



Princeton Hydro

**NATURAL RESOURCE INVENTORY  
TOWNSHIP OF UNION  
HUNTERDON COUNTY, NEW JERSEY**

**PREPARED FOR:**

Township of Union  
Environmental Commission  
140 Perryville Road  
Hampton, New Jersey 08827

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## **INTRODUCTION**

The following Natural Resources Inventory (NRI) of Union Township has been designed and is intended to be used as a complimentary document to the Township's Master Plan and various ordinances and regulations pertaining to zoning, development and the protection of the Township's natural, historic and anthropomorphic resources. As with any NRI, the Union Township NRI catalogs important cultural and natural resources attributes, and more importantly, discusses the significance of these attributes. As such, the Union Township NRI is a comprehensive compilation of text, maps, and charts that fully describe the resources of the Township. This information reflects the most recent Geographic Information System (GIS) data, mapping and database technology available through the New Jersey Department of Environmental Protection (NJDEP), Hunterdon County Planning Department and other relevant sources of such information. The NRI also includes an overview of current resource protection information, a comprehensive resource inventory, and a resource protection plan.

## **METHODOLOGY**

As mentioned above, several information sources were used to obtain the most updated natural and cultural resources information. Information sources pertaining to local planning and resource protection included the Union Township Master Plan and the Township's development and zoning ordinances as well as the Township Master Plan, including available amendments and supplements to these documents.

Other sources of information and data used in the preparation of the NRI included federal, state and local agencies, specifically, the United States Environmental Protection Agency (EPA), the United States Department of the Interior, the New Jersey Office of State Planning, the New Jersey Department of Environmental Protection (NJDEP), the Hunterdon County Soil Conservation District and the Hunterdon County Planning Department.

The majority of the digital GIS mapping information were obtained from the NJDEP GIS Data Web Site. The base data was supplemented with digital composite overlay analysis to assist in the identification of certain vulnerable natural resources within the Township. This involved for instance, the combination of existing zoning data with the map coverages for significant habitat associated with threatened or endangered species.

Following an analysis of the data and the review of the mapped information, a narrative was developed for each significant resource and the composite analyses of mapped and regulatory information. These narratives are presented in the following sections of the report and are presented in a manner by which they can be used in concert with the maps and referenced either independently or synergistically in evaluating and assessing the Township's resources.

The overall report has been prepared in a PDF format that allows for the easy access and cross-referencing of mapped data, base data and the section narratives prepared in support of each narrative.

## **SECTION I – NATURAL FEATURES**

Information included in this section includes a short narrative describing the value, location and the extent of Union Township’s most significant natural resources. Each sub-section supports a GIS/Digital Data map that depicts the resources or interest, its spatial distribution throughout the Township, and highlights unique attributes or features of the resource.

Interactions between the natural resource components of the Township occur on a regular basis. At times these interactions are imperceptible, whereas at other times the interactions are quite obvious and noticeable. Furthermore, interactions occur on a regular basis between humans and these various natural resources, in some cases with the results being extremely disruptive and negatively impacting. Recognition of these interactions is an important part of presenting and discussing natural resource inventory information. The five most important interacting factors that have the potential to shape, define and alter the Township’s natural resources are: human activities, climatic elements, geology, soils and biotic interactions. Since humans are unique in their ability to alter the environment through the land development process, information contained in this NRI and the following sub-sections should be utilized proactively as guidance for the management of the Township’s natural resources by Township officials, staff, professionals, planning board members, zoning board members, developers, and citizens. When the NRI is used as a land development and resource management tool, as opposed to a catalog of natural resources, better decision-making will be possible when the Township is confronted with the need to protect sensitive, significant natural resources, whether for the purpose of protection of the health, safety, and welfare of the populous or the protection of the resource itself.

### **I.1 Regional Location**

Union Township is located in northwestern portion of Hunterdon County, New Jersey. It encompasses 20.5 square miles or 13,120 acres. The Township was officially formed in 1853 as a result of the partitioning of land from the southern section of Bethlehem Township.

Union Township is bordered on the south by Alexandria Township, to the east by Lebanon Township, Clinton Township, Town of Clinton, and Franklin Township and along the length of its northeast-southwest border by Bethlehem Township. A portion of the Township’s eastern border traverses Spruce Run State Recreation Area and Spruce Run Reservoir (Map 1).

Several major roads transverse or run parallel to Union Township. These include Interstate 78, County Routes 173, 513, 579, 614, 625, 635, and Perryville Road and Van Syckles Road.

Interstate-78 essentially transects the center of the Township, running in an East-West direction. County Road 635 crosses through the approximate center of the Township in a North-South direction. Van Syckles Road runs through Spruce Run State Recreation Area along the reservoir's northeast-southwest border. Route 513 defines the Township's eastern boarder up to Spruce Run State Recreation Area and the boundary of the Town of Clinton.

The Lehigh Valley Railroad runs through the Township in an East-West direction, essentially paralleling Route 78. The railroad is an active working line that is used to haul freight.

The major surface waters of the Township include Spruce Run Reservoir, Spruce Run, Black Brook, Mulhockaway Creek, Sidney Brook, Grandin Stream, and Cakepoulin Creek. These waterbodies will be discussed in more detail in later sections of this report.

Within the boundaries of the Township are several historic hamlets, specifically Jutland, Perryville, Mt. Salem, Pattenburg, Grandin and Norton.

Climate, in many ways, defines a region's natural resources. The following climatic information is derived from data compiled for northern Hunterdon County (Collins and Anderson, 1994). Union Township's climate is classified as continental in that it is characterized by significant fluctuations in seasonal and daily temperature. Winter temperatures during the month of January average 27.9 °F, while July temperatures average 73.2 °F. Annually, the average air temperature is approximately 53 °F with the date of the last killing frost typically May 12. Regionally, on a seasonal scale, these climatic conditions are caused during the winter months by the northwesterly prevailing winds that originate in Canada. During the summer months, air temperatures are primarily the result of moist tropical air masses that originate in the Gulf of Mexico and converge with air masses that originate from the Canadian plains and the Great Lakes.

Annual precipitation for Union Township averages approximately 47 inches. During winter months, snowfall averages fifty inches. The length of daylight, as measured at New Brunswick is 9.5 hours in January, nearly 12 hours in March and September, and approximately 15 hours in June.

## **I.2 Aerial Photograph**

Color infrared digital imagery data obtained through the NJDEP was used to prepare an aerial photograph of Union Township (Map 2). As so noted on the map, these data are only as recent as 1997. As such, Map 2 should not be used to locate recent residential developments or assess changes in land use and land cover. Map 2 shows that a substantial portion of the eastern section of the Township, especially that located immediately south of Route 173 and east of Route 635,

has been developed. However, Map 2 also shows that the more westerly portions of the Township remain relatively undeveloped and characterized by substantial forest stands, agricultural areas, and other open spaces. Spruce Run Reservoir is also very noticeable feature of the Township, located along the northeastern.

### **I.3 Surficial Geology**

Geology is generally subdivided into three (3) separate study areas: bedrock geology, surface (surficial) geology, and soils. The soils portion of the geologic cross-section is discussed later in this report; this preceding sub-section will deal with bedrock geology and surficial geology.

Union township is unique in that the boundaries span over several major physiographic and mechanical boundaries. The Township falls within the contact zone between the Piedmont Plain and Highlands physiographic provinces of New Jersey. Specifically Union Township lies in the contact zone of the Piedmont Plain the New Jersey Highlands. The New Jersey Highlands consist of several broad, rounded or flat-topped ridges. The ridges tend to run the northeast - southwest trend and are separated by narrow valleys. The Piedmont Plain by contrast is gently sloping towards the southeast and intermittently with gently rolling hills separated by wide shallow valleys.

The Highland province within Union Township is chiefly composed of rocks of pre-Cambrian age. These are highly metamorphosed rocks of the Byram Intrusive Suite, Hopatcong Intrusive suites, and the Losse Metamorphic Suite. The highland area is part of the larger Reading Prong province that continues into Pennsylvania.

The Piedmont Plains province within Union Township is chiefly composed of rocks of Triassic to Jurassic age sedimentary and metamorphic rocks of the Newark Supergroup. The main constituents include the Passaic and Lockatong formations. However, the extensive faulting in the northeastern portion of the township also reveals Ordovician and Cambrian formations of the Kittatinny Supergroup, the Jutland Klippe, and Lehigh Valley and Schuylkill sequences.

The oldest glaciers have also affected Union Township. Pre-Illinoisan glaciers (formerly Jerseyan) have been observed to have extend approximately into the center of the township during the Pliocene or early Pliocene glaciation. The materials left behind by the glaciers include heavily weathered and eroded pockets of glaciofluvial and glaciolacustrine deposits collectively designated as the Port Murray formation.

#### *Bedrock Geology*

Bedrock geology is generally responsible for the macro landforms of the township. In Union Township the older rocks tend to be more resistant to weathering, the exception being carbonate

rocks. The older formations of the Highlands province (Jutland Klippe Sequence, Byram Intrusive Suite, Hopatcong Intrusive Suites, and the Losse Metamorphic Suite) have been mechanically and chemically altered by igneous rock intrusions throughout; this is where the intrusive description of the rocks is derived from.

The process of intrusion in Union Township includes the pressurized movement of super-heated, liquefied, igneous rocks into the foliations and unconformities of the younger rocks thereby heating and applying pressure to the rocks within the zone of influence of the intrusion. These types of intrusion are prolific in the highland formations of Union township.

In general the Highlands province was formed by the extensive vulcanism during the Mesozoic era in the later portion of the Triassic deposition period, followed by the Newark deposition and finally brought to the current configuration by faulting and erosion.

The Piedmont Plains province in the vicinity of Union Township is not less complicated than the Highlands province. These formations were formed by a mixture of different depositional methods. The rocks were deposited initially and sediment in cyclic weathering of the Highland province and the recession and melting of glaciers. The majority of the Passaic and Lackatong formations within the township are conglomerates of pebbles, sands, and gravels. The other major feature of the Piedmont Plain is the Jutland Klippe Sequence. This series of rocks include the bulk of the faulting and soluble rocks in the Township. The shape of the Spruce Run Reservoir lends a large portion of its edge shape to the faulting sequence within the Jutland Klippe.

The fault system, typically associated with bedrock, within the township is generally configured in the northeast-southwesterly direction with interlaced fault systems. The system is adjusted slightly to the Jutland Klippe area where the faults run perpendicular to the regional trend. Many of the faults tend to be inclined thrust faults with the upper plates to the south of the fault line. Approximately ten (10) major faults are observable within the township boundaries.

### Surficial Geology

Surficial geology is referenced in Map 3 and is the governing factor where comparing the geologic conditions of a Township to the processes of development and human interaction. The surface geology can sometimes be connected directly to bedrock geology, and in the case of Union Township, large portions of the Piedmont formations (refer to the areas on the map marked as weathered conglomerate, and weathered shale, mudstone, and Sandstone) are both the rock and surficially geologic formations. The highlands province rocks have two distinct systems for the bedrock and surficial geologic systems.

The Highlands surficial geologic formations include the units mapped as Extensive bedrock outcrops, scattered bedrock outcrops, and Weathered Gneiss on Map 3. These units correlate directly to the middle Proterozoic formations of the Byram intrusive suite. The rocks labeled here as weathered gneiss may also consist of variations including hornblendes and biotites. These rocks tend to be pink to light-gray, medium to coarse grained, gneissoid granite, foliated granite, and sparse granite gneiss, observable in the outcrop units. The Gneiss Colluvium is remnant deposit of glacial outwash from the Illianioian glacial retreat. These are pockets of materials weathered from the Byram intrusives.

The contact zone between the highlands and piedmonts tend to have some unique shallow rock formations. Due to faulting along the contact zones there are several unique formations found in Union Township including the weathered carbonate rock, till, upper & lower terrace deposits, Alluvium and Colluvium Deposits.

The least abundant (but most well-known) are the weathered carbonate rock formations. These units correlate directly to the limestones of the beakmantown group and the Allentown formation. The till units are remnants of Pre-Illioian glacial retreats. These till deposits are generally pockets of the Port Murray Formation. The materials are deeply weathered and thin. Upper & Lower Terrace deposits include mixtures of glacial outwash, till deposition and latter age erosional deposits (alluvium), including sands, silts, and clays. Indirectly related to the contact zone is the Alluvium and Colluvium deposits unit. This unit is a mixture of materials deposited by erosional effects of the uplands and has small areas along the contact, but as the deposits move into the piedmont area there are more closely related to effects of water bodies within the quantary period.

In the piedmont areas, the alluvium deposits include the surficial, deeply bedded, sands, clays, and gravels related to flooding and river course meandering. These deposits can be to 20 feet thick. The weathered conglomerate unit correlates directly to units mapped as the Passaic formations Quartzite conglomerate (JTTrpcq.) The Weathered shale, mudstone, and sandstone correlate directly with the Jutland Klippe Sequences and the Stockton Formation. These include the lower unit A, and upper unit B, consisting of interbedded shales, silty sandstones, dolomites, and limestone conglomerates, and the medium to coarse-grained arkose sandstones and quartzite conglomerates of the Stockton formation.

### *Effects of Geology*

The geologic constraints of Union Township are numerous and varied. Bedrock geologic constraints dictate the overall landform of the township and the groundwater regime. The older rocks of the highlands tend to provide a greater contrast of relief, thereby increase storm water runoff and decreasing groundwater recharge. The shallower gently sloping geology of the piedmonts allow for the ponding of waters and the recharge of surface water run off into

groundwater. The carbonate formations around the reservoir allow surface water integrate more freely with ground water.

Formations of special concern with respect to groundwater contamination are the alluvium and carbonate formations, both of which allow seepage of water through the soil and geologic layers. These formations could allow contaminated water, either precipitation or runoff, and/or leakage from damaged septic systems to move into groundwater or aquifers.

A majority of the carbonate rock formations exist in land surrounding Spruce Run Reservoir, which is located in State Recreation Area land (Map 15) and zoned as Agricultural Preservation Land (Map 16). Therefore, intense development is not likely, minimizing some risks to groundwater quality. However, agriculture can exist in this area, thus the potential for groundwater contamination by pesticides and fertilizers exists. To prevent such contamination, pesticides that are likely to bind to the soil, and those with short persistence times in the environment, should be utilized. Also, fertilizers, especially mobile nitrates, should be applied only when necessary, and environmentally sound application techniques should be utilized, including soil tests to minimize unnecessary applications.

Most of these geologic formations are suitable for development. However, site inspections are recommended to rule out the existence of pockets of problematic situations (e.g. faults or fractures) or isolated areas of alternative formations (e.g. carbonate rocks).

The land use ordinances of Union Township specifically address development in areas of carbonate geology, referred to as the Carbonate Area District. Section 30-6.9 (§30-6.9) of Chapter 30, Land Use Ordinances, addresses development in the Carbonate Area District (CAD). The CAD has been divided into two areas, the Carbonate Rock District (CRD) in which the underlying geology is carbonate rocks and the Carbonate Drainage Area (CDA) that contains all lands that drain surface water into the CRD. Since most of the carbonate rock formations in Union Township exist in land surrounding Spruce Run Reservoir, the CRD is appropriately located in the same region. A majority of the remainder of the Township is located in the CDA, with the exception of a small section in the southern most corner of the Township.

The underlying geology of the CAD is carbonate bedrock, primarily limestone and dolomite. The susceptibility of this bedrock to dissolution can result in surface depressions, open drainage passages, and development of karst topography. Such conditions can yield areas unstable and susceptible to collapse. In addition, the creation of open drainage passages can promote the movement of water, which may contain contaminants, through the geologic formations of the area into groundwater and aquifers, possibly resulting in contamination of these resources. The Township acknowledges the importance of carbonate aquifers as groundwater resources in the municipality. Therefore, ordinances have been developed to protect clean water supplies, human health, and the welfare, economic, and social development of the area. Specifically, the purpose

of the ordinance is to “protect, preserve, and enhance a sensitive and valuable potable groundwater resource area and to reduce the frequency of structural damage to public and private improvements or subsidence in areas of carbonate rock geology” (§30-6.9a).

Proposed development in the CAD requires completion of a geologic investigation program to identify existing geologic conditions for which site design and/or engineering solutions may be required to minimize negative development impacts (§30-6.9g2). In addition, the Township will review the geological investigation report to determine if the proposed development will not adversely impact the health, safety, and welfare of the community and the quality and quantity of surface and subsurface water (§30-6.9g6).

#### **I.4 Elevation**

Elevation, the height of an object or natural feature above sea level, is basically defined as the difference in vertical distance from mean sea level to a point on the earth’s surface (American Geological Institute 1984). Elevation is also used to describe a topographically elevated feature. There are several methods by which elevation is measured. Some of the most common and accurate techniques include those based on data gathered by aerial photogrammetry, airborne based elevation tools, and USGS geodetical survey information. The USGS geodetical survey information used as the basis for the preparation of Map 3, is based on the USGS benchmarks and measured elevations above sea level recorded for numerous points of interest. The data gathered is used to develop a grid from which elevation can be determined. Elevation measurements are important because they, in conjunction with latitude and longitude, create the basis for the preparation of topographic contour lines. The contour lines are in turn used to develop topographic maps that accurately show the earth’s surface in three-dimensional form.

Map 4 displays the topography and slopes of Union Township. Much of Township is characterized by rolling, hilly terrain with steep (10-15%) to very steep (15%-25%) slopes. The significance of slope will be discussed in greater detail with respect to the analysis of Map 12, Slope. However, identifying steeply sloping areas and then protecting them from significant disturbance, whether that be in the form of silvaculture, agriculture or development, is important for a number of reasons. For instance, steeply sloping areas in the Township pose land development, soil erosion, and water quality problems. For example, such areas, if disturbed or improperly developed, are more prone to generate excessive quantities of stormwater runoff, pollutants, and eroded soil than are more gently sloped areas. As such, disturbance and development of steep sloped areas are often more likely to create flooding and/or pollution problems. Special zoning and development provisions may therefore be warranted in steeply sloped areas to prevent environmental impacts. Protection of steep slopes, in particular those associated with higher elevations is also important from the perspective of maintaining the rural and scenic character of Union Township. Disturbance of hilltops and hillsides, as well as

promoting erosion, pollution and flooding problems, alters the visual appeal of the landscape and can detract from the existing viewshed. As stated above, further details of the environmental significance of slope is provided in section I.12.

## **I.5 Soils**

Hunterdon County soils formed under forest cover (primarily hardwoods) from either residual material weathered from underlying rocks or transported material deposited by water, glacial ice, wind, or gravity (USDA/SCS 1974). Soils formed from sedimentary shale, sandstone, and red quartzose conglomerate, comprise the majority of the soil types occurring within Union Township. Other soils occurring within the Township are derived from shale, sandstone, argillite, granitic gneiss, and alluvium. Soil formation processes, coupled with various soil qualities such as texture (e.g. sand, silt, clay), water-holding capacity, and nutrient content, are active factors in determining the resident biological community. In turn, vegetation, microorganisms, and animal life (e.g. soil invertebrates such as earthworms) living in and on soils are active factors in soil formation.

The soils of Union Township belong to four soil associations. The Rowland-Birdsboro-Raritan association, described as deep, nearly level to gently sloping soils that are somewhat poorly to well-drained, and located on floodplains and terraces. The Parker-Edneyville-Califon association soils are deep, gently to steeply sloping, somewhat poorly to excessively drained, gravely, cobbly, or stony soils located on uplands. The Pattenburg association consists of deep, gently to steeply sloping soil, well drained, gravelly soils located on uplands. Finally, the Washington-Berks-Athol association is composed of moderately to deep, gently sloping to steep, well-drained soils that are found on uplands.

Understanding the characteristics of a prevailing soil or soil association is very useful in land use planning. Most commonly, the soil characteristics that are most often used to analyze and determine land use limitations include slope, depth to seasonal high water, water content, permeability, depth to bedrock, susceptibility to erosion, shrink-swell potential, bearing strength (the ability to support a load such as a building), and erosion potential. This information can be derived and interpreted through data supplied in the Hunterdon County Soil Survey. Land use limitations, as based on the above characteristics of the prevailing soil, are classified as none to slight, moderate, and severe with respect to the planned use (e.g. septic system construction, agriculture, silviculture, construction of basements, etc.). None to slight limitations means that the soil is relatively free of any limitations, or has limitations that can be readily mitigated with respect to the proposed use of the site. Moderate limitations are those that can be mitigated, addressed or overcome but will require more astute planning, somewhat advanced engineering design, and proper construction techniques. Moderately limited soils may also require the implementation of advanced erosion control measures to prevent or reduce the opportunity for acute and chronic soil erosion. Soils with severe limitations may be impossible or impractical to

use in particular manner or are incapable of supporting a particular use. In such cases, specific land use activities may not be practical and could be excluded or prohibited by the Township. In other cases, although it may be possible to overcome the inherent limitations of the native soils, doing so will require the implementation of special planning, engineering design, environmental impact mitigation and construction measures. As such, it may be prudent in many instances to integrate in the Township's zoning and development ordinances restrictions to the certain uses, development intensity or extent of disturbance in areas predominated by soils with severe limitations.

