

# 2001

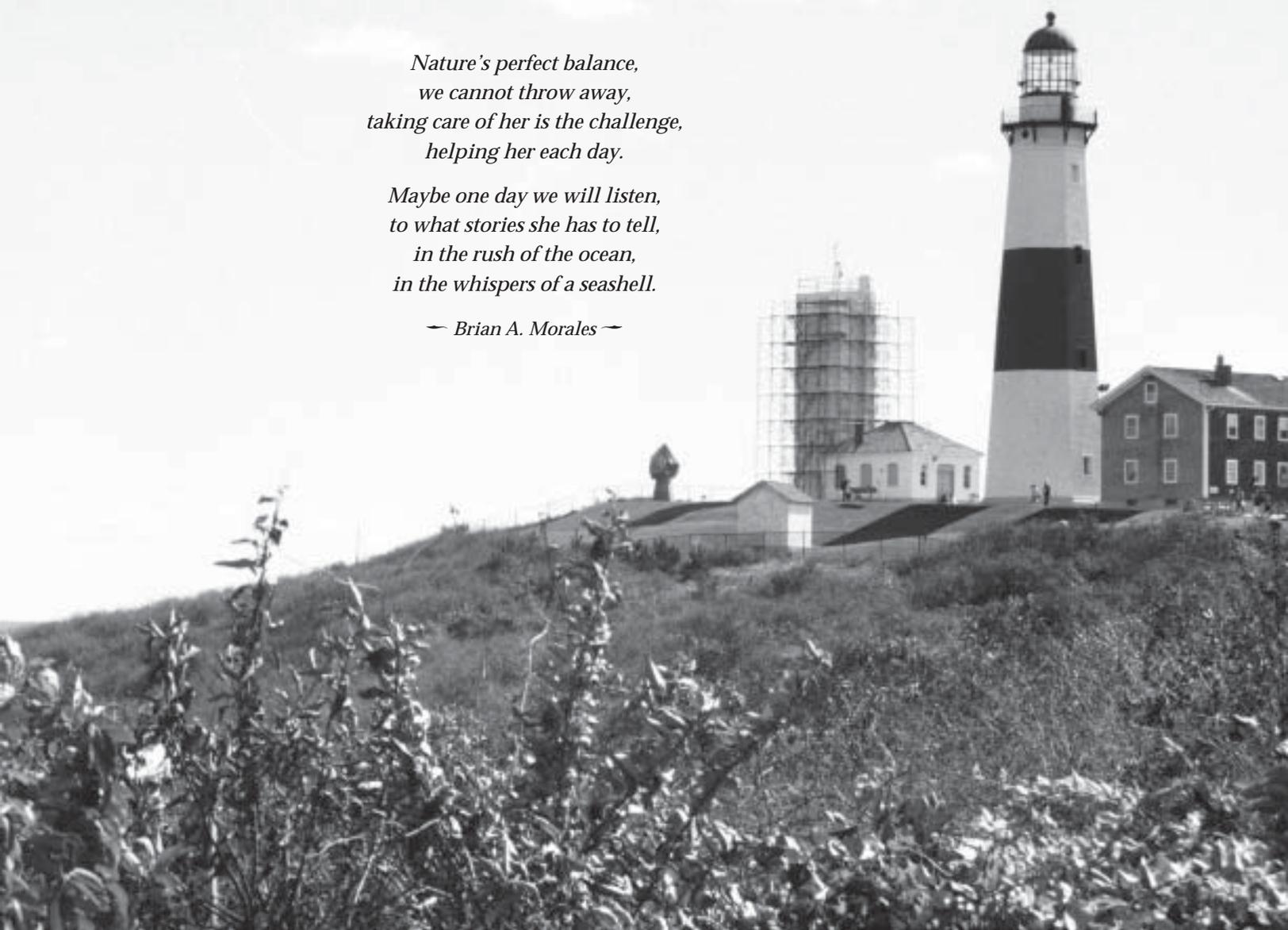
## SITE ENVIRONMENTAL REPORT

### *Summary Booklet*

*Nature's perfect balance,  
we cannot throw away,  
taking care of her is the challenge,  
helping her each day.*

*Maybe one day we will listen,  
to what stories she has to tell,  
in the rush of the ocean,  
in the whispers of a seashell.*

— Brian A. Morales —





## Environmental Stewardship Policy

*It is Brookhaven National Laboratory's (BNL's) policy to integrate environmental stewardship into all facets of the Laboratory's missions.*

*We will manage our programs in a manner that protects the ecosystem and public health.*

*In support of this policy, BNL makes the following commitments:*

■  
*We are committed to achieving compliance with applicable environmental requirements.*

■  
*In consideration of the potential impacts of our activities on the environment, we will integrate pollution prevention/ waste minimization, resource conservation, and compliance into all of our planning and decision-making.*

*We will adopt cost-effective practices that eliminate, minimize or mitigate environmental impacts.*

■  
*We will define, prioritize, and aggressively correct and clean up existing environmental problems.*

■  
*We will work to continually improve our environmental management system and performance.*

*We will establish appropriate environmental objectives and performance indicators to guide these efforts and measure our progress.*

■  
*We will maintain a positive, proactive, and constructive relationship with our neighbors in the community, regulators, DOE, and our other stakeholders.*

*We will openly communicate with stakeholders on our progress and performance.*

*In addition to my annual review of BNL's progress on environmental 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.*

A handwritten signature in black ink that reads "John H. Marburger".

John H. Marburger, Laboratory Director

11/19/98

### About the Summary Booklet

The 2001 Site Environmental Report Summary Booklet provides highlights from Brookhaven National Laboratory's 2001 Site Environmental Report (SER). The SER and the SER Summary Booklet are prepared annually to summarize environmental data and information, to describe environmental management performance, to demonstrate the status of compliance with environmental regulations, and to highlight major environmental programs and efforts. The report is written to meet the requirements and guidelines of the U.S. Department of Energy and also to meet the informational needs of the public.

The full report is available on the CD ROM included with this booklet. For additional copies of this summary booklet or a hard copy of the full report, please write or call:

Brookhaven National Laboratory  
Environmental Services Division  
Attention: SER Project Manager  
Building 120  
P.O. Box 5000  
Upton, NY 11973-5000  
(631) 344-3711

The report and summary booklet can also be accessed on the Internet at <http://www.bnl.gov/esd/ser.htm>



*Peter Paul, formerly Brookhaven's Deputy Director for Science and Technology, was appointed Interim Director on October 26, 2001, when John H. Marburger was confirmed by the U.S. Senate as Director, Office of Science and Technology Policy.*

**A Message from the Interim Laboratory Director**

The U.S. Department of Energy's Brookhaven National Laboratory

Since taking over as the Interim Director of Brookhaven National Laboratory (BNL) in October 2001, I have been and remain fully committed to excellence in environmental performance and protecting our environment. As a first-rate scientific laboratory, BNL made significant progress in environmental remediation and communications under Dr. Marburger's leadership. I take our environmental stewardship responsibilities very seriously and I expect all of our employees and visitors to do the same.

This year, BNL demonstrated environmental leadership by becoming fully ISO 14001 registered. BNL is the first DOE Office of Science national laboratory and the first Long Island-based organization to obtain third-party registration to this globally recognized environmental management standard. BNL has made major commitments to the protection of the environment and we are realizing some of these benefits. In 2001, BNL received two Pollution Prevention awards from DOE. Pollution prevention projects saved nearly \$1.4 million and resulted in the reduction or reuse of more than one and one-half million pounds of industrial, sanitary, radioactive, and hazardous waste. From 1993 to 2001, BNL reduced annual routine hazardous waste generation by 87 percent, mixed hazardous/radioactive waste by 81 percent, and radioactive waste by 72 percent. We have made continual improvements in our compliance record and a significant reduction in our environmental vulnerabilities. We have a groundwater protection program that focuses on the restoration of groundwater quality and preventing future impacts. BNL continues to address historical issues and made significant progress in 2001 in decommissioning the research reactors on site. Additionally, we are supporting ecological research and habitat enhancement at the 530-acre Upton Ecological and Research Reserve. I am committed to an expedited cleanup of our site as well as stewardship of our natural resources.

Communication with our stakeholders—neighbors, regulators, employees, and others—on environmental issues and progress has now become an integral part of how we do business at BNL. In 2001, BNL was named the "Organization of the Year" by the International Association for Public Participation for our success at integrating public participation into our operations, and ensuring that stakeholders are kept informed and have a voice in decisions and issues that affect them. We continue to deliver on our commitments and have made tremendous effort to set in place a permanent environmental stewardship strategy for the Laboratory. As we continue to forge onward with innovative research while improving our environmental operations, we are able to achieve the balance that is in our motto, "Exploring Earth's Mysteries...Protecting Its Future."

Peter Paul, *Interim Laboratory Director*



## introduction

---

2001 was a year of milestones for Brookhaven National Laboratory, both in its work at the frontiers of science as well as in terms of its commitment to protecting the environment.

