOURCE' AQUIFER IS BNL'S WATER SOURCE

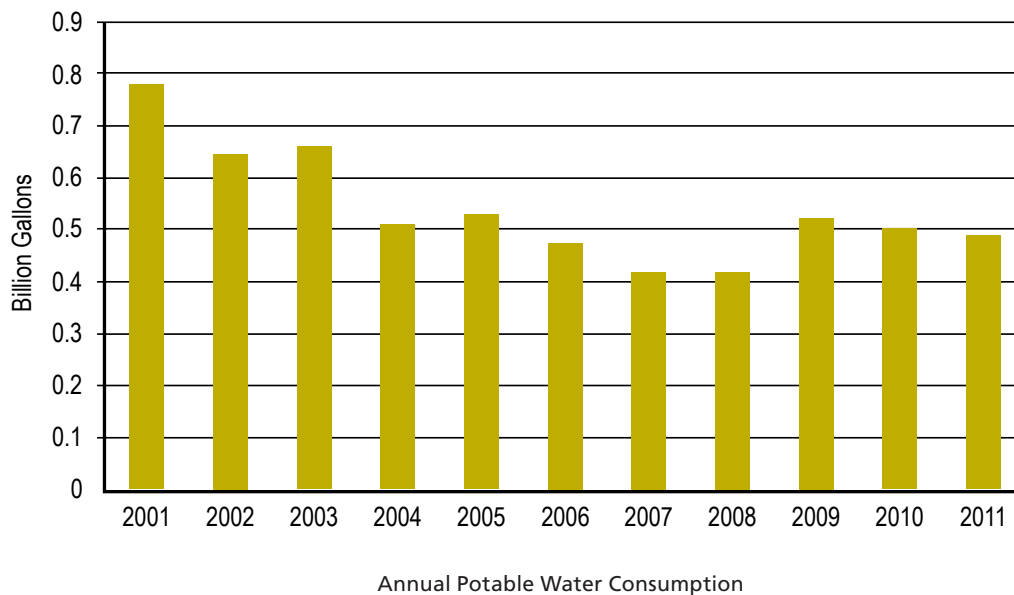
The Long Island aquifer system is made up of three primary formations. From the surface to approximately 150 feet down is the Upper Glacial aquifer, from 150 to 1,000 feet is the Magothy, and from 1,000 to about 2,000 feet is the Lloyd. Drilled into the Upper Glacial, BNL's five in-service drinking-water wells draw up to 1,000 gallons per minute, or about 1.34 million gallons of water a day for use as drinking water, process cooling water, or fire protection. In 2011, the Laboratory pumped some 488,824,000 gallons.

Long Island's aquifer system is one of 72 "sole source" aquifers in the nation recognized under the aquifer-protection program authorized by the U.S. Safe Drinking Water Act. As required by the 1996 amendments to the Safe Drinking Water Act, an assessment of the source water used by BNL's public water

system is performed annually by the New York State Department of Health. Based upon available hydrogeological, land use, and water-quality susceptibility information, the assessment of the Laboratory's source water provides additional information for use in protecting the source of BNL's drinking water.

Each year, BNL publishes an annual Water Quality Consumer Confidence Report. In addition to reminding consumers of the importance and need to protect drinking-water sources, the report's purpose is to inform drinking-water consumers where our water comes from, what analytical tests are conducted, what the test results reveal, and how those results compare to state standards. In 2011, as in the past, BNL's drinking water was in full compliance with all county, state, and federal regulations. Additional information regarding the complete analysis can be found at <http://www.bnl.gov/bnlweb/pubaf/water/reports.htm>.





However, the Laboratory did receive two Notices of Violation (NOV) with fines totaling \$10,000 from the State of Utah for shipments of waste received at EnergySolutions that did not comply with the site's Waste Acceptance Criteria. In July, a small piece of lead that was used as shielding was found in a container that was previously used for transporting radio-active materials. Lead was not listed or approved under the waste profile for this shipment. In August, the concentration of radionuclides contained in a bin of dust removed from BNL's Brookhaven Graphite Research Reactor during demolition exceeded Class A waste limits and was therefore a violation of the EnergySolutions license.

Each year, the DOE Brookhaven Site Office (BHSO) conducts several environmentally-related assessments, some of which are supported by the DOE Chicago Office. In April 2011, BHSO performed an assessment of the Laboratory's waste characterization processes, including both radioactive and hazardous waste, in response to a 2010 State of Utah NOV regarding insufficient characterization of wastes. The review showed several weaknesses in waste characterization, including inadequate support documentation and ineffective implementation of a corrective action following the 2010 waste characterization NOV. Additional corrective actions have been developed to address these findings.

In August 2011, BHSO conducted a second surveillance assessment of the BNL waste characterization processes. The review was restricted to radiological waste streams and looked at radioactive wastes generated by the Environmental Remediation Program (ERP) for cleanup projects and the Brookhaven Linac Isotope Producer (BLIP) program. Overall, the assessment found that future ERP waste streams should be compliant with disposal site waste acceptance

criteria and that BLIP waste streams were appropriately characterized. Several recommendations were made to enhance and strengthen the waste characterization processes at BNL, and are currently being implemented.

Also in August, BHSO performed a collaborative assessment with Brookhaven Science Associates on the National Environmental Policy Act (NEPA) process at BNL and within the BHSO. The assessment looked at NEPA implementation across all departments and divisions. Additionally, a review of cultural resource institutional awareness was included in the assessment scope. Knowledge of cultural resources was found to be deficient in the Integrated Facility Management System, and NEPA implementation was found to be strong in the scientific departments and at the institutional level. Some smaller projects were found to be deficient in NEPA compliance, and training of newly hired engineers was identified as an opportunity for improvement. Administrative weaknesses were also identified, including out-of-date categorical exclusion updates.

Finally, BNL conducted a programmatic self-assessment on several aspects of the Laboratory's environmental management program in 2011. Topics for this assessment were determined based on institutional risk, DOE and regulatory agency expectations, and to ensure that key environmental requirements are being implemented as designed. The self-assessment focused on requirements related to natural and cultural resources and endangered species management. The Natural Resource and Endangered Species assessment included a review of and updating the BNL Natural Resource Management Plan. Additional actions aimed at preserving wildlife and enhancing endangered species habitats were identified and added to the plan for future implementation.

## AIR QUALITY PROGRAM

BNL monitors radioactive emissions at three facilities on site to ensure compliance with the requirements of the Clean Air Act (CAA). Environmental Protection Agency (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. During 2011, Laboratory facilities released a total of 5,793 curies of short-lived radioactive gases.

