2 LABORATORY SETTING

2.1 INTRODUCTION

To help evaluate past and present impacts from BNL operations on the environment and to better identify potential pathways for possible exposures to the public and employees, local site characteristics are taken into consideration. These characteristics include human population, geology, hydrology, meteorology data, and natural and cultural resources.

2.2 SITE LOCATION AND LOCAL POPULATION

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. More than 75 percent of the Laboratory's approximately 3,000 employees, which include scientists, engineers, technicians, and administrative personnel live in Suffolk County. In addition, an estimated 4,000 guest researchers and students visit the Laboratory annually, many of which reside in apartments and dormitories on site or in nearby communities.

2.3 FACILITIES AND OPERATIONS

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

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

The balance of the site, approximately 3,400 acres, is mostly wooded and represents the native Long Island Pine Barrens ecosystem.

2.4 HYDROGEOLOGY AND GEOLOGY

The Laboratory 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 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 (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. 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 the Laboratory 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).

The Laboratory used approximately 1.33 million gallons of groundwater per day to meet potable water needs and heating and cooling requirements in 2011 (most recent data available). 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 Laboratory site. Human consumption, evaporation (cooling tower and wind losses), and sewer line losses account for the remaining 25 percent. An additional 4.9 million gallons of groundwater weree pumped each day from remediation wells for treatment and then returned to the aquifer by way of recharge basins or injection wells in 2011.

Groundwater flow direction across the Laboratory site is influenced by natural drainage systems flowing eastward along the Peconic River, southeast toward the Forge River, and south toward the Carmans River (see Figure 2-1 on the following page). 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, the Great South Bay, and the Atlantic Ocean. 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.

2.5 METEOROLOGICAL DATA

The Meteorological Group at BNL has been recording weather data on site since 1948. The Laboratory is broadly influenced by continental and maritime weather systems. Locally, the Long Island Sound, 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 the Laboratory are from the southwest during the summer, from the northwest during the winter, and about equally from thest two directions during the sping and fall (Nagle 1975, 1978).