As mentioned above, some of the more common soil limitations are depth to seasonal high water table and depth to bedrock. Depth to seasonal high water level is the distance between the surface and the highest level reached in most years by ground water or water perched over a fragipan (hard impervious layer). Most of the soils of Union Township have depths to the seasonal high water table, defined by the soil survey, as moderately deep to deep. However, many of the soils of the Township that are associated with wetlands or adjacent to surface waters have a shallow (< 3 feet) depth to seasonal high water table. Such soils include Alluvial, Bowmansville, Califon, Chalfont, Lansdowne, Raritan, Rowland, and Turbotville.

Depth to bedrock is defined as the distance between the surface of the soil and the upper surface of the fixed rock layer (Soil Survey Division Staff 1993). The soils of Union Township, with the exception of Klinesville and Penn soils, have a moderately deep to deep depth to bedrock (3 feet to 10+ feet). Klinesville and Penn soils have a depth to bedrock of 1-1½ and 1½ to 3½ feet, respectively.

The prevailing depth to seasonal high water table and bedrock, along with along with slope, stoniness, and permeability, largely determine the suitability of most soils for urban uses, including septic systems, building foundations, roads, parking lots, lawns/landscaping, and recreation (athletic fields, picnic areas, etc). Construction plans can be designed to address and alleviate the limitations associated with some soil uses. For instance, development sites with a moderately high water table are typically drained or filled to alleviate this condition. However, doing so may necessitate the issuance of special permits by the NJDEP and/or County. Thus, it is important to understand the limitations of local soils with regard to zoning, planning and environmental protection. For example, a septic system constructed in a soil characterized as rapidly permeable and overlaying a fractured bedrock, may appear to function efficiently, but groundwater contamination would likely occur as a result of the movement of improperly filtered septic effluent into the aquifer. If the bedrock is shallow, insufficiently filtered effluent can also run along the rock barrier and "breakout" into nearby wetlands or surface waters (Clark, Caton & Hintz 1998).

The soils of Union Township, in general, present only slight to moderate limitations for most urban uses. However, there are some characteristics that will limit some soils for some uses. For

instance, Alluvial, Bowmansville, and Rowland soils have several severe limitations due to their susceptibility to flooding. Steep slopes limits the uses of the following soils: Annandale, Bedington, Berks, Duffield, Edneyville, Meckesville, Norton, Pattenburg, Penn, Quakertown, rough broken land, steep stony land, and Washington. The high water table limits the utilization of Califon, Chalfont, Cokesbury, Lansdowne, Pattenburg, Raritan, and Turbotville soils. The depth to bedrock affects the usefulness of Berks and Pattenburg. The high frost potential of Califon and Pattenburg, affects their use for certain forms of development, in particular roads and parking lots. Finally, rippable bedrock (shale) hampers the usefulness of Berks, Klinesville, Norton, and Penn for many urban uses.

The Township of Union, Chapter 30 Land Use Ordinances, includes soil restrictions and considerations in development. Section 30-2 (§ 30-2) defines soils as “all unconsolidated mineral and organic matter of whatever origin that underlies bedrock and which can be readily excavated.” Section 30-2 (§ 30-2) also provides the following definition for a soil erosion and sediment control plan: “a plan which fully indicates necessary land treatment measures, including a schedule for the timing of their installation, which will effectively minimize soil erosion and sedimentation.” Soil erosion and sediment control plans are addressed further in Section 7: Erodible Soils.

With regard to limitations, Table 2.2 and the associated GIS maps provide the following information on soil limitations:

- **Soils and limitations to building structures** - Soils will also present limitations when viewed in light of their abilities to handle the weight of structures (e.g., homes). Approximately 26% of the soils in the Township present severe limitations and 2 % present moderate to severe limitations (buildings with basements). Approximately 10% of the soils in the Township present severe limitations and 3% present moderate/severe limitations (buildings without basements).
- **Soils and on-lot septic system constraints-** Approximately 82% of the soils in Readington Township present severe limitations to the placement of individual, on-lot septic systems. In addition 17 % present moderately severe limitations for on-lot septic systems (Map 10).
- **Soils and land development erosion potential-** Approximately 8% of he soils in the Township present severe erosion potential, 8% moderate/severe, and 15% slight to moderately severe erosion potential when sites are developed (Map 7).

## **I.6 Agricultural Soils**

A majority of Union Township contains prime farmland soils and state important soils. In fact, with the exception of land containing surface waters and a small section of the Township located

between Van Syckles Road and the northwestern border of the Township, most of the land is considered either prime farmland or state important soils.

Soils that have the potential to support agriculture are usually classified as prime farmland soils, soils of statewide importance, or soils of local importance. According to the USDA/NRCS (1990a), prime farmland soils includes those soils that “have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops and is also available for these uses”. The prime farmland soils have the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when managed according to acceptable methods (USDA/NRCS 2001). These soils are not excessively erodible nor do they become or remain saturated for long periods of time. In addition, these soils either do not flood frequently or are protected from floods. Finally, these soils exhibit adequate natural rainfall, permeability, and moisture, have the proper temperature range and pH, and lack excessive gravel, cobbles or stones. The Hunterdon County Soil Conservation District lists thirty-two (32) prime farmland soils in Hunterdon County (Map 6). Among these are a number of soils that commonly occur in Union Township, including several mapping units of the soil series Annandale, Bedington, Birdsboro, Bucks, Califon, Duffield, Edneyville, Meckesville, Norton, Pattenburg, Penn, Quakertown, Raritan, Riverhead, Turbotville, and Washington.

Soils of statewide importance do not meet the criteria for prime farmland soils. However, they are nearly prime farmland soils and economically produce high yields of crops when managed appropriately (USDA/NRCS 1990b). These soils, under favorable conditions, have the potential for yields as high as prime farmland soils. These soils are usually suited to the production of regional crops. The Hunterdon County Soil Conservation District (USDA 1974) lists thirty-six (36) soils of statewide importance in the County. Union Township contains twenty (20) of them including several mapping units of the following series: Annandale, Bedington, Berks, Birdsboro, Bowmansville, Bucks, Califon, Chalfont, Duffield, Edneyville, Hazleton, Lansdowne, Meckesville, Norton, Parker, Pattenburg, Penn, Quakertown, Riverhead, and Washington (Map 6).

Finally, the State of New Jersey categorizes specific soils as farmland soils of local importance. These soils are not of prime or statewide importance. Instead they are of local (e.g. county) importance (USDA/NRCS 1990c). Locally important soils are used for the production of high value food, fiber, and horticultural crops. No locally important soils have been identified for Hunterdon County, New Jersey. Additionally, the State of New Jersey maintains a list of farmland soils of unique importance (USDA/NRCS 1990d). None of these soils are located in Union Township.

Chapter 30 Land Use Ordinances for the Union Township regulate development on prime agricultural soils. The Township divides the agricultural soils into three classes with differing development restrictions on each class. Development is limited to 10% of the area containing

Class I soils. Class II soils have development restricted to 15% of the area on which they are contained. Finally, no more than 20% of the area containing Class III soils can be developed. The Township's Land Use Ordinances, in §30-2, defines agricultural soils as those classified in the Hunterdon County Soil Survey of November 1974 as land capability classes I, II, and III. Such soils may be considered prime agricultural soils.

### **I.7 Erodible Soils**

The erosion hazard of a soil can be defined as the potential of a soil to erode naturally if not adequately protected. It is unrelated to historical erosion tendencies or prevailing, surrounding land use. A soil's erosion potential is largely determined by soil texture, organic matter content, structure, hydraulic conductivity, and to a lesser extent, slope. Soil erosion can result in several problems including loss of agricultural soils, seeds, plants, and organic matter, the presence of which helps prevent erosion through the development of a healthy vegetative stands (OMAFRA 2002). In addition, erosion can contribute to surface water quality problems through sedimentation of the waterbodies and movement of soil adhered pollutants (e.g. some pesticides and phosphorus).

The erosion hazard of soils is often reported in soil surveys. However, these values are meaningful with regard to zoning, land development and environmental protection only if the conditions of the surface and of the plant cover are also provided (USDA 1981). The erosion hazards that are presented in many soil surveys assume full vegetative cover, such as woodland, and are therefore inappropriate to apply to cleared or developed land. However, soil surveys may contain information pertaining to the erosion hazard of a soil for conditions other than wood lot management (agriculture) or for alternative, non-agricultural types of uses.

Erodible soils are those soils classified as having a severe hazard of erosion in the soil profiles described in the most recent county soil survey (<http://www.ci.rockville.md.us/cityprojects/envguide/table2.htm>). Eroding or erosion susceptible soils present a problem when disturbed or developed, as they are likely to become unstable. This can affect construction activities or limit the types of agriculture or silvaculture associated with a given site or area. These types of soils also present potential environmental problems because they can contribute to surface water sedimentation, thereby degrading water quality. This will cause streams, lakes and ponds to be turbid or "muddy". The suspended sediments can clog the gills of fish and aquatic insects and decrease light penetration, thereby imposing a negative effect on photosynthesis by phytoplankton, benthic algae and aquatic plants (macrophytes). Conversely, because the water is turbid, heat energy from the sun is better absorbed and retained, thereby causing an increase in water temperature to a point where trout and thermally sensitive aquatic species can no longer be supported or sustained. The deposited sediments can in turn impact fish breeding and nesting, and impact the feeding of aquatic insects and benthic invertebrates such as mussels and clams. Resuspension of the resulting sediments deposited in streams (the bed load)

can exacerbate the scour and erosion of the stream channel and promote the physical degradation of flowing waters. Finally, eroded soils serve as vectors for certain pollutants, often transporting adhered or absorbed contaminants, in particular pesticides and phosphorus, to receiving waters or wetlands, thereby contributing in manner to water quality and wetland degradation. Mapping erodible soils is therefore important in that designating such soils can help identify erosion risk areas. Once identified, steps can be taken by the Township to minimize disturbance or development of these areas and/or require the imposition of special erosion control measures in advance of any proposed disturbance or development, whether that is for the purpose of construction, agriculture or silvaculture.

Soils in Hunterdon County have been divided into three classes that describe their susceptibility to erosion. Class 1 (Highly Erodible Land) soils meet the requirements for this classification, and are thus considered to be at high risk for erosion. Class 2 (Potentially Highly Erodible) soils contains a range of soil characteristics, some of which meet the requirements for Highly Erodible Lands, and some of which do not. Thus, the erosive potential of Class 2 soils will depend on several factors, most especially the prevailing slope of the land. Class 3 (Not Highly Erodible) soils do not meet any requirements of Highly Erodible Land.

Highly erodible lands (soils) identify areas in which advanced or special erosion control measures should be utilized. Erodible land is defined using the Erosion Indexes from the Universal Soil Loss Equation (see Wischmeier and Smith 1978) and the Wind Erosion Equation (see Woodruff and Siddoway 1965). Both the Universal Soil Loss Equation and the Wind Erosion Equation provide the tones of soil loss by erosion under bare ground conditions divided by the sustainable soil loss factor (T factor). The USDA/NRCS of Hunterdon County, New Jersey defines highly erodible lands (soils) as those soils that erode at 8 times or more the T factor (G. Bartok, Hunterdon Co USDA/NRCS, personal communication).

The erodible soils of Union Township (Map 7) include Annandale gravelly loam (8-15%), Annandale and Edneyville gravelly loam (8-15%), Berks shaley (channery) loam eroded (15-25%), Duffield very rocky silt loam (15-25%), Edneyville gravelly loam eroded (8-15%), Edneyville gravelly loam (15-25%), Norton loam (8-15% and 15-25%) (all Norton soils in Union Township), Parker cobbly loam (15-25%), Pattenburg gravelly loam (15-25% and 25-45%), Quakertown silt loam eroded (8-15% and 15-25%), Rock land Edneyville material and Rough broken land shale (at slopes greater than 15% and 25%, respectively), and Steep stony land Parker material (25-45%).

Not highly erodible land includes Bowmansville silt loam (0-3%) (all Bowmansville soils in the Township), Cokesbury loam and very stony loam (0-3%), Raritan silt loam (0-3%), and Rowland silt loam (0-3%). The remaining soils are potentially highly erodible, depending on the slope of the land and the length of the slope.

As was mentioned in Section I.5: Soils, Union Township's Land Use Ordinances include soil restrictions and considerations with respect to any proposed development activity. Section 30-2 (§ 30-2) defines soils as "all unconsolidated mineral and organic matter of whatever origin ... and which can be readily excavated." Section 30-2 (§ 30-2) also provides the following definition for a soil erosion and sediment control plan:

"A plan which fully indicates necessary land treatment measures, including a schedule for the timing of their installation, which will effectively minimize soil erosion and sedimentation."

Soil erosion and sediment control plans must be in accordance with the State's plans, as promulgated by the State Soil Conservation Committee.

Soil Erosion and Sediment Control Plans are addressed in §30.25 of the Land Use Ordinances. According to this section, such plans are required to minimize erosion and sedimentation promoted by development and caused by water runoff, soil disturbance, destruction or removal of ground cover or plant life, and grading and filling. Minimizing soil erosion and sedimentation can help 1) maintain the useful life of reservoirs by minimizing sedimentation, 2) minimize clogging of drainage structures to help prevent flooding due to excessive water runoff, 3) help prevent stagnation of waterbodies and preserve their recreational use, 4) maintain sufficient water levels in streams and rivers to enhance recycling of waste water, 5) prevent the movement of contaminants into surface waters, and 6) reduce public costs for repair of damage to public facilities by eroding soils and sediments. Soil Erosion and Sediment Control Plans must be reviewed and certified by the Township Engineer and approved by the Planning Board for projects disturbing more than 5,000 square feet. Soil Erosion and Sediment Control Plan requirements are provided in §30.25-2e.

## **I.8 Surface Water**

Union Township contains surface water bodies of local and regional significance, in particular Spruce Run Reservoir (Map 8). Additional, particularly important surface waters are Spruce Run, Mulhockaway Creek, Black Brook, Cakepoulin Creek, Grandin Stream, and Sidney Brook. It should be noted that Spruce Run Reservoir, and all of its tributaries, as well as Mulhockaway Creek and Sidney Brook, are listed by NJDEP (NJAC 7:9B) as Category 1 waters of the State. C1 waters are protected under the State's antidegradation policies (NJAC 7:9B). In essence this means that the water quality of these waters can not be degraded in any manner and if currently impaired, efforts must be taken address the problem and improve the water quality of the affected waterbody.

Spruce Run Reservoir was created in response to the 1958 New Jersey Water Supply Law and its companion Water Bond Act. These legislative acts mandated that water be conserved and

effectively managed as a natural resource. As a result, Spruce Run was dammed using a 6,000-foot long earthen dam and two earthen dikes to form the reservoir. Spruce Run Reservoir was one of the first water supply facilities created and operated by the State of New Jersey; it became operational in 1963. The associated Spruce Run Recreation Area was opened in 1973.

Spruce Run Reservoir is an “on-stream” water storage reservoir. With a maximum storage capacity of 11 billion gallons, it encompasses 1,290 acres at full pool elevation and has 15 miles of shoreline. The depth of Spruce Run Reservoir can exceed 75 feet in some areas. The New Jersey Water Supply Authority (NJWSA) manages spruce Run Reservoir. Together with Round Valley Reservoir and the Delaware and Raritan Canal Transmission Complex, Spruce Run Reservoir is part of a water supply system that delivers approximately 225 millions of gallons of raw water per day to central New Jersey water utilities.

As well as being an important source of potable water, Spruce Run Reservoir is a highly popular recreational facility providing boating, fishing, and hiking opportunities. It is extremely popular with anglers, as it supports over 18 varieties of fish, the most popular of which are the hybrid striped bass and northern pike. Other fish include carp, trout, perch, and other bass. Each year the reservoir is stocked with over 5,400 rainbow and brook trout. In addition to fish, the reservoir supports an abundance of wildlife including deer, foxes, and birds. Local bird watcher groups often use the reservoir and its associated recreation area due to the large contingent of birds, including eagles, which inhabit the area.

As mentioned above, the water quality of Spruce Run Reservoir and its tributaries is governed by the State of New Jersey. NJAC 7:9B-1.15 classifies the waters of the state with respect to water quality and delineates the required water quality parameters for each of the classifications. Spruce Run Reservoir, and its unnamed tributaries, is classified as FW2-TM (C1). Spruce Run, from its source to, but not including the reservoir, is a FW2-TP (C1) surface water. From Spruce Run dam (on the reservoir) to its confluence with the South Branch of the Raritan River, Spruce Run is a FW2-TM water body. Additional tributaries to Spruce Run Reservoir include Mulhockaway Creek, Black Brook, and Willoughby Brook, all of which are FW2-TP (C1) surface waters. Cakepoulin Creek, Sidney Brook, and Grandin Stream are surface waters located in Union Township that are not tributaries to Spruce Run Reservoir. According to NJAC 7:9B, all tributaries of the South Branch Raritan River, which would include Grandin Stream, are FW2-NT. Cakepoulin Creek and Sidney Brook are classified as FW2-NT (C1).

According to NJAC 7:9B-1.4, surface waters classified as “TP” waters are those that are trout production waters, meaning they are used by trout for spawning or nursery purposes during their first summer. TM waters are trout maintenance waters, or waters that support trout throughout the year. The FW2 designation is used as a general surface water classification that is applied to those surface waters that are neither FW1 (exceptional water quality) or Pinelands waters. The designation as “C1” means Category one waters, those waters that are regulated by

antidegradation policies for protection from measurable changes in water quality because of their clarity, color, scenic setting, aesthetic value, or exceptional ecologic significance, recreational significance, water supply significance, or fisheries significance. C1 waters include those that 1) originate wholly within Federal, interstate, State, county or municipal parks, forests, fish and wildlife lands, or other special holdings that were not designated as FW1 waters, 2) are classified as FW2 trout production and their tributaries, 3) FW2 trout maintenance for FW2 non trout that are upstream of FW2 trout production, or 4) are waters and their tributaries that flow through, or border, Federal, State, county, or municipal parks, forests, fish and wildlife lands, and other special holdings. Regulations for C1 waters include protection from any measurable changes (including those calculable or predicted) to existing water quality. Again as noted above, when due to non-natural conditions the existing quality of a C1 water body fails to meet designated water quality criteria/standards, it can be no further degraded and must be improved to provide for or maintain designated uses (NJAC 7:9B-1.5(d)).

In general, the water quality of the surface waters of Union Township is of a high caliber. Testimony to this is the fact that many of the Township's surface waters are capable of or maintain and promote viable trout populations. However, some of these waters do appear on the Federal 303(d) list of impaired waters. In general, the 303D list consists of the impaired waters of the State, as so compiled by the NJDEP and submitted to the USEPA, and serves as a means of tracking and establishing the consistency of the State's waters with the Federal Clean Water Act. Spruce Run Reservoir is listed as impaired due to the presence of mercury in fish tissue. Mulhockaway Creek is listed due to high ammonia, cadmium, fecal coliform, and total phosphorous levels and pH problems. Spruce Run impairments include pH, temperature, and high cadmium, copper, fecal coliform, lead, and total phosphorus concentrations. Finally, Cakepoulin Creek is biologically moderately impaired, but detailed information on the nature of the impairment is not available.

Map 8: Surface Waters also illustrates the floodplains associated with the surface waters of Union Township. Delineated flood zones include zones A, AE, X, and X500. The A and AE zones are within the 100-year flood zone as determined by FEMA. Land in the X500 zone is located in the 500-year flood zone. Finally, land in the X zone is located outside of the 500-year flood zone. The Union Township Chapter 30 Land Use Ordinances address development in the floodplain district in §30-6.6. The regulations in §30-6.6 apply to those lands determined, by the Flood Insurance Administration, a division of the Federal Emergency Management Association (FEMA), to be in areas subject to inundation by the 100-year flood. The ordinances are designed to minimize loss of life and property, creation of health and safety hazards, disruption of commercial and governmental services, and expenditure of public funds resulting from flooding in the Township (§30-6.6a). While development regulations in the floodplain district are discussed in detail in §30-6.6, in summary, the regulations prevent development that would 1) decrease the capacity of drainage facilities or systems to convey floodwaters, 2) cause a rise in flood heights that would not be offset by accompanying improvements, and 3) allow infiltration

of floodwaters into public sanitary sewer systems. In addition, storage of toxic, explosive, or floatable materials is forbidden and utilities (e.g. gas lines, etc.) must be designed to minimize the chance of impairment during a flood (§30-6.6h).

## **I.9 Wetland Resources**

In 1979, the US Fish and Wildlife Service, in the report *Classification of Wetlands and Deepwater Habitats of the United States*, defined wetlands as:

“...Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water...Wetlands must have one or more of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes, 2) the substrate is predominantly undrained hydric soil, and 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season each year.”

This definition is widely accepted by wetland scientists because it is broad, flexible, and addresses vegetation, hydrology, and soils, the three factors used to delineate wetlands. The US Government provides an alternative definition to be used by the US Army Corps of Engineers for dredge and fill permits, as required by Section 404 of the 1977 Clean Water Act. The current joint EPA/Corps defines wetlands as “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions”.

Wetlands are among the most important ecosystems and are sometimes described as “the kidneys of the landscape” due to the pollutant filtering functions they perform (Mitsch & Gosselink 1986). Wetlands prevent floods, protect shorelines and provide habitat for a wide variety of plants and animals. In some cases, wetlands may serve as a means of recharging groundwater aquifers and maintaining stream base flow. In all cases, they are recognized as having the ability to cleanse polluted waters as a result of filtering, bioabsorption and biouptake. There are approximately 1,134 acres of agricultural, forested, and herbaceous wetlands in Union Township (Map 9). Most of these wetlands extend from the western arm of Spruce Run Reservoir. Additional wetlands are associated with the flood plain and riparian corridor of the various streams that transect the Township. This is especially evident with respect to the corridors of Sydney Brook and Mulhockaway Creek, both of which are bordered by extensive forested wetlands. It should be noted that the NJDEP typically imposes a 150-foot transition area (buffer) from the landward edge of all wetlands associated with Category 1 (C1) waters.