BNL's Brookhaven Linear Isotope Producer (BLIP) is the only Laboratory facility subject to EPA's continuous monitoring requirements. 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 2011. The combined emissions were approximately 4 percent lower than 2010 levels.

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 2011 continued to be very small (0.0861  $\mu$ Ci). Low levels of tritium from the HFBR (0.41 Ci) were primarily due to the presence of residual tritium in ambient air exhausted from the facility.

The Laboratory conducts ambient radiological air monitoring to verify local air quality and assess possible environmental and health impacts from BNL operations. Samples collected from air monitoring stations around the perimeter of the site were analyzed for tritium and gross alpha and beta airborne activity. Results for 2011 continued to demonstrate that on-site radiological air quality was consistent with air

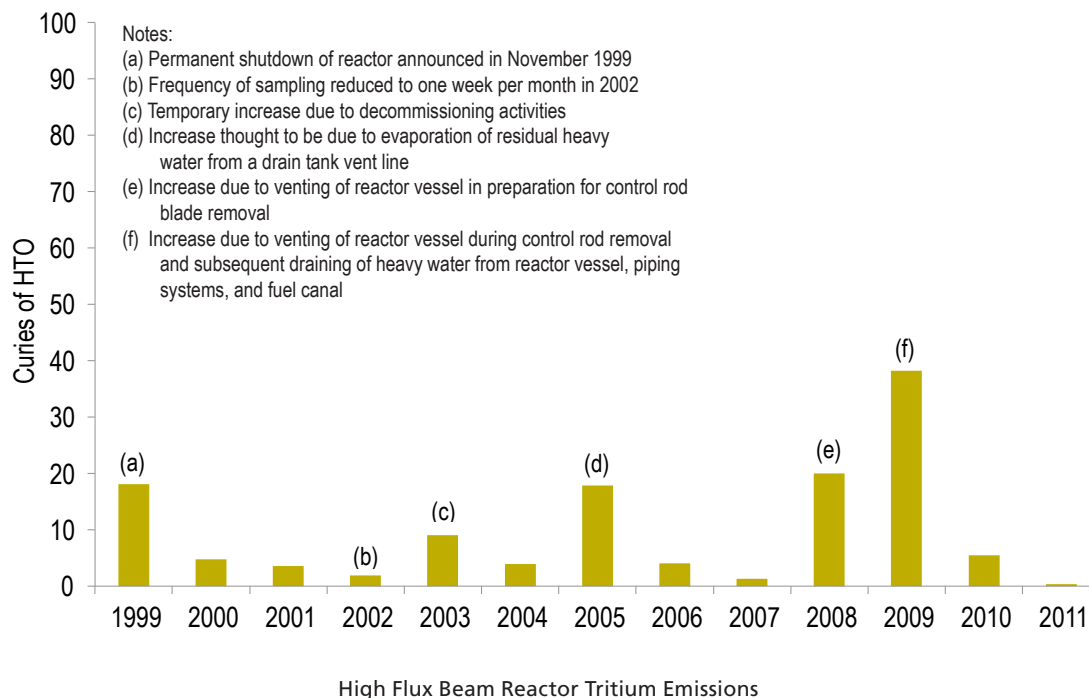
quality measured at locations in New York State that are not located near radiological facilities.

Various state and federal regulations governing non-radiological releases require facilities to conduct periodic or continuous emissions monitoring to demonstrate compliance with emission limits. The BNL Central Steam Facility (CSF) is the only Laboratory facility that requires monitoring. Two of the four boilers at the CSF, specifically 6 and 7, are equipped with continuous emission monitors to measure nitrogen oxide (NOx) emissions and opacity. NOx emissions cannot exceed 0.30 lbs./MMBtu when No. 6 fuel oil is burned or 0.20 lbs./MMBtu when natural gas or No. 2 fuel oil is combusted. Opacity levels cannot exceed 20 percent, except for one 6-minute period per hour of not more than 27 percent opacity.

In 2011, there were no exceedances of the NOx emission standards for either boiler, and there were no excess opacity measurements recorded for either boiler during routine operations. The only recorded opacity excursions were observed during performance testing of the opacity monitors.

Because natural gas prices were lower than residual fuel oil prices throughout 2011, BNL used natural gas to supply more than 99 percent of the heating and cooling needs of the Laboratory's major facilities during the year. As a result, annual facility emissions of particulate matter, nitrogen oxides, and sulfur dioxide were at their lowest in the last decade.

One of the overarching goals of Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance, is for Federal agencies to establish agency-wide



28% Scope 1&2  
GHG reduction by  
FY 2020 from a  
FY 2008 baseline

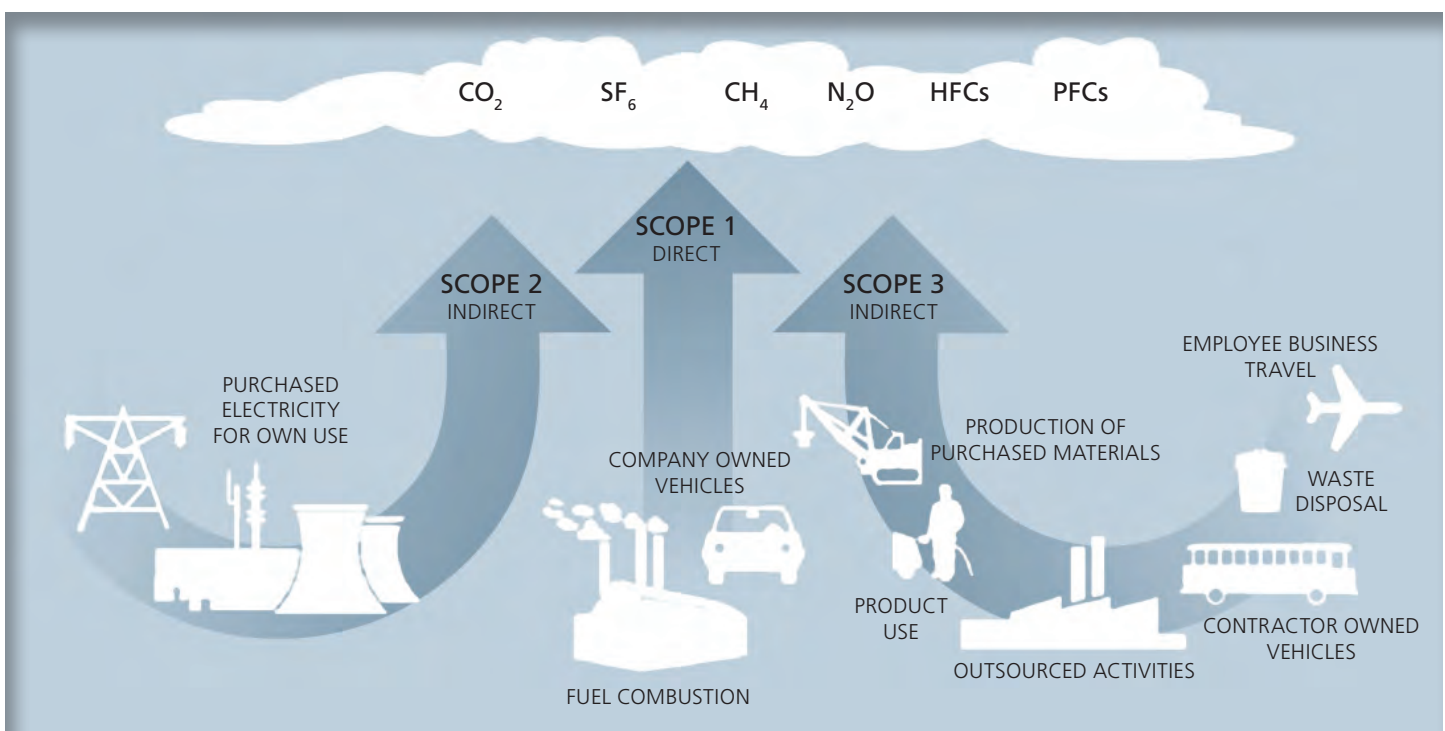
BNL has taken an aggressive approach to addressing our greenhouse gas (GHG) emissions, despite challenges due to realized and projected programmatic growth and ongoing facility construction. In 2011, the purchase of hydropower provided credits which significantly reduced GHG emissions impact. In addition, energy intensity reductions are being implemented and a detailed evaluation of the feasibility to construct a 5MW combined heat and power plant is in progress. As required, BNL will implement a sulfur hexafluoride (SF<sub>6</sub>) emissions capture program by September 2012.

