

Introduction

Established in 1947, Brookhaven National Laboratory is a multi-program research institution primarily funded by the U.S. Department of Energy's Office of Science. The Laboratory is operated and managed by Brookhaven Science Associates, a limited-liability company founded by the Research Foundation for the State University of New York on behalf of Stony Brook University, the largest academic user of Laboratory facilities, and Battelle, a nonprofit applied science and technology organization. BSA has been managing and operating the Laboratory under a performance-based contract with DOE since 1998. From 1947 to 1998, BNL was operated by Associated Universities, Incorporated. Prior to 1947, the site operated as Camp Upton, a U.S. Army training camp, which was active from 1917 to 1920 during World War I and from 1940 to 1946 during World War II.

One of 10 national Laboratories, BNL has a history of outstanding scientific achievements. For over 60 years, Laboratory researchers have successfully worked to envision, construct, and operate large and innovative scientific facilities in pursuit of research advances in many fields. Programs in place at BNL emphasize continual improvement in environmental, safety, security, and health performance.

1.1 LABORATORY MISSION

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

- Advance energy and environment-related basic research and apply it to 21st Century problems of critical importance to the Nation.
- Advance fundamental research in nuclear and particle physics to gain a deeper understanding of matter, energy, space, and time.

BNL's Environmental, Safety, Security, and Health (ESSH) Policy is the Laboratory's commitment to continual improvement in ESSH performance. Under this policy, the Laboratory's goals are to protect the environment, conserve resources, and prevent pollution;

maintain a safe workplace by planning work and performing it safely; provide security for people, property, information, computing systems, and facilities; protect human health within our boundaries and in the surrounding community; achieve and maintain compliance with applicable ESSH requirements; maintain an open, proactive, and constructive relationship with employees, neighbors, regulators, DOE, and other stakeholders; and continually improve ESSH performance.

In 2001, BNL was the first DOE Office of Science National Laboratory to be registered under the prestigious International ISO 14001 environmental management standard. In addition, in December 2006, BNL was the first DOE Laboratory to achieve full registration under the Occupational Health and Safety Assessment Series (OHSAS) 18001 Standard. These programs are described in detail in Chapter 2 of the report. Registration to these standards was maintained throughout 2013.

1.2 RESEARCH AND DISCOVERIES

BNL conducts research in physics, chemistry, biology, medicine, applied science, and a wide range of advanced technologies. BNL's world-class research facilities are also available to university, industrial, and government personnel from around the world. Current research includes energy security to help address the world's need for new, more efficient, and sustainable energy sources such as solar, wind, hydrogen, and other renewable sources; photon sciences, using ultra-bright light to reveal the structures of materials critically important to biology, technology, and more; quantum chromodynamics (QCD) to recreate matter and study the force that gives shape to visible matter in the universe from the dawn of time to today, using colliding subatomic particles; physics of the universe to explore cosmic mysteries across the smallest and largest scales imaginable, from neutrinos to dark energy; and climate, environment, and biosciences, to map climate change, greenhouse gas emissions, and plant biology to help protect our planet's future.

To date, researchers working at BNL have received seven Nobel Prizes, National Medals of Science, Enrico Fermi Awards, Wolf Foundation Prizes, R&D 100 awards, as well as other recognitions for discoveries made wholly or partly at BNL. Some significant discoveries and developments made at the Laboratory include new forms of matter, subatomic particles, technologies that fuel leading experimental programs around the world, and life-saving medical imaging techniques for diagnosis and treatment of disease.

1.3 HISTORY

BNL was founded in 1947 by the Atomic Energy Commission (AEC), a predecessor to the present DOE. AEC provided the initial funding for BNL's research into peaceful uses of the atom. The objective was to promote basic research in the physical, chemical, biological, and engineering aspects of the atomic sciences. The result was the creation of a regional laboratory to design, construct, and operate large scientific machines that individual institutions could not afford to develop on their own.

Although BNL no longer operates any research reactors, the Laboratory's first major scientific facility was the Brookhaven Graphite Research Reactor (BGRR), which was the first reactor to be constructed in the United States following World War II. The reactor's primary mission was to produce neutrons for scientific experimentation in the fields of medicine, biology, chemistry, physics, and nuclear technology. The BGRR operated from 1950 to 1968 and decommissioning was completed in June 2012. The BGRR is currently undergoing long-term surveillance and maintenance.

