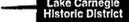


- 
Site 28ME2 Archeological site listed or eligible for listing in the National Register of Historic Places
- 
Site 28ME186 Archeological site not listed or not eligible for listing in the National Register of Historic Places or eligibility undetermined

- 
Lake Carnegie Historic District Historic architectural property listed or eligible for listing in the National Register of Historic Places
- 
CR 571 Bridge Historic architectural property eligible for listing in the National Register of Historic Places as a contributing resource of the Pennsylvania Railroad Historic District

NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
EIS
HISTORIC & ARCHAEOLOGICAL
RESOURCES

FIGURE 3-21 DATE: OCTOBER 2002
SCALE: 1:1000

No Action alternative, showing the locations of previously identified historic architectural resources and archeological sites.

David Voorhees House

The David S. Voorhees House is located on the southwest corner of the Washington Road/Station Drive intersection in West Windsor. David S. Voorhees purchased the property, then a farm, in 1836. The two-story, wood-framed residence is a typical example of vernacular Italianate farmhouse architecture. Despite some changes, it retains a substantial degree of original exterior architectural character. It is the only farmhouse of its period in the immediate Princeton Junction area. It possesses local significance as one of the first buildings erected in response to relocation of the railroad line and as a well-preserved example of an Italianate farmhouse. The David Voorhees House is recommended eligible for the National Register under Criteria A and C (SHPO Opinion Pending).

Delaware and Raritan Canal Historic District

The Delaware and Raritan Canal is 43 miles in length and begins at the northernmost point of Bull's Island in the Delaware River and follows the east bank of the river to Trenton where it turns north to follow the Millstone River and the Raritan River to New Brunswick. Included in the District are eighteen lock and bridge tender's dwellings, generally small two-story stone or wood framed structures, and two toll houses.

The significant characteristics of the Delaware and Raritan Canal that form the basis of its National Register listing include the survival of the canal prism, associated berm and towpath, as well as the survival of associated canal structures, including locks. It was designed by Canvas White, the principal engineer of the Erie Canal, and represents a historically significant engineering work associated with the broad pattern of commerce and transportation in the United States (National Register Listed: 05/11/75).

Lake Carnegie Historic District

The Lake Carnegie Historic District consists of several elements: a three-and-one-half mile manmade lake, which incorporates several small islands and associated landscape elements; a dam; two bridges that cross the lake and its tributaries; and the Princeton University, Class of 1887 Boathouse.

The significant characteristics of the Lake Carnegie Historic District that form the basis of its National Register eligibility include the presence of the lake, the first man-made lake in the United States created specifically as a course for crew racing, and its designed landscape, including ornamental arrangements of trees, winding walks, and pedestrian and vehicular bridges (National Register Listed: 06/28/90).

Penns Neck Cemetery

Penns Neck Cemetery is located approximately 1,450 feet west of Route 1 and approximately 1,140 feet north of Washington Road. The cemetery is the oldest in West Windsor Township, dates from the 1730s, and contains many graves of members of the founding families of Penns Neck.

The significant characteristics of the Penns Neck Cemetery which form the basis of the recommendation of National Register eligibility include the presence of early burials, probably associated with the very early period of settlement in West Windsor Township (National Register Eligible, SHPO Opinion: 03/10/97).

Pennsylvania Railroad Historic District

Princeton Junction marks the junction of two railroad lines, the former Philadelphia to New York Main Line (present NEC) and the Princeton Branch (the "Dinky"). The entire NEC between Philadelphia and New York City has been recommended eligible in an opinion rendered by the Bureau for Historic Preservation, Pennsylvania Historical and Museum Commission. The New Jersey Historic Preservation Office concurred with the opinion that any element of the NEC in the Princeton Junction vicinity erected between 1839 and 1976 that retains integrity is eligible for the National Register as a contributing resource of a larger district. Eligible resources include the Nassau Interlocking Tower, the Mercer CR 571 bridge over NEC, and the former Princeton Junction Hotel. The present Princeton Junction Station, the track bed and catenaries are ineligible because they postdate the period of significance of the district (SHPO Opinion Pending).

Princeton Baptist Church at Penns Neck

The church complex (known in the National Register listing as the Penns Neck Baptist Church) is located on the northeasterly corner property of the Princeton Circle at the intersection of Route 1 and Washington Road. The property, consisting of over two acres, is the chief surviving manifestation of the old Hamlet known as Penns Neck.

The significant characteristics of the Penns Neck Baptist Church that form the basis of its National Register eligibility include the presence of an intact assemblage of components. These include the original nineteenth century meeting house, a nineteenth century tavern converted to a parsonage, and an associated church cemetery, as well as the retention of exterior and interior detailing of both the church and the parsonage (National Register Listed: 12/28/98).

Princeton Operating Station

The Princeton Operating Station is located on the northwest corner of Route 1 and Eden Way. The American Telephone and Telegraph Company (AT&T) built the structure in 1917 and it remained in their possession until 1982. The building is a remnant of the early era of long-distance telephone communications in the United States. A major portion of the building was used to house test and repeater facilities.

The Princeton AT&T Operating Station was determined significant under National Register Criteria A and C. Under Criterion A, the property was associated with the development of the East Coast long-distance telephone network. Under Criterion C, it was considered as an example of a rare surviving building type, an early twentieth century long distance telephone repeater-test station (National Register Eligible, SHPO Opinion: 07/08/98).

Sarnoff Corporation

The Sarnoff Corporation campus is located on the east side of Route 1, south of the Millstone River, north of Fisher Place, and west of Little Bear Brook in West Windsor. The campus is the location of one of the premier electronics research institutions in the world. Sarnoff, and its predecessors, are known for their role in the development of the all-electronic compatible color television system. Other notable achievements in the field of electronics include pioneering work in liquid crystal technology, development of Metal Oxide Semiconductor (MOS) transistors, which is one of the mainstays of the integrated circuit industry, and early development of music synthesizer and facsimile technology. The campus, including its buildings and immediately surrounding grounds, is eligible for the National Register of Historic Places under Criterion A for its significance in the areas of engineering and science (SHPO Opinion: 01/03).

Washington Road Elm Allée

An allée of American elms lines a straight segment of Washington Road between the Penns Neck Circle (the intersection of Washington Road and Route 1) and the Delaware and Raritan Canal. The original portion of the allée consists of single rows of American elms planted on either side of Washington Road. These elms, planted over 60 years ago, are fully mature.

The Washington Road elms are listed on the National Register under Criterion C as a designated historic landscape reflecting significant early twentieth century trends in landscape design. The elms represent an intact example of an American elm allée, a once common but now uncommon designed landscape (National Register Listed: 0118/99).