#### DOE Sustainability Goal

GHG reduction targets for their combined Scope 1 and 2 greenhouse gas emissions and for their Scope 3 greenhouse gas emissions. Scope 1 emissions are direct GHG emissions from sources that are owned or controlled by a Federal agency. Scope 2 emissions are indirect GHG emissions resulting from the generation of electricity, heat, or steam purchased by a Federal Agency. Scope 3 emissions are GHG emissions from sources not owned or directly controlled by a Federal Agency, but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting. DOE has set the following GHG emission reduction goals for fiscal year (FY) 2020: reduce Scope 1 and 2 GHG emissions by 28 percent relative to their FY 2008 baseline and reduce Scope 3 GHG emissions by 13 percent relative to their

FY 2008 baseline. These goals are included in BNL's Site Sustainability Plan.

Due to planned programmatic growth with the addition of the Laboratory's National Synchrotron Light Source-II and other programs, meeting the Scope 1 and 2 reduction goal will be especially difficult, and BNL's Site Sustainability Plan identifies a number of actions that have or will be taken to help the Laboratory move towards this goal. These include offsets from the Long Island Solar Farm on site, receiving hydropower from the New York Power Authority, and the proposed construction of a 5 megawatt combined heat and power plant. To meet the 2020 Scope 3 GHG emissions reduction goal, the Laboratory will focus its efforts on reducing employee airline travel and increasing employee ride-sharing.





BNL's Sewage Treatment Plant

## WATER QUALITY SURVEILLANCE PROGRAM

The Laboratory discharges treated wastewater into the headwaters of the Peconic River via BNL's Sewage Treatment Plant (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.

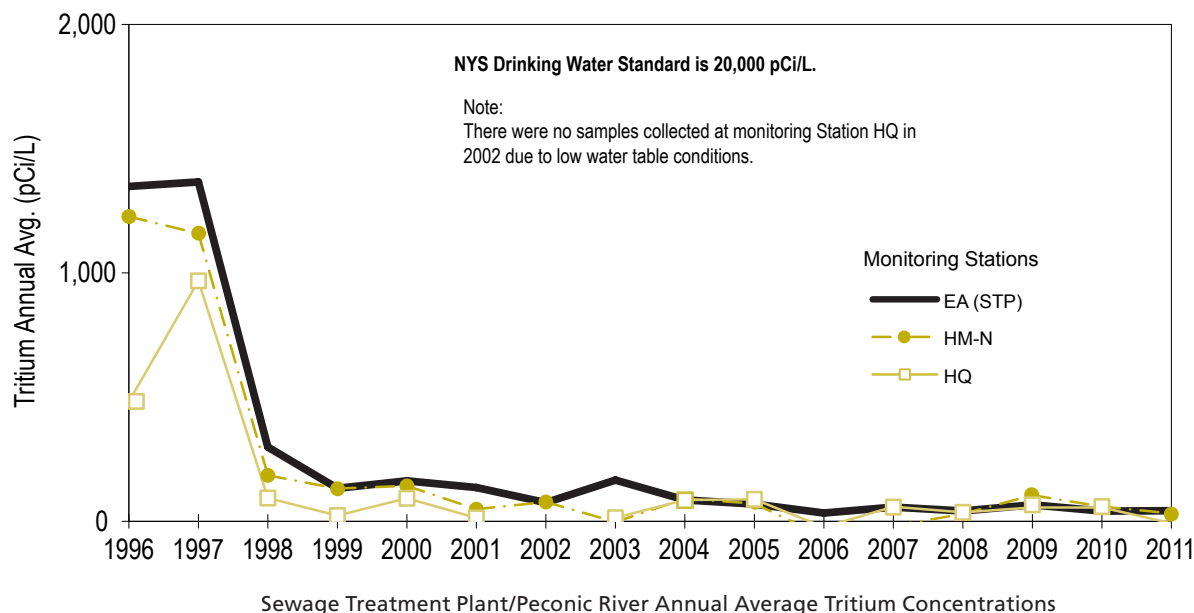
In 2011, the average gross alpha and beta activity levels in the STP discharge were within the typical range of historical levels and well below New York State Drinking Water Standards (NYS DWS). Tritium was detected once in the STP effluent at a concentration just above the minimum detectable activity ( $320 \text{ pCi/L} \pm 130 \text{ pCi/L}$ ), which is less than 2 percent of the NYS DWS. Analysis of the STP effluent and the Peconic River continued to show no detection of cesium-137, strontium-90, or other gamma-emitting nuclides attributable to BNL operations.

The STP is also monitored for nonradiological contaminants. In 2011, monitoring of the STP effluent showed that, except for isolated incidents of noncompliance for metals,

organic and inorganic parameters were within SPDES effluent limitations or other applicable standards, and no volatile organic compounds (VOCs) were detected above contract laboratory method detection limits.

