1 Introduction

Established in 1947, Brookhaven National Laboratory (BNL) is a multi-program national laboratory operated by Brookhaven Science Associates (BSA) for the U.S. Department of Energy (DOE). BSA, a nonprofit, limited-liability company founded in 1997 by Stony Brook University and Battelle Memorial Institute, 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 has a long, distinguished history as one of the top research laboratories in the world. For over 50 years, BNL researchers have successfully worked to visualize, construct, and operate large and unique scientific facilities and use the data generated to make advances in many fields. Under BSA's management, new programs in place at BNL emphasize improved environmental, safety, and health performance, including pollution prevention and waste minimization.

1.1 LABORATORY MISSION

BNL's broad mission is to produce world-class science in a safe and environmentally sound manner with the cooperation, support, and appropriate involvement of its scientific and local communities. The Laboratory supports DOE's strategic missions of carrying out basic and applied research in long-term programs. The Laboratory plays a lead role in the DOE Science and Technology mission and contributes to the DOE missions in Energy Resources, Environmental Quality, and National Security. The fundamental elements of BNL's role in support of these key DOE missions are:

- To conceive, design, construct, and operate complex, leading-edge, user-oriented research facilities.
- To develop advanced technologies that address national needs and initiate their transfer to other organizations and to the commercial sector.
- To disseminate technical knowledge to educate future generations of scientists and engineers.
- To maintain technical currency in the nation's workforce and encourage scientific awareness in the general public.

BNL's Environmental, Safety, Security, and Health (ESSH) Policy is the Laboratory's commitment to continual improvement in ESSH performance and is consistent with the Laboratory's research interests, ethics, and shared values. Environmental commitments in the policy include compliance, pollution prevention, cleanup, community outreach, and continual improvement. The complete policy can be found at http://www.bnl.gov/eshq/ESSH.asp.

1.2 RESEARCH AND DISCOVERIES

Primarily funded by DOE, BNL conducts applied research in nuclear and high-energy physics, chemistry and physics of materials, environmental and energy research, nonproliferation, neurosciences and medical imaging, and structural biology. Approximately 2,700 scientists, engineers, technicians, and support staff work at BNL, and more than 4,000 guest researchers from all over the world visit the site each year to participate in scientific collaborations. BNL also designs, builds, and operates major world-class research facilities that are available to university, industrial, and government personnel. In addition to BNL's current facilities, construction of a Center for Functional Nanomaterials (CFN) is planned to start in the spring of 2005, with building occupancy and technical equipment installation to begin in early 2007. One of five nanotechnology centers approved by DOE, it will provide researchers with state-of-the-art capabilities to fabricate and study nanoscale materials. The possible bene-fits of nanoscience include faster computers, improved solar energy conversion, stronger and lighter materials, improved chemical and biological sensing, efficient and rapid detection and remediation of pollutants and pathogens in the environment, more efficient catalysts to speed chemical processes, molecular motors, and new drugs.

To date, six Nobel Prizes, including the 2002 Nobel Prize in Physics and the 2003 Nobel Prize in Chemistry, have been awarded for discoveries made at BNL. Examples of current research being conducted at the Laboratory include pollution mitigating bacteria; structural studies of the Lyme disease protein for new vaccines; studies of the brain, including the roots of drug addiction, psychiatric disorders, and metabolism; asbestos-digesting foam; the invention of the quiet jackhammer, which won a 2000 Discover Award; promising cocaine addiction treatments; large-scale studies of the effect of increased carbon dioxide on ecosystems; cleaner, more efficient oil burners; testing of the impacts of space radiation on spacecraft parts; the investigation of the basic building blocks of matter; and testing the Standard Model of physics, a theory which attempts to explain the forces of nature such as gravity. Some important discoveries made at BNL include L-dopa, used to treat Parkinson's disease; Magnetically-levitated (maglev) trains; the use of x-rays and neutrons to study biological specimens; the radionuclide thallium-201, used in heart stress tests; the radionuclide technetium-99, used to diagnose heart disease; x-ray angiography for noninvasive heart imaging; and pioneering solar neutrino studies seeking the answer to the mystery of the "missing neutrinos from our solar system's sun, and neutrino bursts from supernovae." Further information regarding research and discoveries at BNL can be found at http://www.bnl.gov.

1.3 FACILITIES AND OPERATIONS

Most of BNL's principal facilities are located near the center of the site. The developed area is approximately 1,650 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

The balance of the site, approximately 3,600 acres, is mostly wooded and represents the native Pine Barrens ecosystem.

The major scientific facilities at BNL are briefly described in Figure 1-1. The three former research reactors, no longer operational, are discussed in Section 1.4. Additional facilities, shown in Figure 1-2 and briefly described below, support BNL's science and technology mission by providing basic utility and environmental services.

- *Central Chilled Water Plant*. This facility 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 plant 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. The fire rescue group responds within 5 minutes to any emergency in the core area of the Laboratory and within 8 minutes to emergencies in the outer areas (RHIC and eastern portions of the site).