3.5.3 Archaeological Resources

The following archaeological sites are located within or very close to the APE. Figure 3-21 shows the locations of these sites.

Site 28ME2

Site 28ME2 is located in an open lawn area of the Sarnoff property near Route 1 and the Millstone River. The dimensions of the site within the project right-of-way were documented as approximately 1,000 feet east-west by 500 feet north-south. Archaeological investigations of this large site determined that the site contains both historic and prehistoric components. The site is recommended to be eligible for the National Register under Criterion D.

Site 28ME23

Site 28ME23 is located on the south side of the Millstone River, east of Little Bear Brook on property owned by Sarnoff Corporation. Based on Phase II research, Site 28ME23 was occupied during the Late Archaic and Late Woodland periods. Twenty-four culturally sensitive artifacts were collected, including projectile points, pottery, and one bannerstone. Including Phase I material, 598 artifacts were recovered. The site is approximately 1.21 acres in area. The integrity of the site is good, and it

appears to be culturally stratified. The site is recommended to be eligible for the National Register under Criterion D.

Site 28ME86

Site 28ME23 is located on the south side of the Millstone River, west of Little Bear Brook on property owned by Sarnoff Corporation. A Phase II evaluation was performed within the portion of Site 28ME86 located within and near several of the action alternatives. This research indicates that the site had been occupied during the Late Archaic and late Woodland periods. Considerable disturbance to portions of the site has been documented, although the integrity of the site is good. Based on these findings, the portions of 28ME86 having integrity are considered eligible for listing in the National Register under Criterion D.

Sites 28ME60 and 28ME91

Sites 28ME60 and 28ME91 are located in a currently plowed field near the east or south bank of Stony Brook. Both sites are intact prehistoric lithic scatters. Site 28ME60 contains remains of intermittent occupations spanning the Middle Archaic, Late Archaic, Terminal Archaic, and possibly the Early and Middle Woodland periods. Site 28ME91 contains evidence of intermittent occupations spanning the Paleo-Indian, possibly the Early Archaic, and the Late Archaic, Terminal Archaic, and the Woodland periods. On the basis of the information currently available, Sites 28ME60 and 28ME91 are eligible for listing in the National Register of Historic Places under Criterion D.

Site 28ME201

Site 28ME201 is located in an open lawn on the northwest corner of Basin Street, west of Alexander Road. Remnant stone foundation and brick pier supports are visible on the surface. Further research indicates that the site is the ruin of a nineteenth-century Episcopal church. The site contains intact architectural features, and on the basis of the information currently available, the site is eligible for National Register listing under Criterion D.

Site 28ME264

Site 28ME264 is located directly west of Logan Drive. The Phase II evaluation of Site 28ME264 determined that it was continually occupied from the early to mid nineteenth century until approximately the mid-1940's. The site is centered on a two-story private residence. Most of the site was extensively disturbed from landscaping activities associated with the occupation of the current house. The integrity of the archeological deposit was determined to be poor. Site 28ME264 is not considered eligible for National Register listing.

Site 28ME282

Historic Site 28ME282 is located within a wooded stand just north of Route 1 and between Washington Road and the Dinky rail line. Large dirt piles are present near the location of the former house. Foundation remains of the barn and silo appear to be intact. Intact remains of the barn include the ramp, mortared stonewall, interior concrete floor, and two concrete troughs. Recent earth-moving activities have destroyed much of Site 28ME282, rendering it ineligible for the National Register.

Site 28ME283

Site 28ME283 is located within a small wooded stand west of Route 1, north of Alexander Road, and south of the Dinky rail line. Site 28ME283 is a farmstead that dates to the nineteenth to mid-twentieth century with relatively intact archeological deposits. On the basis of the information currently available, Site 28ME283 is eligible for National Register listing under Criterion D.

Site 28ME284

Site 28ME284 is located east of the Delaware and Raritan Canal and north of Alexander Road. The site consists of a large basin and a rectangular depression approximately 15x30 feet, which may represent the cellar hole to a building owned by the Camden & Amboy Railroad. The Camden & Amboy Railroad was the first chartered railroad in the United States, and represents an important milestone in the development of efficient transportation networks related to the industrialization of the northeast. On the basis of the information currently available, Site 28ME284 is eligible for NRHP under Criterion D.

Site 28ME291

Site 28ME291 is located north of Washington Road, just west of the Northeast Corridor right-of-way. A small number of prehistoric artifacts were recovered during Phase I testing at this site. A determination of National Register eligibility is pending Phase II research.

Site 28MI129

Site 28MI129 is situated near Route 1 and Mapleton Road. In a previous Phase II evaluation by others, this site was determined to be not eligible to the National Register of Historic Places.