Discharges to recharge basins are sampled throughout the year for analyses of gross alpha and beta activity, gamma-emitting radionuclides, and tritium. Each recharge basin is a permitted point-source discharge under the Laboratory's SPDES permit. In 2011, there were no reported gamma-emitting nuclides attributable to BNL operations in any discharges to recharge basins, and tritium was detected only once at a low level in a single sample just above method detection limits. Inorganics (i.e., metals) were detected; however, their presence is due primarily to sediment runoff in stormwater discharges.

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 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. Radiological data from Peconic River surface water sampling in 2011 shows that the average concentrations of gross alpha and gross beta activity from off-site locations and control locations were indistinguishable from BNL on-site levels, and all detected levels were below the applicable NYS DWS. No gamma-emitting radionuclides attributable to Laboratory operations were detected either upstream or downstream of the STP. One tritium sample was detected above method detection limits, but was considered questionable due to the fact that tritium was not detected in the STP discharge during this same period. Inorganic data from Peconic River samples collected upstream, downstream, and at control locations demonstrated that elevated amounts of aluminum and iron detected in the river are associated with natural sources.

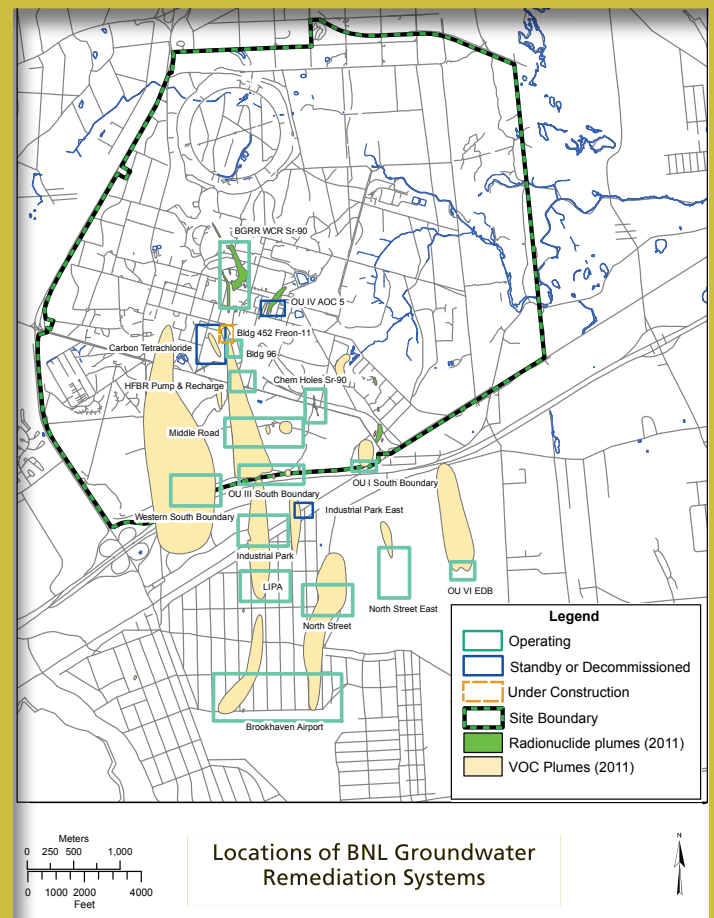
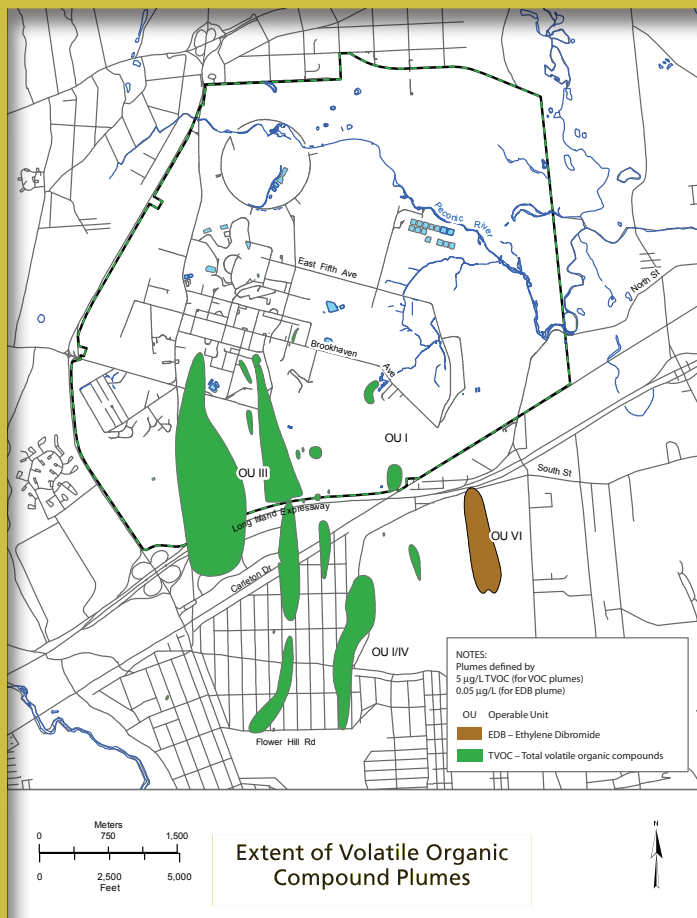
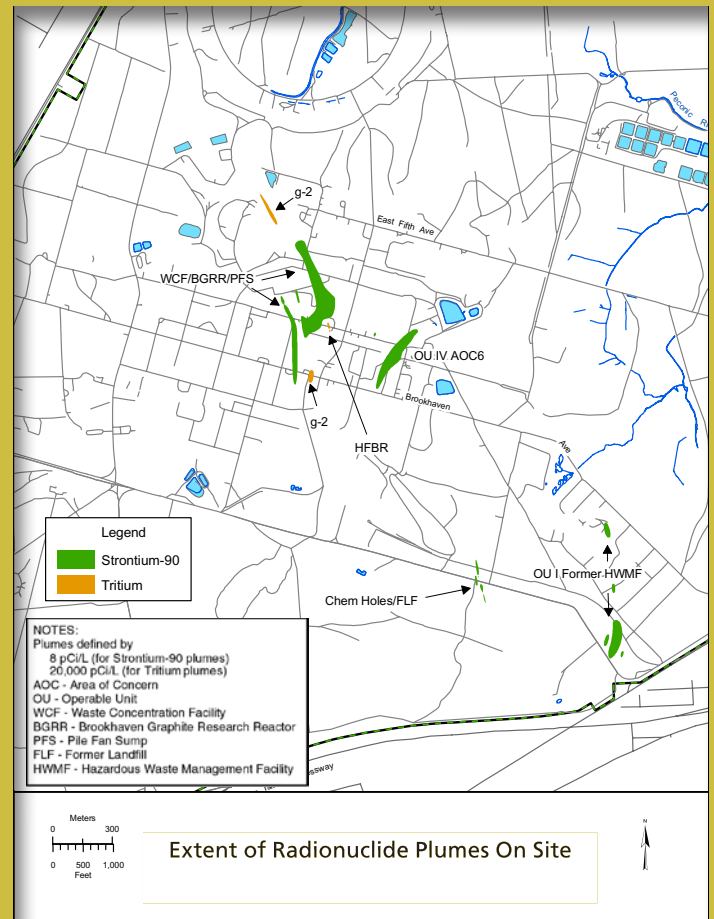