- *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 the CSF boilers to burn natural gas as well as oil has significantly reduced BNL's reliance on oil as a fuel source and reduced emissions.
- *Sewage Treatment Plant (STP)*. This facility 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 Concentration Facility (WCF)*. This facility was previously used for the receipt, processing, and volume reduction of aqueous radioactive waste. At present, the WCF houses equipment and auxiliary systems required for operation of the Liquid Low-Level Radioactive Waste pump systems.
- *Waste Management Facility (WMF)*. This facility is a state-of-the-art complex for managing the wastes generated from BNL's research and operation 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 facility has a capacity of 5 million gallons per day. Potable water is obtained from six on-site wells. Three wells located along the western boundary of the site are treated with a lime softening process to remove naturally occurring iron. 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. Three wells located along the eastern section of the developed site are treated with carbon to ensure that VOC levels meet the drinking water standards. BNL's water met all drinking water standards in 2004.

1.4 HISTORY

BNL was founded in 1947 by the Atomic Energy Commission. The objective was to build a regional laboratory that could provide researchers with powerful tools too costly for their home institutions to build and maintain. Although BNL no longer operates any research reactors, the Laboratory's first major scientific facility was the Brookhaven Graphite Research Reactor (BGRR), which operated from 1950 to 1968 and is now being decommissioned. The BGRR was used for peaceful scientific exploration in the fields of medicine, biology, chemistry, physics, and nuclear engineering. The BGRR's capacity was replaced and surpassed in 1965 by the High Flux Beam Reactor (HFBR), which provided neutrons for researchers in diverse subjects ranging from solid state physics to art history. For more than 30 years, the HFBR was one of the premier neutron beam reactors in the world. During a scheduled maintenance shutdown in 1997, workers discovered a leak in the HFBR's spent fuel storage pool. In November 1999, the Secretary of Energy decided that the HFBR would be permanently closed and decommissioned. All spent fuel from the HFBR has been removed and transported off site for disposal.

Medical research at BNL began in 1950 with the opening of one of the first hospitals devoted to nuclear medicine. It was followed by the Medical Research Center in 1958, the Brookhaven Medical Research Reactor (BMRR) in 1959, and the Brookhaven Linac Isotope Producer (BLIP) in 1973. The BNL Center for Imaging and Neuroscience was established in 1996 and includes the Positron Emission Tomography (PET) and magnetic resonance imaging (MRI) equipment. The development of these powerful imaging methods has given scientists a unique opportunity to reveal the molecular mechanisms of human disease and to facilitate the development of new drugs for

Figure 1-1. Major Scientific Facilities at BNL.

1. Relativistic Heavy Ion Collider (RHIC)
The RHIC is a world-class scientific research facility. The RHIC accelerator drives two intersecting beams of gold ions, other heavy metal ions, and 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. Current RHIC experiments include the Solenoidal Tracker at RHIC (STAR), a detector used to track particles produced by ion collisions; the PHENIX detector, used to record different particles emerging from collisions; the Broad Range Hadron Magnetic Spectrometer (BRAHMS), used to study particles as they pass through detectors; and PHOBOS, an experiment based on the premise that when new collisions occur, new physics will be readily identified.

2. Alternating Gradient Synchrotron (AGS)
The AGS is a particle accelerator used to propel protons and heavy ions to high energies for physics research. The AGS is capable of accelerating protons and heavy ions, such as gold and iron. The Linear Accelerator (Linac) serves as a proton injector for the AGS Booster.

3. 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 will also serve as the energetic heavy ion source for the NASA Space Radiation Laboratory. Construction is planned for spring 2005. This new facility will be used to simulate the harsh cosmic and solar radiation environment found in space.

4. Linear Accelerator (Linac) and Brookhaven Linac Isotope Producer (BLIP)
The Linac provides beams of polarized protons for the AGS and RHIC. The excess beam capacity is 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.

5. Heavy Ion Transfer Line (HITL)
The HITL connects the Tandem Van de Graaff and the AGS Booster. This interconnection enables the transport of ions of intermediate mass to the AGS Booster, where they are accelerated before injection into the AGS. The ions are then extracted and sent to the AGS experimental area for physics research.

6. Radiation Therapy Facility (RTF)
Part of the Medical Research Center, the RTF is a high energy dual x-ray mode linear accelerator used for radiation therapy for cancer patients. This accelerator delivers therapeutically useful beams of x-rays and electrons for conventional and advanced medical radiotherapy techniques.

7. Brookhaven Medical Research Reactor (BMRR)
The BMRR was the world's first nuclear reactor built exclusively for medical research and therapy. It produced neutrons in an optimal energy range for experimental treatment of a type of brain cancer known as glioblastoma multiforme. The BMRR was shut down in December 2000 due to a reduction in medical research funding.

8. Scanning Transmission Electron Microscope (STEM)
The STEM facility includes two microscopes, STEM 1 and STEM 3, used for biological research. Both devices allow scientists to see the intricate details of living things, from bacteria to human tissue. The images provide a picture and data that are used in Mass Analysis.

9. 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.

10. High Flux Beam Reactor (HFBR)
The HFBR was one of the premier neutron physics research facilities in the world. Neutron beams produced at the HFBR were used to investigate the molecular structure of materials, which aided in pharmaceutical design and materials development and expanded the knowledge base of physics, chemistry, and biology. The HFBR was permanently shut down in November 1999.

11. Tandem Van de Graaff and Cyclotron
These accelerators are used in medium energy physics investigations and for producing special nuclides. The Tandem Van de Graff accelerators are used to bombard materials with ions for manufacturing and testing purposes, and to supply RHIC with heavy ions. The cyclotrons, operated by the Chemistry Department, are used for the production of radiotracers for use in Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) studies.