Union Township contains agricultural wetlands, deciduous scrub/shrub wetlands, deciduous wooded wetlands, disturbed wetlands, herbaceous wetlands, and managed wetlands (Map 9).

Agricultural wetlands are those wetlands located on agricultural land. The NRCS will identify wetlands on agricultural lands, which are defined as “those lands intensively used and managed for the production of food or fiber to the extent that the natural vegetation has been removed and therefore does not provide reliable indicators of wetland vegetation. Areas that meet this definition may include intensively used and managed cropland, hayland, pasture land, orchards, vineyards, and areas which support wetland crops (e.g., cranberries, taro, watercress, rice)” (<http://www.epa.gov/owow/wetlands/facts/fact8.html>).

One characteristic used to identify a wetland is the presence of hydric soils. Hydric soils are those soils that “formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part” (USDA/NRCS, N.D. [http://soils.usda.gov/soil\\_use/hydric/intro.htm](http://soils.usda.gov/soil_use/hydric/intro.htm)). Hydric soils are poorly drained, frequently ponded or flooded for long durations, or have a water table close to the surface.

The following hydric soils have been identified in Union Township by the NRCS (1995): Califon loam (3-8%), Cokesbury very stony loam (3-8%), Pattenburg gravelly loam, moderately wet (3-8%), and Raritan silt loam (3-8%) slopes. Additionally, the soils located in Union Township that appear on the Hunterdon County hydric soils list consist of Bowmansville silt loam (in floodplains), Califon very stony loam (3-8%, in depressions), Chalfont silt loam (3-8%, in depressions), Cokesbury loam (0-3%, in depressions and floodplains), Lansdowne silt loam (3-8%, in depressions), Pattenburg gravelly loam (3-8%, in depressions), Raritan silt loam (0-3%, in floodplains and depressions), Rowland silt loam (in floodplains), and Turbotville loam (3-8%, in depressions). Thus, prior to development, areas that are mapped to contain the above soil families (Califon, Cokesbury, Lansdowne) should be surveyed for the presence of wetlands.

### **I.10 Aquifers and Community Wells**

Aquifers are underground formations of permeable rock or loose material that contain water (Khorsand 2001). When tapped by a well, these formations may yield water in useful quantities. Groundwater supplies are replenished through surface water that percolates through the soil and underlying geology. These surface waters include precipitation that is able to move through the soil and geology, or lakes, streams, ponds, and other surface water formations from which water seeps through their substrate into underlying groundwater formations. Areas in which water moves from the land’s surface into underlying groundwater formations are referred to as recharge zones.

The State of New Jersey contains four physiographic provinces. The Coastal Plain, which is the largest province, lies to the southeast of the Fall Line, and comprises a majority of the eastern/southeastern part of the State (USGS, n.d.). The Fall Line is the boundary between the Coastal Plain and Piedmont Provinces, and runs roughly from Carteret to Trenton. To the north and west of the Fall Line, the State is comprised, from a southeast to northwest direction, the Piedmont, Highlands, and Valley and Ridge Provinces. The majority of Union Township is in

the Piedmont Province, but the northeastern-southwestern border is in the Highlands (see Section 3- Surficial Geology). The Piedmont Province is underlain by dense, almost impermeable bedrock; glacial deposits overlie the bedrock (Trapp and Horn 1997). Aquifers in this province yield water from both secondary porosity and permeability provided by fractures in the bedrock and productive sand and gravel aquifers in the glacial deposits.

Union Township overlies five aquifers, the Brunswick formation (containing the Passaic and Stockton aquifers), the Jacksonburg Limestone/Kittatinny Supergroup/Hardystown Quartzite aquifers, the Lockatong Formation conglomerate, the Martinsburg Formation/Jutland Sequence aquifers, and the igneous and metamorphic rock formations. The formations that are only located in small sections of the Township are the Stockton Formation Conglomerate and the Lockatong Formation. These aquifers supply groundwater to Union Township and Hunterdon County. Moderate to large supplies of water can be obtained from the Stock Formation and Hardyston Quartzite (Kasabach 1966). The Lockatong Formation will usually produce very low yields, and the chance of obtaining yields greater than 50 gallons per minute (gpm) is slight. The Kittany Limestone aquifers have the potential to yield large amounts of water if wells intersect solution cavities. The quality of water obtained from the various aquifers in this region is similar. It is generally suitable for drinking and other uses, but can locally be high in iron, manganese, and sulfate (Trapp and Horn 1997). The sandstone, siltstone, shale, and limestone formations, including the Kittany Limestone, Jacksonburg Limestone, the Martinsburg shale, Stockton Formation (Stockton Sandstone), are relatively soluble and will provide water with relatively higher concentrations of dissolved solids, a hardness averaging 160 mg/CaCO<sub>3</sub> (which is considered to be hard water), and a medium pH of 7.6. The less soluble formations, including those containing igneous and metamorphic rocks, such as the Lockatong Formation (Lockatong Argillite), will provide water that has a lower dissolved-solids concentration with a hardness averaging 63 mg/L CaCO<sub>3</sub>, and a pH of 6.7.

Sole source aquifers are defined as those aquifers that contribute more than 50% of the drinking water to a specific area (NJGS n.d.). Furthermore, the water, if contaminated, would be impossible to replace. The guidelines for sole source aquifers were developed by the USEPA are authorized in section 1424(e) of the Safe Water Drinking Act of 1974. Primary in the protective measures outlined for sole source aquifers is the requirement that the USEPA review all proposed federally funded projects that could affect groundwater in a sole source aquifer. These projects include areas of the aquifer's recharge zone and its stream-flow source area. All of the aquifers in Union Township are within the boundaries of the New Jersey 15 Basin Sole Source Aquifer. The New Jersey 15 Basin Sole Source Aquifer is 1,735 square miles in size and contains portions of Hunterdon, Mercer, Middlesex, Morris, Passaic, Somerset, Sussex, and Warren Counties New Jersey and Orange County New York (USEPA 1988).

The Lockatong and Stockton Formations date to the Triassic period (180 to 225 million years ago). The Lockatong Formation is composed of argillite with interbedded shale. The Stockton

Formation is composed of sandstone with interbedded shale. The Martinsburg Shale and Jacksonburg Limestone formations developed during the Ordovician Period (440 to 550 million years ago). The Martinsburg Shale contains shale, some interbedded sandstone, and limestone beds near the base. The Jacksonburg Limestone is limestone and calcareous shale. The Kittatinny Limestone, which formed during the Cambro-Ordovician Period, contains dolomitic limestone. And they Hardyston Quartzite formation, of the Cambrian Period (500 to 600 million years ago), is composed of feldspathic quartzite.

The Township of Union, Chapter 30 Land Use Ordinances address aquifers and groundwater in several sections. Section 30-6.9 addresses groundwater protection in the ordinances related to the Carbonate Area District (CAD); this is discussed in Section 3: Surficial Geology of this Natural Resources Inventory. In addition, §30-6.8 of the ordinances outlines regulations regarding aquifer tests and analysis. Aquifer Tests and Analyses are to be provided with the preliminary plat application for a major subdivision, submitted with a minor site plan, and submitted with a preliminary site plan when proposed development will be served by one or more on-site wells. In addition, the installation of any well for purposes other than providing a sole source of drinking water is considered to serve a nonresidential use and is subject to the aquifer test and analysis requirements of this section. Aquifer tests and analyses are required to determine and evaluate aquifer characteristics, such as transmissivity, the storage coefficient, and the cone of depression, among others, and to predict the effect of long term pumping on existing and future wells.

### **I.11 Land Cover**

Although land cover and land use are often used interchangeably, the accurate application of these terms pertains to distinct conditions. Land cover is best defined as the dominant, prevailing use of a parcel of land. Examples of land cover are upland forest, cornfield, wetlands and high-density residential development. Land use on the other hand is best defined as the existing approved or designated utilization of a parcel. Examples of land use designations that appear in the Union Township Land Use Code include Agricultural Conservation Easement Area, AP-2 Agricultural Preservation 2, B16 Community Residence, and LI Light Industrial and numerous other designations that apply to residential, commercial and industrial land development designations.

The New Jersey Department of Environmental Protection's 1995/97 Land Use / Land Cover was mapped for the purpose of providing land use and land cover trend analysis data throughout the state. In 1986, a baseline Land Use / Land Cover was completed using aerial photographs and photo interpretation. With advances in computer technology and Geographic Information Systems (GIS), a second, more accurate Land Use / Land Cover data set was created during 1995 through 1997. While final data has not been field-verified, it provides an excellent overview of the township's development and conservation trends.

In the preparing Map 11, the NJDEP's Land Use / Land Cover classifications, as based on the 1995/97 data set, were re-classified so as to better to conform to the land use districts and zones as described by the township of Union Township's Land Use Code and its various amendments and related ordinances. As such, what is presented on Map 11 is a combination of actual land cover and defined land use. These refinements are reflected in the following designations presented below and illustrated on Map 11:

- Agricultural Preservation – Areas designed to preserve and protect lands containing prime agricultural soils for the continuation of agricultural purposes. These areas contain the township's most productive agricultural soils.
- Conservation Management – districts that have limited development potential due to steep slopes, poor septic suitability, wetlands, high soil erosion potential, and limited groundwater availability. This district contains mostly environmentally sensitive land and contains areas desirable for open space preservation and environmental protection.
- Country Residential – districts designed to protect areas of existing residential development while preserving areas of the Township that are currently rural in character and use.
- Light Industrial – Standards in these areas allow for a wide range of industrially related uses to provide an employment center for the region while enhancing open space characteristics and natural features.
- Parkland – Parks owned and maintained by either the State, County or Township
- Quarry – Areas that provide safe and efficient quarrying operations and set standards for their ultimate reclamation.
- Multi-Family Residential – Areas that provide higher density development opportunities adjacent to similarly developed areas in the neighboring town of Clinton.
- Special Commercial – These areas were developed to control existing and future use of lands with intense vehicular use and limit these areas to their present locations.
- Utility – Areas of the Township in which essential services can be located and concentrated. These areas also provide standards for the location, maintenance, and buffering of electric transmission lines.
- Watershed Management – Areas that have limited development potential due to steep slopes, poor septic suitability, high soil erosion potential, and limited groundwater availability.

Review of Map 11 shows that overall the Township is still very rural and characterized by land cover /land use that is agricultural in nature. Commercial and industrial development is concentrated along the major thoroughfares, in particular Interstate 78, Route 173 and the northern terminus of Route 513. Although residential use is scattered throughout the Township,

the greatest concentrations occur south of Interstate 78 in the southern and southwestern portions of the Township. Some of these residential uses reflect recent development and sub-division of what was once farmland, whereas other sections date back to the 1800's and even earlier. This is reflected in residential and mixed commercial development in the Pattenburg, Jutland and Van Syckle historic districts (Map 18).

## **SECTION II - SECONDARY NATURAL RESOURCES**

The following section of the NRI deals with significant features of the Township that are interpreted through the analysis of some the primary natural resource data (e.g. slope). These resource attributes are considered special or unique and thus need to be addressed in more detail. As such, Section I and Section II of the NRI should be used in concert when evaluating impacts, considering zoning changes or modifying or amending the Township's master plan.

### **II.1 Slope**

In general, Union Township can be characterized as having rolling terrain of variable but most commonly gentle slope (Map 4 & 12). This is reflected in part in the extensive amount of prime agricultural soils that exist in the Township (Map 6). However, some areas of more steeply sloped land do exist (Map 12). Land sloping at greater than 10% primarily exists adjacent to surface water features (compare with Map 8), including the perimeter shoreline of Spruce Run Reservoir. In addition, the northeast corner of the Township is characterized by areas having slopes greater than 10%. Examining Map 12 in closer detail shows that the more steeply sloped lands (slopes of 10%-15%, 15%-20% and > 20%) occur in distinct "pockets" primarily along the northern border and the southwestern border of the Township. A pocket of steeply sloped land also occurs along the Interstate 78 / Route 179 corridor.

Of particular interest is the fact that much of the more steeply sloped sections of the Township coincide with areas dominated by erodible soils (Map 7). This association is not uncommon as many erodible soils have a thin horizon and a geologic origin that often is associated with ridge formation. The importance of this association though is that the impacts arising from the development, clearing or disturbances of steep sloped areas may be further exacerbated or compounded by the presence of erodible soils in these same areas. This increases the need for careful planning, the implementation of disturbance limitations and judicious engineering design and soil erosion control.

As noted above, steep sloped lands are also often times characterized by other environmentally sensitive conditions including increased erosion, soil instability, and shallow depths to bedrock. The combination of these conditions contributes to the fact that highly sloping ground has the potential of being inherently unstable, thus increasing the potential problems associated with the

development of such land (Legget and Karrow 1983). Specifically, development of steep slopes can also affect the ability of the prevailing soils to infiltrate precipitation. This occurs as a result of soil compaction, the disturbance of thin soils, the removal of vegetation or the exposure of bedrock. This promotes an increase in runoff and can lead to additional instability of the down gradient soil and rock. As such, landslides are not uncommon when steep slopes have been altered, eroded or made especially unstable.

Development on steep slopes is not the only human activity that can promote slope instability and soil erosion. Agricultural practices can also contribute to these hazards. The simple agricultural or silvacultural disturbance and clearing of land may promote soil erosion, leading to the loss of quality agricultural soils and/or the sedimentation of surface waters (USEPA 2003). The United States Department of Agriculture (USDA) has determined that slopes greater than 3% have an increased risk of soil erosion. However, the potential for soil erosion is related not only to slope, but also to farming practices and crop selection. For example, crop cultivation removes ground cover, exposes soil and makes surface erosion more likely as opposed to the use of land for pasture.

The erosion of steep slopes can also contribute off-site movement of sediment in nearby natural resources, including surface waters. As such, erosion of steep slopes can contribute to sedimentation of surface waters. In addition, when phosphorus is bound to these sediments, their movement into surface waters can contribute to nutrient enrichment and eutrophication. Sedimentation of surface waters can affect water quality, in ways other than the addition of nutrients, but also through loss of habitat and physiological impacts on aquatic organisms (e.g. sediments can clog and cover gills and the mouthparts of filter-feeding organisms).

The Township of Union's Chapter 30, Land Use Ordinance, regulates development on sloped land. According to Section 30-6, lands with slopes equal to or greater than 10% are considered steep. For land with slopes of 10%-15%, the ordinance mandates that no more than 35% of these areas be developed and/or re-graded and stripped of vegetation. Development of areas with 15%-20% slopes is limited to no more than 20%. Finally, development is limited to 10% in those areas characterized by slopes of 20% or greater. Building permits must be obtained for development in areas with slopes greater than or equal to 15%.

## **II.2 Septic Suitability**

New Jersey Action Code (NJAC) 7:9A defines septic suitability for soils in the State of New Jersey. Traditionally, soils have been divided into three Septic Suitability Classes, I, II, and III. Soils assigned to Suitability Class I are understood to have minimal limitations for septic system installation, while Suitability Class III indicates severe risk to septic system installation. Recently, however, the assignment of septic suitability has been expanded beyond simple assignment to one of three classes to include the type and depth of soil limiting zones. Soils are

now ranked as Suitability Class I, II, or III for each of six limiting zones. The limiting zones include fractured rock or excessively coarse substrata, massive rock or hydraulically restrictive substrata, hydraulically restrictive horizon with a permeable substratum, excessively coarse horizon, zone of saturation (regional), and zone of saturation (perched).

For the purpose of developing the Soil Septic Suitability map (Map 13) for the Union Township NRI, it was necessary to simplify the above soil characterizations. Thus, the listing of the Township's soils with respect to septic suitability, and the presentation of these data in Map 13, has been limited to assigning a specific soil to a major septic suitability class (I, II, or III). The process used to assign a soil to a given class began first with the examination of the relevant properties of each soil. This involved the assimilation of much of the data used to create Maps 3,5,7,8 and 9. Soils were then cross-referenced to the States septic classifications. Any soil that was classified as a Type III (severe limitation) soil for at least one of the soil limiting factors (e.g. shallow depth to bedrock) was determined to have Type III limitations (in essence, Septic Suitability Class III), therefore making these soils suspect for the construction of proper operation of on-site wastewater management systems (septic systems).

Not surprising, many of the Township's soils that were determined to have Type III limitations occur adjacent to surface waters. A substantial portion of the Township located off the western branch of Spruce Run Reservoir contains Type III restricted soils. In addition, Type III restriction soils are also dominant in the southern most corner of the Township near Route 579. Finally, Type III restricted soils are prevalent along the northeast-southwest border of the Township.

The construction of septic systems in areas having soils with severe septic limitations can have serious environmental consequences. For example, in housing developments, where rapidly permeable soils overlay fractured bedrock, a septic system will often appear to function efficiently, but groundwater contamination can occur from the percolation of improperly filtered septic effluent into the aquifer. It should be noted though that the occurrence of septic limited spoils does not preclude the development of such areas. Special septic designs and the construction of septic leach fields using imported, select fill will likely be required in these areas in order for the septic system to satisfy County health codes and State design regulations. The Township should however be cognizant of the fact that the septic systems servicing developments that pre-date the advent of State and County septic design requirements may be sub-standard and could be impacting local surface and groundwater resources. In addition, care needs to be taken in overall planning to ensure that the septic/aquifer conflicts are minimized or avoided. This would be particularly imperative in areas where limestone formations are dominant or where limited water yielding bedrock formations exist (Map 10). Coincidentally, some of these sensitive aquifer areas coincide with areas of soils having Type III septic limitations. Special care and precautions are thus needed with respect to development of these areas of potential significant environmental conflict.

### **II.3 National Heritage Database and New Jersey Landscape Data**

In 1994, the New Jersey Division of Fish and Wildlife's Endangered & Non-game species program adopted a landscape level approach to rare species protection. The landscape approach focuses on large tracts of land, called landscape regions, which are ecologically similar in regards to their plant and animal communities. The landscape data utilizes a combination of land cover data and an extensive database of rare species locations to focus on the long-term protection of cultural habitat, and not just individual locations. Satellite imagery from 1995 was used to map critical habitat throughout New Jersey: forest, grassland, forested wetland, emergent wetland and beach/dune. Next, the Natural Heritage Program's Biological Conservation Database (BCD) was integrated with the selected land cover. The BCD contains species sightings records from a variety of sources. Finally, critical habitat patches are delineated based on the species present and it's conservation status; areas with federally threatened or endangered species receive the highest ranking, followed by state endangered, state threatened and finally lands suitable for listed species habitat. Ultimately, these maps will assist state, local and private agencies in prioritizing conservation acquisitions, guide regulators and planners, provide citizens with conservation tools, and guide stewardship of already conserved lands. For example, if a development site falls within a highest priority forested wetland, further investigation must take place to determine if buffer zones and set backs have increased due to the presence of a federally listed species.

The New Jersey Natural Heritage Program identifies the state's most significant natural areas through a comprehensive inventory of rare plant and animal species and representative natural communities. Unlike the Landscape data, which maps habitat first, the Natural Heritage Data relies primarily on the Natural Heritage Database, which contains occurrences and locations of endangered and threatened species. Although the database is continuously updated and is the state's comprehensive, centralized source of information on rare plants, animals, and natural communities, this information does not cover all known habitat for endangered and threatened species in New Jersey. This information can be used to help identify the highest quality areas for natural diversity and those areas in most need of protection, supplement field surveys conducted to assess project impacts on natural diversity and help plan government, commercial and residential development by foreseeing potential problems related to development in specific areas before commitments are made.

## **SECTION III – REGULATORY FEATURES**

### **III.1 State Planning Areas**

In March 2001, the State of New Jersey adopted the New Jersey State Development and Redevelopment Plan (State Plan). The State Plan was adopted to enable New Jersey to plan for

its future in order to preserve and maintain its natural, cultural, economic and social assets, and its quality of life. The goals of this act are to “conserve its natural resources, revitalize its Urban Centers, protect the quality of its environment, and provide needed housing and adequate public services at a reasonable cost while promoting beneficial economic growth, development, and renewal” (NJ State Planning Commission 2001a). It should be noted that with the NJDEP’s recent initiative to define and direct development in a somewhat different manner through the Blueprint for Intelligent Growth (BIG) map, the State Plan is no longer the State’s primary land use planning tool. However, as the State Plan was a consensus based planning effort that involved extensive input from the participating municipalities, watershed management groups, development and builder interest groups and the public, there remains a considerable amount of value in referencing the findings and recommendations of the State Plan. This is particularly true for a municipality such as Union that has extensive undeveloped land, numerous sensitive resources and is experiencing increased development pressure.

Under the aforementioned State Plan, Union Township is divided into three planning areas, Environmentally Sensitive, Rural Environmentally Sensitive, and Suburban (Map 15). The remainder of the Township is land containing State Recreation Area, State and/or County penal facilities and/or major water resources, specifically Spruce Run Reservoir. Planning areas are relatively large land areas that are defined by certain environmental and anthropomorphic attributes including population density, roadway infrastructure, existing nature and intensity of development, and certain natural resources or ecological features (NJ State Planning Commission 2001a). Within the State Plan, the State Planning Commission developed objectives for each of the planning areas; the objectives for the Suburban, Rural, and Environmentally Sensitive Planning Areas are presented below (NJ State Planning Commission 2001b).