The High Flux Beam Reactor (HFBR) was in operation from 1965 through 1996. The facility was used solely for scientific research and provided neutrons for experiments in materials science, chemistry, biology, and physics. For more than 30 years, the HFBR was one of the premier neutron beam reactors in the world. In late 1996, workers discovered that a leak in the HFBR spent fuel storage pool had been releasing tritium to the groundwater (see SER, Volume II, Groundwater Status Report, for further details). The reactor was shut down for routine maintenance at the time of the discovery and was never restarted. In November 1999, DOE decided that the HFBR would be permanently shut down. With input from the community, a final Record of Decision (ROD) was approved outlining the remedy for the HFBR's permanent decontamination and decommissioning (D&D). To date, completed actions include the removal and disposal of HFBR fuel and primary coolant; shipment of equipment for reuse at other facilities; cleanup and transfer of the Cold Neutron Facility for reuse; dismantling of ancillary buildings, including fan houses; removal and disposal of the reactor control rod blades and beam plugs; draining and isolation of all utility piping penetrating the reactor building; removal of the stack silencer baffles; and rendering all former hazardous material storage tanks permanently out of service. Demolition of the stack will be completed by 2020 in accordance with the ROD. Starting in 2010, the HFBR entered a period of long-term surveillance and maintenance. During this period, the building will remain unheated and electrical services will only

be energized during periodic inspections and for leak detection monitoring. The HFBR will remain in this state for 65 years to permit sufficient decay of remaining radioactivity within the reactor. At the end of the low-energy period, D&D of the reactor will continue.

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 and the Brookhaven Medical Research Reactor (BMRR) in 1959. The BMRR was the first nuclear reactor in the nation to be constructed specifically for medical research. 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, and the facility is currently in a “cold” shutdown mode as a radiological facility and has entered a period of surveillance and maintenance.

The Brookhaven Linac Isotope Producer (BLIP) was built in 1973. It creates radioactive forms of ordinary chemical elements that can be used alone or incorporated into radiotracers for use in nuclear medicine research or for clinical diagnosis and treatment.

Although the Laboratory no longer performs research associated with neuroimaging, BNL’s Center for Translational Neuroimaging used brain-imaging tools, including positron emission tomography (PET) and magnetic resonance imaging (MRI) equipment, to research the causes of and treatments for, brain diseases such as drug addiction, appetite disorders, attention deficit disorder, and neurodegenerative disease. The development of PET and MRI also helped facilitate the development of new drugs for physicians worldwide to treat patients for cancer and heart disease.

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 Nobel Prize in 1957. After 14 years of service, the Cosmotron ceased operation and was dismantled due to design limitations. The Alternating Gradient Synchrotron (AGS), a much larger particle accelerator, became

operational in 1960. The AGS has allowed scientists to accelerate protons to energies that have yielded many discoveries of new particles and phenomena, for which BNL researchers were awarded three Nobel Prizes in physics. The AGS receives protons from BNL’s linear accelerator (Linac), designed and built in the late 1960s as a major upgrade to the AGS complex. The Linac’s purpose is to provide accelerated protons for use at AGS facilities and BLIP. 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 metals, and protons for experiments at the Relativistic Heavy Ion Collider (RHIC). In 2010, BNL began operating a new heavy ion beam source for use by RHIC and the NASA Space Radiation Laboratory, the Electron Beam Ion Source (EBIS). This source produces and accelerates intense and bright heavy ion beams, allowing studies with new types of ions previously unavailable from the Tandem Van DeGraaff accelerator.

RHIC began operation in 2000. Inside this two-ringed particle accelerator, two beams of gold ions, heavy metals, or protons circulate at nearly the speed of light and collide head-on, releasing large amounts of energy. RHIC is used to study what the universe may have looked like in the first few moments after its creation, offering insights into the fundamental forces and properties of matter. Planned upgrades to RHIC will expand the facility’s research capabilities. The first upgrade, RHIC II, will increase the collider’s collision rates and improve the sensitivity of the large detectors it uses. Another planned upgrade, the eRHIC, will add a high-energy electron ring to create the world’s first electron and heavy ion collider.

The NASA Space Radiation Laboratory (NSRL) became operational in 2003. It is jointly managed by DOE’s Office of Science and NASA’s Johnson Space Center. The NSRL uses heavy ions extracted from the AGS booster

to produce beams of radiation similar to radiation that would be encountered by astronauts on long missions. Studies are conducted to assess risks and test protective measures. The NSRL is one of the few facilities in the world that can simulate the harsh cosmic and solar radiation environment found in space.