12. Brookhaven Graphite Research Reactor (BGRR)
The BGRR was the first peace-time reactor to be constructed in the United States following World War II. It was used for scientific exploration in the fields of medicine, biology, chemistry, physics, and nuclear engineering. The BGRR is currently being decommissioned under the Environmental Restoration Program.

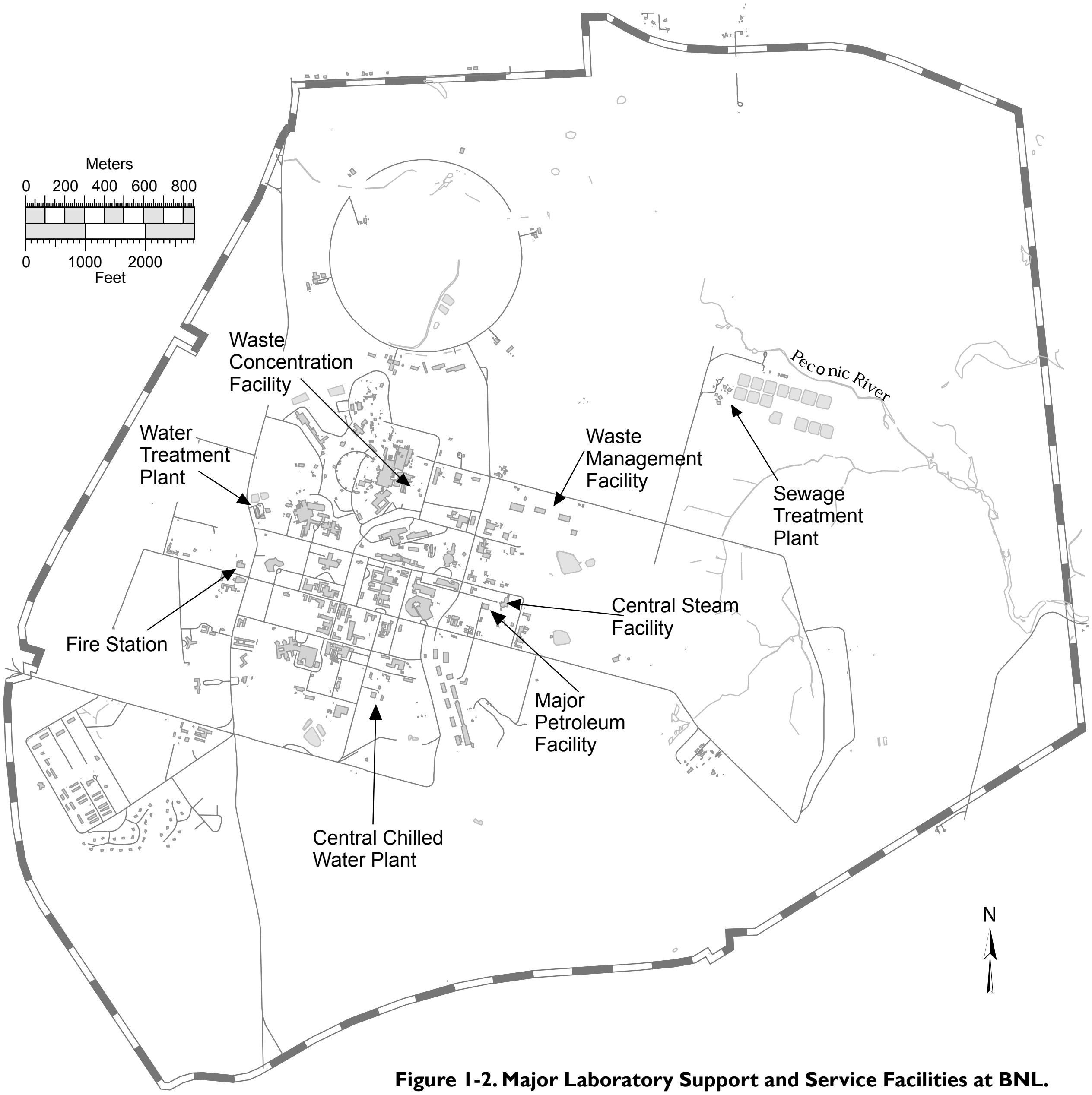


Figure 1-2. Major Laboratory Support and Service Facilities at BNL.

doctors worldwide to treat patients and perform medical research. BNL's establishment of the Center for Translational Neuroimaging (CTN) bridges the gap between the microscopic cellular world and human behavior by using a network of complementary brain-imaging tools, including PET and MRI. The Laboratory also has an active outpatient Radiation Treatment Facility (RTF) operated by Stony Brook University where patients receive radiation treatments for a wide variety of cancers. Except for the BMRR, all of the medical facilities are currently operating. Due to a reduction of research funding, the BMRR was shut down in December 2000. All spent fuel from the BMRR has been removed and transported off site for disposal.

High-energy particle physics research at BNL began in 1952 with the Cosmotron, the first particle accelerator to achieve billion-electron-volt energies. Work at the Cosmotron resulted in a Noble Prize in 1957. The Alternating Gradient Synchrotron (AGS), a much larger particle accelerator that surpassed the Cosmotron's capabilities, became operational in 1960. The AGS has yielded many discoveries of new particles and phenomena, for which BNL researchers were awarded three Nobel Prizes in Physics in 1976, 1980, and 1988. The AGS Booster, constructed in 1991, further enhanced the capabilities of the AGS, enabling it to accelerate protons and heavy ions to even higher energies. The Tandem Van de Graaff accelerator began operating in 1970 and is the starting point of the chain of accelerators that provide ions of gold, other heavy metal ions, and protons for experiments at the Relativistic Heavy Ion Collider (RHIC).