## GROUNDWATER PROTECTION MANAGEMENT PROGRAM

The mission of the Laboratory's Groundwater Protection Program is to protect and restore the aquifer system at BNL. Four key elements make up the program: pollution prevention, monitoring, restoration, and communication.

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 2011, the Laboratory collected groundwater samples from 796 permanent monitoring wells during 2,041 individual sampling events.

Under the environmental surveillance program, 12 active research and support facilities are monitored. During 2011, groundwater samples were collected from 134 wells during 230 sampling events. Fifty temporary wells were also installed as part of this program. Although BNL has made significant investments in environmental protection programs over the past 15 years and is making progress in achieving its goal of preventing new groundwater impacts and remediating



previously contaminated groundwater, in 2011, a plume of trichlorofluoromethane (also known by the trade name Freon-11) was discovered in the area of the Laboratory's Site Maintenance Facility. In response, the BNL Groundwater Protection Contingency Plan was followed to assure that the appropriate characterization, stakeholder notifications, and corrective actions were implemented. The maximum Freon-11 concentration was 38,000 µg/L. Based upon the high levels of Freon-11 in the groundwater, BNL began to install a new treatment system in late 2011 to remediate the plume.

In addition, the Laboratory monitors groundwater that continues to be impacted from past releases. Tritium continues to be detected in the former g-2 source area monitoring wells associated with BNL's Alternating Gradient Synchrotron facility, at concentrations above the 20,000 pCi/L Federal drinking water standard (DWS), with a maximum concentration of 119,000 pCi/L. Although the engineered stormwater controls are effectively protecting the activated soil shielding at the source area, monitoring data indicate that the continued release of tritium appears to be related to the flushing of residual tritium from the deep vadose zone following significant natural periodic fluctuations in the local water table. As a result of natural radioactive decay and dispersion in the aquifer, the downgradient portion of the g-2 tritium plume is breaking up into small, discrete segments. Several segments of the plume extend immediately south of BNL's National Synchrotron Light Source facility at a distance of approximately 600 feet. In 2011, the highest tritium concentration observed in the downgradient portion of the plume was 58,600 pCi/L. The tritium is expected to naturally attenuate to less than the 20,000 pCi/L DWS within a short period of time.

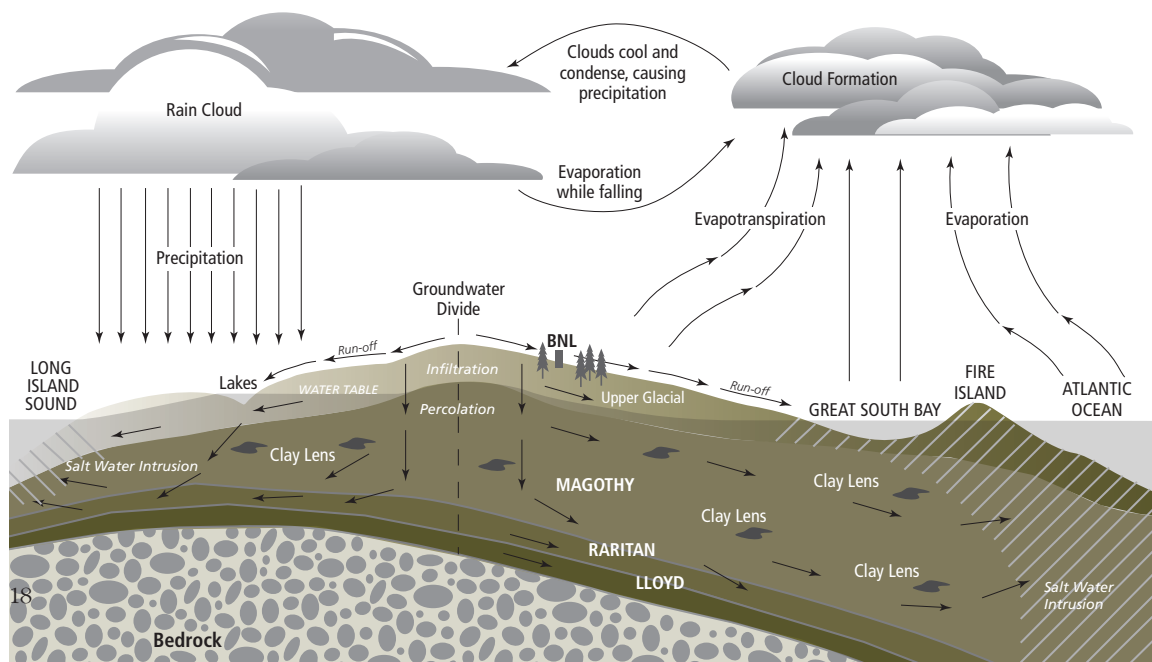
Since April 2006, all tritium concentrations in the Brookhaven Linear Isotope Producer facility surveillance wells have been less than the 20,000 pCi/L DWS. The maximum tritium concentration during 2011 was 2,000 pCi/L. These results indicate that the engineered stormwater

controls are effectively protecting the activated soil shielding, and that the amount of residual tritium in the deep vadose zone is diminishing.

At the on site Upton Service Station, volatile organic compounds (VOCs) associated with petroleum products and the solvent PCE continue to be detected in the groundwater directly downgradient of the facility. Groundwater monitoring results indicate that the petroleum-related compounds break down within a short distance from the facility. Monitoring of the leak detection systems at the Upton Service Station indicates that the gasoline storage tanks and associated distribution lines are not leaking, and all waste oils and used solvents are being properly stored and recycled. Therefore, it is believed that the contaminants detected in groundwater originate from historical vehicle maintenance activities and are not related to current operations.