The National Synchrotron Light Source (NSLS) uses a linear accelerator and booster synchrotron to guide charged particles in orbit inside two electron storage rings for use in a wide range of physical and biological experiments. The NSLS produces beams of very intense light in the x-ray, ultraviolet, and infrared spectra, allowing scientists to study the structure of proteins, investigate the properties of new materials, and understand the fate of chemicals in the environment. Although the current NSLS has been continually updated since its commissioning in 1982, today the practical limits of its performance have been reached. To continue advances in these fields, construction of the NSLS-II, conceived as the next generation synchrotron light source, began in 2008. To help meet the critical scientific challenges of our energy future, this new state-of-the-art, medium-energy electron storage ring synchrotron will provide x-rays more than 10,000 times brighter than the current NSLS and will focus on research at the nanoscale. The NSLS-II will enable scientists to focus on some of the nation's most important scientific challenges at the nanoscale level, including clean, affordable energy, molecular electronics, and high-temperature superconductors. The NSLS-II is expected to be operational in 2015.

The Laboratory's Research Support Building (RSB) was completed in 2006 and provides administrative and support functions in a single location for employees and visiting scientists. The RSB has been awarded the Leadership in Energy and Environmental Design (LEED) Silver certification from the U.S. Green Building Council. This award is based on five categories: sustainability, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality.

BNL's Center for Functional Nanomaterials

(CFN) provides state-of-the-art capabilities for the fabrication and study of nanoscale materials, with an emphasis on atomic-level tailoring to achieve desired properties and functions. Nanoscience has the potential to bring about and accelerate new technologies in energy distribution, drug delivery, sensors, and industrial processes. The CFN is a science-based facility used for developing strong scientific programs while offering broad access to its capabilities and collaboration through an active user program. It is one of five Nanoscale Science Research Centers funded by DOE's Office of Science, and supports the Laboratory's goal of leadership in the development of advanced materials and processes for energy applications. The CFN building has also been awarded LEED Silver certification.

The new Interdisciplinary Science Building (ISB), completed in 2013, is an energy-efficient and environmentally sustainable building that provides labs, offices, and support functions to bring together a broad spectrum of researchers, including industry, universities, and other National Laboratories. The ISB fosters energy research, focusing on the effective uses of renewable energy through improved conversion, transmission, and storage. The ISB has been awarded LEED Gold certification.

Construction of a 32 megawatt Long Island Solar Farm (LISF) at BNL was completed in the fall of 2011. The LISF is the largest solar photovoltaic (PV) electric generating plant in the Northeast region. Its goal is to help Long Island be less reliant on fossil fuel-driven power generation and to meet peak load demands from summertime air conditioning use. It is generating enough renewable energy to power approximately 4,500 homes and is helping New York State meet its clean energy and carbon reduction goals. The LISF will be one of the most studied solar installations, as it will be a focal point of the Northeast Solar Energy Research Center (NSERC) at BNL. Construction for the NSERC will be complete in 2014. Research will include work done at the LISF, as well as a dedicated research array for testing solar panel modules, inverters, and other equipment being developed for the solar

energy industry. Additional information on the LISF can be found in Chapters 2 and 6 of this report.

1.4 FACILITIES AND OPERATIONS

Most of the Laboratory's principal facilities are located near the center of the site. The developed area is approximately 1,820 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
- 520 acres used for outlying facilities, such as the Sewage Treatment Plant, ecology field, housing facilities, and fire breaks
- 400 acres of roads, parking lots, and connecting areas
- 200 acres occupied by the Long Island Solar Farm

The balance of the site, approximately 3,400 acres, is mostly wooded and represents the native pine barrens ecosystem.

The location of the major scientific facilities at BNL are shown on Figure 1-1. Additional facilities, shown on 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 plant provides chilled water sitewide for air conditioning and process refrigeration via underground piping. The plant has a large refrigeration capacity and reduces the need for local refrigeration plants and air conditioning.
- *Central Steam Facility (CSF)*. This facility provides high-pressure steam for facility and process heating sitewide. Either natural gas or fuel oil can be used to produce the steam, which is conveyed to other facilities through underground piping. Condensate is collected and returned to the CSF for reuse, to conserve water and energy.
- *Fire Station*. The Fire Station houses six response vehicles. The BNL Fire Rescue Group provides on-site fire suppression, emergency medical services, hazardous material response, salvage, and property protection.