Following 10 years of development and construction, RHIC, a two-ringed particle accelerator that drives two intersecting beams of gold ions, other heavy metal ions, or protons head-on in subatomic collisions, began operation in 2000. RHIC is used to study what the universe may have looked like in the first few moments after its creation. Physicists hope to understand more about why the physical world works the way it does, from the smallest subatomic particles as they existed in their earliest forms.

In 1984, researchers began using the National Synchrotron Light Source (NSLS), which uses a linear accelerator and booster synchrotron to guide charged particles in orbit inside electron storage rings for use in a wide range of physical and biological experiments. A proposal is in place for the construction of NSLS-II, a state-of-the-art energy storage ring that will produce x-rays up to 10,000 times brighter than those produced at the NSLS today.

Due to past operations and waste management practices at the Laboratory, BNL was added to the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priorities List of contaminated sites in 1989. One of 27 such sites on Long Island identified for priority cleanup, BNL has made significant progress toward improving environmental operations and remediating past contamination.

1.5 LOCATION, LOCAL POPULATION, AND LOCAL ECONOMY

BNL is located on Long Island, 60 miles east of New York City. The Laboratory's 5,265-acre site is near Long Island's geographic center and is part of the Town of Brookhaven, the largest township (both in area and population) in Suffolk County. Approximately 150 people live in apartments on site, and many of the scientists and students who visit BNL each year stay in the Laboratory's dormitories. More than 75 percent of BNL's employees live in Suffolk County.

BNL is one of the five largest high-tech employers on Long Island. With an annual budget of approximately $454 million, the Laboratory has a major, positive economic impact on Long Island and New York State. An independent Suffolk County Planning Commission concluded that BNL's spending for operations, procurement, payroll, construction, medical benefits, and technology transfer spreads throughout Long Island's economy, making BNL vital to the local economic health (Kamer 1995).

In 2004, BNL purchased $26.7 million worth of supplies and services from Long Island businesses. In addition to buying goods and services from Long Island vendors, Laboratory employees do most of their shopping locally. Employee salaries, wages, and fringe benefits account for almost 61 percent, or about $279 million, of the Laboratory's total annual budget. BNL's total procurement budget in 2004 was approximately $160 million. Out of that amount, approximately $22.4 million was spent on 3,000 purchases in Suffolk County and approximately $4.3 million went toward 507 purchases made in Nassau County.

1.6 GEOLOGY AND HYDROLOGY

BNL is situated on the western rim of the shallow Peconic River watershed. The marshy areas in the northern and eastern sections of the site are part of the headwaters of the Peconic River. Depending on the height of the water table relative to the base of the riverbed, the Peconic River both recharges to, and receives water from, the sole source aquifer system beneath Long Island. In times of sustained drought, the river water typically recharges to the groundwater; with normal to above-normal precipitation, the river receives water from the aquifer.

In general, the terrain of the BNL site is gently rolling, with elevations varying between 44 and 120 feet above mean sea level. Depth to groundwater from the land surface ranges from 5 feet near the Peconic River to about 80 feet in the higher elevations of the central and western portions of the site. The hydrology of the local area is well defined. Studies of Long Island hydrology and geology in the vicinity of the Laboratory indicate that the uppermost Pleistocene deposits, composed of highly permeable glacial sands and gravel, are between 120 and 250 feet thick (Warren et al. 1968, Scorca et al. 1999). Water penetrates these deposits readily and there is little direct runoff into surface streams unless precipitation is intense. These sandy deposits store large quantities of water in the Upper Glacial aquifer. On average, about half of the annual precipitation is lost to the atmosphere through evapotranspiration and the other half percolates through the soil to recharge the groundwater (Koppelman 1978).

The Long Island Regional Planning Board and Suffolk County have identified the BNL site as overlying a deep-flow recharge zone for Long Island groundwater (Koppelman 1978, Suffolk County Department of Health Services 1987). Precipitation and surface water that recharge within this zone have the potential to replenish the deep Magothy and Lloyd aquifer systems lying below the Upper Glacial aquifer. Experts estimate that up to two-fifths of the recharge from rainfall moves into the deeper aquifers. The extent to which groundwater on site contributes to deep flow recharge has been confirmed through the use of an extensive network of shallow and deep wells installed at BNL and surrounding areas (Geraghty and Miller 1996). This groundwater system is the primary source of drinking water for both on- and off-site private and public supply wells and has been designated a sole source aquifer system by the Environmental Protection Agency (EPA).

During 2004, BNL used approximately 1.4 million gallons of groundwater per day to meet potable water needs and heating and cooling requirements. Approximately 75 percent of the water pumped from BNL supply wells is returned to the aquifer through on-site recharge basins and permitted discharges to the Peconic River. Under normal hydrologic conditions, most of the water discharged to the river recharges to the Upper Glacial aquifer before leaving the BNL site. Human consumption, evaporation (cooling tower and wind losses), and sewer line losses account for the remaining 25 percent. An additional 4.1 million gallons of groundwater are pumped each day from remediation wells for treatment and then returned to the aquifer by way of recharge basins.