3.6 Aesthetics

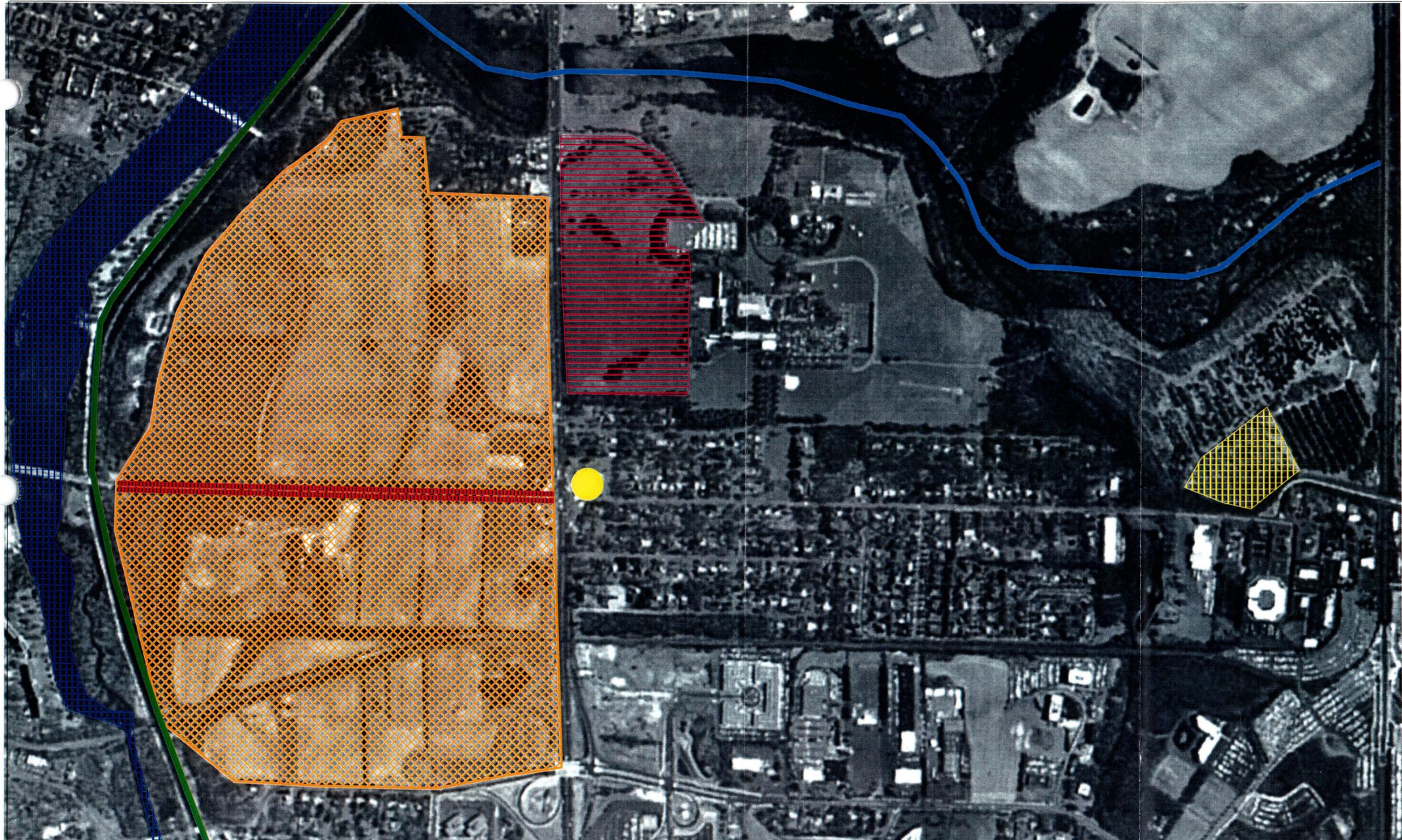
The FHWA specifies three categories of viewsheds for consideration: highly sensitive sites, moderately sensitive sites, and low sensitivity sites⁷. Highly sensitive sites include locations such as bodies of water, meadows, lawns and landscaped areas, and unique natural or manmade features. Moderately sensitive viewsheds include structures such as residences and religious sites, or areas that are partially blocked by

⁷ FHWA, 1988, Visual Impact Discussion.

vegetation, such as forests and hedgerows. Sites of low visual sensitivity include developed areas such as urban and industrial settings.

Viewsheds of each sensitivity occur within the study area. The eastern edge of the study area abuts the Princeton Junction Station and adjacent parking lots and development; thus, it is definable as a low sensitivity site. Continuing westward, viewsheds are a combination of moderately and highly sensitive areas of open space interspersed with a variety of structures, manicured lawns and landscaping, horticulture, forests, and bodies of water. Visually sensitive sites are shown graphically in Figure 3-22. Following is a description of these sites:

- The Princeton University athletic and agricultural fields the west of Route 1 – These fields are primarily seen by drivers headed southbound on Route 1, just south of the PSE&G substation. These fields are visible on the stretch of Washington Road between the Delaware and Raritan Canal and Route 1 for pedestrians and drivers traveling along this road. The western end of these fields is used for recreational purposes and the eastern end for agricultural uses. Princeton University agricultural fields are also visible to drivers along Alexander Road. Princeton University has indicated that the fields on both sides of Washington Road are set aside for future campus expansion. Although these fields are an important visual resource, the visual impact assessment takes into account these future development plans.
- The Millstone River – The Millstone River is an important natural and visual resource in the study area than runs along its northern edge. The river is surrounded by wetland and wooded areas that also provide a natural and visual resource. At the intersection of Route 1 and Harrison Street, the Millstone River is visible to drivers on Route 1.
- The Sarnoff Corporation front lawn east of Route 1 – The front lawns of Sarnoff contribute to the campus-like setting along Route 1. They are mainly visible to Sarnoff, and drivers on Route 1. The Sarnoff Corporation's approved General Development Plan calls for development throughout its campus. The visual impact analysis acknowledges that the status of the Sarnoff lawns as a visual resource will change.
- Washington Road Elm Allée – The allée creates a pleasing view and atmosphere for those traveling along Washington Road. The elms line both sides of Washington Road between Route 1 and the Delaware and Raritan Canal.



Legend

- | | |
|---|--|
|  Princeton University Fields |  Carnegie Lake |
|  Millstone River |  Mature Pine Grove |
|  Front Lawns of Sarnoff |  Princeton Baptist Church at Penns Neck |
|  Washington Rd. Elm Allee |  Delaware & Raritan Canal |

Aerial Source: New Jersey Department of Environmental Protection

NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
 ENVIRONMENTAL IMPACT STATEMENT
 STUDY AREA
 VISUAL RESOURCES

DATE: NOVEMBER 2002
 SCALE: 1:1200

FIGURE 3-22

As previously mentioned, Princeton University plans to develop the fields on either side of Washington Road. Although the preservation of the elm allée will depend on the development plans for the fields, the visual impact analysis assumes that the elm allée will remain an important visual resource.

- The mature pine grove on Washington Road east of Little Bear Brook –The grove is located on Sarnoff property, but is visible for drivers and pedestrians on Washington Road and CR 571.
- The Princeton Baptist Church at Penns Neck – The church complex includes the church building, associated structures, the building known locally as the Red Lion Inn, and the cemetery. It is located on the northeast corner of the intersection of Route 1 and Washington Road. These resources are visible to travelers on Washington Road and Route 1.
- The Delaware and Raritan Canal – The D&R Canal, constructed between 1830 and 1834 and now a state park, serves as an important recreational, historic, and visual resource along the western perimeter of the study area. Viewers of the canal include users and those that cross the canal using one of the east-west roadways.
- Carnegie Lake – Carnegie Lake was created in 1906 by the construction of a dam at Kingston that impounded the confluence of Stony Brook and the Millstone River. Lake Carnegie provides a place for undergraduate rowing, and for canoeing, sailing, fishing, and skating by members of the Princeton community.

In addition to these resources, a number of notable visual sites are currently privately accessible.

- Within the Sarnoff property, the main entrance driveway at Fairview Avenue features a mature oak allée and large maintained lawn areas.
- Open lawn sites border the Sarnoff building cluster to the north and east.
- The Princeton University property west of Route 1 provides viewsheds from the private access roads within the athletic field areas.

3.7 Natural Ecosystems

3.7.1 Soils

Unless otherwise noted, the following information on soils was obtained from the U.S. Department of Agriculture (USDA) *Soil Survey of Mercer County, New Jersey* (1972) and the USDA *Soil Survey of Middlesex County, New Jersey* (1987). There are 30 major soil series within the study area, with a total of 48 soil types. A listing of soils within the study area is provided in Table 3-26.