- *Major Petroleum Facility (MPF)*. This facility provides reserve fuel for the CSF during times of peak operation. With a total capacity of 2.3 million gallons, the MPF primarily stores No. 6 fuel oil. The 1997 conversion of CSF boilers to burn natural gas as well as oil has significantly reduced the Laboratory's reliance on oil as a sole fuel source when other fuels are more economical.
- *Sewage Treatment Plant (STP)*. This plant treats sanitary and certain process wastewater from BNL facilities prior to discharge into the Peconic River, similar to the operations of a municipal sewage treatment plant. The plant has a design capacity of 3 million gallons per day. Effluent is monitored and controlled under a permit issued by the New York State Department of Environmental Conservation (NYSDEC).
- *Waste Management Facility (WMF)*. This facility is a state-of-the-art complex for managing the wastes generated from BNL's research and operations activities. The facility was built with advanced environmental protection systems and features, and began operation in December 1997.
- *Water Treatment Plant (WTP)*. The potable water treatment plant has a capacity of 5 million gallons per day. Potable water is obtained from five on-site wells. Water pumped from three supply wells located along the western boundary of the site is treated at the WTP with a lime-softening process to remove naturally occurring iron and with sodium hypochlorite for bacterial control. The plant is also equipped with dual air-stripping towers to ensure that volatile organic compounds (VOCs) are at or below New York State drinking water standards. Two wells located along the eastern section of the developed site are treated by the addition of sodium hydroxide to increase the pH of the water to make it less corrosive, and by the addition of sodium hypochlorite to control bacteria. BNL's potable water met all drinking water standards in 2013.

Past operations and research at the BNL site, dating back to the early 1940s when it was Camp Upton, have resulted in localized



Figure 1-1. Major Scientific Facilities at BNL.

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| 1. Relativistic Heavy Ion Collider (RHIC) | 6. Heavy Ion Transfer Line (HITL) | 11. National Synchrotron Light Source II (NSLS-II) |
| 2. NASA Space Radiation Laboratory (NSRL) | 7. Radiation Therapy Facility (RTF) | 12. National Synchrotron Light Source (NSLS) |
| 3. Alternating Gradient Synchrotron (AGS) | 8. Scanning Transmission Electron Microscope (STEM) | 13. Tandem Van de Graff and Cyclotron |
| 4. AGS Booster | 9. Interdisciplinary Science Building (ISB) | |
| 5. Brookhaven Linac Isotope Producer (BLIP) and Linear Accelerator (Linac) | 10. Center for Functional Nanomaterials (CFN) | |