Groundwater flow direction across the BNL site is influenced by natural drainage systems flowing eastward along the Peconic River, southeast toward the Forge River, and south toward the Carmans River (Figure 1-3). Pumping from on-site supply wells affects the direction and speed of groundwater flow, especially in the central, developed areas of the site. The main groundwater divide on Long Island is aligned generally east–west and lies approximately one-half mile north of BNL. Groundwater north of the divide flows northward and ultimately discharges to the Long Island Sound. Groundwater south of the divide flows east and south, discharging to the Peconic River, Peconic Bay, south shore streams, the Great South Bay, and the Atlantic Ocean. The regional groundwater flow system is discussed in greater detail in *Stratigraphy and Hydrologic Conditions* (Scorca et al. 1999). In most areas at BNL, the horizontal velocity of groundwater is approximately 0.75 to 1.2 feet per day (Geraghty and Miller 1996). In general, this means that groundwater travels for approximately 20 to 22 years as it moves from the central, developed area of the site to the BNL southern boundary.

1.7 CLIMATE

The Meteorological Group at BNL has been recording weather data on site since 1948. BNL is broadly influenced by continental and maritime weather systems. Locally, the Long Island Sound, the Atlantic Ocean, and associated bays influence wind directions and humidity and provide a moderating influence on extreme summer and winter temperatures. The prevailing ground-level winds at BNL are from the southwest during the summer, from the north-

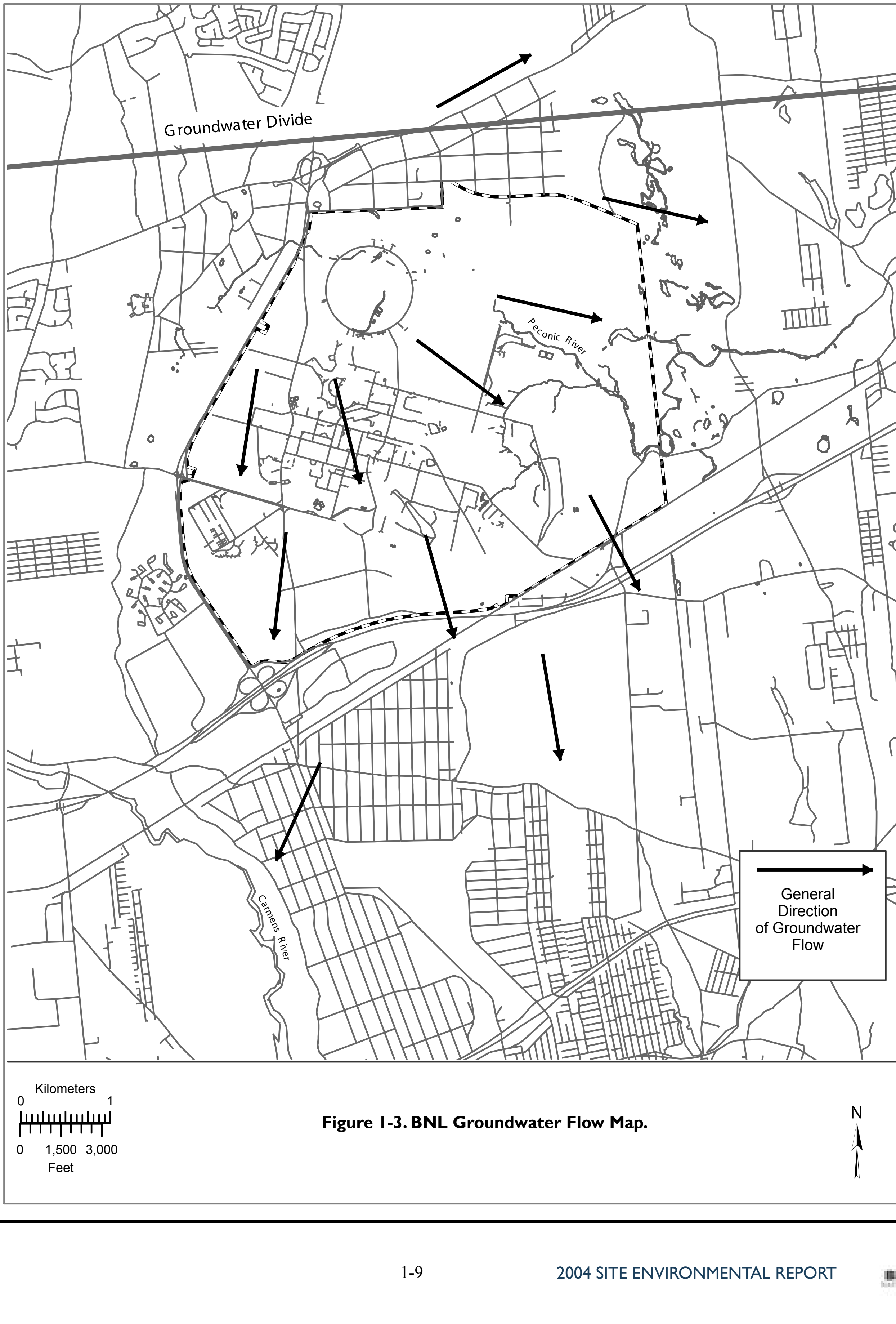
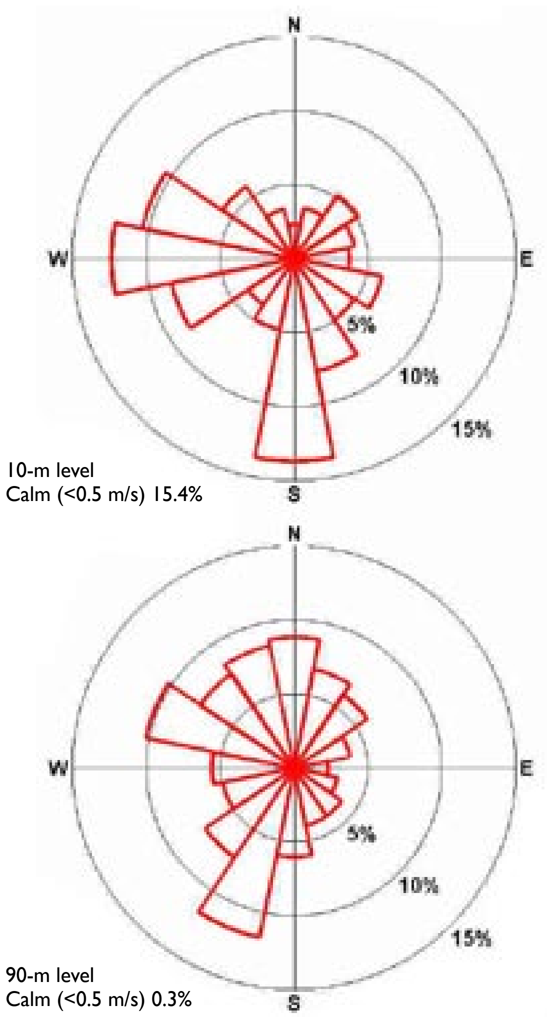