As Laboratory scientists used the world's newest and largest accelerator for nuclear physics to probe the basic structure of matter and the birth of the universe, groundbreaking work was proceeding on another front as well: Brookhaven Lab became the first U.S. Department of Energy (DOE) national laboratory to develop an environmental management system that qualified for third-party registration to the globally recognized ISO (International Organization for Standardization) 14001 Environmental Standard. Brookhaven Lab's Environmental Management System is designed to fully integrate compliance assurance, pollution prevention, and community outreach into the plan-

ning, decision-making, and implementation phases of all site activities.

In 2001, Brookhaven Lab continued working to reverse the effects of past disposal practices that contaminated soil and water at the site. Highlights included the completion of several projects associated with decommissioning the Laboratory's original research reactor, substantial progress in cleaning groundwater beneath the site and plans for installing additional off-site groundwater treatment systems, and the cleanup of areas associated with the on-site sewage treatment facility.

Brookhaven Lab continued to expend considerable effort to monitor and minimize its environmental impact on the site and surrounding area. This booklet summarizes the *2001 Site Environmental Report* (SER), which details the status of the Laboratory's environmental programs and performance,

including its steady progress in cleaning up the site and integrating environmental stewardship into all of its missions.

An electronic copy of the complete *2001 Site Environmental Report* is included on the CD found in the back of this booklet. For additional copies of this summary booklet, the CD, or a printed copy of the complete report, contact the SER project manager at (631) 344-3711. The report and summary booklet can also be found on the Internet at <http://www.bnl.gov/esd/SER.htm>.

Landsat 7 image of Long Island  
(Courtesy of NASA).



## about Brookhaven Lab

Brookhaven National Laboratory hosts more than 25,000 guests each year, from world-renowned scientists conducting research at the Laboratory's unique science facilities to local school children learning about the mysteries of the universe and our environment. As a U.S. Department of Energy multidisciplinary national laboratory, Brookhaven Lab is committed to conducting its dual mission of research and education in a safe and environmentally responsible manner with the cooperation, support, and involvement of the surrounding community.

Since March of 1998, the Laboratory has been operated by Brookhaven Science Associates, a partnership between the Research Foundation of the State University of New York at Stony Brook and the Battelle Memorial Institute, on behalf of DOE. Brookhaven Lab is located near the geographical

center of Suffolk County, Long Island, New York. Of the property's 5,265 acres, about 1,650 have been developed to accommodate the Laboratory's 360 buildings and facilities; the balance of the site is woodland.

The Laboratory occupies 5 percent of the Central Pine Barrens protection area of Long Island, a unique ecosystem of forests and wetlands. The Upton Ecological and Research Reserve was established on site in 2000 to study and manage 530 acres in support of ecological research and habitat enhancement.

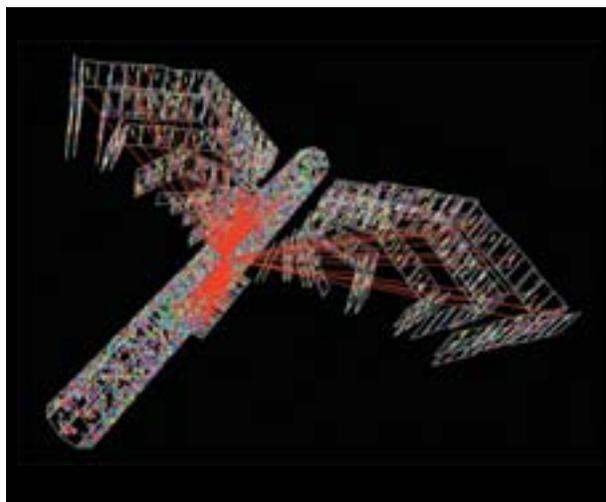
As part of its scientific mission, the Laboratory:

- Conceives, designs, constructs, and operates complex, leading-edge, user-oriented facilities in a safe and environmentally responsible manner that is responsive to DOE and the needs of its international community of users
- Carries out basic and applied research in long-term programs

at the frontier of science that support DOE missions and the needs of the Laboratory's user community

- Develops advanced technologies that address national needs and transfers them to other organizations and to the commercial sector
- Disseminates technical knowledge to educate new generations of scientists and engineers, to maintain technical capabilities in the nation's workforce, and to encourage scientific awareness in the general public.

As part of its operations, Brookhaven Lab maintains extensive environmental protection programs. The Laboratory and DOE work closely with environmental regulators to ensure that current operations minimize environmental impacts, and to remediate areas where past operations have had an impact on the environment.



*Collision event recorded by the BRAHMS detector at Brookhaven's Relativistic Heavy Ion Collider.*



*IBM researcher Jean Jordan-Sweet studies silicon germanium samples using x-rays at Brookhaven's National Synchrotron Light Source.*

## scientific discovery

---

Brookhaven Lab is one of the world's outstanding research facilities. For more than 55 years, it has been home to discoveries in physics, chemistry, biology, medicine, materials science, advanced technology, and environmental science. Prior to 1947, the site served as a U.S. Army training camp called Camp Upton, which was active from 1917–1920 during World War I and 1940–1946 during World War II.

Today, Brookhaven Lab is well known for the large-scale scientific machines it builds and operates, including accelerators, electron microscopes, and medical imaging devices. The newest Laboratory facility, a particle accelerator called the Relativistic Heavy Ion Collider (RHIC), will keep Brookhaven at the forefront of nuclear physics. The basic scientific research conducted at these “big machines” provides a solid foundation for the advancement of human knowledge and the potential for future scientific innovations.

The Laboratory currently runs more than 600 research programs in fields ranging from high-energy physics to drug addiction and global climate change. Brookhaven Lab has approximately 3,000 employees, including scientists, engineers, technicians, and support staff, and, in 2001, operated on a budget of approximately \$450 million. In 2001, the Laboratory purchased more than \$24 million in Long Island goods and services, and employee salaries and fringe benefits represent 57 percent of

the annual budget. Much of that money is returned to the local economy, as more than 75 percent of the Laboratory's employees live within a 15-mile radius of the site.

The Laboratory's own scientists, and more than 4,000 visiting scientists from the United States and abroad who come to Brookhaven Lab to conduct research each year, have used its diverse facilities to contribute greatly to humankind's knowledge of the world and the universe. Four Nobel Prizes in physics have been awarded for discoveries made at the Laboratory.

Some of Brookhaven Lab's many scientific accomplishments include:

- Nobel-prize winning discoveries of the muon neutrino and the J/psi particle
- Highest energy density ever created in a laboratory
- First evidence of a significant deviation from the standard model of particle physics
- Development of pollution-eating bacteria
- Development of asbestos-digesting foam
- Use of L-dopa in treating Parkinson's disease
- Drug studies that may lead to treatment for cocaine and nicotine addiction
- Brain-scan studies of addiction, mental illness, obesity, and aging
- First images of the AIDS virus attacking a human cell.



In July 2001, the Laboratory became registered to the globally recognized ISO 14001 environmental standard.

## environmental stewardship

Along with scientific discoveries, Brookhaven Lab’s research activities produce wastes, effluents, and emissions that are carefully controlled to prevent harm to employees, the neighboring community, and the environment. Current programs seek to minimize and carefully manage the impact of Laboratory operations. Although some historical operations and waste management practices have led to “legacy” soil and groundwater contamination, Brookhaven Lab has extensive programs in place to identify, contain, and clean up these areas.

In 2001, Brookhaven Lab continued to enhance and implement an environmental management system to ensure that it operates in an environmentally responsible manner. In July 2001, the Laboratory became officially registered to the globally recognized ISO 14001 environmental management standard, affirming Brookhaven Lab’s leadership position as the first Long Island–based operation and the first DOE Office of Science facility to achieve this goal. ISO 14001 requires an organization to identify potential environmental impacts and establish controls needed to minimize them, to monitor and communicate environmental performance, and to establish a formal process for continually improving the system.

In order to achieve registration, the Laboratory’s environmental management system was independently audited to verify that the system met all ISO requirements and that it was effectively imple-

mented. To maintain accreditation, this type of auditing must be repeated each year.

Brookhaven Lab’s Environmental Monitoring Program, which has been in place for several decades, has been expanded over the past three years to evaluate current programs protecting the environment and help assess potential impacts. Monitoring also ensures adherence to regulatory and permit limits. In the Environmental Restoration Program, monitoring measures the impact of past operations and ensures that remedial measures are effective.

Brookhaven Lab works closely with county, state, and federal agencies—including the Suffolk County Department of Health Services, the New York State Department of Environmental Conservation, and the U.S. Environmental Protection Agency—to extensively test air, soil, sediment, groundwater, surface water, flora, and fauna on and near the Laboratory. The test results, summarized in this booklet and published in depth in the annual *Site Environmental Report*, provide an assessment of Brookhaven Lab’s environmental performance in 2001.

**2001 National DOE Pollution Prevention Awards**

The “Process Evaluation Project,” completed in May 2000, was a systematic environmental assessment of all waste-generating operations and experiments at the Laboratory. This assessment used specialized tools called process maps to evaluate every step of an industrial operation or experiment, to identify wastes, effluents, and emissions generated, and to pursue pollution prevention opportunities. Approximately 145 industrial operations and more than 1,800 experiments were initially evaluated; of these, more than 260 opportunities for pollution prevention were identified. Ninety-seven of these opportunities were determined to be technically feasible and to have a high probability of success. Seventy-six opportunities were affordable and were acted on quickly; 21 others that required substantial funding were prioritized and are being funded through Brookhaven Lab’s Pollution Prevention Program.