Table 3-26
Soils within the Study area

Symbol	Hydric	Description
BoB	N	Birdsboro soils, gravelly solum variants, 0 to 5 percent slopes
Bt	Y	Bowmansville silt loam, 0 to 2 percent slopes
BuB	N	Bucks silt loam, 2 to 6 percent slopes
BuB2	N	Bucks silt loam, 2 to 6 percent slopes, eroded
BuC2	N	Bucks silt loam, 6 to 12 percent slopes, eroded
Cg	N	Cut and fill land, gravelly material
Ct	N	Cut and fill land, rock substratum
Df	N	Downer fine sandy loam, gravelly clay loam substratum, 0 to 5 percent slopes
DnA	N	Downer loamy sand, 0 to 5 percent slopes
DnC	N	Downer loamy sand, 5 to 10 percent slopes
DTB	N	Downer-Urban land complex, 0 to 10 percent slopes
DgA	Y	Doylestown silt loam & Reaville silt loam, 0 to 2 percent slopes
DwB	N	Dragston and Woodstown sandy loams, 0 to 4 percent slopes
EvB	N	Evesboro sand, 0 to 5 percent slopes
Fd	Y	Fallsington sandy loam
Fm	Y	Freshwater marsh
FrB	N	Fort Mott loamy sand, 0 to 5 percent slopes
GaB	N	Galestown loamy sand, 0 to 5 percent slopes
GeB	N	Galestown sandy loam, 0 to 6 percent slopes
HeA	N	Hammonton loamy sand, 0 to 3 percent slopes
HmA	N	Hammonton sandy loam, 0 to 2 percent slopes
HU	Y	Humaquepts, frequently flooded
Km	N	Klej soils, sandy loam subsoil variants, 0 to 3 percent slopes
LaB	N	Lansdale sandy loam, 2 to 6 percent slopes
LcC2	N	Lansdale channery loam, 6 to 12 percent slopes, eroded
LcD2	N	Lansdale channery loam, 12 to 18 percent slopes, eroded
Ma	Y	Manahawkin muck
MoA	N	Matapeake loam, 0 to 2 percent slopes
MoB	N	Matapeake loam, 2 to 5 percent slopes
Mq	N	Mattapex and Bertie loam, 0 to 5 percent slopes
NaB	N	Nixon loam, 2 to 5 percent slopes
NfA	N	Nixon variant loam, 0 to 2 percent slopes
NfB	N	Nixon variant loam, 0 to 2 percent slopes
PeB	N	Penn shaly silt loam, 0 to 6 percent slopes
Pg	N	Pits
PN	N	Psammments, nearly level
Pu	Y	Plummer sandy loam
Pv	Y	Plummer sandy
RaA	N	Readington and Abbottsville silt loam, 0 to 2 percent slopes
SdE	N	Sandy and silty land, steep
SIB	N	Sassafras loam, 2 to 5 percent slopes
SrB	N	Sassafras sandy loam, 2 to 5 percent slopes
SrC	N	Sassafras sandy loam, gently undulating
SrC2	N	Sassafras sandy loam, 5 to 10 percent slopes
UB	N	Udorthents, bedrock stratum
WIA	N	Woodstown loam, 0 to 2 percent slopes

3.7.1.1 Farmland Soils

Historically, large portions of the study area were farmed until the middle of the 20th century. The relatively recent development of the study area has changed the land use characteristics from primarily agricultural use to that of residential and office use. The land most recently used for agricultural purposes is the Princeton University property, located west of Route 1. Small portions of this land are commercially farmed at present, while the largest areas are used for horticultural and athletic purposes.

The New Jersey Important Farmlands Inventory (USDA, 1990) is a list of important farmland soil types in New Jersey. The soils documented in this inventory have been determined to be valuable to farming in New Jersey and are categorized according to the following classifications: Prime Farmlands, Soils of Statewide Importance, Unique Soils or Locally Important Soils. A description of each category of farmland is given below. In addition, Table 3-27 provides a summary of each farmland soil within the study area and its farmland designation. Figure 3-23 illustrates the different farmland types within the study area.

Prime Farmland Soils. According to the New Jersey Important Farmlands Inventory, Prime farmlands include all those soils in Land Capability Class I and selected soils from Land Capability Class II. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops and is also available for these uses. It has the soil quality, growing season and moisture supply needed to economically produce and sustain high yields of crops when treated and managed according to acceptable farming methods. Prime farmlands are not excessively erodible or saturated with water for a long period of time and they either do not flood frequently or are protected from flooding. There are 12 Prime farmland soils mapped in the study area.

Soils of Statewide Importance. These soils include those in Land Capability Classes II and III that do not meet the criteria as Prime farmland. Statewide Important Soils are nearly Prime farmland and economically produce high yields of crops when treated and managed according to acceptable farming methods. Some of these soils may produce yields as high as Prime farmland if conditions are favorable. There are ten soils of Statewide Importance in the study area, including two that are only considered in this category when drained.

Unique Soils. Unique soils are defined as those soils which are used for early crops or crops that are tolerant of drought. The USDA (1990) identifies GaB and Ma as the only Unique farmland soils located within the study area.

**Table 3-27
Farmland Soils within the Study Area**

Soil Type	Prime	Statewide	Unique	Locally Important
Birdsboro (BoB)				Mercer County
Bowmansville (Bt)		When Drained		
Bucks (BuB, BuB2)	X			
Bucks (BuC2)		X		
Downer (Df)	X			
Downer (DnA, DnC)		X		
Dragston and Woodstown (DwB)	X			
Evesboro (EvB)				Mercer County
Fallsington (Fd)		X		
Fort Mott (FrB)		X		
Galestown (GaB)			X	
Galestown (GeB)	X			
Hammonton (HmA)	X			
Klej (Km)		X		
Lansdale (LaB)	X			
Manahawkin muck (Ma)			X	
Matapeake (MoA)	X			
Mattapex (Mq)		X		
Nixon (NaB, NfA, NfB)	X			
Penn (PeB)	X			
Plummer (Pu)		When Drained		
Readington-Abbottsville (RaA)	X			
Reaville (ReA)		X		
Rowland (Ro)				Middlesex County
Sassafras (SIB, SrB)	X			
Sassafras (SrC, SrC2)		X		
Woodstown (WIA)	X			

Source: United States Department of Agriculture (USDA), Natural Resources Conservation Service, "New Jersey Important Farmlands Inventory", (September, 24, 1990).