Figure 1-3. BNL Groundwater Flow Map.



Explanation: The arrows formed by the wedges indicate wind direction. Each concentric circle represents a 5 percent frequency, that is, how often the wind came from that direction. The wind direction was measured at heights of 10 and 90 meters. This diagram indicates that the predominant wind direction was from the south at the 10-m level and south-southwest at the 90-m level.

Figure 1-4. BNL 2004 Wind Rose.

west during the winter, and about equally from these two directions during the spring and fall (Nagle 1975, 1978). Figure 1-4 shows the 2004 annual wind rose for BNL, which depicts the annual frequency distribution of wind speed and direction, measured at an on-site meteorological tower at heights of 33 feet (10 meters) and 300 feet (90 meters).

Total snowfall in 2004 was 60.2 inches, well above the annual average of 30.4 inches. Total precipitation for 2004 was 35.86 inches, making 2004 the third driest year on record at BNL. The average yearly precipitation is 48.5 inches. Figures 1-5 and 1-6 show the 2004 monthly and the 56-year annual precipitation data. The average yearly temperature for 2004 was 51.3°F. July was the hottest month with an average temperature of 71.8°F and January was the coldest month with an average temperature of 23.6°F. Figures 1-7 and 1-8 show the 2004 temperatures and the historical annual mean temperatures.

1.8 NATURAL RESOURCES

BNL is located in the oak/chestnut forest region of the Coastal Plain and constitutes about 5 percent of the 100,000-acre New York State–designated region on Long Island known as the Central Pine Barrens. The section of the Peconic River running through BNL is designated Scenic by the New York State Wild, Scenic, and Recreational River System Act of 1972. Due to the general topography and porous soil, the land is very well drained and there is relatively little surface runoff or open standing water. However, depressions form small, pocket wetlands with standing water on a seasonal basis (vernal pools), and there are six significant, regulated wetlands on site. Thus, a mosaic of wet and dry areas correlates with variations in topography and depth to the water table.

Vegetation on site is in various stages of succession, which reflects a history of disturbances to the area. For example, when Camp Upton was constructed in 1917, the site was entirely cleared of its native pines and oaks. Portions were then cleared again in 1940 when Camp Upton was reactivated. Other past disturbances include fire, local flooding, and draining. Current operations minimize disturbances to the more natural areas of the site.

More than 230 plant species have been identified at BNL, including one New York State threatened species and two that are rare. Fifteen animal species identified on site include a number that are protected in New York State, as well as species common to mixed hardwood forests and open grassland habitats. At least 85 species of birds have been observed nesting on site, and more than 200 transitory bird species have been documented as visiting the