The “EMS Principles Leading Change” award was for the ongoing effort to fully integrate environmental stewardship into all facets of the Laboratory’s operations. The runner-up project, “Preparing for High Flux Beam Reactor Facility Stabilization,” saved more than \$300,000 in disposal costs by finding alternative uses for equipment and supplies that were once part of the former High Flux Beam Reactor.

## pollution prevention

A strong pollution prevention and waste minimization program is an essential element of Brookhaven Lab’s environmental management system and an integral part of the Laboratory’s operating philosophy. Recognizing Brookhaven Lab’s strong commitment to reducing waste and protecting the environment, in 2001 DOE awarded the Laboratory two prestigious national pollution prevention awards for the “Process Evaluation Project” and “Environmental Management Systems Principles Leading Change” project. A third project, “Preparing for High Flux Beam Reactor Facility Stabilization,” was selected as a runner-up in the DOE national awards program. In addition to the DOE awards, Region II of the Environmental Protection Agency also recommended both projects for inclusion in President Clinton’s Library of Accomplishments.

Brookhaven Lab’s Pollution Prevention Program reflects national and DOE pollution

prevention goals and policies, and represents an ongoing effort to make pollution prevention and waste minimization an integral part of the Laboratory’s operating philosophy. Key elements of the program are:

- Eliminating or reducing wastes, effluents, and emissions at the source where possible
- Ensuring that environmental effluents, emissions, and wastes are as low as is reasonably achievable
- Procuring environmentally preferable products (also known as “affirmative procurement”)
- Conserving natural resources and energy
- Reusing and recycling materials
- Meeting pollution prevention goals, saving money, and increasing awareness of the program.

Implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has significantly reduced waste volumes as well as

associated costs. In 2001 alone, these efforts saved nearly \$1.39 million and reduced, recycled, or reused approximately 1.95 million pounds of materials.

Brookhaven Lab’s energy management group continued to implement new projects and initiatives to reduce the use of electricity and fossil fuels. Highlights included the completion of a new compressed natural gas fueling facility for Laboratory vehicles and the connection of several buildings to the chilled water facility, eliminating the need for two large, outdated chlorofluorocarbon water chillers.

In 2001, the Laboratory also participated in the Long Island Power Authority Peak Load Reduction Curtailment Program by agreeing to reduce electrical demand during critical days throughout the summer when the utility company expects user demand to meet or exceed the available supply. Overall, the Laboratory’s energy savings for 2001 were \$15,000,000.

### Scientists Help Prevent Pollution

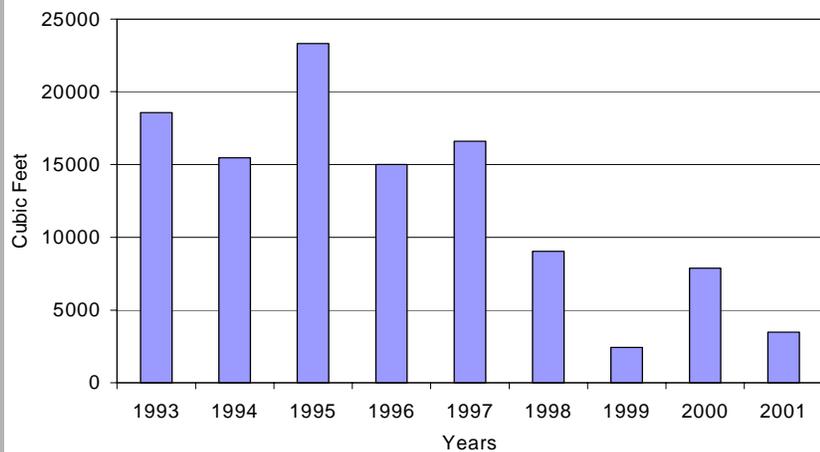
The Biology Department's Dieter Schneider was one of several Brookhaven scientists who came up with winning pollution prevention ideas in 2001. As a user of the protein crystallography beam lines at Brookhaven Lab's National Synchrotron Light Source, Schneider saw an opportunity to improve methods used by crystallographers to prepare derivatives of proteins and protein crystals for analysis, and to reduce the wastes generated by that process. At that time, a wide variety of heavy metal solutions were used for this purpose, and the tracking and disposal of these often-toxic metallic solutions was an involved and expensive process.

Schneider recognized that many of these heavy metal solutions could be replaced by nontoxic xenon gas, which would eliminate the need for researchers to prepare, manipulate, and dispose of toxic substances and residues. He proposed the purchase of a commercially available \$3,500 xenon pressure cell and gas recovery unit, which was expected to immediately cut the amount of hazardous waste generated at Brookhaven Lab by more than 120 gallons per year and avoid more than \$2,000 in disposal costs in the first year alone, with the ability to substantially increase those savings in the future.

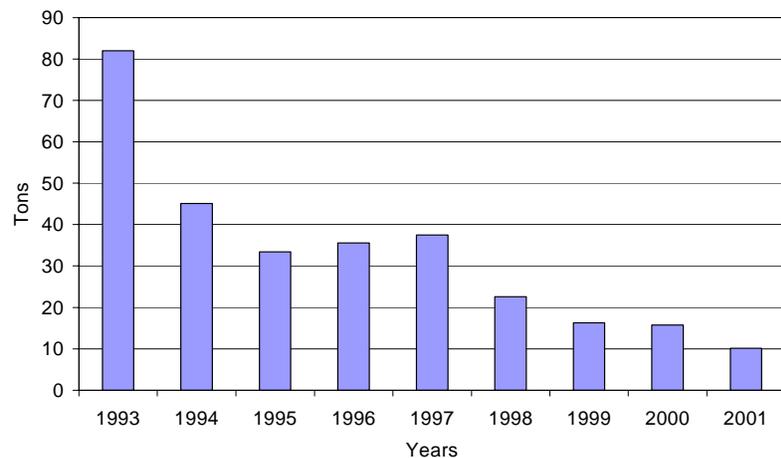
Each year since 1991, Brookhaven Lab has asked employees to submit proposals for reducing wastes, effluents, and emissions, thereby protecting the environment and cutting associated costs. In 2001, seven out of 11 proposals were selected. Although they will cost \$113,000 to implement, the expected return on this investment is \$155,500 per year.

Pollution prevention planning has been incorporated into all of Brookhaven Lab's work planning processes, including experimental safety reviews, facility design reviews, and routine work planning. This approach is beginning to produce excellent results; the number of pollution prevention project proposals being generated by scientific research staff is up nearly 300 percent since 1999.

*Hazardous Waste Generation Trends, 1993–2001*



*Radioactive Waste Generation Trends, 1993–2001*



### RADIATION AND BROOKHAVEN

Radiological materials are used in many research activities conducted at the Laboratory. This section explains Brookhaven Lab's maximum possible contribution to the radiation dose that a member of the public might receive in any given year and compares that dose to other typical radiation exposures.

*What radiation dose might I receive each year?*

The radiation dose received by a person is commonly expressed in "rem" or "millirem" (a millirem is one-thousandth of a rem). The average U.S. (and Long Island) resident's radiation dose from natural sources is approximately 300 millirems per year. This originates from natural cosmic and terrestrial radiation, radon, and minerals in food, water, and air. The average U.S. resident is also exposed to about 60 millirems per year from manmade sources, including medical procedures and consumer products. People who smoke tobacco receive a much higher dose, as do people who live in areas where radon is prevalent in the soil or at high altitudes where cosmic radiation is not so effectively shielded by the atmosphere. Here are some examples of radiation doses from common sources, in millirem per year:

- Cigarette smoking (one pack per day) — 1,300
- Radon from the ground — 200
- Minerals in water, food, and air — 40
- Cosmic radiation — 26
- Chest x-ray — 9
- Fallout from historical worldwide nuclear weapons testing — 1

*What radiation dose might I receive from Brookhaven Lab?*

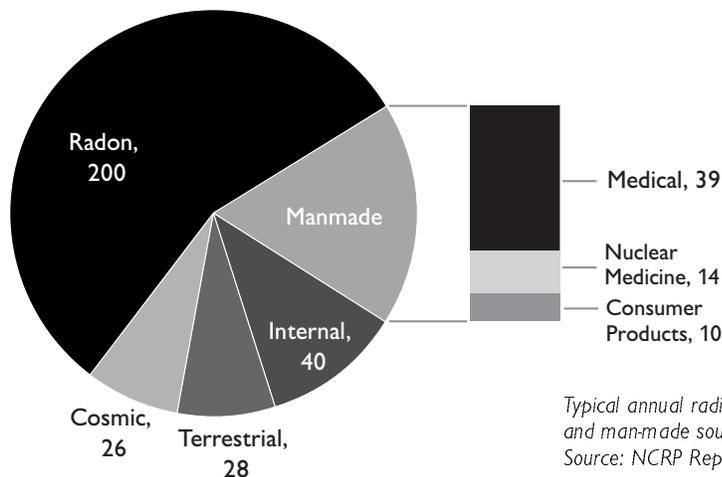
The largest hypothetical radiation dose that a member of the public could receive in 2001 from all pathways potentially affected by Brookhaven Lab operations—including air, water, deer, and fish at the Laboratory—is 2.5 millirems. This is about one percent of the dose Long Island residents receive from natural sources of radiation each year, and three percent of the limit set by DOE for man-made sources of radiation. The radiation dose is

calculated for a hypothetical person living at the Laboratory boundary for the entire year, eating 64 pounds of local deer meat and 15 pounds of fish caught on site. The largest portion of this worst-case dose (2.3 millirems, or 92 percent) would result from eating deer meat. (Testing of deer killed by cars on and near Laboratory grounds, and by hunters near the site, shows elevated amounts of cesium-137 in the meat.) However, a person could eat four times as much (256 pounds) and still not exceed the New York State Department of Health "action level" of 10 millirems. In 1999, the state department of health formally concluded that there was no reason to issue health restrictions on consumption of deer taken near the Laboratory. (Hunting is not allowed on site, but deer typically range up to one mile.) The N.Y. State Department of Environmental Conservation and Brookhaven Lab have informed hunters of the test results so they may make their own decisions about whether to eat meat from deer taken near the site.