The primary mission of the Laboratory's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) groundwater program is to operate and maintain groundwater treatment systems and prevent additional groundwater contamination from migrating off site. During 2011, BNL continued to make significant progress in restoring groundwater quality with the removal of approximately 156 pounds of VOCs and approximately 2.9 mCi of strontium-90 (Sr-90). With the treatment of approximately 1.5 billion gallons of groundwater to date, 6,709 pounds of VOCs have been removed from the aquifer, and noticeable improvements in groundwater quality are evident in several monitored areas. Also to date, two of the treatment systems have removed approximately 26 mCi of Sr-90.

BNL will continue efforts to prevent new groundwater impacts and is vigilant in measuring and communicating its performance. A detailed Groundwater Status Report is provided as Volume II of the Site Environmental Report, and provides a comprehensive summary of data collected during the calendar year, as well as an evaluation of Groundwater Protection Program performance.



*Precipitation Cycle in the Area of Brookhaven National Laboratory*

## RADIOLOGICAL DOSE ASSESSMENT PROGRAM

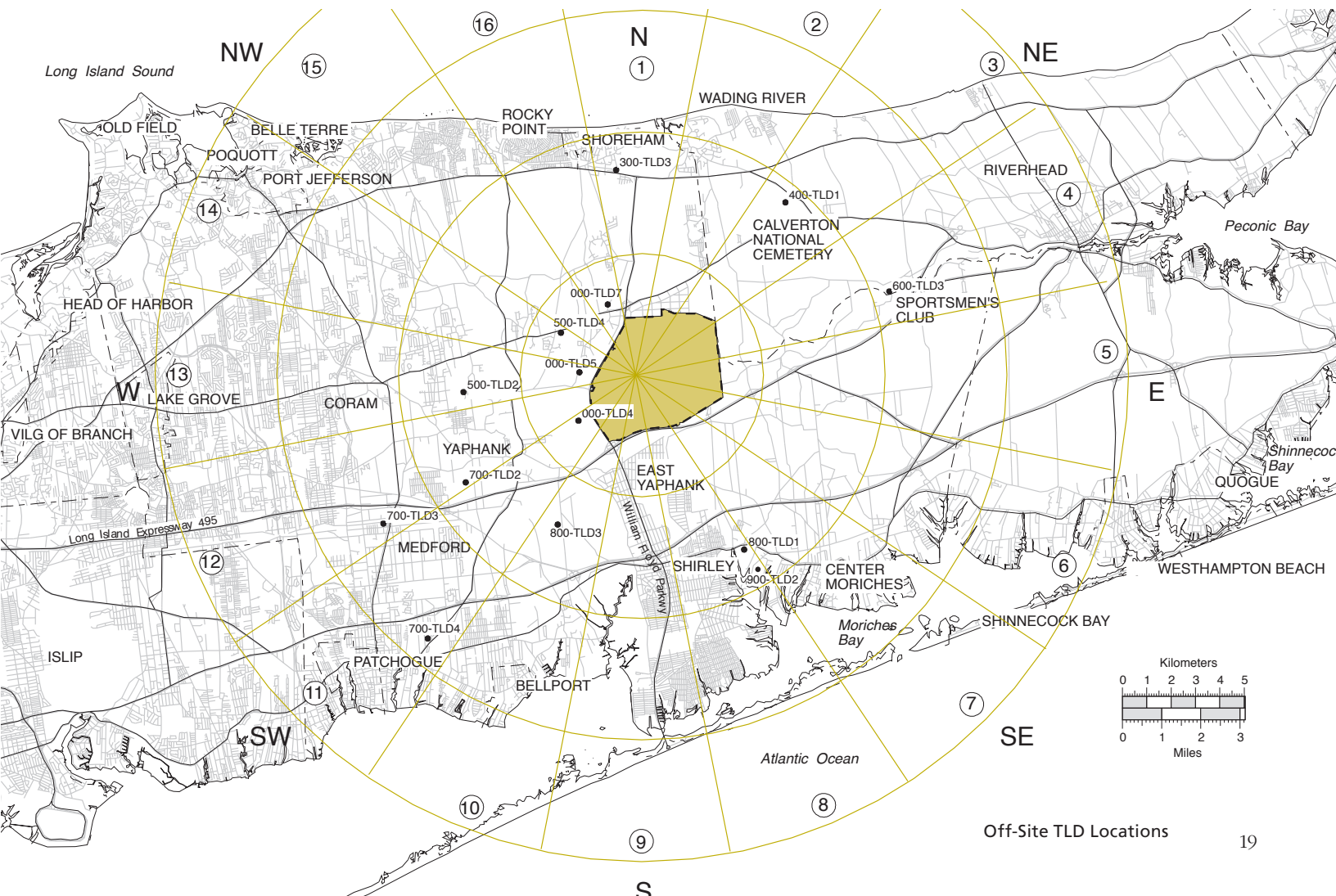
BNL routinely assesses its operations to ensure that any potential radiological dose to members of the public, BNL workers, visitors, and the environment is “As Low As Reasonably Achievable” (ALARA). The potential radiological dose is calculated as the largest possible dose to a hypothetical Maximally 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 Environmental Protection Agency and DOE regulatory dose limits for the public and the environment.

To measure direct radiation from Laboratory operations, 58 environmental thermoluminescent dosimeters (TLDs) were placed on site and 14 TLDs were placed in surrounding communities in 2011. An additional 30 TLDs were placed in a lead-shielded container for use as reference and control TLDs for comparison purposes. A TLD is a device used to measure radiation dose to occupational workers and radiation levels in the environment. The average dose from all TLDs showed there was no additional contribution to on- and off-site locations from BNL operations in 2011.

In 2011, the annual on-site external dose from all potential

sources, including cosmic and terrestrial radiation, was estimated as  $68 \pm 13$  mrem ( $680 \pm 130$   $\mu$ Sv), and the annual off-site external dose was estimated as  $61 \pm 10$  mrem ( $610 \pm 100$   $\mu$ Sv). The effective dose to the MEI from air emissions was estimated as  $3.02E-01$  mrem (3.0  $\mu$ Sv). The ingestion pathway dose was estimated as 5.9 mrem (59  $\mu$ Sv) from the consumption of deer meat and 0.18 mrem (1.8  $\mu$ Sv) from consumption of fish caught in the vicinity of the Laboratory. The total dose to the MEI from all pathways was estimated as 7.08 mrem (71  $\mu$ Sv). The dose from the air inhalation pathway attributable to BNL operations was less than 1 percent of the Environmental Protection Agency’s annual regulatory dose limit of 10 mrem (100  $\mu$ Sv), and the total dose was less than 8 percent of DOE’s annual dose limit of 100 mrem (1,000  $\mu$ Sv) from all pathways. Doses to aquatic and terrestrial biota were also evaluated and found to be well below the regulatory limits.