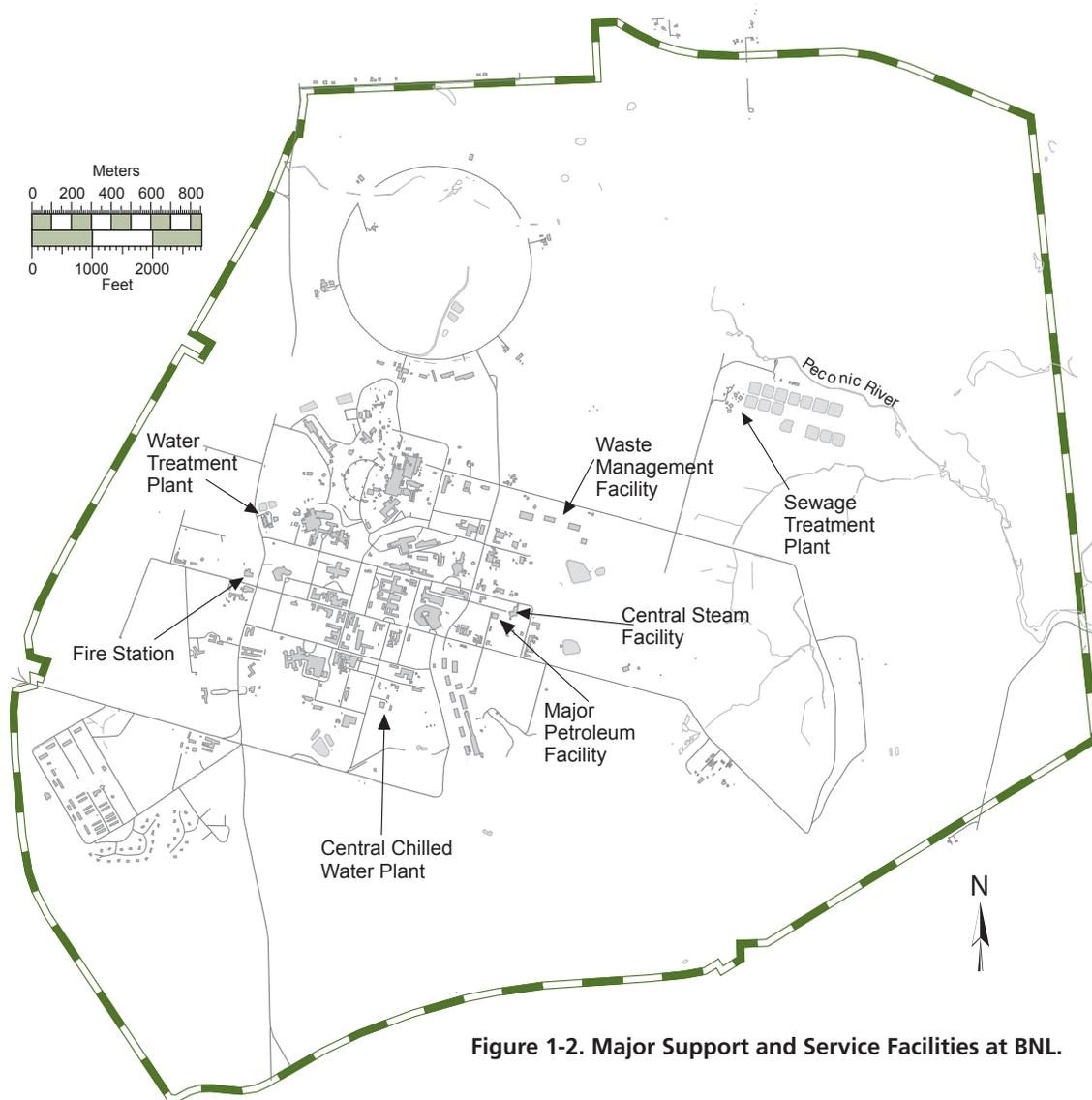


Figure 1-2. Major Support and Service Facilities at BNL.

environmental contamination. As a result, the Laboratory was added to the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priorities List of contaminated sites in 1989. One of 40 sites on Long Island identified for priority cleanup, BNL has made significant progress toward improving environmental operations and remediating past contamination. DOE will continue to fund cleanup projects until the Laboratory is restored and removed from the National Priorities List. Major accomplishments in cleanup activities at BNL are discussed further throughout this report.

1.5 LOCATION, LOCAL POPULATION, AND LOCAL ECONOMY

BNL is located near the geographical center of Suffolk County, Long Island, New York. The Laboratory's 5,265-acre site is located in Brookhaven Township, the largest township in both area and population, and is approximately 60 miles east of New York City. BNL is one of the five largest high-technology employers on Long Island, with approximately 3,000 employees that include scientists, engineers, technicians, and administrative personnel. More than 75 percent of BNL employees live in Suffolk County. In addition, the Laboratory annually

hosts almost 4,000 visiting scientists, more than 30 percent of whom are from New York State universities and businesses. The visiting scientists and sometimes their families, as well as visiting students, reside in apartments and dormitories on-site or in nearby communities.

BNL strengthens Long Island's position as a center of innovation in energy, the life sciences, and other fields crucial to the growth of New York State's economy. With an annual budget of over \$652 million in 2013, the Laboratory had a significant economic impact on New York State. In fiscal year 2013, employee salaries, wages and fringe benefits accounted for over \$399 million of its total annual budget. Supporting local and state businesses whenever possible, BNL spends million each year on goods and services. It is estimated that between 2012 and 2014, the Laboratory will generate, on an average annual basis, \$947 million in economic output and approximately 7,000 jobs throughout New York State.

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 underlying Upper Glacial aquifer. In times of sustained drought, the river water recharges to the groundwater; with normal to above-normal precipitation, the river receives water from the aquifer.

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 approximately 80 feet in the higher elevations of the central and western portions of the site. 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. The sandy deposits store large quantities of water in the Upper Glacial aquifer. On average, approximately half of the annual precipitation is lost to the atmosphere through evapotranspiration, and the other half percolates through the soil to recharge the groundwater (Franke and McClymonds 1972, Aronson and Seaburn 1974).

The Long Island Regional Planning Board and Suffolk County have identified the Laboratory site as overlying a deep-flow recharge zone for Long Island groundwater (Koppelman 1978). Precipitation and surface water that recharge within this zone have the potential to replenish the Magothy and Lloyd aquifer systems lying below the Upper Glacial aquifer. It has been estimated 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 & 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.

During 2013, the Laboratory pumped approximately 434 million gallons of water for use on site. Approximately 70 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 site. Human consumption, evaporation (cooling tower and wind losses), and sewer line losses account for the remaining 25 percent. An additional 3.8 million gallons of groundwater were pumped each day from remediation wells. This water is treated to remove contaminants and is then returned to the aquifer by way of recharge basins or injection wells.