The radiation dose a person would receive from eating 15 pounds of fish containing cesium-137 at the highest level seen in any part of the Peconic River system would be 0.1 millirem. This dose can be compared to the dose of about 40 millirems a person receives annually from naturally occurring radionuclides in food, air, and water. The maximum credible radiation dose a member of the public could receive due to Laboratory air emissions in 2001 was 0.1 millirem.

The internal radiation dose from drinking groundwater was expected to be zero. No radionuclides at levels above the EPA's drinking water standards have been detected off the Laboratory site. On site, there are pockets of groundwater that contain radionuclides; these areas are regularly monitored and drinking water is not drawn from these areas.

For a person to be exposed to even the low levels cited above is an extremely unlikely "worst case" scenario. In reality, it is unlikely that anyone receives the maximum dose from any one pathway and implausible that anyone receives all of the individual pathway doses together.



Typical annual radiation doses from natural and man-made sources (in millirems).  
Source: NCRP Report No. 93 (NCRP 1987)

# environmental compliance

Brookhaven Lab is committed to complying with all applicable environmental requirements, including local, state, and federal regulations and permits, as well as DOE orders. Complying with these requirements helps eliminate or minimize any impact that the Laboratory's operations might have on the environment.

Many processes and facilities at Brookhaven Lab are subject to regulatory and permit requirements. The Laboratory must comply with over 50 sets of regulations and 65 site-specific operating permits. Major federal environmental laws and regulations that govern operations at the Laboratory include the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, and the Resource Conservation and Recovery Act, among many others.

Brookhaven Lab's environmental monitoring results and its compliance with these environmental requirements in 2001 are discussed on the following pages.

## AIR MONITORING

The Laboratory's emissions to the air are governed by state and federal standards and monitored both at the point of emission and, in the case of radioactive elements, at many locations on the Laboratory site and in the surrounding area. This monitoring has shown that Brookhaven Lab's air emissions are well below the standards set by regulators to protect human health.

### Nonradiological Air Emissions

Brookhaven Lab tracks all of its major sources of air emissions. The Central Steam Facility is the only Laboratory emission source requiring continuous monitoring for nonradiological emissions. In 2001, all airborne emissions were in compliance with the requirements of the Clean Air Act.

### Radiological Air Emissions

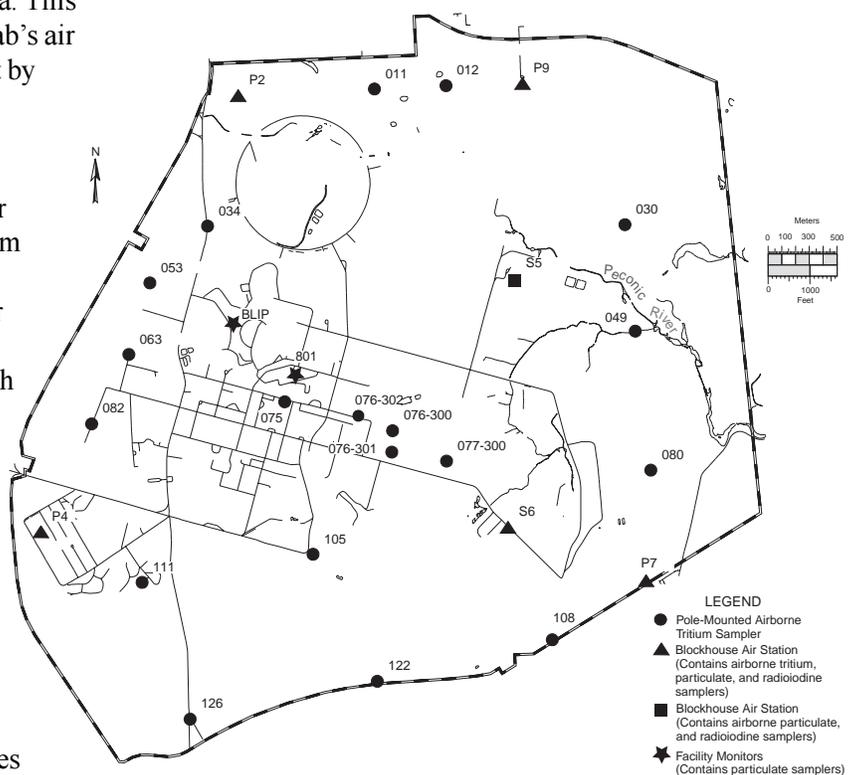
As part of the environmental monitoring program, the Laboratory maintains an array of monitoring stations around the site. Ambient air samples are collected to determine radiological air quality and ensure that environmental impacts from Brookhaven Lab operations are minimized. More than 1,000 air samples were collected on site during 2001. Analytical

results indicated that airborne radionuclide levels around the Laboratory site were consistent with control location data reported by the New York State Department of Health. (Control locations are areas in New York State not located near nuclear facilities.)

With the permanent shutdown of the Laboratory's last two operating reactors, the High Flux Beam Reactor (in 1999) and the Brookhaven Medical Research Reactor (in 2000), the already-low levels of radionuclides emitted from these facilities will continue to decline over time.

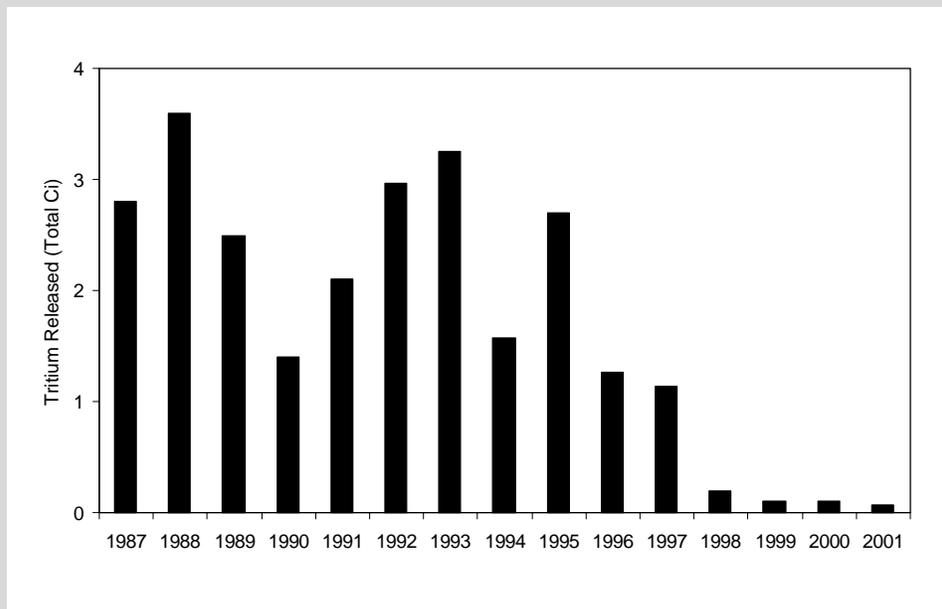
### External Radiation Measurements

Brookhaven Lab monitors external radiation exposure at 41 on-site and 17 off-site locations. These monitors measure cosmic and terrestrial radiation, as well as any contribution from Laboratory operations. On-site measurements were statistically indistinguishable from off-site measurements in 2001, verifying that Brookhaven Lab's operations had no impact on the external radiation levels as measured on the Laboratory site or in the surrounding area.



On-site ambient air monitoring stations.

*Tritium released to the Peconic River, 1987–2001.*



### **SURFACE WATER QUALITY**

Brookhaven Lab routinely monitors liquid effluents at 21 locations on the site. This ensures compliance with all applicable permits and laws, and continued protection of the environment, including area groundwater and the Peconic River.