Suburban Planning Areas are usually found adjacent to more densely developed Metropolitan Planning Areas. However, they can be distinguished from Metropolitan areas by their lack of high intensity centers, availability of developable land, and a more dispersed pattern of low-density development. Development in Suburban Planning Areas is dispersed in nature, promoting urban sprawl and related environmental impacts (e.g. increased automobile traffic and related air and noise pollution). In response to these issues, the objectives for the Suburban Planning areas are to provide much of the State’s future development, in Centers and other compact forms, while protecting the character of existing communities, natural resources, minimizing further sprawl. In terms of natural resource conservation in Suburban Planning Areas, the State desires to conserve continuous natural systems, strategically locate open space, and buffer Critical Environmental Sites. The Suburban Planning Area of Union Township is located along I-78.

Rural Planning Areas and Rural/Environmentally Sensitive Planning Areas are characterized by large amounts of cultivated or open land surrounding regional, town, village, and hamlet centers. The Rural and Rural/Environmentally Sensitive Planning Areas serve as the “greensward” for

the regions in which they are located. These areas are not urban or suburban in nature, and are not intended to be so in the future. Most of the State's prime farmland is located in the Rural Planning Areas, and these areas have the greatest chance of sustaining agricultural activities in the future since they contain fertile soils and adequate water resources, and other natural resources. Thus, prudent land development practices are required to preserve these natural resources. The Rural Planning Areas commonly contain wooded tracts, lands with one or more environmentally sensitive features, and rural towns and villages. A combination of agricultural lands, open lands, and compact, rural, and historic centers make Rural Planning Areas appealing places for people to live. Rural/Environmentally Sensitive Planning Areas contain one or more environmentally sensitive features, such as valuable ecosystems or wildlife habitats. Development in these areas should respect and preserve the natural resources and environmentally sensitive features of the area. The State's objectives for these planning areas are: 1) maintain environs as large contiguous areas of farmland and other lands, 2) revitalize cities and towns, 3) accommodate growth in Centers, 4) promote a viable agricultural industry, 5) protect the character of existing stable communities, and 6) confine programmed sewers and public services to Centers. The majority of the Township was classified in the State Plan as Rural and Rural/Environmentally Sensitive Planning Areas. Rural Planning Areas occur in the south-center portion of the Township, extending up to and along its northeastern-western border. Rural/Environmentally Sensitive Planning Areas occur in the southern and western corners of the Township.

While State Parks and waters are not designated planning areas, the State Plan is designed to conserve the State's natural resources as capital assets of the State. This is to be accomplished by 1) promoting ecologically sound development and redevelopment in the Metropolitan and Suburban Planning Areas, 2) accommodating environmentally sound development and redevelopment in Centers in the Fringe, Rural, and Environmentally Sound Planning areas, and 3) restoring the integrity of degraded and damaged natural systems. The preservation of natural resources and systems is desired in order to "ensure all of us a richer environment and more spectacular natural resources". The primary water resources in Union Township are Spruce Run Reservoir and its tributaries. Spruce Run State Recreation Area surrounds the reservoir.

### **III.2 Township Zoning**

As developed as part of the most recent Township Master Plan and associated amendments, Union Township consists of sixteen different zoning districts. The Township formed each district such that each type is of "number, shape, kind, and area and of such common unity of purpose and adaptability of use that are deemed most suitable to carry out the objectives of this chapter (Chapter 30 Land Use Ordinances) and the Comprehensive Master Plan" (Union Township 2001). The primary zoning districts are agricultural preservation, commercial, conservation, institutional, residential, light industrial, office research, parkland, quarry, utilities,

and watershed management (Map 16). The majority of the Township is zoned as institutional and agricultural preservation. Each of these districts will be discussed briefly, below.

Several of the Township's zoning districts contain land that has been identified for preservation or limited uses due to prevailing environmental conditions, some of which are recognized as being sensitive to disturbance or development. Agricultural preservation areas are designed to preserve and protect those sections of the Township containing prime agricultural soils in order to perpetuate future agricultural uses. These areas contain the Township's most productive agricultural soils. It is recognized that the loss of these soils, by development, improper management or other factors cannot be compensated. Uses permitted in both the AP-1 and AP-2 agricultural preservation zones are those that provide maximum open space opportunities and perpetuate the protection and preservation of prime agricultural soils. The bulk of the AP lands are located in the southern sector of the Township. Conservation Management districts have limited development potential due to steep slopes, poor septic suitability, wetlands, high soil erosion potential, and limited groundwater availability. By definition, this district contains mostly environmentally sensitive land. As such, it contains lands that the Township consider desirable for open space preservation and environmental protection. The majority of CM lands are located toward the western boundary of the Township. Institutional Lands are owned by governmental entities, and include State, County, and municipal parks and gamelands, and State institutions. These are located primarily in the northeast sector of the Township either in concert with the State Recreation Area or the State and County correctional facilities. The Parkland zones, which occur throughout the Township, contain areas of parkland owned either by the State, County, or the Township. Finally, the Watershed Management district, which is located along the Township's northern border close to Spruce Run Reservoir, consists of areas that have limited development potential due to steep slopes, poor septic suitability, high soil erosion potential, and limited groundwater availability. The sensitivity of these lands to disturbance and development, combined with their proximity to the Reservoir, make them not only susceptible to impact but also deserving of special environmental protections.

The remainder of the Township is divided into districts that allow for more some degree of land development. The following provide an overview of the commercial and residential related zoning districts of Union Township.

There are a number of business, commercial and industrial related districts (Map 16). There are three Commercial districts, Planned Commercial, Special Commercial, and Village Commercial. Planned Commercial areas are intended to provide a reasonable standard for development of highway-oriented businesses and commercial uses along the Route 173 corridor that parallels I-78. Special commercial areas were developed to control existing and future use of areas with intense vehicular use and limit these areas to their present locations. Village Commercial zones provide for small neighborhood commercial uses, often times creating a community focal point for local services. The Light Industrial district standards allow for a wide range of industrially

related uses to provide an employment center for the region while minimizing the potential for the degradation of open space characteristics and natural features. The Office Research/Highway district provides opportunity for the development of major office and research facilities and industrially related uses on large tracks of land. Such developments provide major employment centers. As these land development activities are land and resource consumptive, it is imperative that they be designed in a manner that is sensitive to the prevailing environmental limitations and attributes. Furthermore, it is important that they be designed and implemented in a manner that, to the greatest extent practical and possible, enhance the overall open space characteristics and natural features of the area. Quarry districts were designed to provide for safe and efficient quarrying operations and to set standards for their ultimate reclamation. The Utilities districts establish areas of the Township within which essential services can be located and concentrated. These districts also provide standards for the location, maintenance, and buffering of electric transmission lines.

Finally, the Township has delineated three residential districts, Country Residential, Multifamily Residential, and Village Residential (Map 16). As would be expected, these zones are scattered throughout the Township reflecting historic development patterns, the existing roadway and utility infrastructure, and prevailing environmental attributes that have the potential to exert a limiting or controlling effect on land development (e.g., Karst geology, steep slope, wetlands, etc.). Country Residential districts were designed to protect areas of existing residential development while preserving areas of the Township that are currently rural in character and use. The Multifamily Residential districts provide higher density development areas adjacent to similarly developed areas in the adjacent town of Clinton. Finally, Village Residential districts provide design standards and use regulations for the older village neighborhoods of Jutland, Norton, and Pattenburg. These areas typically contain higher groundwater availability and quality.

### **III.3 Open Space – Preserved and Farmland**

Within Union Township’s Chapter 30 Land Use Ordinances Open Space is defined as land(s) “restricted against any future building, development, or use except as is consistent with that of providing for open space for recreation, conservation, agriculture, and aesthetic satisfaction of the residents of the development or of the general public”. Under this definition, setting aside land to be deemed open space can be, and has been, accomplished in a few ways, by different agencies. The following is a description of the current open space owners/classifications within the Township of Union and is to be used in reference to Map 17.

- Farmette – A clustering of Agricultural Development Areas within Union Township with the provision that there could be only one unit per 25 acres of the open space around the clustered development. The remaining land is deed restricted to prevent

- further development. The goal of creating farmettes was to retain prime agricultural soils after a subdivision on farmland had occurred.
- Board of Education – While this may not exactly meet the Township’s definition of Open Space, these lands do house recreation and may not be developed for residential or business opportunity.
  - Common Owned Open Space – These are areas within housing units such as planned residential developments (PRDs), such as townhouse complexes. These areas, such as courtyards and walking paths, are much smaller by nature, but do meet the definition of open space.
  - County Parkland – Parks owned and maintained by Hunterdon County
  - Farmland Conservation Area – Lands protected from development, to be used for agriculture.
  - Municipal Parks and Open Space – Land owned by the Township of Union, being utilized as parkland and/or conservation.
  - Non-Profit Conservation Lands – Land that is owned by a non-profit environmental group for conservation.
  - Private Open Space – Land owned by individual township residents who have agreed to easements on their property, or have signed a deed restriction agreement to conserve their land.
  - State Parks and Conservation Lands – Land owned and maintained by the State of New Jersey as parkland or open space for conservation efforts.
  - Greenways – The establishment of greenways connects preserved open space that could be used to construct trails and/or provide a pathway for wildlife. Greenways will also provide a buffer between residential developments.

As illustrated in Map 17, a majority of the Township encompasses lands that are designated in some manner as Open Space. As would be expected, the largest contiguous open space area is that surrounding Spruce Run Reservoir and associated with Spruce Run State Recreation Area. A large parcel of Municipal Park / Open Space land exists in the center of the Township between Perryville and Cook’s Cross Road. There is also a very sizable portion of land located along Perryville Road that is County Parkland and a significant amount of acreage located along Route 513 that is County Preserved Farmland. An extensive amount of land designated as Greenways transect the Township.

#### **III.4 Cultural / Historic Features**

Four prominent historic districts occur within Union Township (Map 18). These are Van Syckle National Historic District, Rockhill Agricultural National Historic District, Jutland Historic District, and Pattenburg Historic District.

National Historic Landmarks (NHL's) are buildings, sites, structures, objects, and districts that the Secretary of the Interior has determined to be nationally significant features in American history and culture (NJDEP 2003a). Significant properties or districts that "retain integrity of design, feeling or association are considered historic". These resources can be either above ground (buildings, structures, objects) or below ground (archaeological sites). Only those landmarks that meet the National Register Criteria for evaluation can be considered significant at either the local, state, or national level.

The Van Syckle National Historic District is listed on the New Jersey and National Registers of Historic Places (NJDEP 2003b). It is located at the Van Syckles Corner and Norton Roads. Its listing date on the National registry is 11/8/1979 (NR Reference # 79001495) and on the State registry is 8/9/1979. David Reynolds constructed the first tavern in this region in 1763 (Hunterdon County Cultural and Heritage Commission 2002). It was the site at which three delegates to the "Sons of Liberty" were chosen in 1766. Currently, the restored property is under private ownership.

The Rockhill Agricultural Historic District is also listed on the New Jersey and National Registers of Historic Places (NJDEP 2003b). It is located in Union Township and Franklin Township. It is bound by NJ Routes 41 to the southwest and southeast and by Cook's Grove Road to NJ Route 34 on the northeast. The National registry date is 4/5/1984 (NR Reference # 84002717) and the State registry date is 6/25/1980. The Rockhill Agricultural Historic District is named for the Rockhill Family who took up residence in the area in 1731 and owned 846 acres (Hunterdon County Cultural and Heritage Commission 2002). It is now an agricultural district with extant farms, stone houses, barns, and outbuildings that dates to the 18<sup>th</sup> century.

Other historic places located on the New Jersey and/or National Register of Historic Places include Daniel Case/Sarah Clark Case Farmstead, Peter Mechlin's Corner Tavern, Perryville Tavern, Turner-Chew-Carhart Farm, and Union-Exton Farm (NJDEP 2003). Historic places nominated, which are either under consideration or have been demolished include Bonnell Tavern and the Stowe House.

Section 30-7.8 of the Township of Union's Chapter 30, Land Use Ordinances (2001) contains conservation standards for historic and cultural resources located within the Township. These standards are to be applied to existing structures and development activities proposed within the aforementioned historic districts and other area as determined by the Township's master plan or the Historic Preservation Committee. The ordinances allow limited development in these areas, if the property owner agrees to restore and preserve the resource in its existing location on the site with appropriate appurtenant land surrounding the resource. In addition, it must be demonstrated that the well and septic systems of the site can accommodate additional development.

Section 30-7.8 also promotes restoration and conservation of historic resources. The ordinances stipulates that the conversion of historic and cultural resources be completed with materials and architecture that is consistent with the style and design of property targeted property.

### **III.5 Upland Forests: Historic Comparison**

Urban, and suburban, sprawl has been a major hot topic in the State of New Jersey for the past few years. The term “sprawl” indicates the amount and rate of development and the subsequent loss of open space and wildlife habitat due to this development. Residential development is the main cause behind the State’s changing landscape, as well as Commercial and Industrial development. This section analyzes one classification of Land Use/Land Cover that is on the decline not only in Union Township, but also throughout the entire State: Upland Forests.

The data for this analysis was produced for a report by Rutgers University (*New Jersey Land Cover Change Analysis Project*, Richard G Lathrop, Rutgers University, October 2000). Map 19 is an overlay of upland forested areas in 1972 and 1995. According to the Rutgers data, in 1972 there were approximately 5,164 acres of upland forest, while the 1995 data shows only 4,022 acres. This is a loss of 1,142 acres (22%) in 23 years and an average loss of just under 50 acres per year. Due to easy access and high visibility, residential and commercial development tend to occur along or adjacent to main transportation corridors. This trend holds true within Union Township. Nearly 300 acres of upland forest was lost along the east-west Interstate 78 corridor (Union Township’s main transportation corridor) to residential, commercial and industrial development. Along other transportation lines, such as State Routes 513 and 579, more acres of upland forest are lost, once again to residential development, and also to Agricultural. A large majority of the southern peninsula of Union Township of zoned as Agricultural Preservation 1, which has restrictions on residential development to preserve prime agricultural soils in this area. In the area to the west of Route 513, more than 152 acres of upland forest has been lost; these acres may have been lost to land clearing for Agricultural use, due to the larger tax lot sizes indicating possible farmland (see Map 19). To the east/northeast of Route 579, over 254 acres of upland forest were lost. Some of these acres may have been lost to agricultural land use, but with smaller lot sizes in this area, some acres may have been lost to residential development.

Upland forests play a major role in the overall environmental health of an area. Porous soils allow rainfall to percolate down to the aquifer, acting as a filter and promoting Groundwater recharge. Upland forests area also an important wildlife habitat, playing host to numerous species of flora and fauna. As development, and it’s subsequent impacts, either eliminate or degrade more acres of upland forests, steps must be taken to protect this important natural resource. Union Township has some existing measures in place, such as the zoning classifications. Restrictions in different zoning areas dictate minimum lot sizes and certain land uses. Yet, these measures may not provide enough protection, as witnessed by the loss of over

250 acres of upland forest in a zoned Agricultural Preservation area (east/northeast of Route 579). Future steps to protect upland forested areas should include prioritizing the remaining acres (old-growth/mature forests and large tracts of land given the highest priority) and possible restoration/planting zones, to reconnect broken, isolated tracts of land.

## **CONCLUSIONS**

There are extensive factors that interact to define the environmental resources of a given locale. As discussed above, geological features, prevailing soils, topography and elevation greatly affect the nature of the prevailing vegetative cover. This in turn will in part determine the type of flora and fauna that can be supported. Water availability, whether that be groundwater or surface water are inescapably linked to the regional geology and soils. The quality, quantity and availability of water will also help define and determine the types of biota that can be supported. Overall, often complex, but not so obvious linkages link the natural resources of an area. Disturbance of these linkages can have a serious detrimental consequence on these resources, with the impacts being both acute and chronic.

As we are inextricably linked to our environment and are reliant on the resources of the environment, damage, disruption and impact of natural resources can have serious negative consequences on the health and well being of the Township's residents. This can be the result of flooding, soil erosion, contamination of drinking water supplies, or air pollution.

Furthermore, the ambiance and character of our communities, and of Union Township as a whole, is tied directly to the natural resources and visual aesthetics of the surrounding land. Destruction of viewsheds, improper land development and development that does not abide the natural limitations of the land and the supporting resources leads to significant, non-reversible consequences that impact the quality of life and the rural character of Union Township.

Therefore, the implementation of judicious development and conservation measures are warranted to ensure, not only the protection of the environment, but also the protection of the residents of Union Township. Measures that restrict development or disturbance of hydric soils, steep slopes, and areas underlain by limestone or areas that are important aquifer recharge zones are thus imperative. Similarly, integration into development regulations and the design of developments that encourage the protection of sensitive resources, be they prime farmland, grasslands, forested areas, high quality surface waters or wetlands, is of utmost importance if the Township's resources are to be sustained for future generations.

The contents of this NRI are intended to provide all those involved in the shaping of the Township for existing and future residents, with the information needed to protect the character, resources and unique attributes of Union Township. Developers should use the maps and supporting narratives extensively to ensure that proper decisions are made and that the

appropriate safe guards are in place before any development initiative is started. Likewise, conservationists and those involved in acquiring and/or preserving open space should reflect on the maps and data to ensure that their efforts will have a significant positive impact on protecting the Township's resources. As with any planning document, the Township should revisit the NRI periodically to reexamine and update its contents. Doing so will help ensure that the materials are current and better integrate the NRI with the Township's Master Plan, local zoning and development ordinances and State and County planning and development initiatives.

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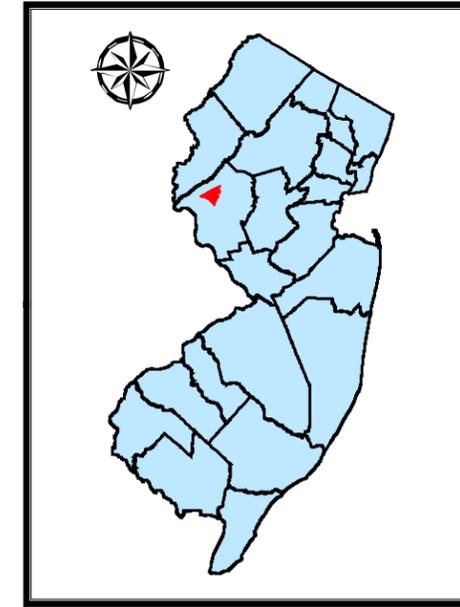
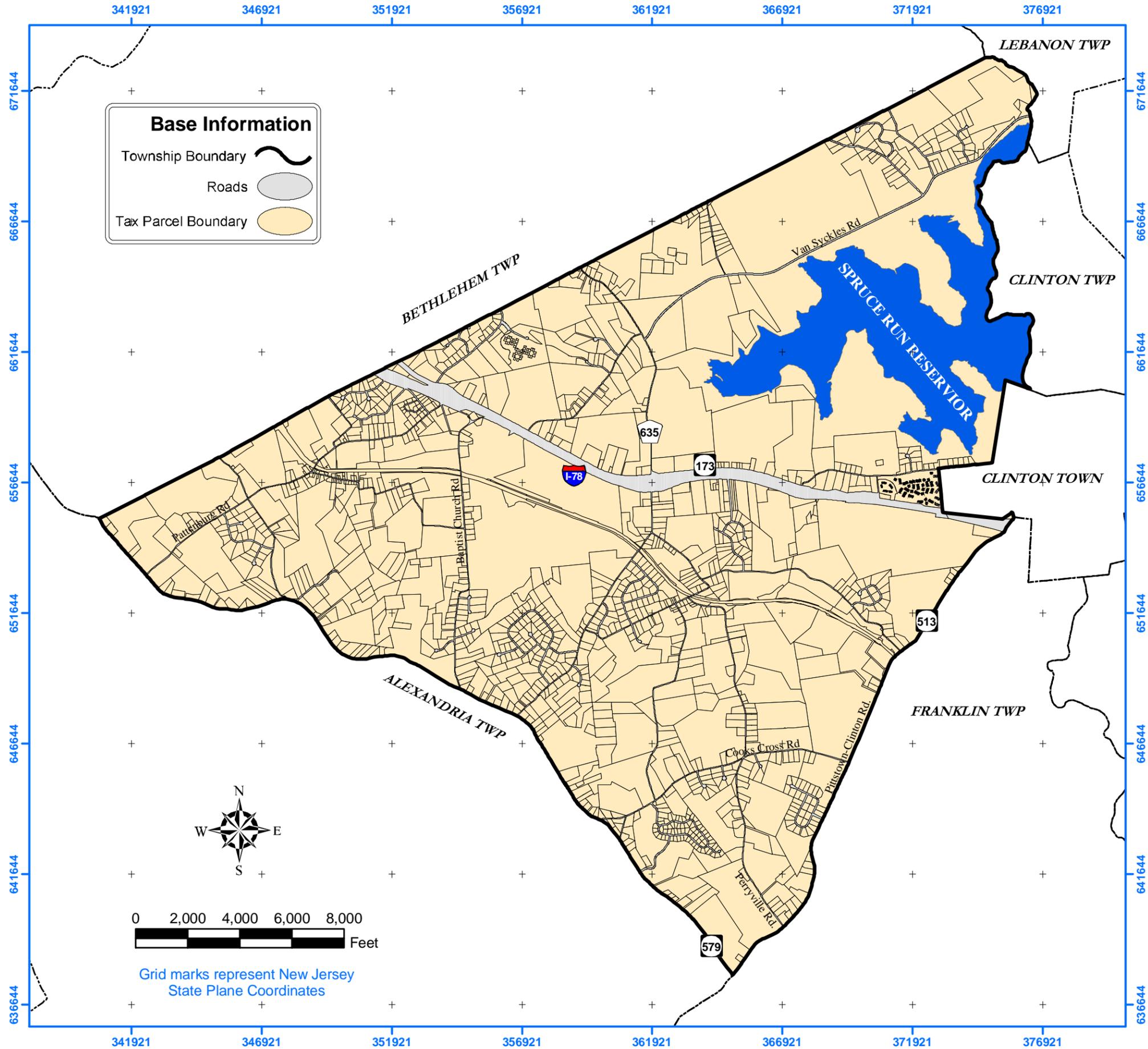
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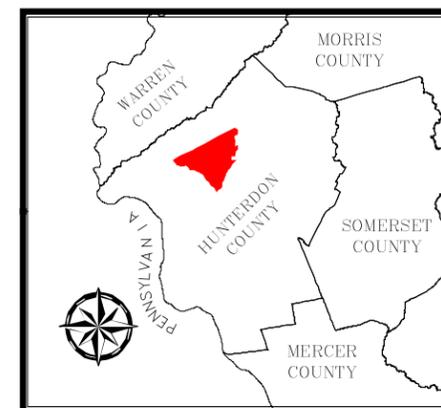
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**APPENDIX A: MAPS**