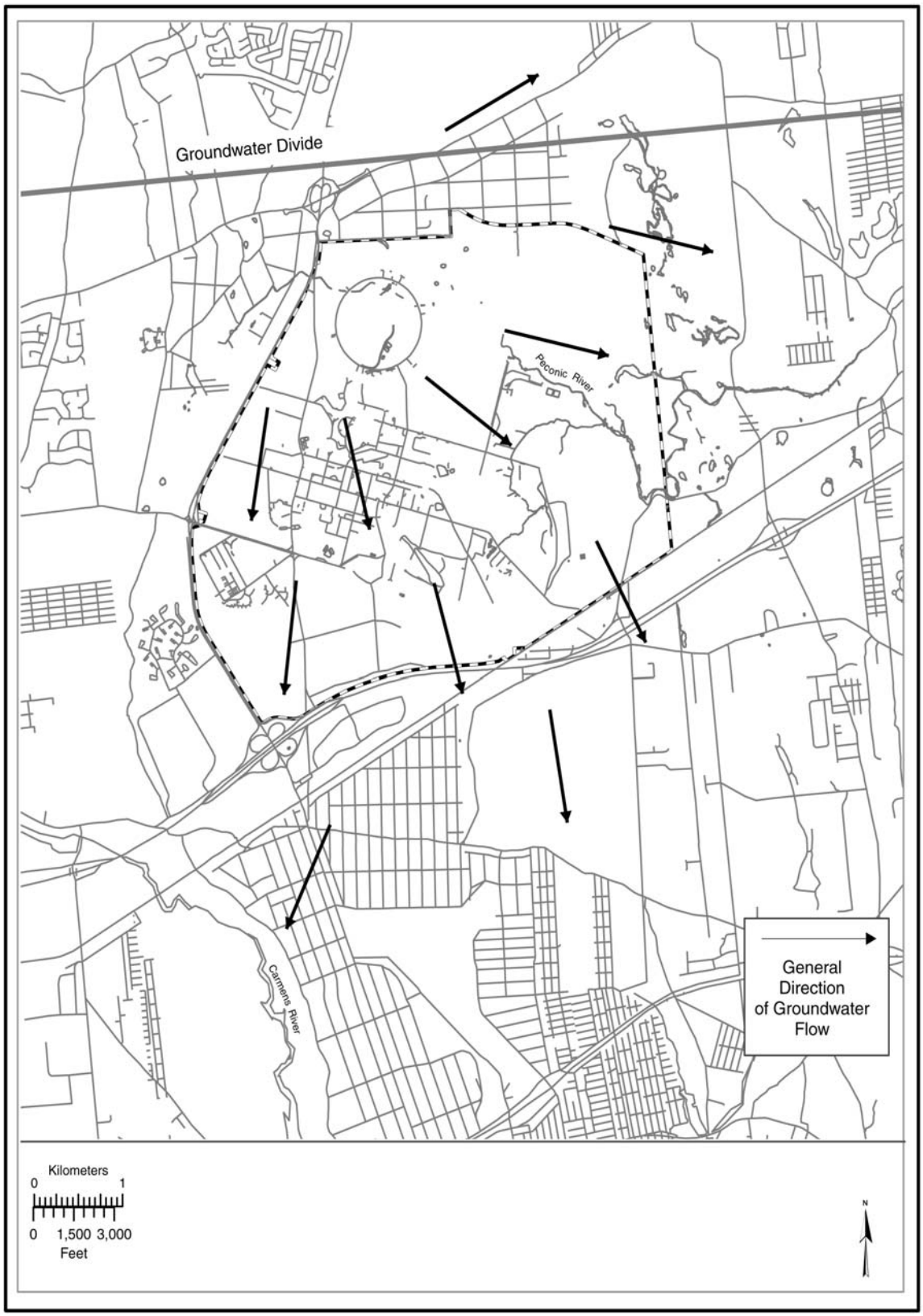

Figure 2-1. BNL Groundwater Flow Map.

Figure 2-2 shows the 2011 wind rose for BNL (most recent data available). Wind direction was measured at heights of 10 and 85 meters above the ground, for a total of 520,064 measurements at each height. The readings plotted on the charts indicate how often wind came from each direction. The concentric circles represent multi-percentage increases in the frequency. The predominate wind direction in 2011 was from the northwest at both the 10-m level and the 85-m level.

The average yearly temperature for the area in 2011 was 50 degrees Fahrenheit (ºF) and the total annual precipitation was 51 inches. Total snowfall for the 2011-2012 winter season was 5.5 inches, well below the 31 inches average yearly snowfall for Long Island.

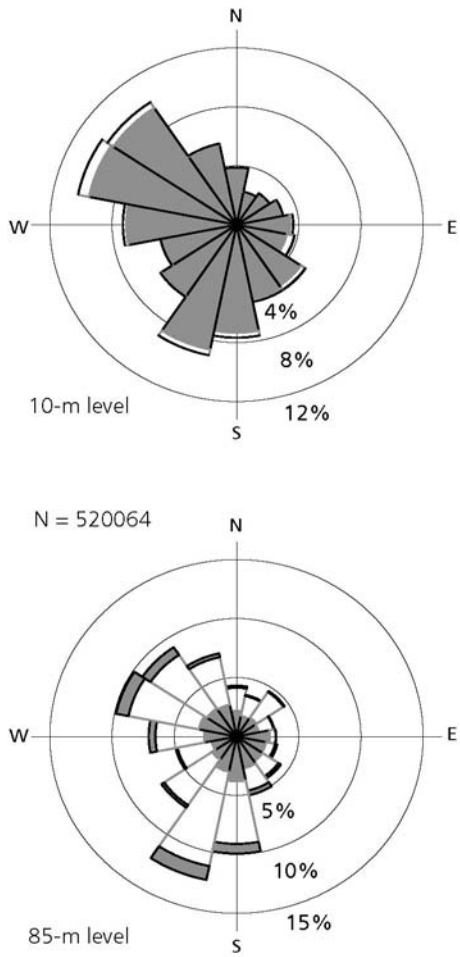

Figure 2-2. BNL Wind Rose, 2012

2.6 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 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 bais (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 is in various stages of succession, which reflects a history of disturbances to the site. 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.

A wide variety of vegetation, birds, reptiles, amphibians, and mammals inhabit the site. More than 230 plant species have been identified at the Laboratory, including two New York State threatened species and two that are classified as 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 site. 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 26 breeding sites for the New York State endangered eastern tiger salamander. Ten species of fish have been identified as endemic to the site, including the banded sunfish and the swamp darter, both of which are threatened species in New York State. Two types of butterflies that are

protected in New York State are believed to breed on site due to preferred habitat and host plants, and a New York State threatened damselfly was found on site in 2005. 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 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 provide habitats for plants, mammals, birds, reptiles, and amphibians. From 2000 to 2004, funding provided by 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 2005, management was transitioned to the Foundation for Ecological Research in the Northeast (FERN). The Laboratory continues to utilize the Reserve for its key ecological values and as an area for research.

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