The headwaters of the Peconic River flow through the Laboratory grounds, fed by groundwater and the treated effluent from the sewage treatment facility. During most of the year, the river generally runs dry before reaching the site boundary. Liquid discharges from Laboratory operations are released to the environment and monitored under a permit from the New York State Department of Environmental Conservation, either as surface water releases to the Peconic River after processing at the treatment plant or as direct releases from certain facilities to recharge basins on the property. To ensure continued protection of the environment, the Laboratory has established administrative controls that are even more protective than required by the regulatory agencies.

Samples of water and sediment from the Peconic River and nearby ponds are collected routinely at several locations on and off the site. The Carmans River and other bodies of water are used as control locations against which the Peconic River is compared.

### **Nonradioactive Discharges**

Treated sewage discharges are monitored and tested for 28 organic and inorganic compounds and water-quality parameters. In 2001, Brookhaven Lab achieved a compliance rate of greater than 99 percent for liquid discharges. The few exceptions did not affect the environment nor employee or public health.

Iron, aluminum, silver, and zinc were occasionally detected at levels above water quality standards in the Peconic River on site. However, similar samples from upstream, downstream, and control locations demonstrated that the elevated levels are a result of natural geology.

From January through March, zinc levels in effluent from the sewage treatment facility exceeded permit limits. The cause was traced to a project to replace outdated sewer lines; sludge that had trapped zinc over the years was dislodged when the old sewer lines were removed. In addition, new liners installed on several sewers had been manufactured using low levels of zinc, which added to the overall levels seen at the treatment plant.

No volatile organic compounds were routinely detected in either the Peconic or Carmans rivers in 2001. Except for occasional variations in pH (acidity) levels, due to the low pH of stormwater runoff and high pH in “softened” water for the on-

site apartments and dormitories, all recharge basin discharges complied with state permits.

During 2001, the Laboratory's Environmental Surveillance Program also confirmed the presence of a significant area of lead contamination at one of the recharge basins. The contamination, attributable to historic operations at the Lab's steam plant, is currently being investigated and will be addressed under the Environmental Restoration Program.

**Radioactive Discharges**

Levels of all radioactive elements in treated discharges to the Peconic River were well below drinking water standards in 2001. Tritium was not detectable in off-site river water. On site, the annual average tritium concentration in the sewage plant effluent was 136 picocuries per liter, which is about 0.7 percent of the New York State drinking water standard. (A picocurie is one-trillionth of a curie.) In all, less than one-tenth of one curie of tritium was

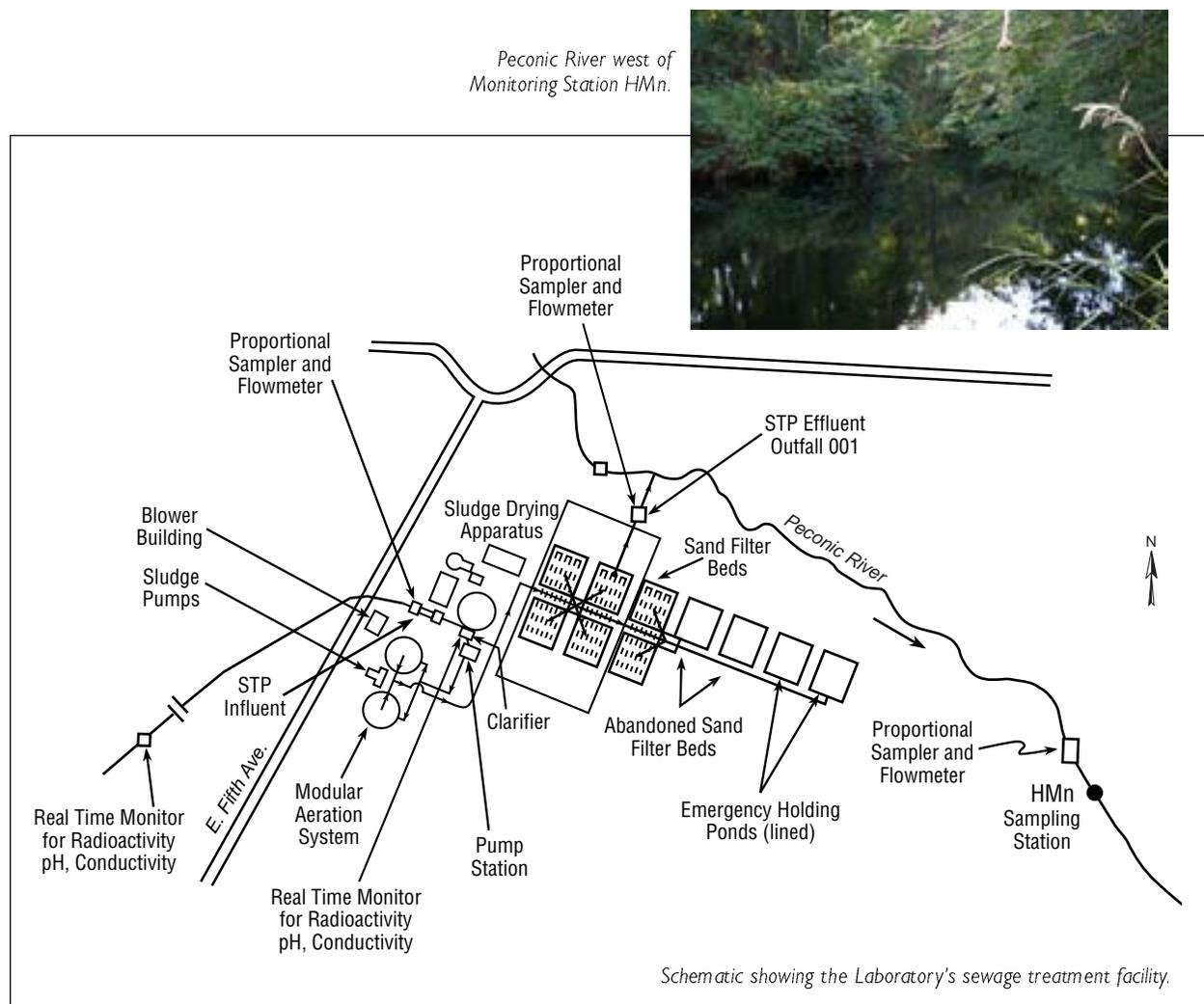
released in sewage plant effluent in 2001. This level is almost 30 percent less than the discharge recorded for 2000, and is the lowest total since routine monitoring began in 1966.

No radionuclides attributable to Brookhaven Lab operations were detected in off-site surface water samples collected along the Peconic River.

**Sediment Analyses**

Past releases have deposited "heavy metals" (such as mercury and silver) and low-level radioactivity in some Peconic River sediments on and near the Laboratory site. These locations are being addressed under the Laboratory's Environmental Restoration Program.

Sediment monitoring results in 2001 indicate that the concentrations of radionuclides in local waterways, including Flanders Bay and Peconic Bay, and Jamaica Bay and Lloyd Harbor (comparison locations), were consistent with global fallout patterns.



**GROUNDWATER PROTECTION**

On Long Island, groundwater is a vital resource. Brookhaven Lab is committed to protecting and restoring groundwater quality. In 2001, the Laboratory collected data from 714 groundwater-monitoring wells on and off the site. There were 2,739 samples collected for chemical and radiological analysis. The Environmental Restoration Program studies and tracks groundwater contamination, cleans up sources of contamination, and removes chemicals from groundwater before returning it to the aquifer.

In 2001, all drinking water at Brookhaven Lab fully complied with state and federal drinking water standards. Off site, most neighboring residents south and east of Brookhaven Lab receive their household water from the public water supply, which is regulated by the Suffolk County Department of Health Services. A few residents in these areas still use wells, having declined free hookup to the public water supply. DOE offers these households free yearly testing of their well water.

**Groundwater Monitoring**

In addition to implementing aggressive pollution prevention measures to protect groundwater re-

sources, Brookhaven Lab has an extensive groundwater monitoring well network to verify that prevention and remediation activities are effective. Groundwater beneath the northeast and northwest sections of the Laboratory site flows toward the Peconic River. Beneath the western portion of the site the flow is generally to the south, and groundwater beneath the southern and southeastern portions of the site also tends to flow toward the south or southeast.