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS

FARMLAND SOILS:

- PRIME
- STATEWIDE
- UNIQUE
- LOCAL

* Pu and Bt soils are only considered statewide farmland soils when drained.

NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT
EXISTING CONDITIONS
SOILS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 3-23

Locally Important Soils. Locally Important soils include those soils that are not Prime, Statewide or Unique farmland soils but are used for the production of high value food, fiber or horticultural crops. There are three Locally Important soils within the study area; two within Mercer County and one in Middlesex County.

Farmland soils, including all four classes (Prime, Statewide, Unique and Local), comprise the majority of the study area with the exception of stream corridors and waterbodies (i.e., the Millstone River, Little Bear Brook, Carnegie Lake).

3.7.2 Geology

The U.S. Geological Survey (USGS) Princeton and Hightstown, New Jersey 7.5 minute series topographic maps (1981) were reviewed to determine the existing topographical features in the vicinity of the expanded study area. Elevations within the expanded study area range from a maximum of +105 feet above mean sea level (msl) along Route 1 at Washington Road, to a minimum of +60 feet above msl along the Delaware and Raritan Canal (D&R Canal), Millstone River and Little Bear Brook. The entire expanded study area can be characterized as relatively flat with gentle slopes descending towards valleys with stream channels. Elevations are generally higher towards Washington Road near the center of the expanded study area and the NEC to the east.

The expanded study area is situated within two major physiographic provinces, the Coastal Plain and the Piedmont. The expanded study area is divided by a "fall line" that divides the Coastal Plain Province to the east and the Piedmont Province to the west. This line approximately parallels Route 1 about 1.2 miles to the east (USDA, 1972; see Figure 3-24).

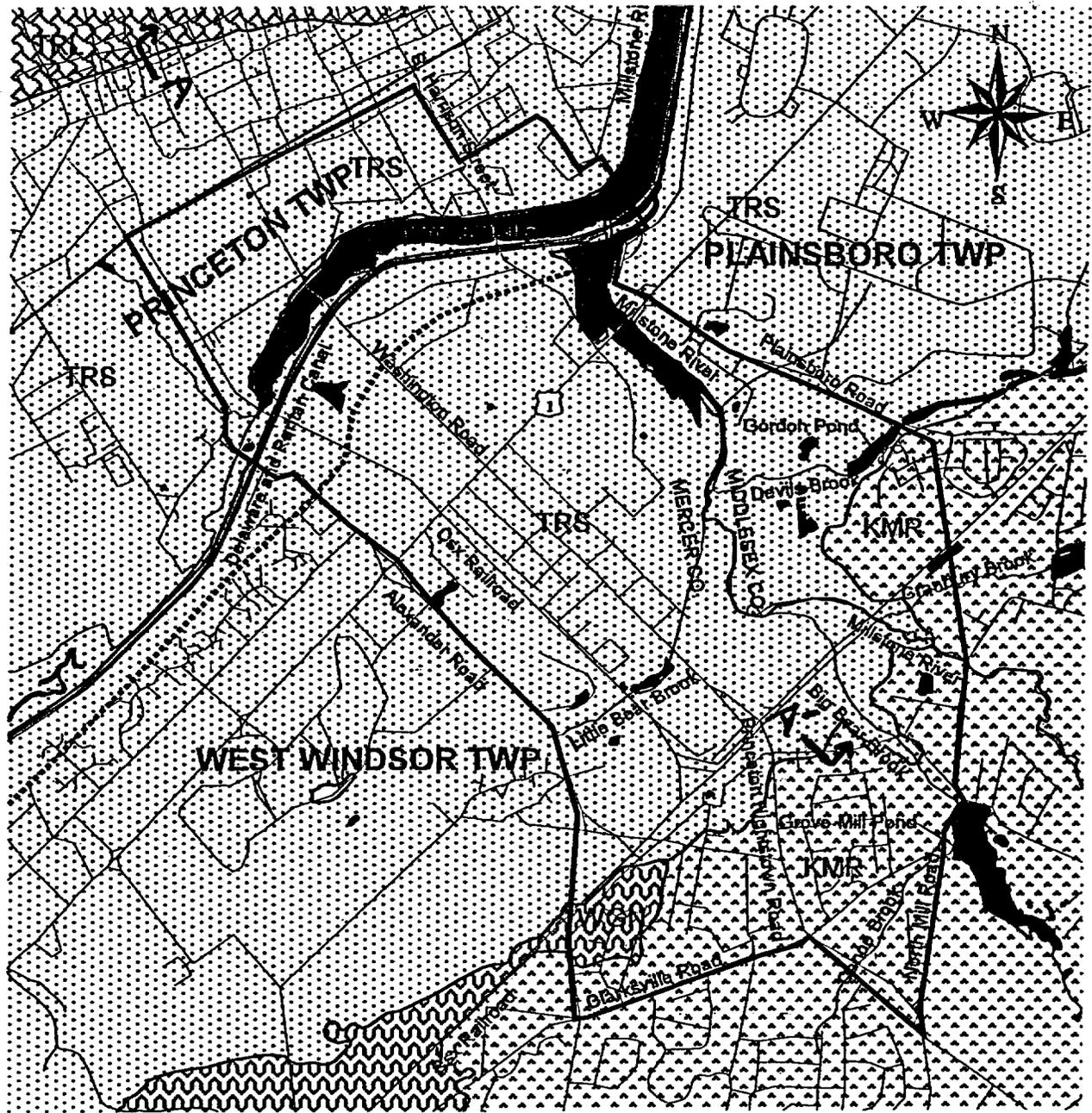
The distinguishing characteristics of the two provinces are the bedrock structure, climate and geomorphologic history. The majority of the expanded study area is situated within the Piedmont Province and underlain by Stockton Sandstone (TRS). This TRS Formation lies primarily west of the NEC in the expanded study area and consists of sedimentary rocks from the Triassic age, made up of siltstone, shale and sandstone conglomerate. The geographic extent of these formations is presented in Figure 3-24. The Pennsauken Formation overlies the Stockton Sandstone in the western portion of the expanded study area and is believed to be approximately 10 feet thick. East of Route 1, the Pennsauken gives way to the Cape May Formation, which is usually less than 20 feet thick.