Groundwater flow directions across the BNL site are influenced by natural drainage systems:

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 the Laboratory. 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, Great South Bay, and Atlantic Ocean. The regional groundwater flow system is discussed in greater detail in Stratigraphy

and Hydrologic Conditions at the Brookhaven National Laboratory and Vicinity (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 & 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 Laboratory's southern boundary.

1.7 CLIMATE

The Meteorological Services Group at BNL has been recording on-site weather data since 1949. The Laboratory is broadly influenced by continental and maritime weather systems. Locally, the Long Island Sound, Atlantic Ocean,

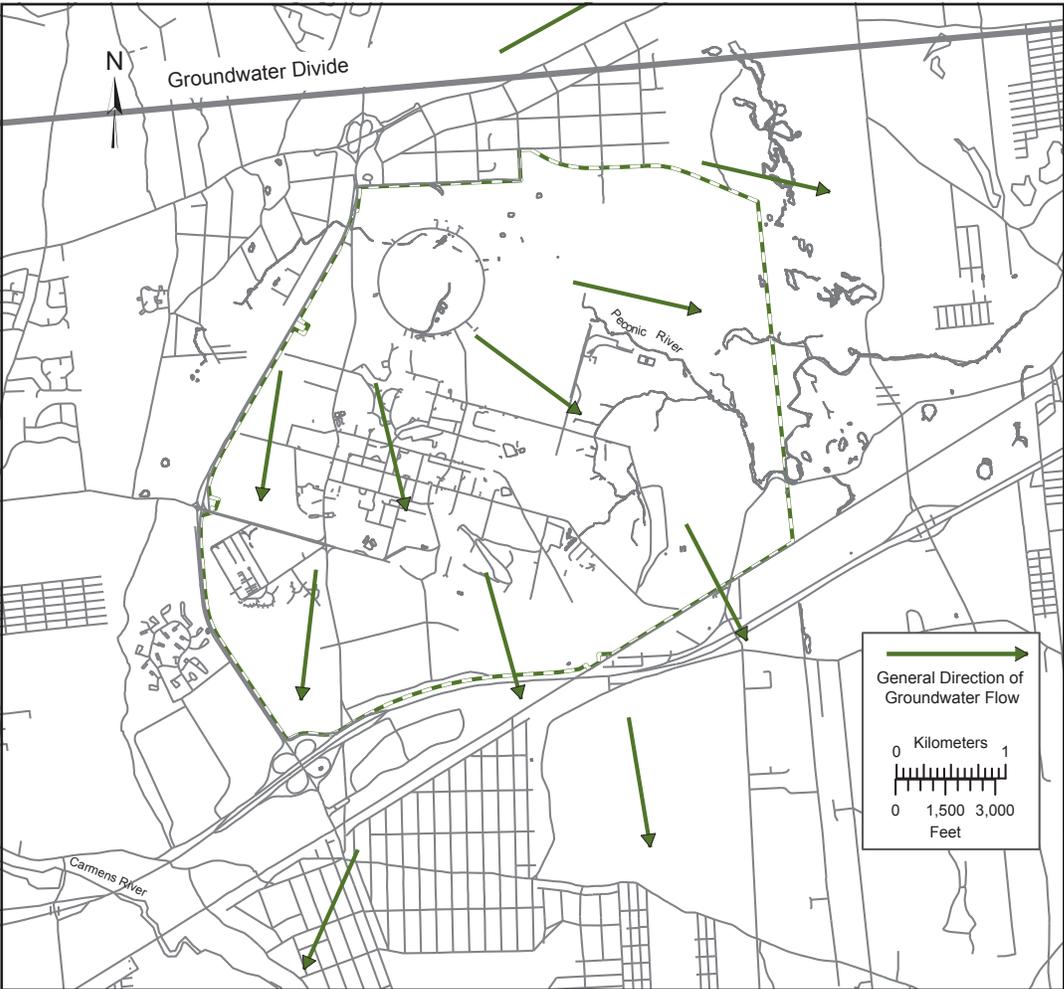


Figure 1-3. BNL Groundwater Flow Map.