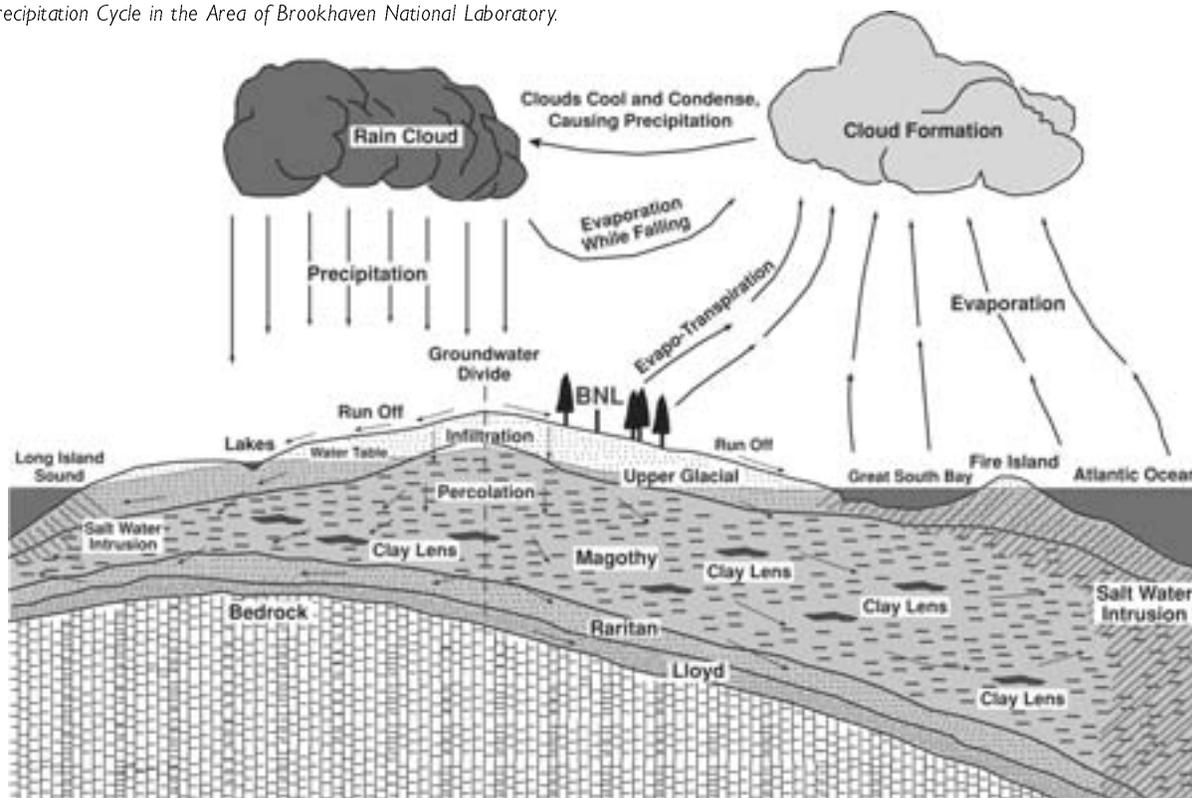
**Nonradiological Analyses**

In 2001, several locations on and off site continued to show volatile organic compounds at levels that exceed drinking water standards. Contamination in these “areas of concern” can be traced to past activities and events, such as former waste storage and disposal areas and known spills. These locations are being addressed under the Environmental Restoration Program (see page 17 for details).

**Radiological Analyses**

For most of the Brookhaven Lab property, groundwater samples from monitoring wells showed little or no detectable radioactivity. In some areas of

*Precipitation Cycle in the Area of Brookhaven National Laboratory.*



the Laboratory site, radionuclide levels in groundwater are above drinking water standards. This water is not used as a source of drinking water. DOE is working with regulatory agencies to study the groundwater in these areas and to formulate and carry out remediation plans that will reduce all radionuclide levels in groundwater to levels that meet drinking water standards.

**Active Facility Monitoring**

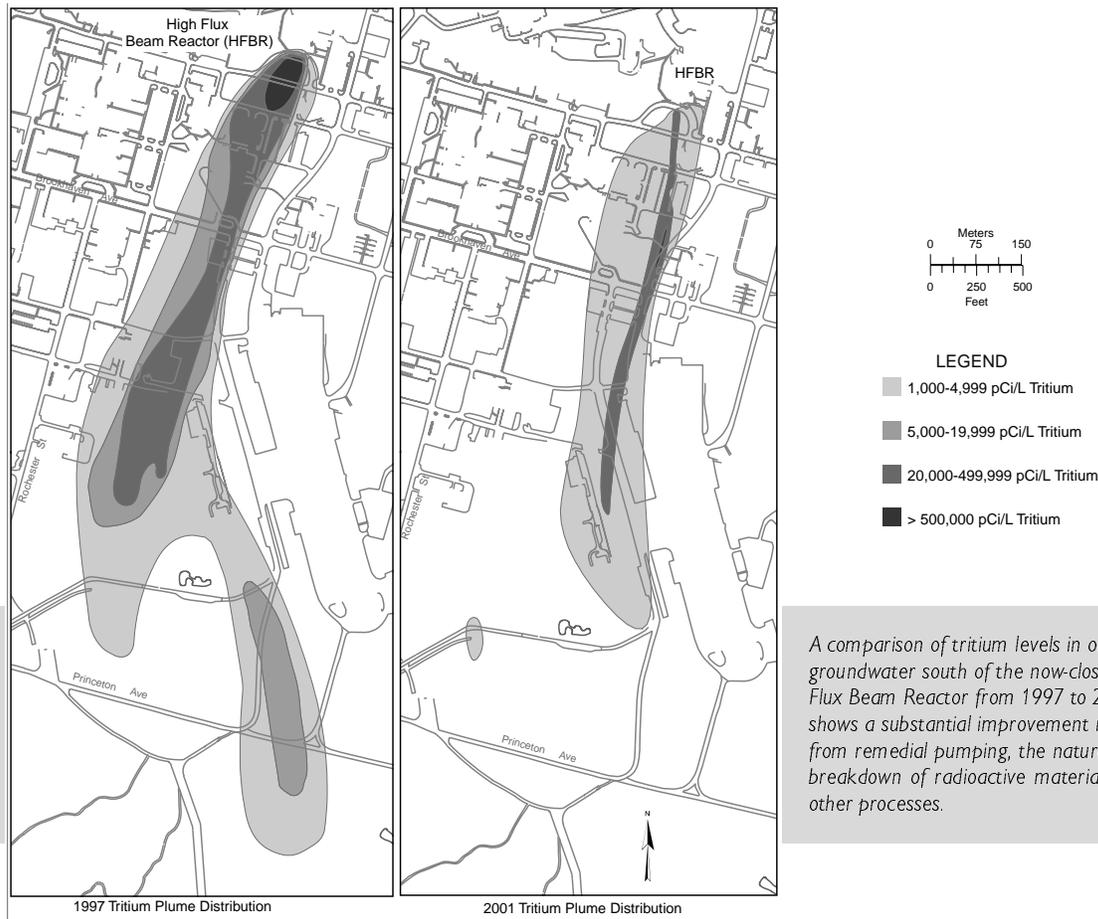
Brookhaven Lab continued to enhance programs to protect and monitor groundwater quality near operating facilities. To supplement existing programs, from 1999 through 2001 more than 120 new monitoring wells were installed near active research and support facilities. The improved groundwater-monitoring network provides timely information on the potential impacts, if any, that facility operations may have on groundwater quality, and on the adequacy of environmental protection measures.

In 2001, the Laboratory continued to track four

areas of groundwater contamination near the center of the site that were originally detected by these new monitoring wells. The Laboratory has thoroughly investigated the causes of the contamination and has taken corrective actions to eliminate or limit impacts.

**QUALITY ASSURANCE**

Brookhaven Lab follows strict quality assurance and control measures for its environmental monitoring programs. All analytical laboratories used are certified by the State of New York. Quality control is maintained in the laboratories through daily instrument calibration, efficiency and background checks, and testing for precision and accuracy. The two primary laboratories reporting radiological analytical data each scored between 92 percent and 100 percent satisfactory results in both state and federal performance evaluation programs. For nonradiological performance evaluation testing, the laboratories each scored over 93 percent in the 2001 New York State Environmental Laboratory Approval Program evaluations.



*A comparison of tritium levels in on-site groundwater south of the now-closed High Flux Beam Reactor from 1997 to 2001 shows a substantial improvement resulting from remedial pumping, the natural breakdown of radioactive material, and other processes.*

## wildlife

Brookhaven Lab is committed to managing its programs in a manner that protects the environment, including state “endangered” or “threatened” species such as the tiger salamander and the banded sunfish. To assess the impact of past and current operations on local wildlife and vegetation, the Laboratory and its regulatory agencies conduct a range of sampling programs each year. In 2001, these programs collected and analyzed fish and deer on site, near the Laboratory, and from comparison locations farther from Brookhaven Lab.

### Fish Sampling

Brookhaven Lab worked with the New York State Department of Environmental Conservation to sample fish from a portion of the Peconic River on site, as well as from other nearby locations.

In the on-site portion of the river and in areas just beyond the Laboratory’s boundary, fish were found to have accumulated low levels of mercury, PCBs, and cesium-137. The New York State Department of Health has evaluated the Peconic River fish data and concluded that they do not merit an upgrade from the general fish advisory for all New York State rivers and ponds, including the Peconic. The general fish advisory states that no more than one meal (one-half pound) per week of fish should be consumed from any freshwater location in New York State.

The heavy metal, PCB, and radioactive contaminants in the Peconic River are a result of historical Brookhaven Lab effluent discharges, with most of these contaminants (except for tritium) being released between the late 1950s and early 1970s. Since the state began measuring radionuclide levels in Peconic River fish (in 1974), there has been a continuing decrease in radionuclide concentrations in all fish species tested.



Monitoring the fish population in the Peconic River.