Boring information collected in the expanded study area indicates the Piedmont Province bedrock formation to be a very soft to medium hard, poor quality rock. The rock core recoveries indicated moderate to completely weathered shale and sandstone, highly fractured with a few soft areas encountered. At the rock line, the zone of weathered and fractured shale varies from 5 to greater than 10 feet deep. The typical shale and sandstone formation becomes less fractured and harder with

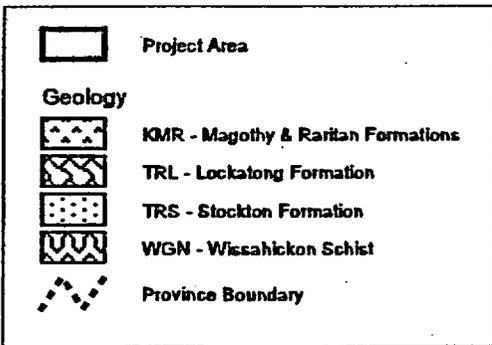
increasing depth. Boring data for the expanded study area is contained in the *Natural Ecosystems Technical Environmental Study, Penns Neck Area EIS*.

East of the NEC, the expanded study area contains sedimentary rocks of the Cretaceous age, consisting of sand, silt and clay known as the Raritan Magothy Formation (KMR). These sediments include sands, silts and clays of marine and continental origin that were deposited in cyclical transgressions and regressions of the sea throughout these two periods resulting in permeable sands overlying layers of relatively impermeable clays and silts (NJWSA, 2000). Both the Triassic and Cretaceous age rocks are from the Mesozoic era.

A small portion of the expanded study area contains Wissahickon Schist. This formation is found in the southeast quadrant of the NEC intersection with Alexander Road and consists of sand and clay sediments deposited in thick layers. These layers compacted to form a massive rock unit of sandstone and shale historically much thicker than it is today.



5-124



Province Boundary = Boundary between Soils of the Piedmont and Soils of the Northern Coastal Plain (Mercer County only).

Source: Information adapted from New Jersey Geological Survey 1962 and the NJDEP Geographic Information System CD-ROM, Series 1, Volume 2 (1996).

NEW JERSEY DEPARTMENT OF TRANSPORTATION	
PENNS NECK AREA ENVIRONMENTAL IMPACT STATEMENT	
GEOLOGIC MAP	
DATE: Nov. 2002	FIGURE 3-24

3.7.3 Groundwater

According to a report published by the NJDEP (1995⁷), groundwater provides approximately 50 percent of the potable water in New Jersey.

Aquifer and Groundwater Recharge

Recharge of the groundwater table occurs when enough water infiltrates the soil to penetrate the unsaturated zone (i.e., soils and geologic strata) and makes its way down through the strata to the water table. Recharge to wells can range from a few days to a few hundred years, depending on the length of the flow path, the porosity of the geologic strata and the average velocity along the flow path (NJWSA¹, 2001).

Precipitation that falls on the expanded study area either infiltrates the soil surface, evaporates, or becomes surface runoff, and is discharged to nearby waterbodies. The majority of the precipitation that infiltrates the ground becomes recharge. The relatively thin cover of porous Pennsauken or Cape May Formations overlying the massive Stockton Sandstones allows for measurable groundwater contributions. In areas where the Stockton Formation is fractured, groundwater contributions would also occur. Elsewhere, precipitation functions mainly as discharge to adjacent waterbodies.

Groundwater recharge rates by subwatershed or hydrologic unit code have been evaluated by the NJWSA for the Raritan Basin. Recharge in the subwatersheds of the Millstone Watershed Management Area (WMA) ranged between 5.4 and 11.7 inches per year. The average 1995 recharge (for the areas of recharge) within the Millstone WMA was 0.40 mgd/mi².

Within the Millstone WMA, the NJWSA reported that 37 of 39 subwatersheds experienced losses in groundwater recharge between 1986 and 1995. Recharge losses ranged between 0.79% (0.07 inches, a minimal change) and 21.63% (1.58 inches). Conversely, two of the subwatersheds in the Millstone WMA demonstrated increases in recharge which ranged between 0.01% (0.001 inches) and 0.38% (0.04 inches).

An aquifer recharge evaluation was conducted as part of this EIS. The study was conducted using *A Method for Evaluating Ground-Water Recharge Areas in New Jersey (The Method)* (NJDEP², 1993). The Method is described in detail in the *Natural Resources Technical Environmental Study, Penns Neck Area EIS*. The findings of the methodology concluded that the expanded study area has areas of high, moderate, and low recharge. Overall, the expanded study area has a recharge capacity of 530.49 million gallons per year. Figure 3-25 illustrates high, moderate, and low recharge areas based on recharge rates in inches per hour, as determined by the groundwater recharge evaluation.

⁸ NJWSA, August 2001. *Ground Water in the Raritan River Basin, A Technical Report for the Raritan River Basin Watershed Management Project*.

The United States Geological Survey (USGS), in cooperation with the NJDEP, operates the Ambient Ground-Water Quality Network (AGWQN), which is designed to monitor the quality of groundwater at or near the water table throughout the State. The AGWQN is a long-term monitoring network with goals to assess the status of groundwater quality by examining the concentrations of various constituents that can be used as environmental indicators, assess water quality trends by examining data collected on a 5-year cycle, determine the effects of land use on shallow groundwater quality, identify threats from nonpoint sources of contamination, and identify emerging or new environmental issues of concern to the public.

The AGWQN Network consists of 150 shallow groundwater wells distributed throughout New Jersey within three land use types. One well was situated in the Millstone WMA, upstream of the expanded study area. This well is located in the Dutch Neck area of West Windsor. The sampling results for the well are as follows:

NJ- WRD Well #	Predominant Land Use	Dissolved Oxygen (mg/l)	Nitrogen (NO ₂ +NO ₃ dissolved (mg/l)	Number of Pesticides detected	Number of VOCs detected	Number of trace elements detected	Well depth (ft)
210606	Urban	5.4	1.65	2	None	12	18

The ambient groundwater quality within the Millstone River Basin Area System (BAS) varies considerably, although for the most part is suitable for drinking following disinfection treatment. Variations are attributed mainly to: 1) differences in the composition of the rocks; 2) the pattern of groundwater movement from recharge to discharge; and 3) the length of time that the water is in contact with the various rock types (NJWSA¹, 2001).

Sole Source Aquifers

Section 1424(e) of the Safe Drinking Water Act of 1974 (PL 93-523) charges the USEPA with protection of Sole Source Aquifers. Designation of a Sole Source Aquifer is based upon the following factors:

- Whether the aquifer represents the sole or principal source (more than 50 percent) of the drinking water for the defined aquifer service area;
- Whether the volume of water available from all alternate sources is insufficient to replace the aquifer in the service area; and,
- Whether contamination of the aquifer would create a hazard to public health.

Federally funded projects potentially affecting an SSA must be reviewed by the USEPA.

The expanded study area is located partially within the Millstone River BAS (one of the Northwestern New Jersey Fifteen Basin Aquifer Systems), and partially within the Coastal Plain Aquifer System.