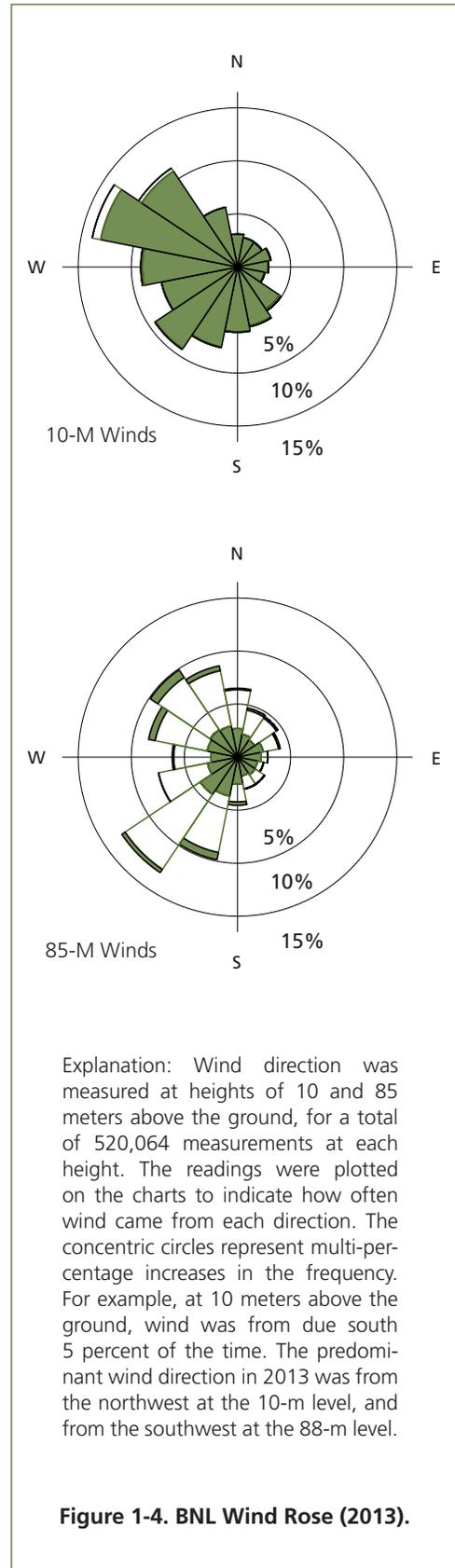
and associated bays influence wind directions and humidity and provide a moderating influence on extreme summer and winter temperatures. The prevailing ground-level winds at BNL are from the southwest during the summer, from the northwest during the winter, and about equally from those two directions during the spring and fall (Nagle 1975, 1978). Figure 1-4 shows the 2013 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 (85 meters) above land surface.

The average monthly temperature in the area for 2013 was 52 degrees Fahrenheit (°F). The average yearly temperature for the area was 50°F. Figures 1-5 and 1-6 show the 2013 monthly mean temperatures and the historical annual mean temperatures, respectively. The total annual precipitation in 2013 was 45.6 inches. Figures 1-7 and 1-8 show the 2013 monthly and the 64-year annual precipitation data. The average snowfall for 2013 was 54.8 inches, well above the 31.7 inches average yearly snowfall for Long Island.

1.8 NATURAL RESOURCES

The Laboratory 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 as “scenic” under 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 little surface runoff or open standing water. However, depressions form numerous small, pocket wetlands with standing water on a seasonal basis (vernal pools), and there are six 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. Although portions of the site were replanted in the 1930s, portions were cleared again in 1940 when Camp Upton was reactivated by the U.S. Army. Other past disturbances include fire, local flooding, and draining. Current operations minimize disturbances to the more natural areas of the site.

More than 200 plant, 15 animal, 85 bird, 13 amphibian, 12 reptile, and 10 fish species have been identified on site, some of which are New York State threatened, endangered, exploitably vulnerable, and species of special concern. To eliminate or minimize any negative effects that BNL operations might cause to these species, precautions are in place to protect habitats and natural resources at the Laboratory.

In November 2000, DOE established the Upton Ecological and Research Reserve at BNL. The 530-acre Upton Reserve (10 percent of the Laboratory's property) is on the eastern portion of the site, in the Core Preservation Area of the Central Pine Barrens. The Upton Reserve creates a unique ecosystem of forests and wetlands that provides habitats for plants, mammals, birds, reptiles, and amphibians. From 2000 to 2004, funding provided by DOE under an Inter-Agency Agreement between DOE and the U.S. Fish & Wildlife Services was used to conduct resource management programs for the conservation, enhancement, and restoration of wildlife and habitat in the reserve. In 2005, management was transitioned to the Foundation for Ecological Research in the Northeast (FERN). Management of the Upton Reserve falls within the scope of BNL's Natural Resource Management Plan, and the area will continue to be managed for its key ecological values and as an area for ecological research (BNL 2011). Additional information regarding the Upton Reserve and the Laboratory's natural resources can be found in Chapter 6 of this report.