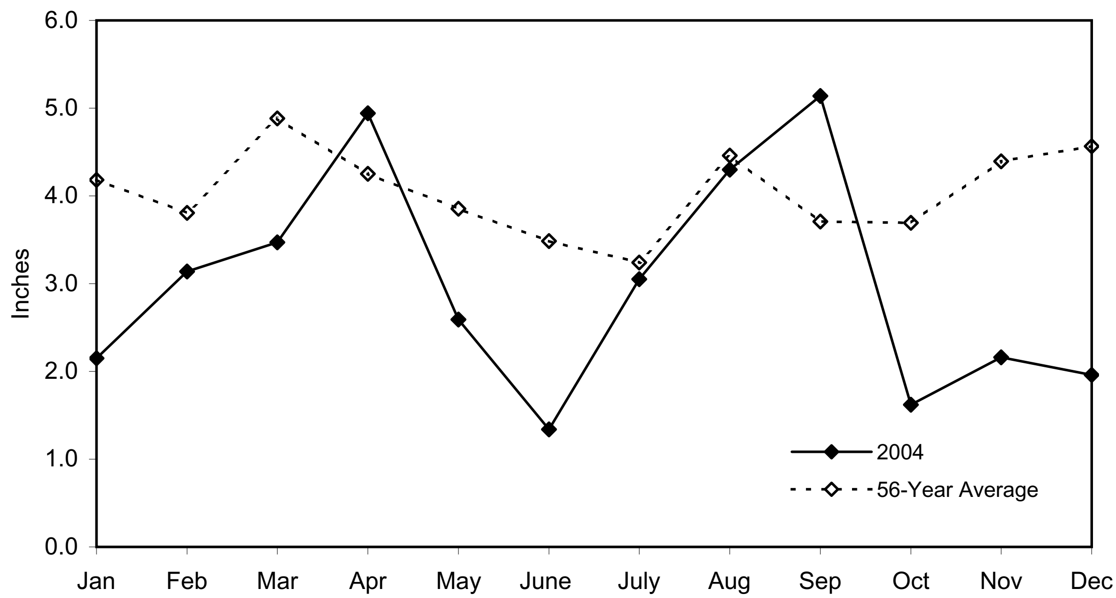


Figure 1-5. BNL 2004 Monthly Precipitation versus 56-Year Monthly Average.

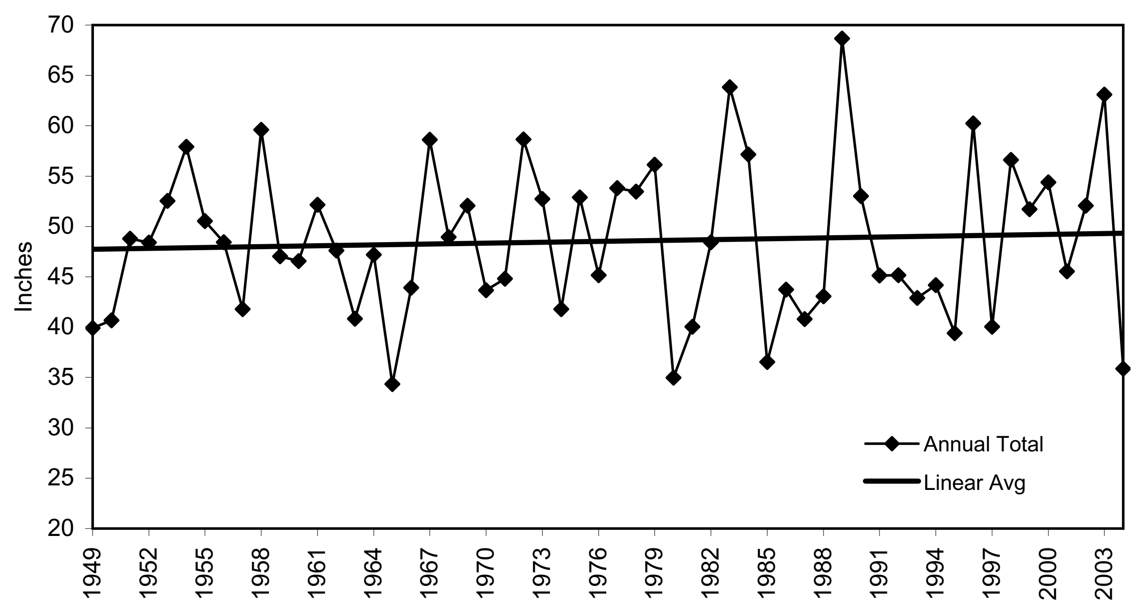


Figure 1-6. BNL Annual Precipitation Trend (56-Year).

site as a result of BNL's location within the Atlantic Flyway, and the scrub/shrub habitats that offer food and rest to migratory songbirds. Permanently flooded retention basins and other watercourses support amphibians and aquatic reptiles. Thirteen amphibian and 12 reptile species have been identified at BNL. Recent ecological studies have confirmed 22 breeding sites for the New York State endangered eastern tiger salamander in ponds and recharge basins on site. Ten species of fish have been identified as endemic to the site, including the banded sunfish and the swamp darter, both of which are New York State threatened species. Two types of butterflies that are protected in New York are believed to breed on site due to preferred habitat and host plants. In 2004, the worm snake, a species of special concern, was identified on