Other short-term projects, such as remediation work and waste management disposal activities, were assessed for radiological emissions; the potential dose from each of these activities was below regulatory limit, and there was no radiological risk to the public, workers, or the environment. In summary, the overall dose impact from all Laboratory activities in 2011 was comparable to natural background radiation levels.



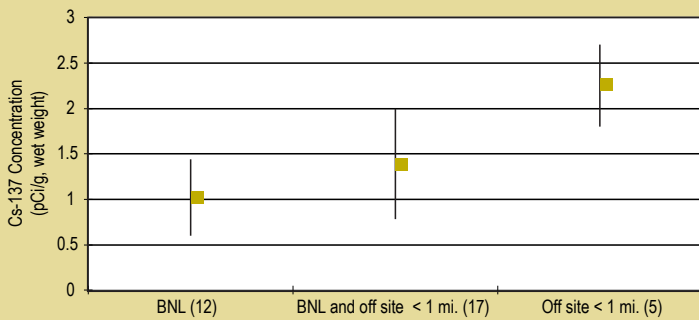
## NATURAL AND CULTURAL RESOURCE MANAGEMENT PROGRAM

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 on site, 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. 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 programs 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 Canada geese.

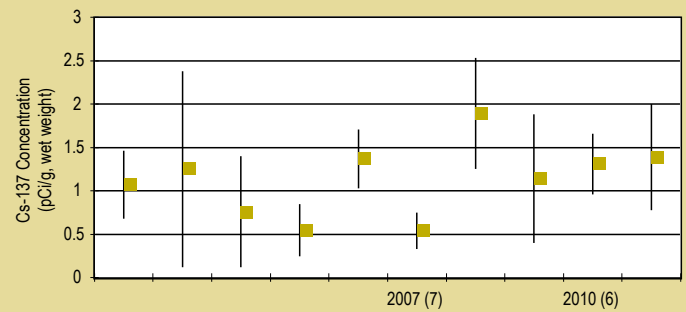
BNL conducts routine monitoring of flora and fauna to assess the impact, if any, of past and present activities on the Laboratory's natural resources. Generally, deer sampled on site

or within 1 mile contain higher concentrations of cesium-137 (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 2011 in on-site deer meat was 3.08 pCi/g, wet weight. The wet weight concentration is before a sample is dried for analysis, and is the form most likely to be consumed. The New York State Department of Health has formally reviewed the potential public health risk associated with elevated levels of Cs-137 in on-site deer and determined that neither hunting restrictions nor formal health advisories are warranted. Testing of deer bones for strontium-90 (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 continues to test for Sr-90 in bone to develop baseline information on this radionuclide and its presence in local white-tailed deer.

In collaboration with the New York State Department of Environmental Conservation (NYSDEC) Fisheries Division, BNL maintains an ongoing program for collecting and



**Notes:** Averages are shown for samples collected at BNL, on site and off site within 1 mile, off site but within 1 mile of the boundary, and off site greater than 1 mile from the boundary. Numbers in parentheses indicate the number of samples in that data set. All values are presented with a 95% confidence interval. Cs-137 = cesium-137



**Notes:** Averages are shown for samples collected at BNL, and within 1 mile. Numbers in parentheses indicate the number of samples in that data set. All values are presented with a 95% confidence interval. Cs-137 = cesium-137

Comparison of Cesium-137 Average Concentrations in Deer Meat, 2011

Ten-Year Trend of Cesium-137 Concentrations in Deer Meat



Eastern Hognose Snake (*Heterodon platyrhinos*).



Banded Sunfish (*Enneacanthus obesus*). This fish was released immediately after the photo was taken.



Eastern Tiger Salamander (*Ambystoma t. tigrinum*).

analyzing fish from the Peconic River and surrounding fresh-water bodies. In 2011, Cs-137 was detected at low levels in all but 13 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 have already removed approximately 88 percent of Cs-137 in the sediment that was co-located with mercury. Natural decay is expected to result in further decreases.

Nonradiological analysis of fish in 2011 showed that concentrations for metals are considered safe and do not pose any health risks to humans or other animals that may consume fish. Due to its known health risk, mercury is the metal of most concern. In general, a trend of decreasing mercury content downstream from BNL's Sewage Treatment Plant (STP) is evident. Polychlorinated biphenyl (PCB) analysis in fish was discontinued off site, but continued to be performed on site. One fish sample tested positive for PCBs. Historically, PCBs have been found in both fish and sediment at BNL and periodically at other locations in the Peconic River. The cleanup of the Peconic River has removed most PCBs within the sediments on site.

Annual sampling of sediment and vegetation in the Peconic River and a control location on the Carmans River was also conducted in 2011. Cs-137 was not detected in any on-site aquatic vegetation samples and was detected at levels near the detection level at off-site locations. In addition, low levels of Cs-137 were detected in sediments at off-site locations.

Metals analysis conducted indicated metals at background levels and many are common in the environment.

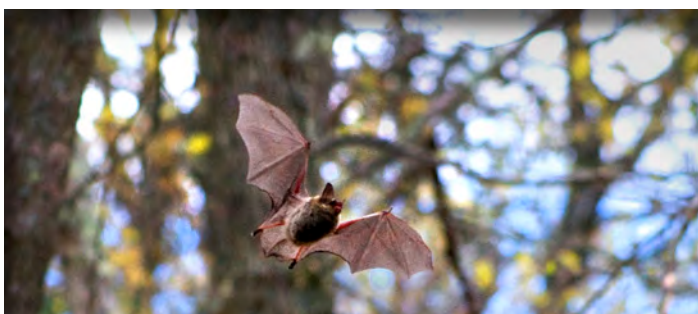
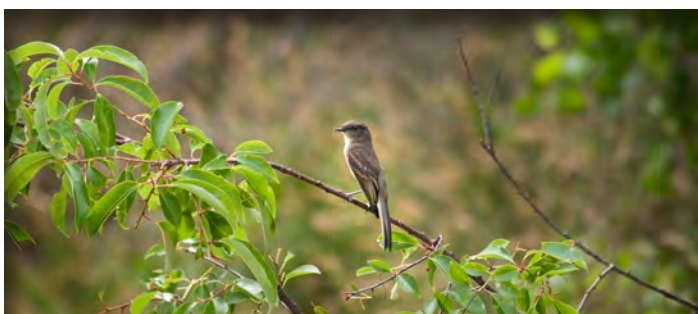
Under the Peconic River remediation project, sediment from the Peconic River was excavated to remove mercury and associated contaminants from the river. Sampling results identified three small areas with mercury concentrations greater than the cleanup goal of 2.0 mg/kg, and cleanup of these areas began in 2010 and was completed in early 2011. Thirty-one of the 33 sediment samples collected in 2011 met the cleanup goal for mercury concentration. A recommendation was made to and approved by the regulators to reduce sampling in 2012 to only the three areas remediated in 2010/2011.