1.9 CULTURAL RESOURCES

The Laboratory is responsible for ensuring compliance with historic preservation requirements. BNL's Cultural Resource Management Plan was developed to identify, assess, and document the Laboratory's historic and cultural resources (BNL 2012). These resources include

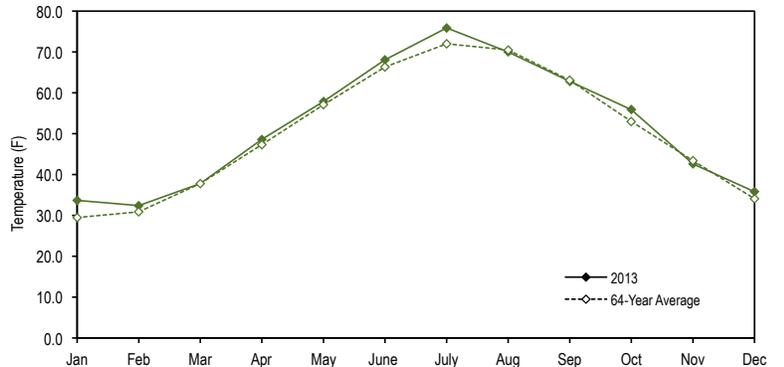


Figure 1-5. BNL 2013 Monthly Mean Temperature versus 64-Year Monthly Average.

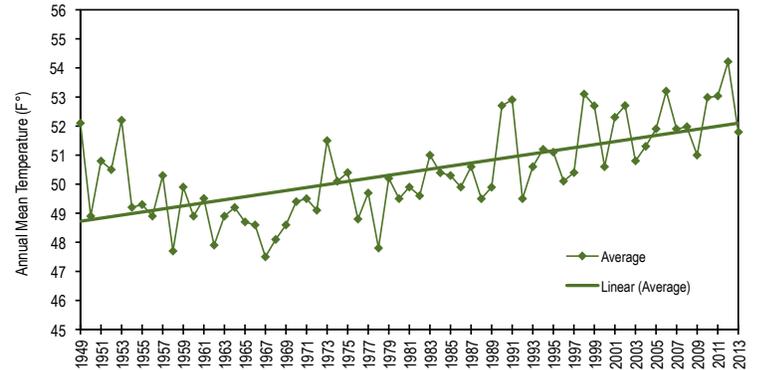


Figure 1-6. BNL 2013 Annual Mean Temperature Trend (64 Years).

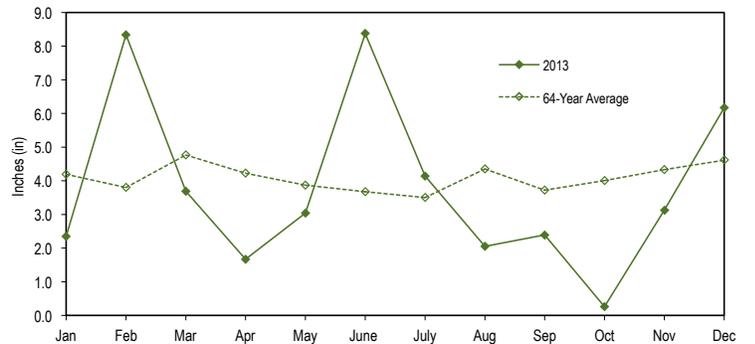


Figure 1-7. BNL 2013 Monthly Precipitation versus 64-Year Monthly Average.

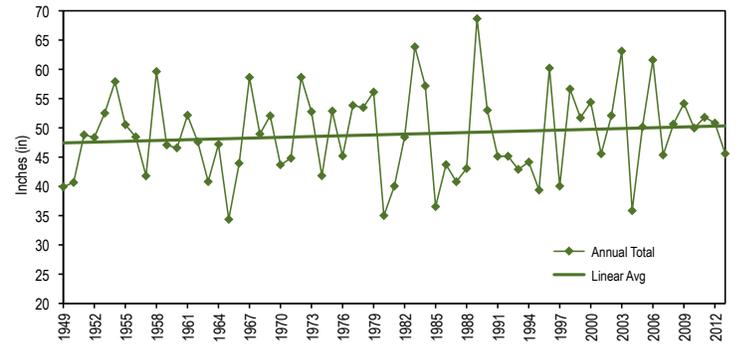


Figure 1-8. BNL 2013 Annual Precipitation Trend (64 Years).

CHAPTER 1: INTRODUCTION

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 conducted at BNL. The Laboratory currently has three facilities classified as eligible for listing on the National Register of Historic Places: 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 can be found in Chapter 6.

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