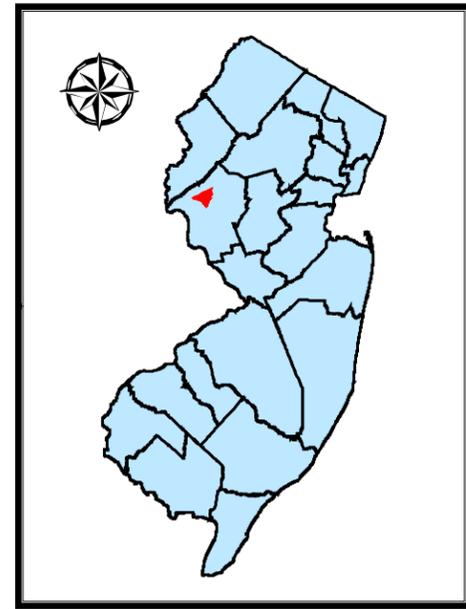
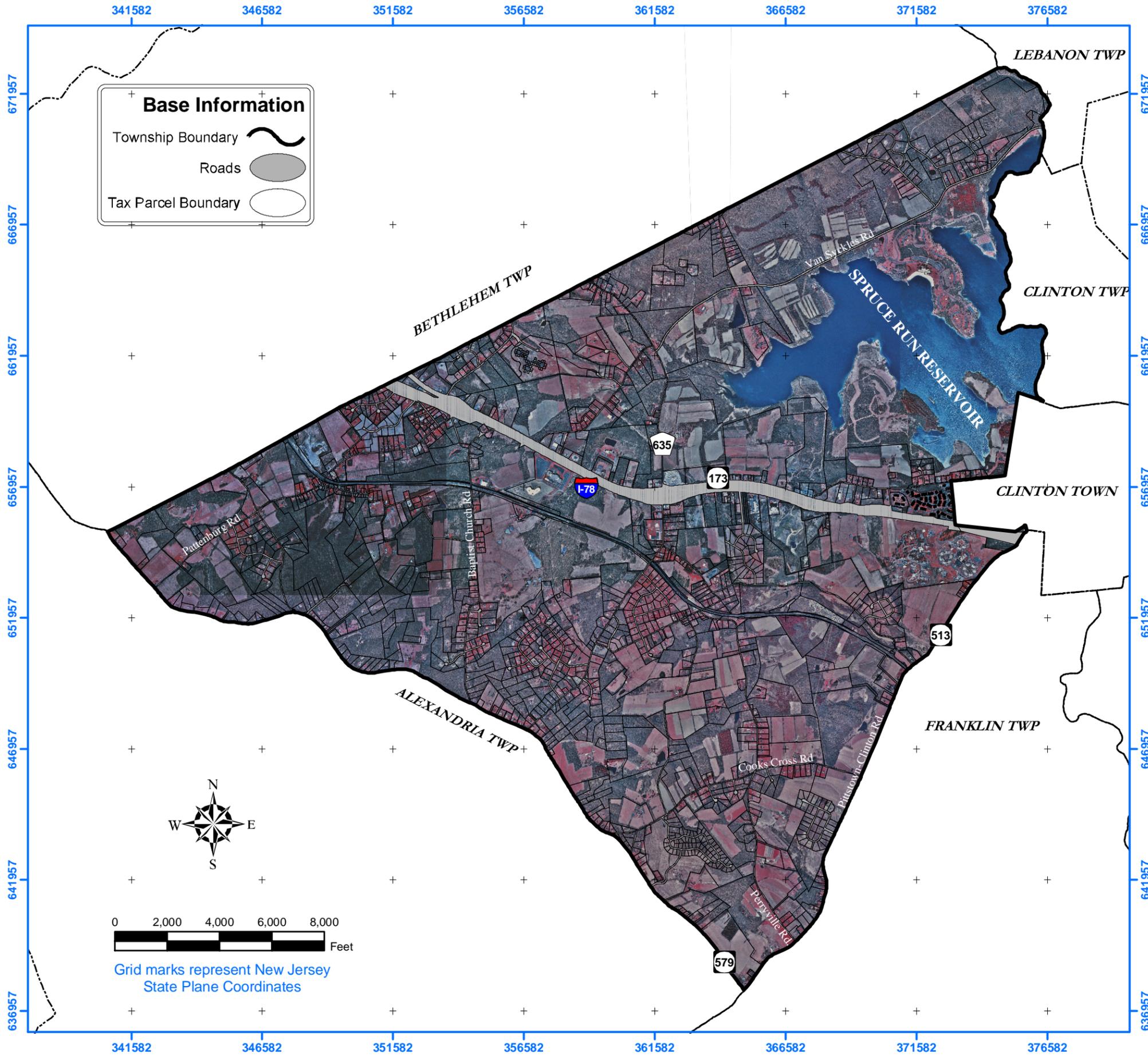


New Jersey Location Map



Regional Location Map

<p><b>TOWNSHIP OF UNION</b>  <b>HUNTERDON COUNTY, NJ</b>  <b>NATURAL RESOURCE INVENTORY</b></p>	<p>Map <b>1</b></p> <p><b>BASE MAP</b></p>	<p>Date: 12/25/02</p> <p>Drawn by: JPB</p> <p>Checked by: SS, KM</p> <p>Revision No: 01</p> <p>Revision Date: N/A</p>
	<p>Notes:</p> <ol style="list-style-type: none"> <li>DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.</li> <li>DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION</li> </ol>	
<p>File P:\0331\Projects\033102\GIS\PFILES\Map1-Base_Map.mxd</p>		<p>Date</p>
<p>1108 OLD YORK ROAD          SUITE 1, P.O. BOX 720          RINGOES, NJ 08551          PH: (908) 237.5660          FAX: (908) 237.5666</p>		<p>Revisions</p>
<p><b>PH PRINCETON HYDRO, LLC</b></p>		<p>PROJ #: 331.02</p>

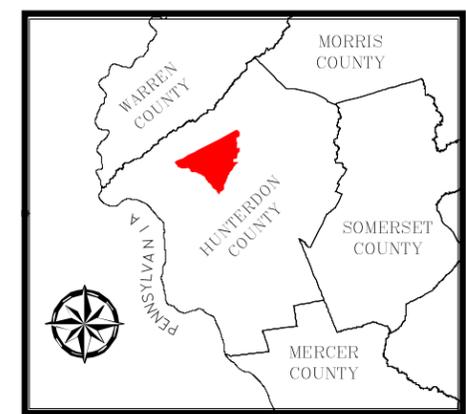


**New Jersey Location Map**

**Aerial Photographs**

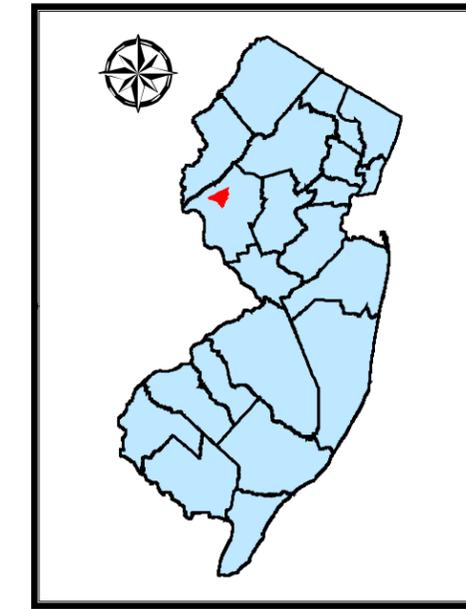
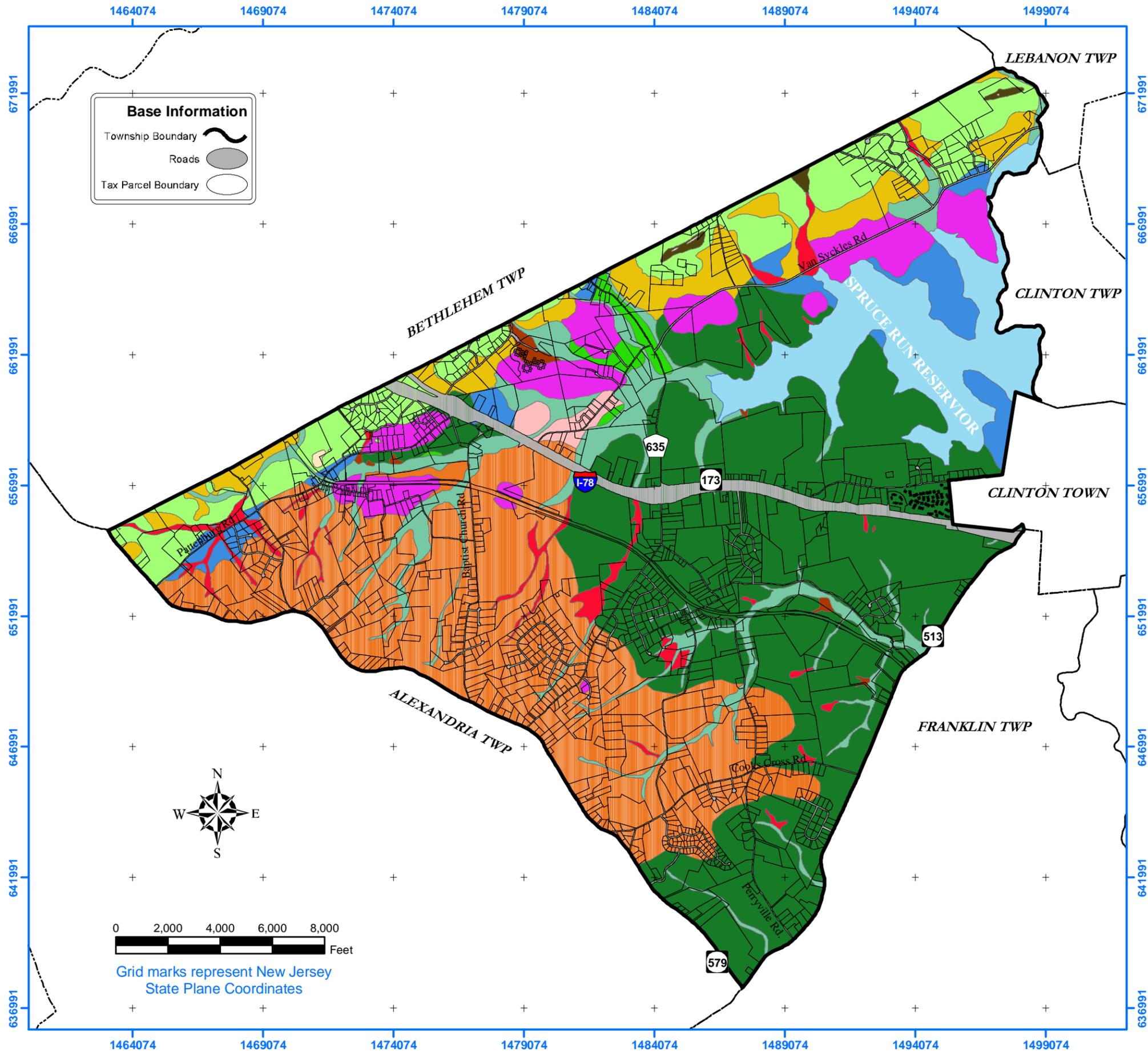
Aerial photography from the NJ Dept. of Environmental Protection's 1995/97 Color Infrared Digital Imagery, Disc 9

"This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized"



**Regional Location Map**

<b>Map</b> <b>2</b>	<b>AERIAL PHOTOGRAPH</b>
	Date: 05/01/03 Drawn by: JPB Checked by: SS, KM Revision No: 01 Revision Date: N/A
Notes: 1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES. 2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION	
File	P:\0331\Projects\033102\GIS\PFILES\Map1-Base_Map.mxd
Date	Revisions
<b>TOWNSHIP OF UNION</b> <b>HUNTERDON COUNTY, NJ</b> <b>NATURAL RESOURCE INVENTORY</b>	
1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 RINGOES, NJ 08551 PH: (908) 237.5660 FAX: (908) 237.5666	
 <b>PRINCETON</b> <b>HYDRO, LLC</b>	
PROJ #: 331.02	

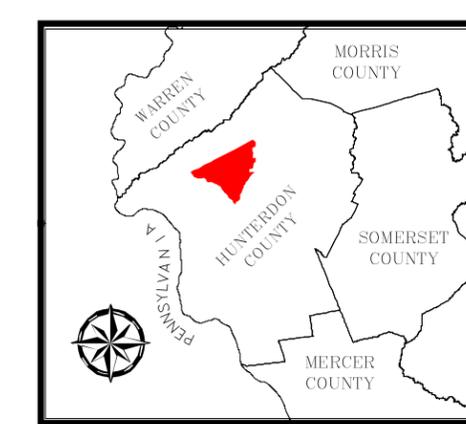


New Jersey Location Map

**Geology**

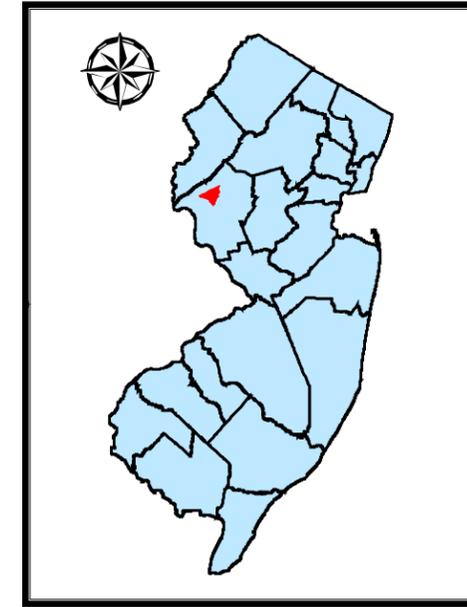
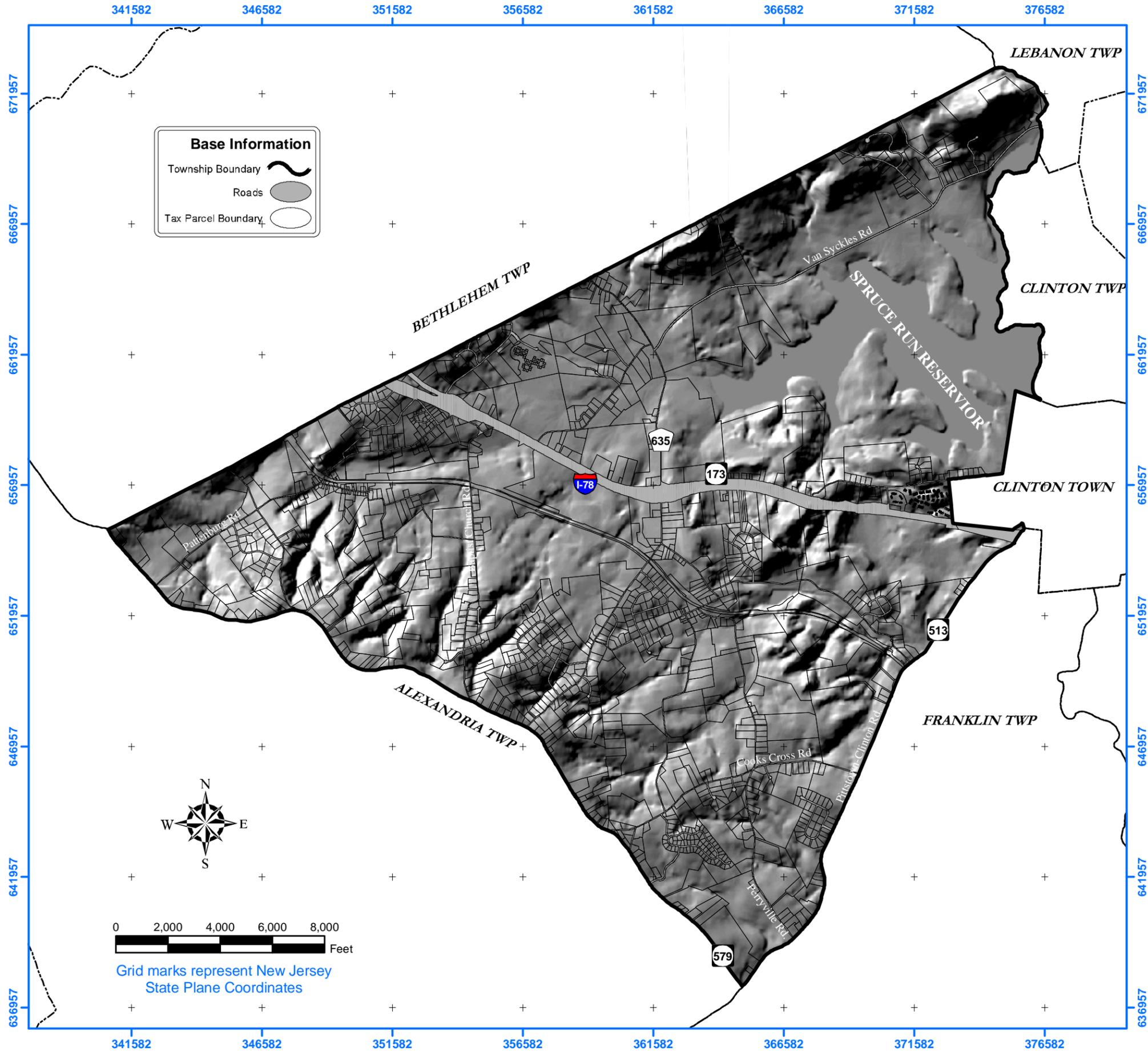
**Formation**

- Alluvium
- Alluvium Fan Deposits
- Alluvium and Colluvium
- Extensive Bedrock Outcrop
- Gneiss Colluvium
- Lower Terrace Deposits
- Scattered Bedrock Outcrop
- Till
- Upper Terrace Deposits
- Weathered Carbonate Rock
- Weathered Conglomerate
- Weathered Gneiss
- Weathered Shale, Mudstone, and Sandstone
- Water



Regional Location Map

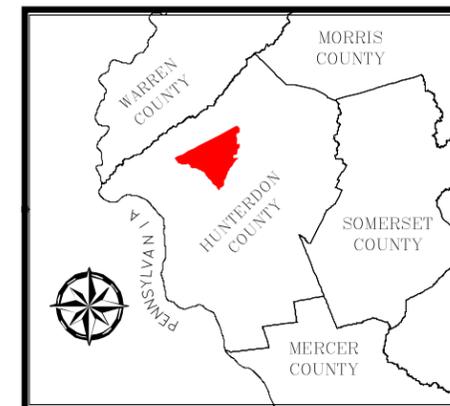
	<b>Map</b>	<b>3</b>	<b>GEOLOGY</b>
Notes: 1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES. 2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.			
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<b>TOWNSHIP OF UNION</b> <b>HUNTERDON COUNTY, NJ</b> <b>NATURAL RESOURCE INVENTORY</b>		1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 PRINCETON, NJ 08551 PH: (908) 237.5660 FAX: (908) 237.5666	
<b>PRINCETON</b> <b>HYDRO, LLC</b>		PROJ #: 331.02	