The boundary between the two aquifer systems is the fall line between the Piedmont and Inner Coastal Plain Provinces, which lies approximately parallel with and about 1.2 miles east of the Route 1 corridor. The Piedmont sandstones of the Northwest New Jersey Sole Source Aquifer terminate approximately along a line following the NEC corridor in the eastern portion of the expanded study area (Figure 3-26). Between the fall line and the NEC, Coastal Plain soils overlie the Piedmont sandstones. Within New Jersey, these two Sole Source Aquifers comprise 6,389 square miles.

In order to be considered a Sole Source Aquifer, an aquifer must supply more than 50% of the drinking water for its aquifer service area (ASA). An ASA is defined as the physical area served by an aquifer. The Millstone River BAS is situated in four counties and includes 20 municipalities, including Plainsboro, Princeton and West Windsor Townships and Princeton Borough. Fifty-seven percent of the ASA is supplied drinking water by the Millstone River BAS. Thirty-eight percent of the drinking water supplied within the Millstone River BAS comes from surface waters within the basin and the remaining five percent comes from surface waters located outside the Millstone River BAS boundaries. The Millstone River BAS supplies 7,219,200 gallons per day (gpd) of drinking water, whereas the total volume supplied by the Fifteen BAS is approximately 49.3 million gpd. Hence, the Millstone River BAS supplies 14.64% of the total drinking water within the Fifteen BAS. The Millstone River BAS has an ASA population of 126,083, with 72,192 people dependent on the Millstone River BAS for drinking water. The Millstone River BAS contains 27,496 domestic and 44,696 public wells (USEPA, 1988).

New Jersey Coastal Plain Aquifer System

The New Jersey Coastal Plain Aquifer System includes the part or all of the southern New Jersey counties. The New Jersey Coastal Plain is part of the Atlantic Plain physiographic province. Of the five major aquifers make up the New Jersey Coastal Plain Aquifer System, the Potomac-Raritan-Magothy aquifer system underlies the expanded study area. Groundwater withdrawals from this aquifer have resulted in groundwater level declines of 1.5 to 2.5 feet per year from 1966 to 1976 (USEPA website, 2002; www.epa.gov/region02/water/aquifer). In the outcrop areas of the Potomac-Magothy aquifer system recharge to the aquifer is about 12-inches per year (USEPA website, 2002; www.epa.gov/region02/water/aquifer).

Public and Private Well Information

NJDEP Bureau of Water Allocation well records indicate a total of 180 wells within and adjacent to the expanded study area. Nearly half of these wells are listed as monitoring wells. The remaining wells are generally divided between domestic, industrial and public water supply. There are 16 public community supply wells within the Millstone WMA that are also within or near the expanded study area. The wells range in depth from 67 feet to 503 feet, and range in capacity from 100 gallons per minute (gpm) to 800 gpm (NJWSA¹, 2001). The majority of these wells are within the Stockton Sandstone geologic formation. These 16 wells yield a total capacity of 6,345 gpm or a total average of 397 gpm.