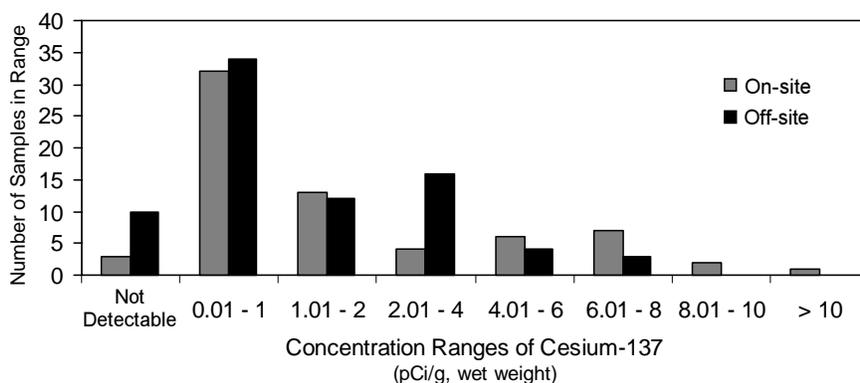
In 2001, Brookhaven Lab suspended on-site fish sampling because several years of sampling have depleted the population and limited the size of the remaining fish. The Laboratory will continue to monitor the on-site fish population to determine when routine sampling may resume.

### Deer Sampling

In 2001, in collaboration with the New York State Department of Environmental Conservation and the U.S. Fish & Wildlife Service, Brookhaven Lab continued to measure radioactivity in deer killed in auto accidents or by off-site hunters.

As in prior years, and as might be expected because of historical low-level cesium-137 contamination in some Brookhaven Lab soils, cesium-137 concentrations in deer meat were somewhat greater in deer sampled on site and within one mile of the site compared to those sampled from farther away. No other Brookhaven Lab-generated radionuclides were detected in the analyzed deer samples. The level of

Five-year trend of average cesium-137 concentrations in meat taken from on- and off-site deer, 1997–2001.



cesium-137 detected in all deer samples was low and is not harmful to the deer.

The Laboratory began testing deer bone (when available) for strontium-90 content during 2000 and continued the program in 2001. Strontium-90 levels were comparable in both on-site and off-site samples, suggesting that the likely source is worldwide fallout from past nuclear weapons testing.

Brookhaven Lab will continue to test for strontium-90 in bone to build baseline information on this radionuclide and its presence in deer on and around the Laboratory site.



*The tiger salamander (Ambystoma t. tigrinum), banded sunfish (Enneacanthus obesus), and swamp darter (Etheostoma fusiforme) are among the New York State-endangered and/or threatened species that inhabit the Laboratory site.*

#### **Marine/Estuarine Sampling**

Annual sampling of mussels, sediment, and seawater from the Peconic Bay, Flanders Bay, and Moriches Bay (a comparison location) continued in 2001. The naturally occurring radionuclide potassium-40 continues to be the only radionuclide observed in these samples. Additionally in 2001, estuarine vegetation located in the Peconic Bay area was sampled, with potassium-40 again the only radionuclide observed. No Brookhaven Lab-generated radionuclides have been detected in marine samples since 1992, when sampling began.

#### **Vegetation Sampling**

Farm vegetable sampling was conducted again in 2001. Samples were collected from farms near Brookhaven Lab, and apples and garden vegetables grown on site were also tested. As in the past, no radionuclides attributable to Laboratory operations were observed in produce. Potassium-40, which occurs naturally, was the only radionuclide detected in the produce sampled, and it was found at levels comparable to those seen in nearby and control locations.

#### **Natural Resource Management Program**

Wildlife management planning begins with a strong understanding of environmental resources. The Central Pine Barrens Commission conducted a natural resource inventory of the Brookhaven Lab site based on data collected between 1970 and 1990. In 2001, through funding managed by the



U.S. Fish & Wildlife Service, the entire Laboratory property was surveyed using the National Vegetation Standard, and a new vegetation map was produced that clearly identifies the major vegetation complexes and their extents. An additional tool provided with the vegetation map allows users to predict distributions of key animal species based on the presence of suitable habitat.

In 2001, the Laboratory conducted its second year of routine monitoring of songbirds at five permanent bird survey routes in various habitats on site. Monthly surveys were conducted starting at the end of March and extending to the end of October 2001. The 2001 surveys resulted in the identification of 73 species during the year—20 more species than in the 2000 surveys. Brookhaven Lab also installed an additional 10 bluebird boxes around open grassland areas of the site to enhance the population of the eastern bluebird, bringing the total number of boxes to 36. The bluebird has been identified as one of the declining species of migratory birds in North

America due to loss of habitat and nest site competition by European starlings and house sparrows. In 2001, bluebirds used 19 of the boxes.

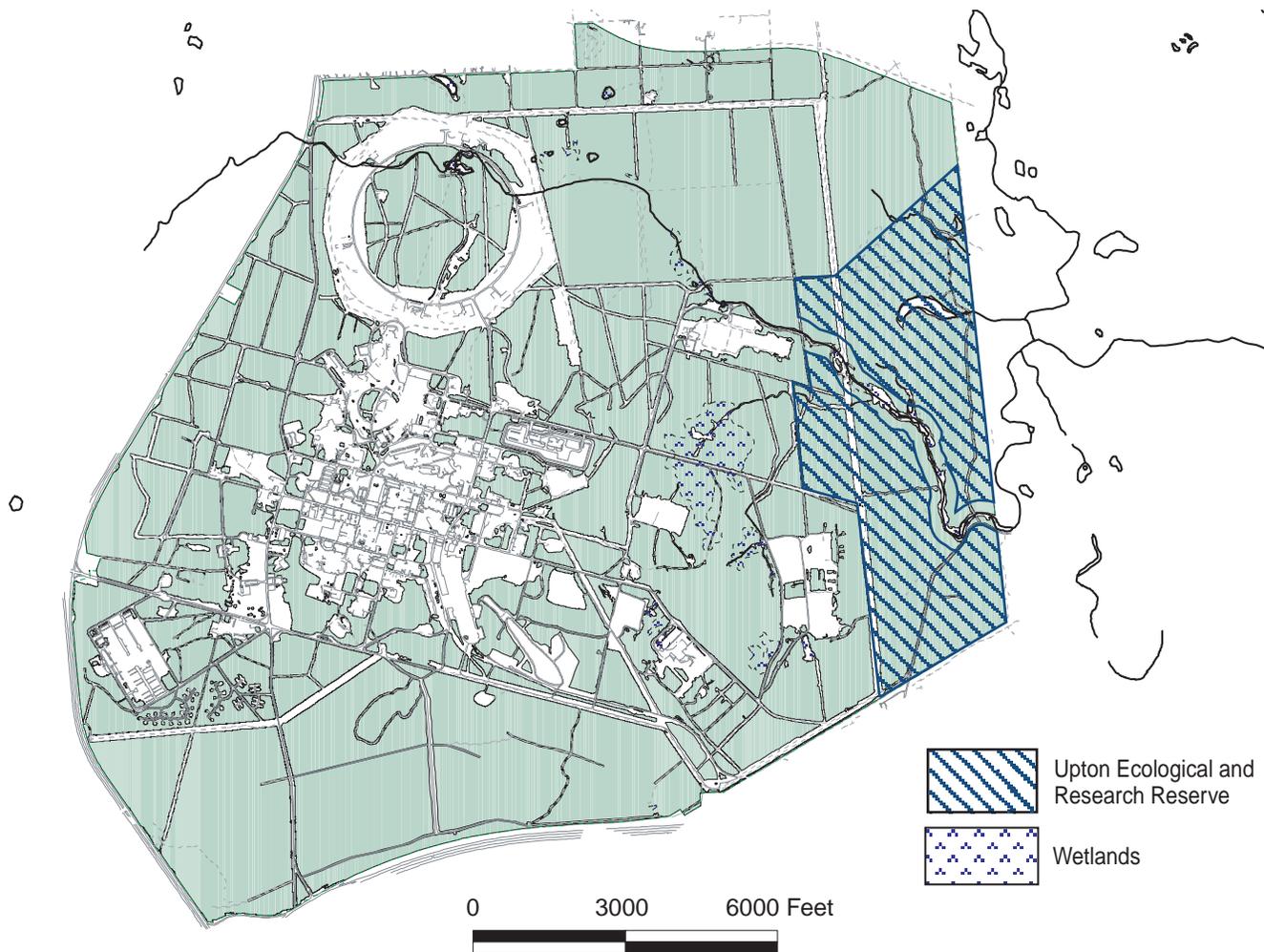
The forested areas of the Laboratory also provide good nesting and foraging habitat for wild turkey, and their population on the Laboratory site continued to grow in 2001. Estimated to be between 60 and 80 birds two years earlier, the population had grown to approximately 250 birds by the end of 2001.

**Upton Ecological and Research Reserve**

On November 9, 2000, then-DOE Secretary of Energy Bill Richardson designated 530 acres of the Laboratory site as the Upton Ecological and Research Reserve. Through a partnership between DOE and the U.S. Fish & Wildlife Service, the Upton Reserve set aside 10 percent of Brookhaven

Lab's property for conservation and research. The reserve provides habitat for approximately 28 New York State endangered, threatened, or "special concern" species, including the eastern tiger salamander and the banded sunfish. Other wildlife species that inhabit this area include the wild turkey, red fox, eastern box turtle, and the red-tailed hawk.