New Jersey Location Map

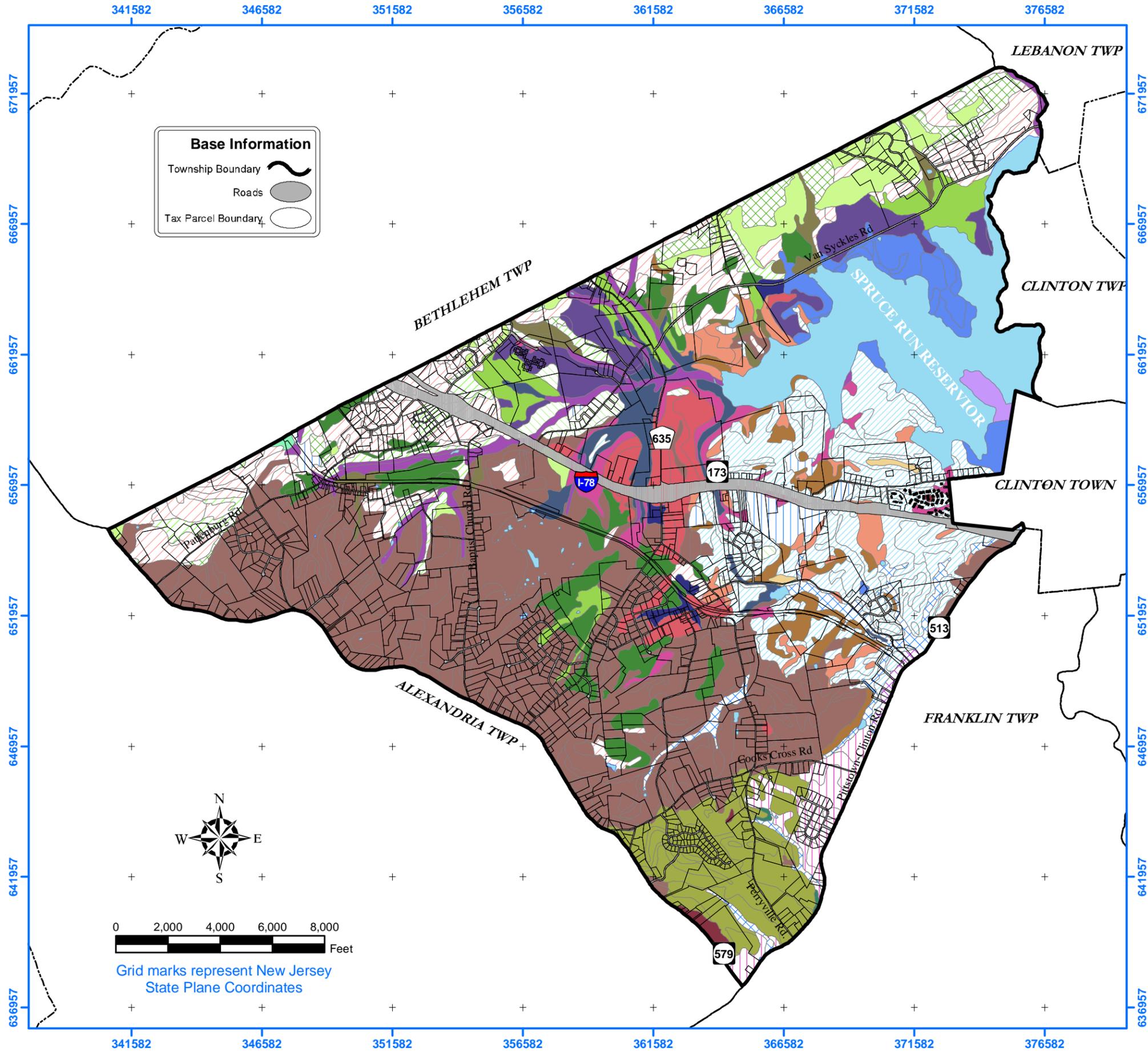
### ELEVATION

The Elevation Relief Model was created with ESRI's ArcView 8.2 and the 3-D Analyst extension, and derived from the NJ DEP 10 Meter Digital Elevation Model (DEM)



Regional Location Map

<p><b>TOWNSHIP OF UNION</b>  <b>HUNTERDON COUNTY, NJ</b>  <b>NATURAL RESOURCE INVENTORY</b></p>	<p>Map <b>4</b></p>	<p><b>ELEVATION RELIEF</b></p>
	<p>Notes:          1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.          2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION</p>	
<p>1108 OLD YORK ROAD          SUITE 1, P.O. BOX 720          PRINCETON, NJ 08551          PH: (908) 237.5660          FAX: (908) 237.5666</p>	<p>File P:\0331\Projects\033102\GIS\PFILES\Map4-Elevation.mxd</p>	<p>Date: 05/01/03          Drawn by: JPB          Checked by: SS, KM          Revision No: 01          Revision Date: N/A</p>
<p><b>PH PRINCETON HYDRO, LLC</b></p>	<p>Revisions</p>	<p>PROJ #: 331.02</p>

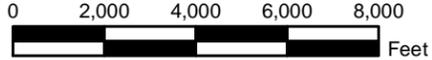


**Base Information**

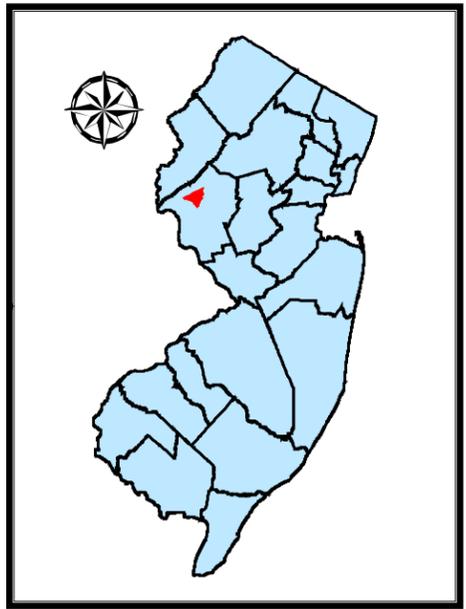
Township Boundary

Roads

Tax Parcel Boundary



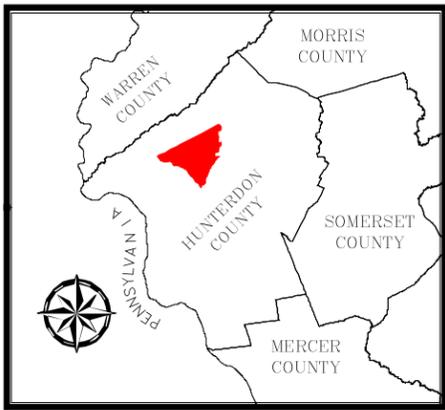
Grid marks represent New Jersey State Plane Coordinates



New Jersey Location Map

**Soil Classification**

ALLUVIAL LAND	MADE LAND
ANNANDALE	MECKESVILLE
BEDINGTON	NORTON
BERKS	PARKER
BIRDSBORO	PATTENBURG
BOWMANVILLE	PENN
BUCKS	PITS, GRAVEL
CALIFON	QUAKERTOWN
CHALFONT	RARITAN
COKESBURY	RIVERHEAD
DUFFIELD	ROCK LAND
EDNEYVILLE	ROUGH BROKEN LAND
HAZLETON	ROWLAND
KLINESVILLE	STEEP STONY LAND, PA
LANSDOWNE	TURBOTVILLE
	WASHINGTON
	WATER



Regional Location Map

Map	<b>5</b>
<b>SOILS</b>	
Date:	05/01/03
Drawn by:	JPB
Checked by:	SS, KM
Revision No.:	01
Revision Date:	N/A

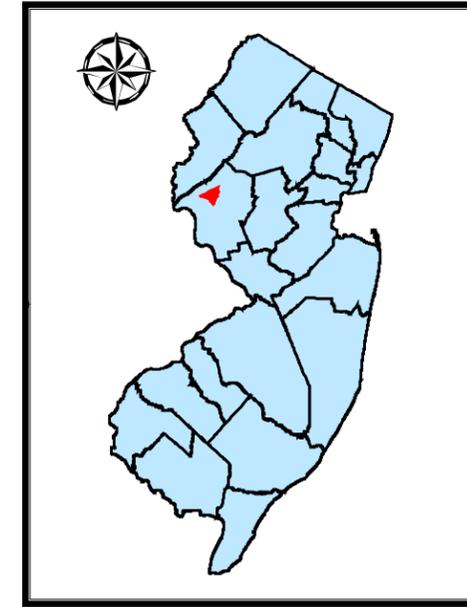
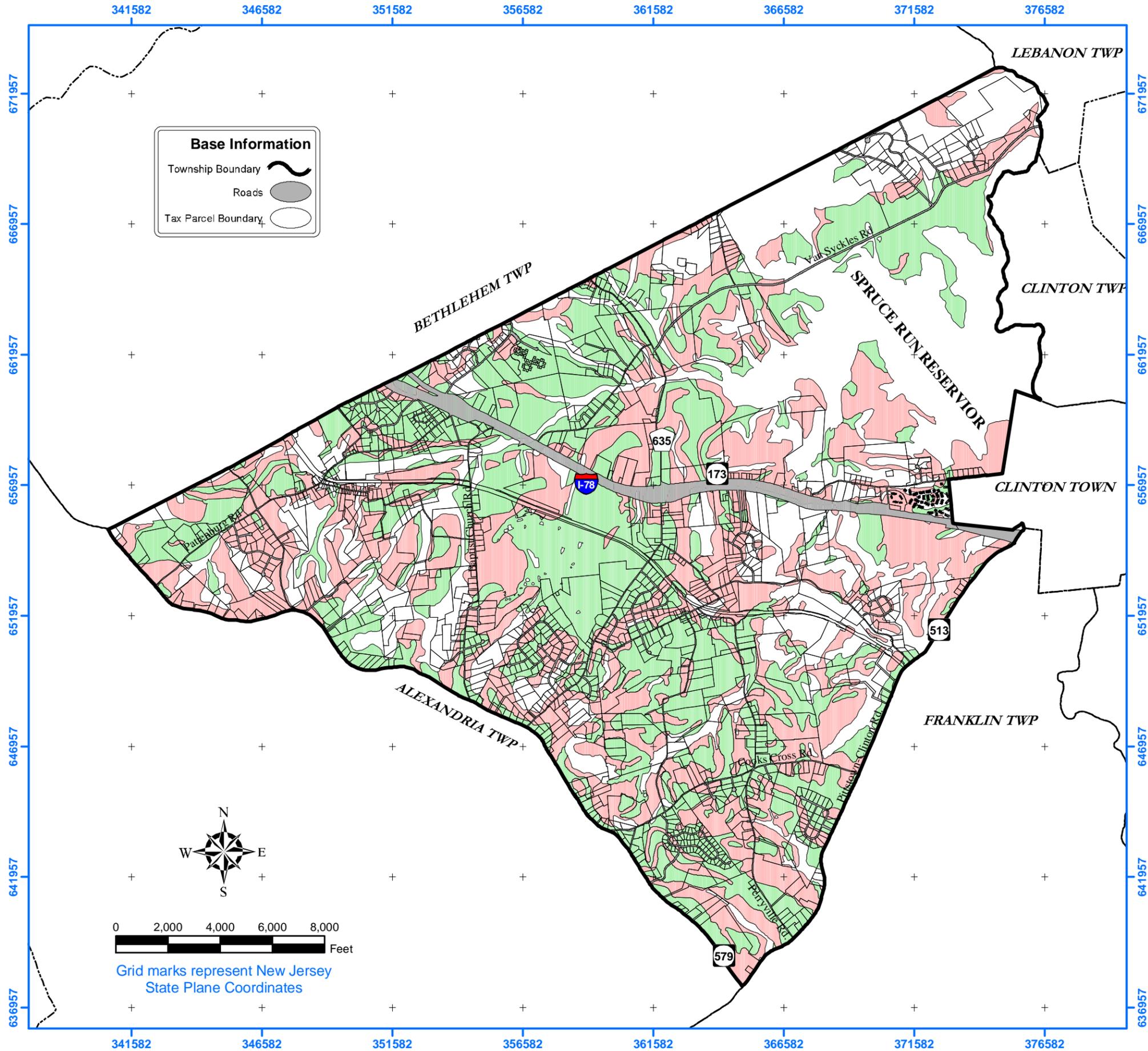
Notes: 1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES. 2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.	Revisions
	File P:\0331\Projects\033102\GIS\PFILES\Map5-Soils.mxd
Date	

**TOWNSHIP OF UNION**  
**HUNTERDON COUNTY, NJ**  
**NATURAL RESOURCE INVENTORY**

1108 OLD YORK ROAD  
 SUITE 1, P.O. BOX 720  
 RINGOES, NJ 08551  
 PH: (908) 237.5660  
 FAX: (908) 237.5666

**PH**  
**PRINCETON**  
**HYDRO, LLC**

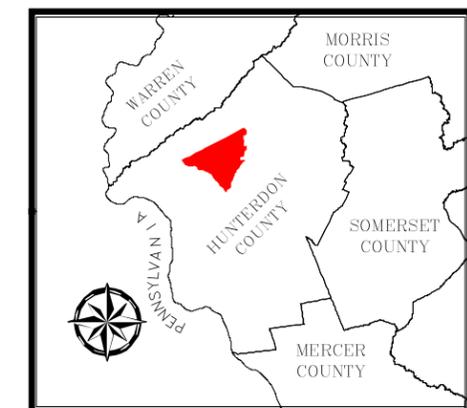
PROJ #: 331.02



New Jersey Location Map

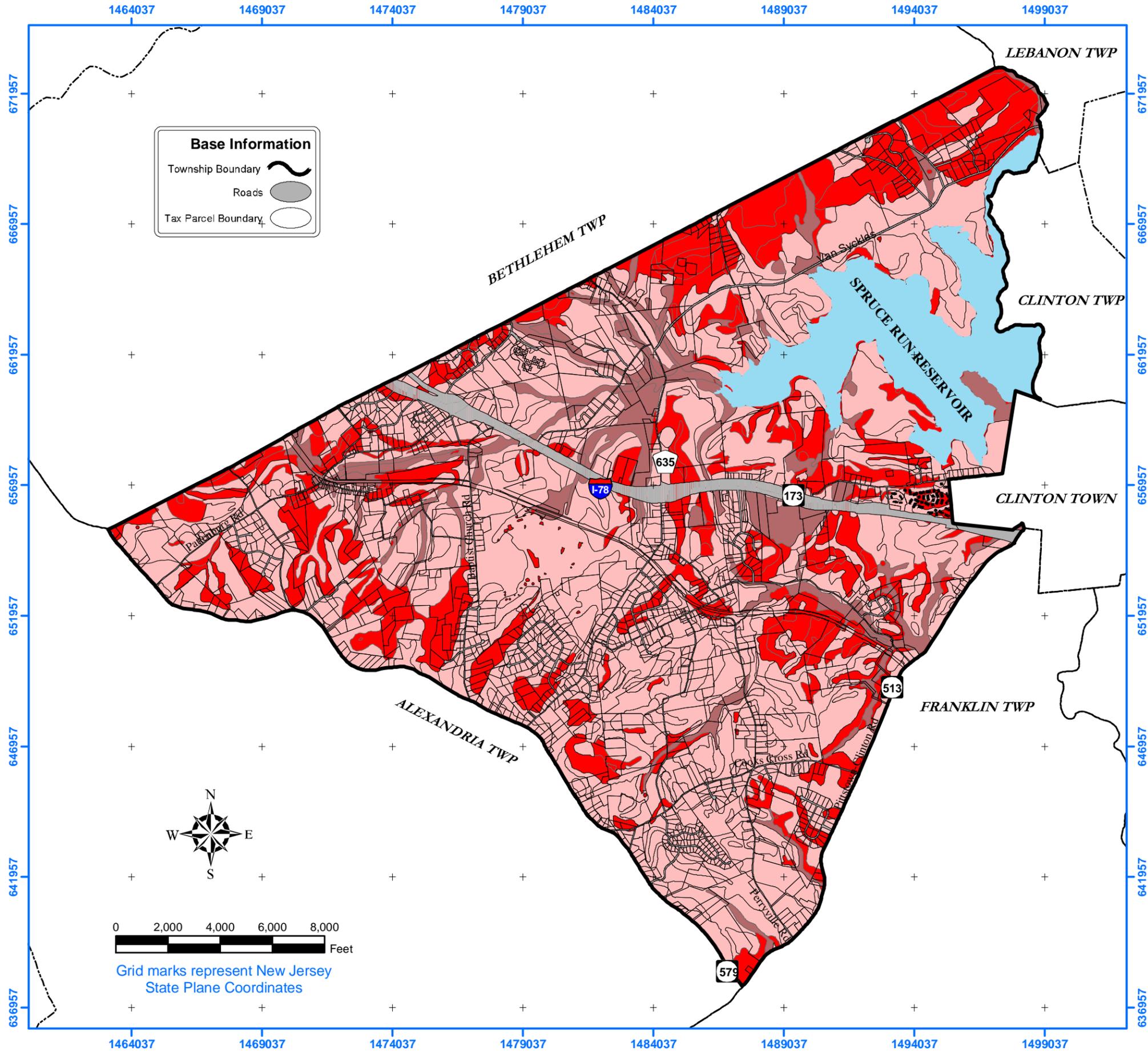
**Soil Classification**

- Prime-Farmland-Soils
- State-Important-Soils



Regional Location Map

<b>6</b>	<b>Map</b>
<b>AGRICULTURAL AND STATEWIDE IMPORTANT SOILS</b>	
<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.</li> <li>2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.</li> </ol>	
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<b>Date</b>	Revisions
<b>Drawn by:</b>	JPB
<b>Checked by:</b>	SS, KM
<b>Revision No.:</b>	01
<b>Revision Date:</b>	N/A
<p><b>TOWNSHIP OF UNION</b>  <b>HUNTERDON COUNTY, NJ</b>  <b>NATURAL RESOURCE INVENTORY</b></p>	
<p>1108 OLD YORK ROAD          SUITE 1, P.O. BOX 720          PRINCETON, NJ 08551  <b>PH PRINCETON HYDRO, LLC</b>          PH: (908) 237.5660          FAX: (908) 237.5666</p>	
<p>PROJ #: 331.02</p>	

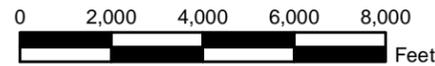


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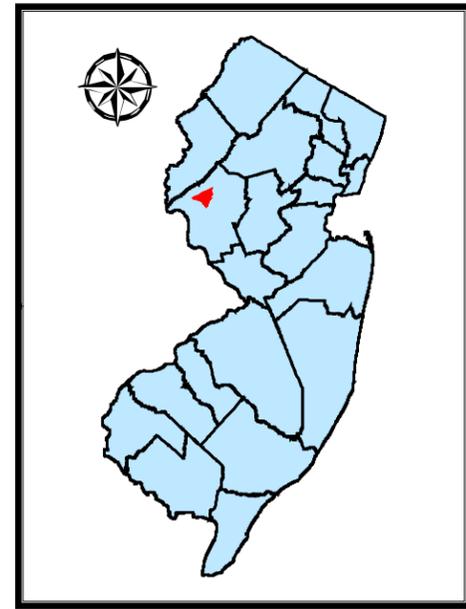
Township Boundary

Roads

Tax Parcel Boundary



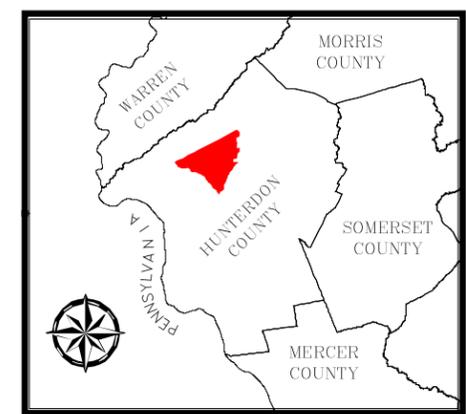
Grid marks represent New Jersey State Plane Coordinates