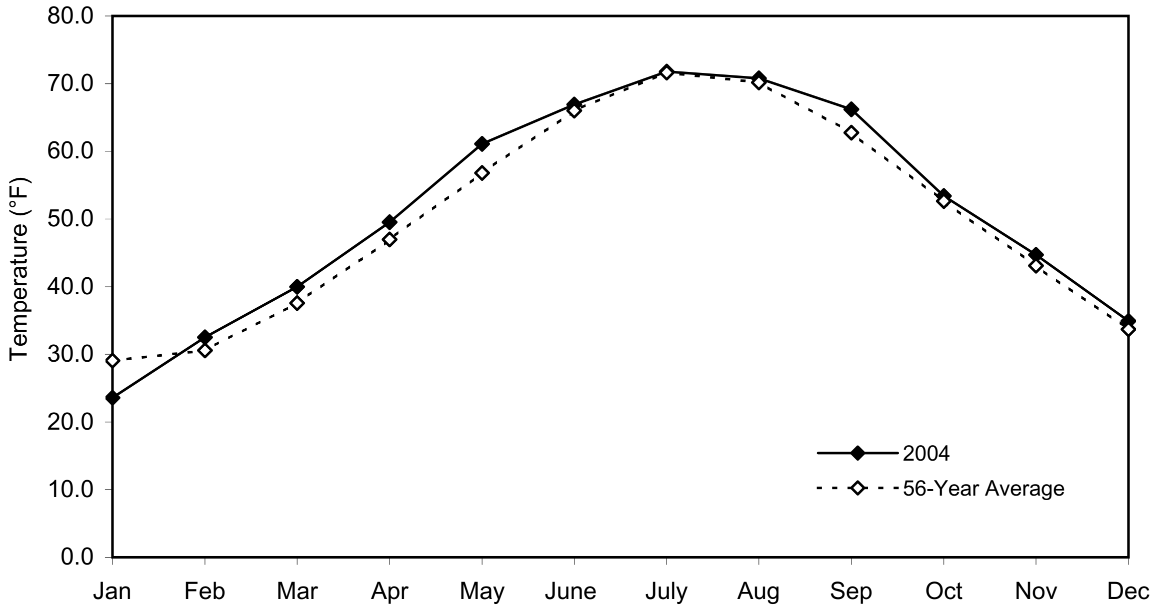


Figure 1-7. BNL 2004 Monthly Mean Temperature versus 56-Year Monthly Average.

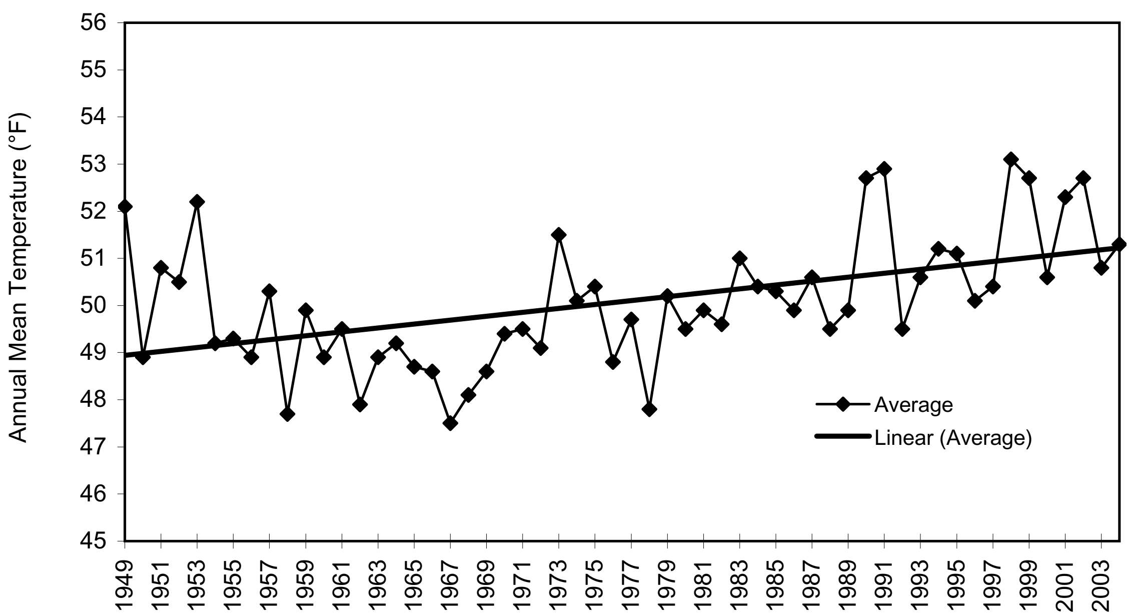


Figure 1-8. BNL Annual Mean Temperature Trend (56-Year).

site. To eliminate or minimize any negative effects that Laboratory operations might cause to these species, precautions are in place to protect the on-site habitat and natural resources.

In November 2000, DOE established the Upton Ecological and Research Reserve at BNL. The 530-acre Reserve (10 percent of the Laboratory's property) is on the eastern portion of the site, in the Core Preservation Area of the Pine Barrens. The Upton Reserve creates a unique ecosystem of forests and wetlands that provide habitats for plants, mammals, birds, reptiles, and amphibians. Under an Inter-Agency Agreement with DOE, the U.S. Fish & Wildlife Services (FWS) conducts resource management programs for the conservation, enhancement, and restoration of wildlife and habitat in the Reserve. The Upton Reserve Technical Advisory Group, made up of local land management agencies, assists BNL and FWS with technical expertise and helps determine policy for the Upton Reserve. Additional information regarding the Upton Reserve and BNL's natural resources can be found in Chapter 6 of this report and at http://www.bnl.gov/esd/wildlife/Home.htm.

1.9 CULTURAL RESOURCES

The Laboratory is responsible for ensuring compliance with historic preservation requirements. A cultural resource management plan is being developed to guide the management of all of BNL's cultural resources. These resources include World War I trenches, Civilian Conservation Corps features, World War II buildings, and historic structures, programs, and discoveries associated with high energy physics, research reactors, and other science. BNL currently has three facilities that have been determined as eligible for listing on the National Register of Historic Places. These historical facilities include the Brookhaven Graphite Research Reactor complex, the High Flux Beam Reactor complex, and the World War I training trenches associated with Camp Upton. Further information and current projects can be found in Chapter 6, Section 6.9.

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