By the end of 2001, a technical advisory group, established to assist Brookhaven Lab with the development of its natural resource management plan for the reserve, had approved two initial research proposals. One was to investigate the physiological responses of oak trees to fall defoliation caused by the orange-striped oakmoth caterpillar. The second proposal was to investigate why some plants are more invasive than others.



The 650-acre Upton Ecological and Research Reserve includes most of the undeveloped eastern portion of the Brookhaven site.

## environmental restoration

---

Brookhaven Lab is committed to defining, prioritizing, and aggressively correcting and cleaning up existing environmental problems. Areas of the site where past activities caused groundwater, soil, and sediment contamination continued to undergo monitoring and cleanup in 2001 under Brookhaven Lab's Environmental Restoration Program. State and federal regulatory agencies oversee this program, and the Suffolk County Department of Health Services also plays a significant role.

Year 2001 Environmental Restoration Program highlights include:

- A new on-site groundwater treatment system was brought online during 2001. The new system is helping the Laboratory meet its cleanup goals of preventing or minimizing the spread of groundwater contamination and restoring the aquifer to drinking water standards.
- Six operating on- and off-site groundwater treatment systems cleaned more than one billion gallons of groundwater and removed more than 600 pounds of chemicals from the aquifer. Over the past five years, more than 2,900 pounds of chemicals have been removed from the aquifer.
- Major steps in the decommissioning of the Brookhaven Graphite Research Reactor were completed, including removal of contaminated, aboveground sections of air ducts.
- The Laboratory and its regulatory agencies signed two "Records of Decision" that authorized Brookhaven Lab to begin cleaning up contaminated soils, sewer lines, and groundwater associated with the Laboratory's sewage treatment plant, as well as groundwater contaminated with pesticides near North Street in Manorsville.



*Aboveground air ducts being removed from the Laboratory's former graphite reactor.*



*The Middle Road groundwater treatment system, one of six on- and off-site systems, began operating in October 2001.*

**BROOKHAVEN NATIONAL LABORATORY**  
**2001 Site Environmental Report**

Name: \_\_\_\_\_

\_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Phone: \_\_\_\_\_

Affiliation, if any: \_\_\_\_\_

\_\_\_\_\_

Comment(s): \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Please add me to your mailing list.

I would like to ask a question or make a comment: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



---

## community outreach/feedback

---

Along with the annual publication of the *Site Environmental Report* and this summary booklet, Brookhaven Lab's public outreach activities include monthly briefings for local civic associations; presentations to local, state, and federal regulators and elected officials; and regular interactions with the business and educational communities. The Laboratory also issues press releases, publishes *The Bulletin* (the Laboratory's weekly newspaper) and *cleanupdate* (a newsletter on environmental restoration), sends e-mail updates informing the public and staff about environmental activities, and has a wealth of information about its environmental programs on the Internet at <http://www.bnl.gov>.

In 2001, more than 25,000 visitors participated in educational and public outreach activities conducted on site. The Laboratory also celebrated the thirty-first anniversary of Earth Day with a variety of activities involving Brookhaven Lab staff and the community. These activities included environmental awards for employees who have demonstrated an outstanding effort in pollution prevention and waste minimization; a student art contest, with the winning artwork selected for inclusion in the *2001 Site Environmental Report*; and an on-site four-mile race through the Pine Barrens.

Brookhaven Lab was also named "Organization

of the Year" by the International Association for Public Participation, for integrating public participation into all aspects of its operations and for ensuring that stakeholders are kept informed and have a voice in decisions and issues that may affect them.

2001 was another year of continual improvement for Brookhaven National Laboratory, and the *Site Environmental Report* documents the progress the Laboratory has made in achieving its environmental stewardship goals. Brookhaven Laboratory continues its mission — to conduct world-class research in an environmentally responsible manner.

Please help guide us in providing the information you want about the Laboratory by filling out the feedback form above and mailing it to:

**Brookhaven National Laboratory**  
**Environmental Services Division**  
**SER Project Manager**  
**Building 120**  
**PO Box 5000**  
**Upton, NY 11973-5000**

## Earth Day 2001



a. Interim Director Peter Paul (left) gets ready to start the 4-mile Earth Day run through the Long Island Pine Barrens.

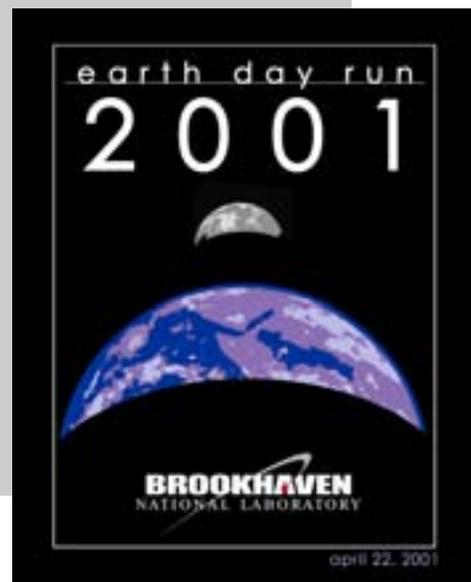
b. Runners start the 4-mile Earth Day race.

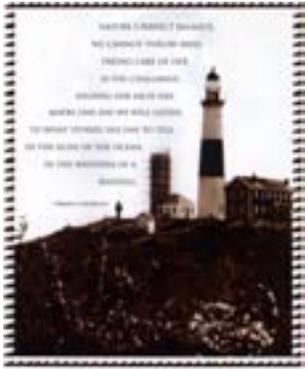
c. Runners reach the finish line after completing the 4-mile Earth Day race.



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

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





*Brian A. Morales*  
Patchogue-Medford High School  
Grade 11, Ms. Johnson  
Cover photo and poem



*Michael Lanuto*  
Ridge Elementary School  
Grade 4, Ms. Cohen  
Executive Summary



*Alexander Sneddon*  
Patchogue-Medford High School  
Grade 11, Ms. Johnson  
Chapter 1



*Channon Greenfield*  
Miller Place High School  
Grade 10, Ms. Meier  
Chapter 2



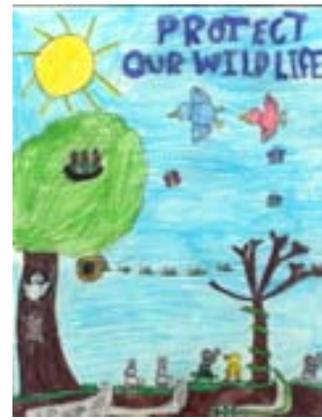
*Steven Manfro*  
Ridge Elementary School  
Grade 3, Ms. Cohen  
Chapter 3



*Kathleen Carey*  
Miller Place High School  
Grade 9, Ms. Meier  
Chapter 4



*Julissa Nunez*  
Coram Elementary School  
Grade 4, Ms. Kelly  
Chapter 5



*Maria Sigalas*  
Coram Elementary School  
Grade 4, Ms. Kelly  
Chapter 6



*John L. Knudsen*  
Ridge Elementary School  
Grade 3, Ms. Cohen  
Chapter 7



*Mariah E. Beltran*  
Coram Elementary School  
Grade 4, Ms. Kelly  
Chapter 8



*Erik Kahl*  
Ridge Elementary School  
Grade 3, Ms. Cohen  
Chapter 9

---

### About the Student Artwork

In celebration of the 32<sup>nd</sup> anniversary of Earth Day, students in grades K–12 from local schools, as well as children of BNL employees, were invited to participate in Brookhaven National Laboratory's third annual Site Environmental Report "Your Environment" Art Contest. The goal of the contest was to raise students' awareness about environmental stewardship, pollution prevention, and waste minimization, and to challenge them to develop artwork that focused on cleaning up and protecting our environment for the future. A panel of BNL staff was asked to choose artwork to represent this year's cover and the chapters of the full report (available on the CD ROM). The winning artists received U.S. Savings Bonds and all the students who participated received Certificates of Appreciation.

The Laboratory thanks all of the students and their teachers, principals, and parents for their commitment to preserving the environment. Shown on the adjacent page are the names of the students, their school, grade level, and teacher, and the chapter for which their artwork was chosen.



---

### About the Student Artwork

In celebration of the 32<sup>nd</sup> anniversary of Earth Day, students in grades K–12 from local schools, as well as children of BNL employees, were invited to participate in Brookhaven National Laboratory's third annual Site Environmental Report "Your Environment" Art Contest. The goal of the contest was to raise students' awareness about environmental stewardship, pollution prevention, and waste minimization, and to challenge them to develop artwork that focused on cleaning up and protecting our environment for the future. A panel of BNL staff was asked to choose artwork to represent this year's cover and the chapters of the full report (available on the CD ROM). The winning artists received U.S. Savings Bonds and all the students who participated received Certificates of Appreciation.

The Laboratory thanks all of the students and their teachers, principals, and parents for their commitment to preserving the environment. Shown on the adjacent page are the names of the students, their school, grade level, and teacher, and the chapter for which their artwork was chosen.