New Jersey Location Map

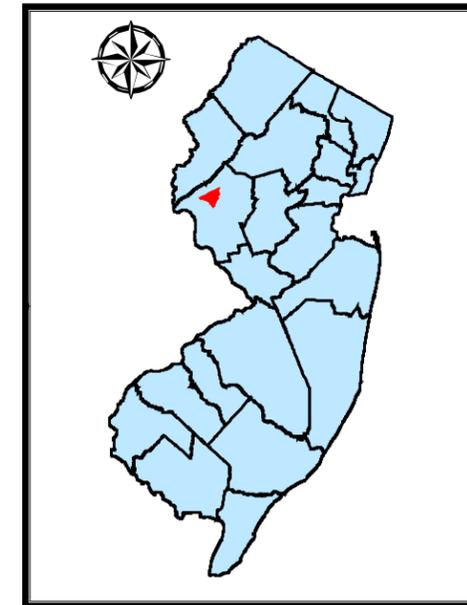
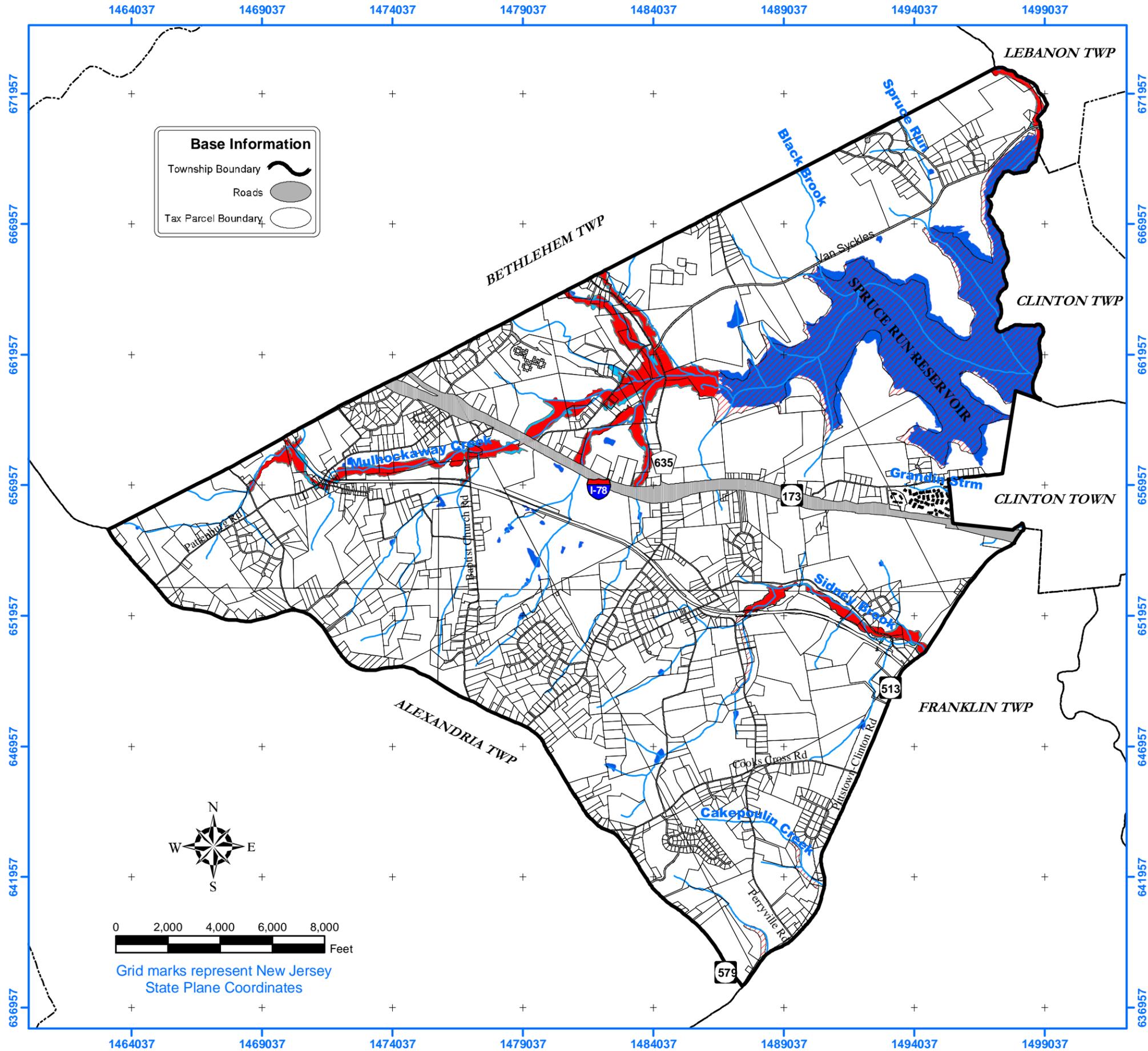
**Erodible Land Classification**

- Erodibility**
- Highly Erodible
  - Potentially Highly Erodible
  - Not Highly Erodible



Regional Location Map

<b>Map 7</b>	<b>ERODIBLE SOILS</b>
	Date: 05/01/03 Drawn by: JPB Checked by: SS, KM Revision No: 01 Revision Date: N/A
<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.</li> <li>DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.</li> </ol>	
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Date:	
<b>TOWNSHIP OF UNION</b> <b>HUNTERDON COUNTY, NJ</b> <b>NATURAL RESOURCE INVENTORY</b>	
1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 RINGOES, NJ 08551 PH: (908) 237.5660 FAX: (908) 237.5666	
PROJ #: 331.02	



New Jersey Location Map

**Surface Water Features**

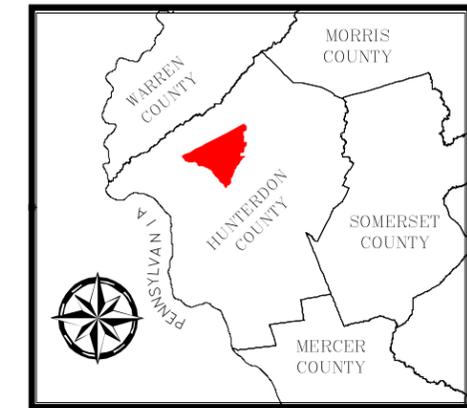
- Lakes
  - Streams
- FEMA Flood Data**
- ZONE**
- AE
  - A
  - X500
  - X

Zone A: Areas within the 100 Year Flood Zone, for which no Base Flood Elevations have been determined

Zone AE: Areas within the 100 Year Flood Zone, for which Base Flood Elevations have been determined

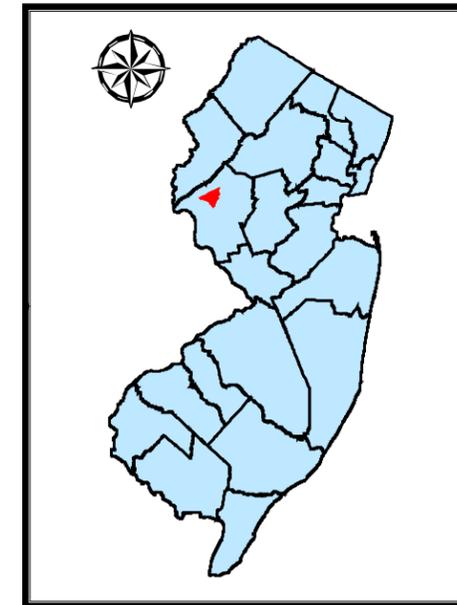
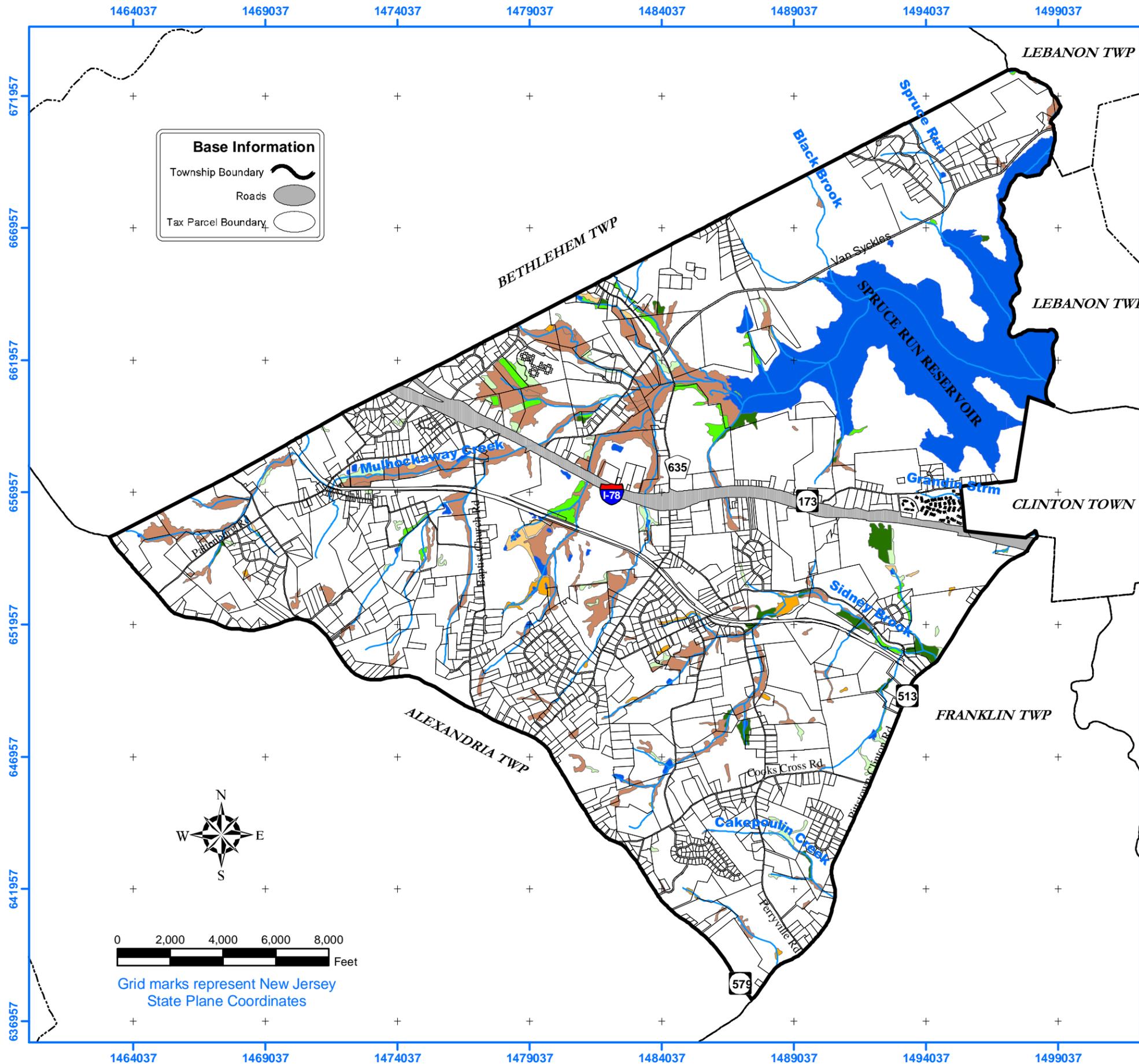
Zone X500: Areas within the 500 Year Flood Zone

Zone X: Areas outside the 500 Year Flood Zone



Regional Location Map

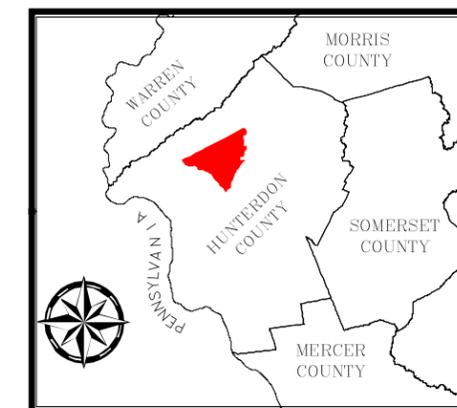
<p><b>TOWNSHIP OF UNION</b>  <b>HUNTERDON COUNTY, NJ</b>  <b>NATURAL RESOURCE INVENTORY</b></p>	<p>Map <b>8</b></p>	<p><b>SURFACE WATER FEATURES</b></p>				
	<p>Notes:          1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.          2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION</p>	<p>Date: 05/01/03          Drawn by: JPB          Checked by: SS, KM          Revision No: 01          Revision Date: N/A</p>	<p>File: P:\0331\Projects\033102\GIS\FILES\Map8-SurfaceWater.mxd</p>			
<p>1108 OLD YORK ROAD          SUITE 1, P.O. BOX 720          RINGOES, NJ 08551          PH: (908) 237.5660          FAX: (908) 237.5666</p> <p><b>PH</b>  <b>PRINCETON</b>  <b>HYDRO, LLC</b></p>	<p>Revisions</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Revisions</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> </tr> </tbody> </table>	Date	Revisions			<p>PROJ #: 331.02</p>
Date	Revisions					



**Wetland Resources**

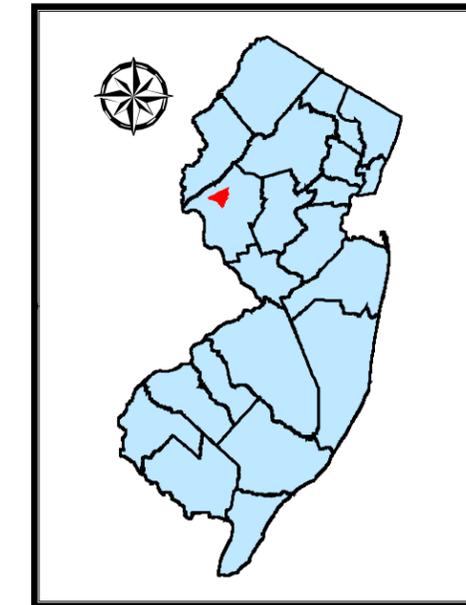
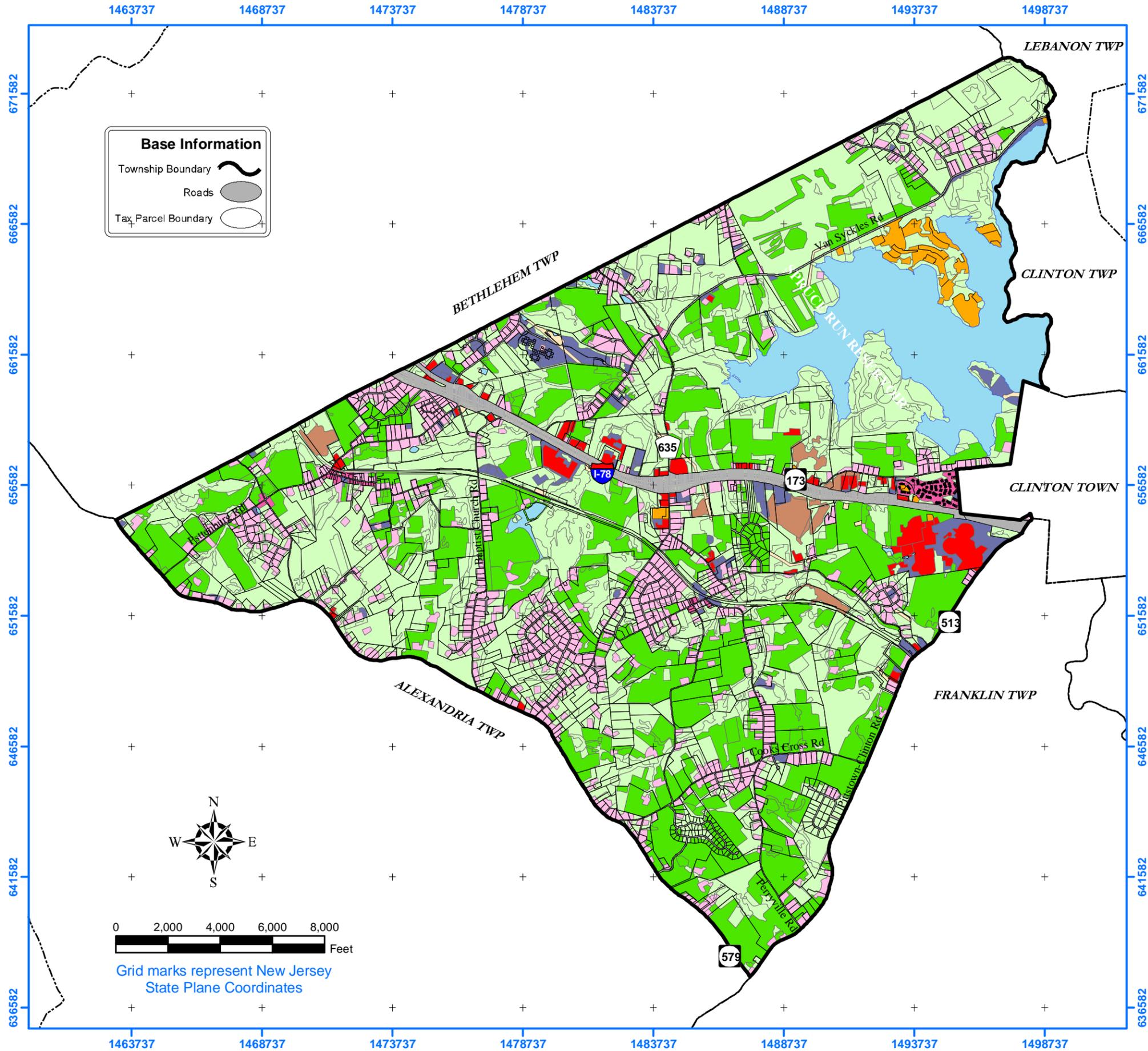
- Lakes
- Streams
- AGRICULTURAL WETLANDS (MODIFIED)
- DECIDUOUS SCRUB/SHRUB WETLANDS
- DECIDUOUS WOODED WETLANDS
- DISTURBED WETLANDS (MODIFIED)
- HERBACEOUS WETLANDS
- MANAGED WETLANDS (MODIFIED)

TOTAL ACRES OF WETLANDS: 1366.7 Acres



<b>Map</b>	<b>9</b>	<b>WETLAND RESOURCES</b>
		Date: 05/01/03 Drawn by: JPB Checked by: SS, KM Revision No: 01 Revision Date: N/A
<b>Notes:</b> 1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES. 2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.		
File	P:\0331\Projects\033102\GIS\PFILES\Map9-Wetlands.mxd	Revisions
Date		
<b>TOWNSHIP OF UNION</b> <b>HUNTERDON COUNTY, NJ</b> <b>NATURAL RESOURCE INVENTORY</b>		
1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 RINGOES, NJ 08551 PH: (908) 237.5660 FAX: (908) 237.5666		
PROJ #: 331.02		



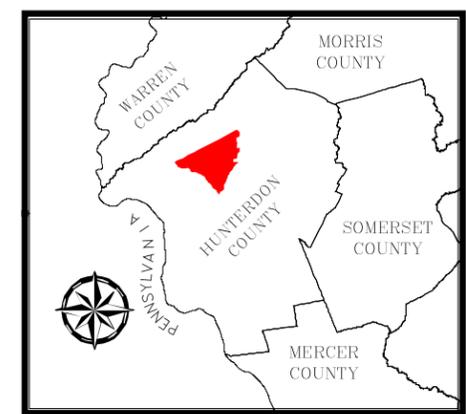


New Jersey Location Map

**1995 Land Use / Cover**

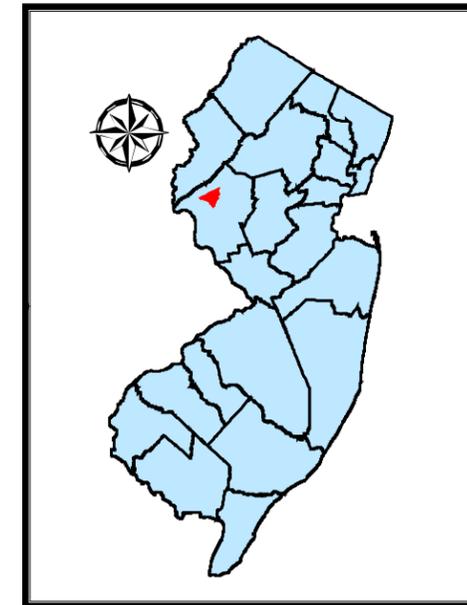
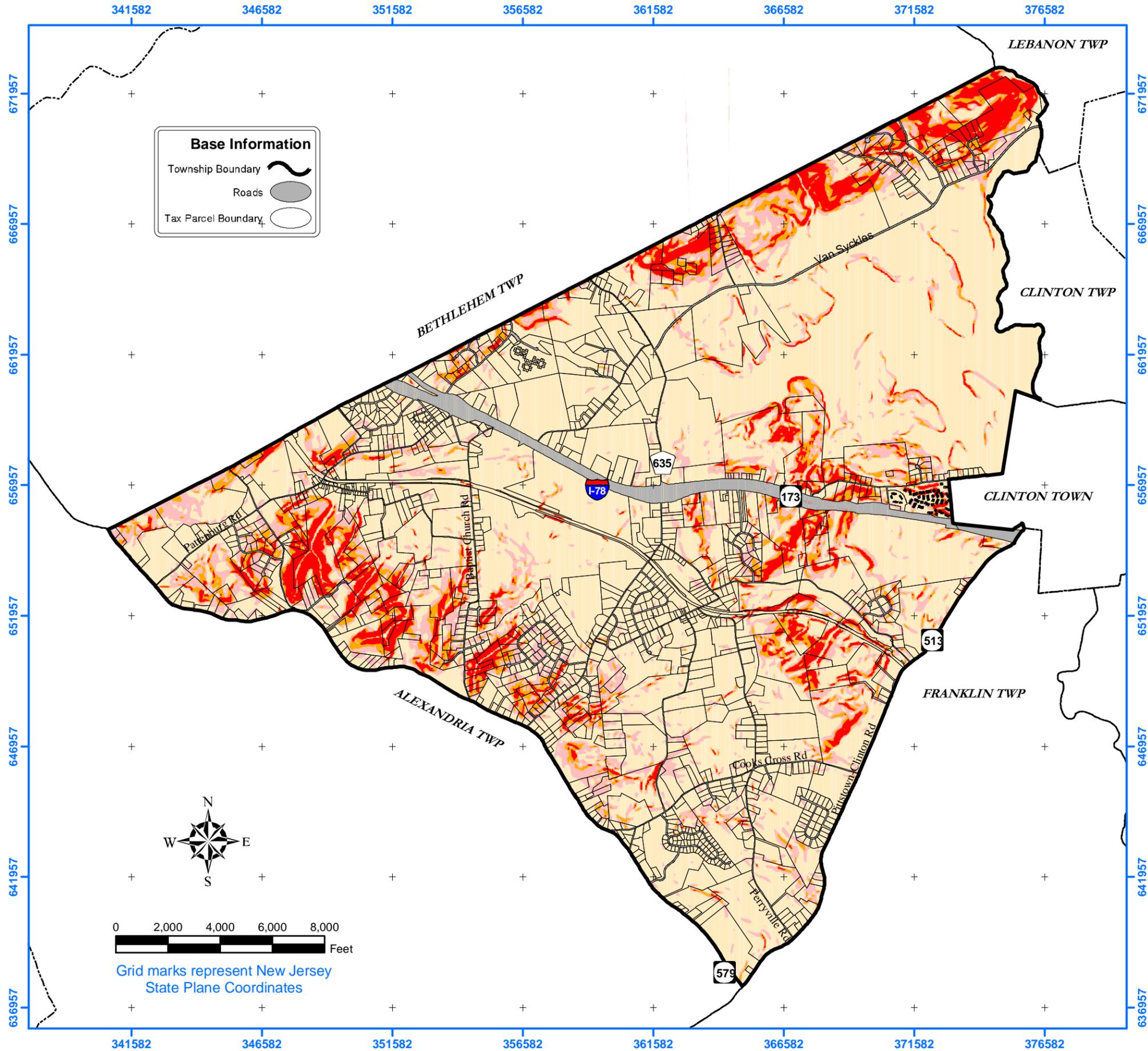
- Agricultural Preservation
- Conservation Management
- Country Residential
- Light Industrial
- Parkland
- Quarry
- Multi-Family Residential
- Special Commercial
- Utility
- Watershed Management