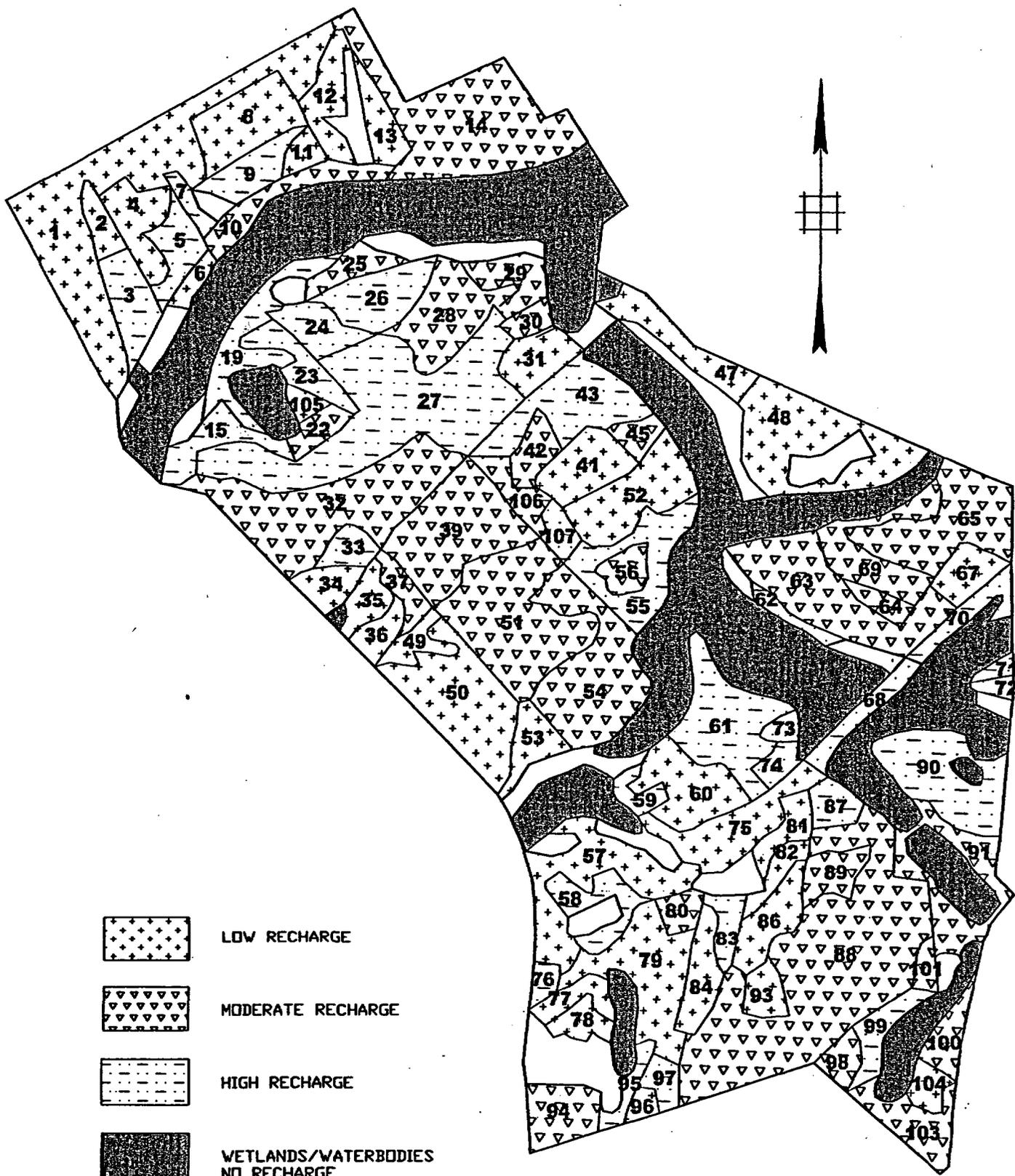
Public Water Supply and Treatment

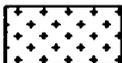
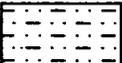
Elizabethtown Water Company (Elizabethtown) provides drinking water to residents, businesses and other facilities within the expanded study area. Elizabethtown maintains and operates two treatment plants: the Raritan-Millstone Plant at the confluence of the Raritan and Millstone Rivers in Bridgewater Township, and the Canal Road Plant in Franklin Township, New Jersey. According to Elizabethtown, water supply is primarily from surface water, and supplemented by groundwater supplies. Surface water is from the Raritan and Millstone Rivers, augmented by Spruce Run and Round Valley Reservoirs. The Raritan and Millstone Rivers are fed by water runoff from more than 925 square miles of watershed area and have a substantial flow during most of the year. Elizabethtown has rights to draw and purchase from the state of New Jersey an average of nearly 70 million gallons daily from the Raritan and Millstone Rivers and 32 million gallons daily from the D&R Canal. Supplementing these resources is a network of Elizabethtown groundwater wells.

Surface water is delivered to the treatment facilities via the Raritan River and the D&R Canal. Surface water intakes are located adjoining the treatment facilities outside the expanded study area. Potable groundwater for the expanded study area municipalities is derived from the Elizabethtown Stony Brook facility in Princeton Township. Any other wells in the expanded study area municipalities are not currently in service.

Elizabethtown Water Company's groundwater wells are situated throughout its service area but all are outside the expanded study area. The average daily groundwater diversion rate between 1990 and 2001 was 0.63 million gallons per day (mgd) out of a permitted 3.89 mgd.

DMJM/HARRIS P:\1356\22\ENV\GROUNDWATER.dwg rbelcher 2/11/02 - 3:24 P 3731

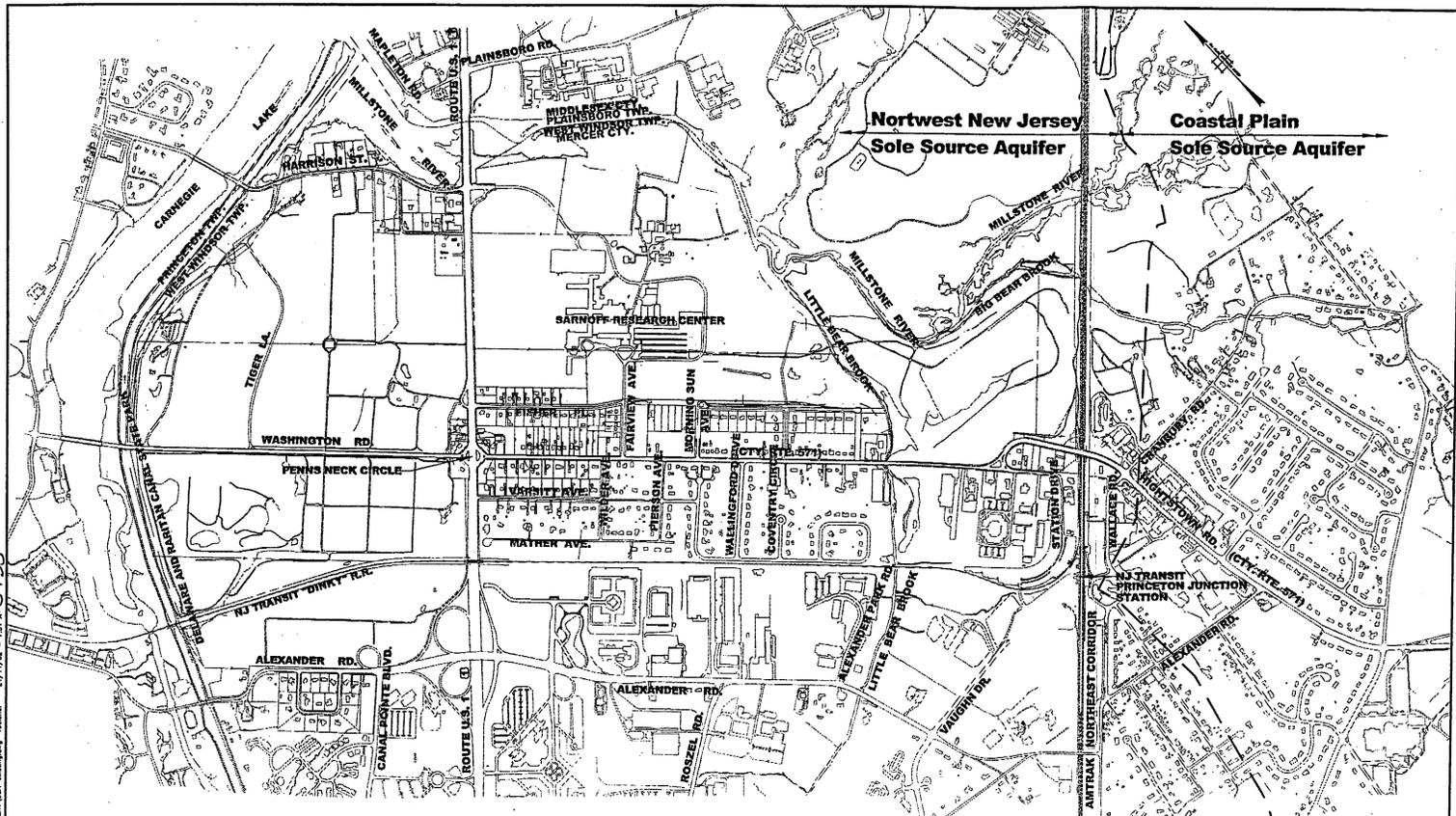


-  LOW RECHARGE
-  MODERATE RECHARGE
-  HIGH RECHARGE
-  WETLANDS/WATERBODIES NO RECHARGE
- 1** ASSIGNED POLYGON NUMBER

NEW JERSEY DEPARTMENT OF TRANSPORTATION	
PENNS NECK AREA	
ENVIRONMENTAL IMPACT STATEMENT	
GROUNDWATER RECHARGE CAPABILITY MAP	
DATE: NOV. 2002	FIGURE 3-25
SCALE: N.T.S.	

DATE: 2/7/02 3:31 A 3135

DATA SOURCES: 1. LIAISON DATA SYSTEM - 2000



LEGEND:

— EXISTING CONDITIONS

NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT
EXISTING CONDITIONS
SOLE SOURCE AQUIFERS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 3-26