Water column sampling for mercury and methyl mercury was performed at Peconic River sampling locations, BNL's STP, and one reference location on the Connetquot River in 2011. The general trend of total mercury in water samples decreased with increasing distance downstream from the STP. Methyl mercury concentrations increased slightly from the STP to the BNL site border; then decreased gradually with increasing distance downstream of the site border until reaching the historic range of concentrations for the Connetquot River reference station.

On-site garden sampling in 2011 did not detect any Cs-137 in vegetables, but was detected in soils at a very low level and are considered consistent with background levels. Grassy vegetation samples also contained very low levels of Cs-137 and is also considered consistent with historical background levels.

BNL Sampling Stations for Surface Water, Fish, and Shellfish





## UPTON ECOLOGICAL AND RESEARCH RESERVE

The Upton Ecological and Research Reserve is managed by BNL and the Foundation for Ecological Research in the Northeast (FERN). The property, 530 acres, is located on the eastern boundary of BNL, and is home to a wide variety of flora and fauna. It contains wetlands and is largely within the core preservation area of the Long Island Central Pine Barrens. Based on information from a 1994–1995 biological survey of the Laboratory, experts believe the reserve is home to more than 200 plant species and at least 162 species of mammals, birds, fish, reptiles, and amphibians.

Research supported by FERN in 2011 included work on isolating novel microbes from pine barrens soils, as well as looking at nitrogen compounds in local soils in an attempt to determine why pine barrens soils are lacking in nitrogen. This work resulted in publication of results in the online peer reviewed journal PLoSOne.

## WILDLIFE PROGRAMS

The Laboratory 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 2011, BNL's Environmental Protection Division hosted 26 interns and 3 faculty members who worked on a variety of projects, some of which included: flying squirrels, soil microbial studies of Pine Barrens soils, banded sunfish, eastern box turtles, vegetation surveys, acoustic bat surveys, and deer exclosures.

## CULTURAL RESOURCE MANAGEMENT PROGRAM

The goal of BNL's Cultural Resource Management Program is to ensure the proper stewardship of BNL and DOE historic resources. Additional goals include maintaining compliance with various historic preservation and archeological 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 2011 included sending documents associated with BNL's Brookhaven Graphite Research Reactor and the High Flux Beam Reactor to be archived, as the cleanup of both facilities was coming to a close. In addition, a loan request was made by the Long Island Museum located in Stony Brook, New York, for materials for display focused on Long Island in the 1950s.

### WORLD WAR I TRENCHES

From 1917 through 1920, the site of what is now the Laboratory was the U.S. Army's Camp Upton. Named for Civil War General Emory Upton, Camp Upton was one of 16 U.S. Army training camps. Here, recruits mostly from the New York metropolitan area were trained for the famed 77th Infantry Division, also known as the Liberty Division, which began leaving Camp Upton for fighting in France in March 1918.

Training included marching, weapons-use and, among other techniques, trench warfare. Trench warfare was a form of combat in which armies dug zig-zagging lines of interconnected ditches. Within these trenches, troops lived in muddy water, among rats and lice while defending their territory and combating their opponents.

The trenches shown here may be some of the only surviving examples of WWI earthworks in the U.S., and they have been determined to be eligible for listing on the National Register of Historic Places.



## COMMUNICATION AND COMMUNITY OUTREACH

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

To facilitate effective dialogue between the Laboratory and key stakeholders, several forums for communication and involvement have been established at BNL. The Brookhaven Executive Roundtable (BER), established in 1997 by DOE's Brookhaven Site Office, meets routinely to update local, state, and federal elected officials and regulatory agencies on environmental and operational issues, as well as on scientific discoveries and initiatives. The Community Advisory Council (CAC), established by BNL in 1998, advises the Laboratory Director, primarily on environmental, health, and safety issues related to the Laboratory that are of importance to the community.

BNL's Community Relations Office website is used to host links to the CAC webpage, which contains meeting agendas, as well as past meeting presentations and minutes, and also hosts links to important cleanup documents and announcements for public meeting dates. Local elected officials and their staff are provided with up-to-the-minute information and updates on environmental issues and research breakthroughs.

The Community Relations Office also manages several outreach programs that provide opportunities for stakeholders to become familiar with the Laboratory's facilities and research projects, as well as new initiatives. The Tour Program offers the opportunity for college, university, professional, and community groups to learn about BNL. Groups visit the Laboratory's scientific machines and research facilities and meet with scientists who conduct research. The Speaker's Bureau provides speakers for educational and other organizations, such as Rotary Clubs, civic organizations, professional societies, and other groups to update the community about Laboratory research and/or operations accomplishments, including environmental stewardship.

The Summer Sundays program enables the public to visit BNL science facilities, experience hands-on activities, and learn about research projects and environmental stewardship activities.

BNL's Media and Communications and Internal Communications Offices issue press releases and publish *The Bulletin*, a weekly employee newsletter. A Director's Office web-based publication, Monday Memo, is issued bi-weekly to employees and focuses on administrative topics important to the Laboratory population. The Laboratory maintains an informative website at <http://www.bnl.gov>, where these publications, as well as extensive information about BNL's science and operations, past and present, are posted. In addition, employees and the community can subscribe to the Laboratory's e-mail news service at <http://lists.bnl.gov/mailman/listinfo/bnl-announce-1>. Community questions and comments may be submitted via the "Contact Us" form found on the Community Relations Office website at: <http://www.bnl.gov/community/>.

In addition, the Laboratory participates in various annual events, such as BNL's week-long celebration in honor of Earth Day, off-site Earth Day fairs and festivals, and the William Floyd Summit Night Out.

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



*Summer Sundays at BNL*

*Annual "Your Environment" Art Contest in Celebration of Earth Day*



One event BNL hosts each year in honor of Earth Day is the “Your Environment” art contest. Students from local schools in grades 3-5 are asked to create a poster focusing on suggested environmental themes. The winning students receive a \$100 gift check and all students who enter the contest receive a Certificate of Appreciation at our annual awards celebration.

The winning posters for Earth Day 2012 were created by:

- a) Jasmine Armann, Frank P. Long Intermediate School
- b) Marissa Castelli, Laddie A. Decker Sound Beach School
- c) Gillian Zarate, Ridge Elementary School
- d) Gianluca Michala, Verne W. Critz Elementary School