The Land Use data was created by the NJ DEP, and re-classified here to conform to Land Use Districts defined by Union Township's Land Use Ordinance book, adopted 11/11/01



Regional Location Map

<b>Map 11</b> <b>1995 LAND USE / LAND COVER</b>	Date: 05/01/03 Drawn by: JPB Checked by: SS, KM Revision No: 01 Revision Date: N/A
	File: P:\0331\Projects\033102\GIS\FILES\Map11 - 1995tule.mxd Date: _____ Revisions: _____
<b>Notes:</b> 1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES. 2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.	
<b>TOWNSHIP OF UNION</b> <b>HUNTERDON COUNTY, NJ</b> <b>NATURAL RESOURCE INVENTORY</b>	
<b>PRINCETON HYDRO, LLC</b> 1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 RINGOES, NJ 08551 PH: (908) 237.5660 FAX: (908) 237.5666 PROJ #: 331.02	

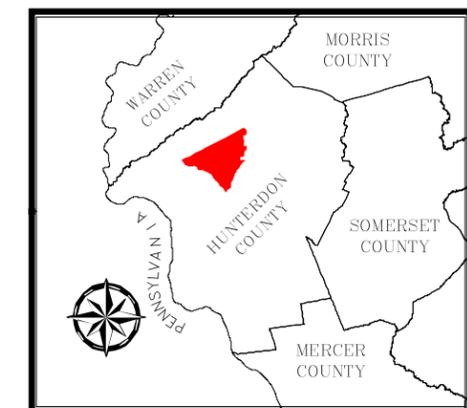


New Jersey Location Map

**Slope Percentages**

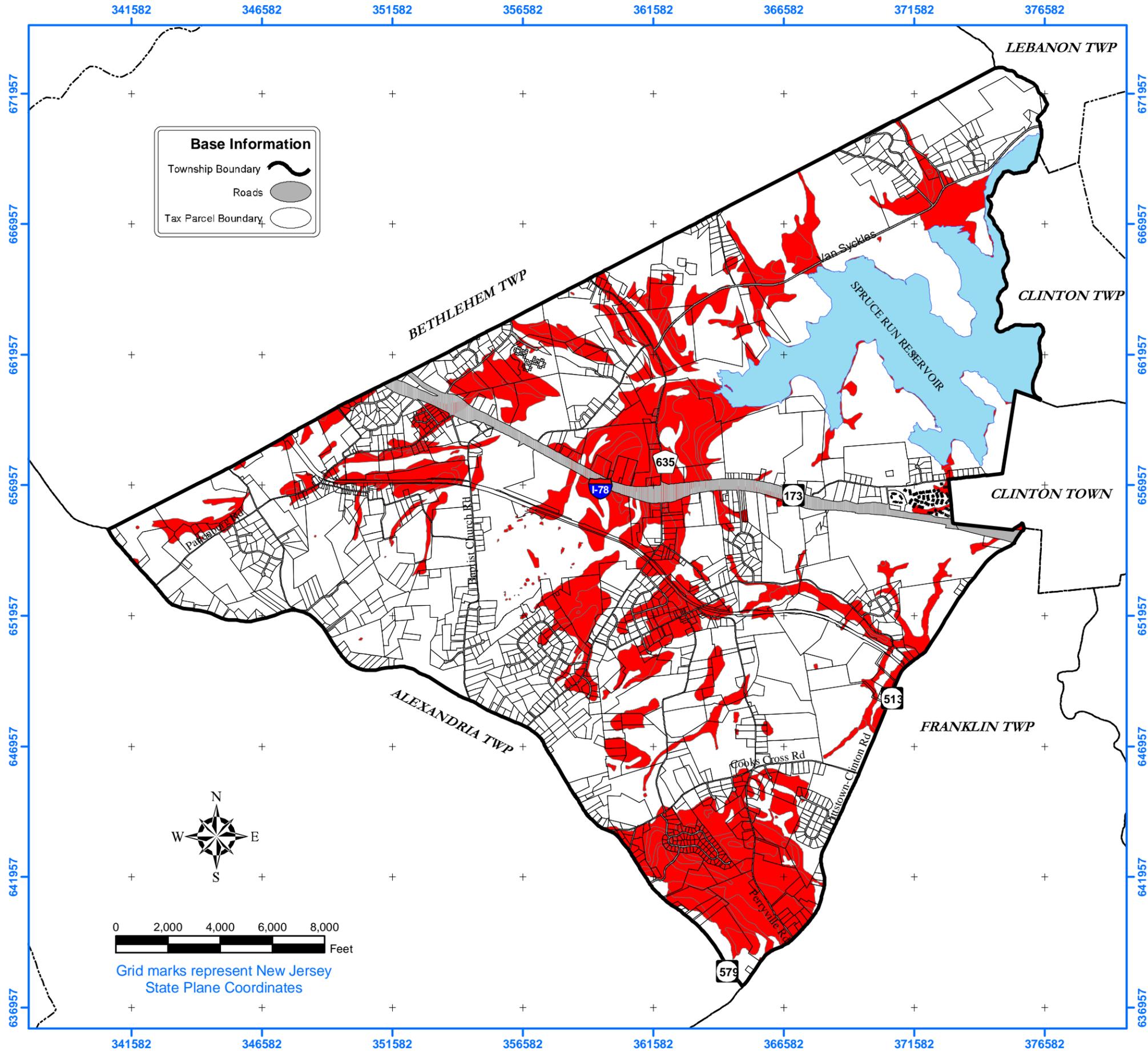


Slopes derived from a 10 Meter Digital Elevation Model (DEM)



Regional Location Map

<p><b>TOWNSHIP OF UNION</b>  <b>HUNTERDON COUNTY, NJ</b>  <b>NATURAL RESOURCE INVENTORY</b></p>	<p>Map <b>12</b></p>	<p><b>SLOPE PERCENTAGES</b></p>
	<p>Notes:          1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.          2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION</p>	<p>Date: 05/01/03          Drawn by: JPB          Checked by: SS, KM          Revision No: 01          Revision Date: N/A</p>
<p>1108 OLD YORK ROAD          SUITE 1, P.O. BOX 720          RINGOES, NJ 08551          PH: (908) 237.5660          FAX: (908) 237.5666</p> <p><b>PH</b>  <b>HYDRO, LLC</b></p>	<p>Revisions</p>	<p>PROJ #: 331.02</p>



**Base Information**

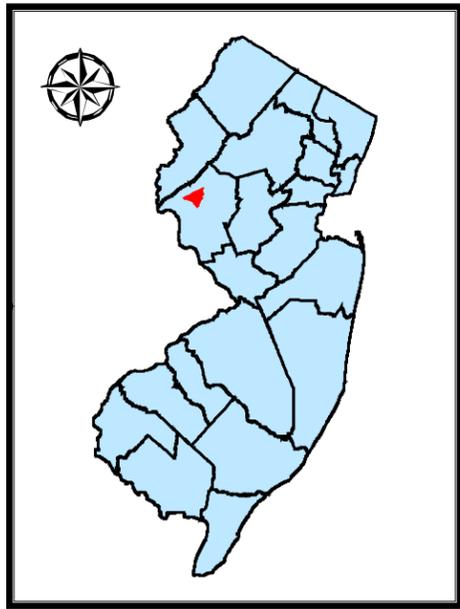
Township Boundary

Roads

Tax Parcel Boundary



Grid marks represent New Jersey State Plane Coordinates

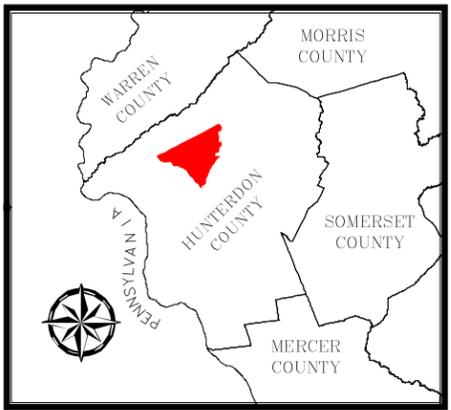


New Jersey Location Map

**Septic Suitability**

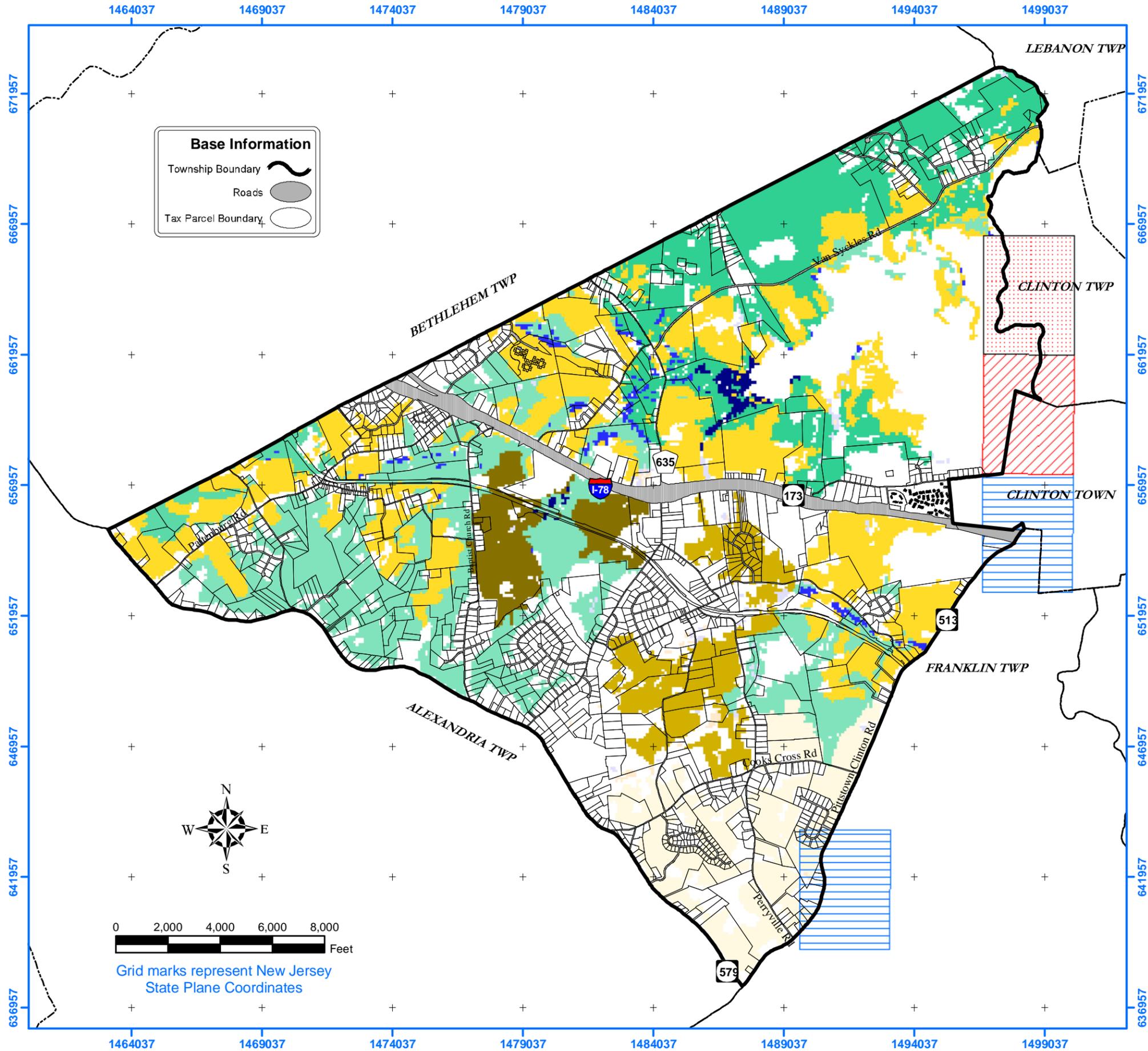
Type III Restrictions

New Jersey Administrative Code 7:9A, Appendix D describes three Suitability Classes (I, II and III) and six different types of limiting zones. This map depicts only those soils with severe limitations (Suitability Class III). For more complete information regarding suitability for all soil types, please see accompanying text.



Regional Location Map

<p><b>TOWNSHIP OF UNION</b>  <b>HUNTERDON COUNTY, NJ</b>  <b>NATURAL RESOURCE INVENTORY</b></p>	<p>Map <b>13</b></p> <p><b>SEPTIC SUITABILITY FOR SOILS</b></p>	<p>Date: 05/01/03</p> <p>Drawn by: JPB</p> <p>Checked by: SS, KM</p> <p>Revision No: 01</p> <p>Revision Date: N/A</p>
	<p>Notes:</p> <p>1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.</p> <p>2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.</p>	
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<p>1108 OLD YORK ROAD          SUITE 1, P.O. BOX 720          PRINCETON, NJ 08551          PH: (908) 237.5660          FAX: (908) 237.5666</p> <p><b>PH PRINCETON HYDRO, LLC</b></p>		<p>PROJ #: 331.02</p>

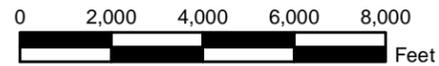


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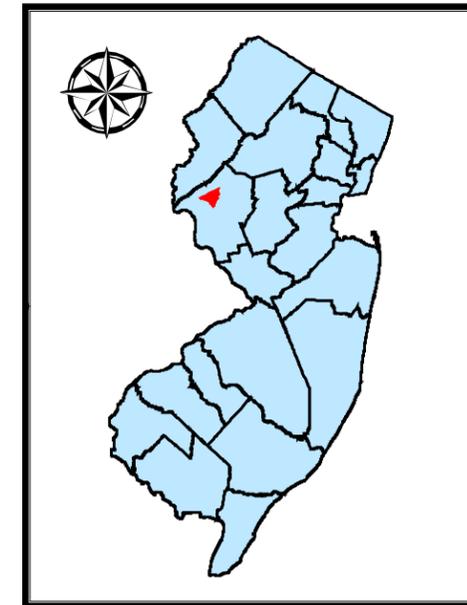
Township Boundary

Roads

Tax Parcel Boundary



Grid marks represent New Jersey State Plane Coordinates



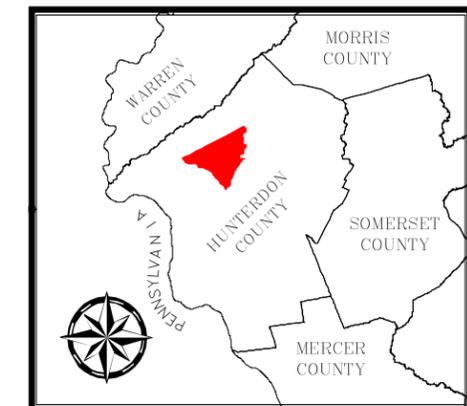
New Jersey Location Map

**Natural Heritage Data**

- Precise Species Location
- Species Located within 1.5 Miles
- Precise AND Remote

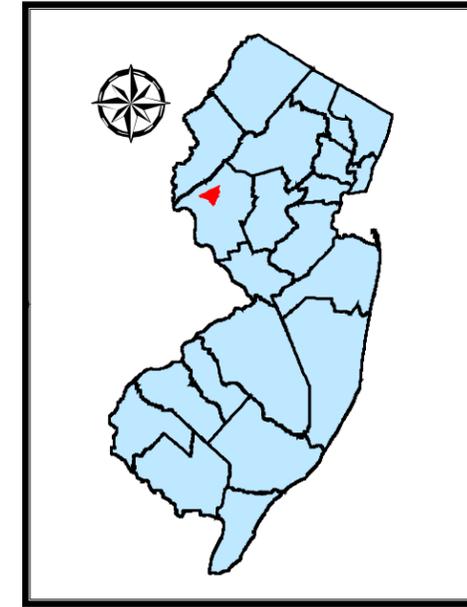
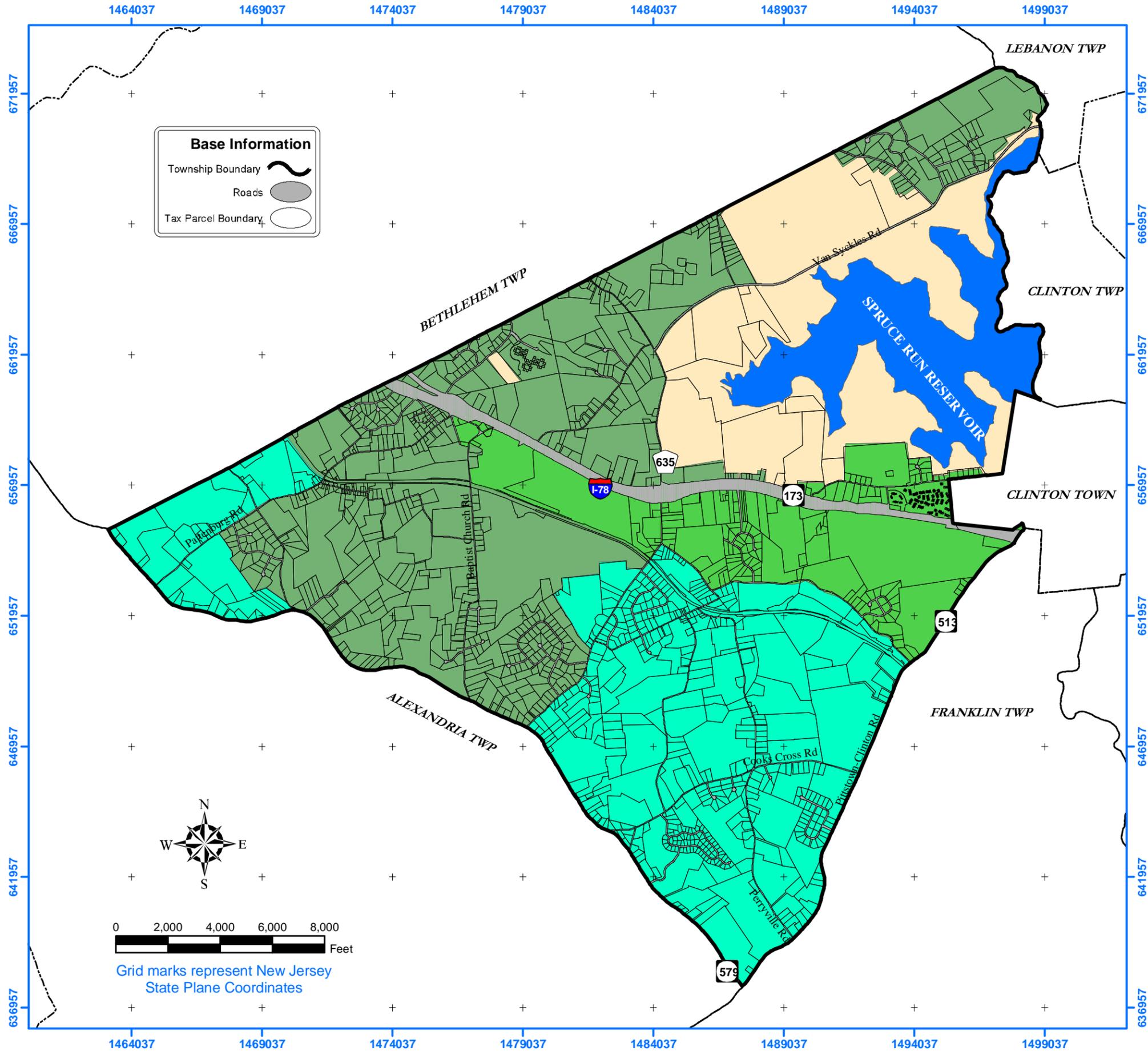
**NJ Landscape Data**

- |                  |                       |
|------------------|-----------------------|
| <b>Emergent</b>  | <b>Grassland</b>      |
| Suitable Habitat | Suitable Habitat      |
| Special Concern  | Special Concern       |
| State Threatened | State Threatened      |
| State Endangered | State Endangered      |
| Federal T & E    | Federal T & E         |
| <b>Forested</b>  | <b>Wetland Forest</b> |
| Suitable Habitat | Suitable Habitat      |
| Special Concern  | Special Concern       |
| State Threatened | State Threatened      |
| State Endangered | State Endangered      |
| Federal T & E    | Federal T & E         |



Regional Location Map

<p><b>Map 14</b></p> <p><b>THREATENED AND ENDANGERED SPECIES HABITAT</b></p>	<p>Date: 12/25/02</p> <p>Drawn by: JPB</p> <p>Checked by: SS, KM</p> <p>Revision No: 01</p> <p>Revision Date: N/A</p>										
	<p>Notes:</p> <p>1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.</p> <p>2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION</p>										
<p>File P:\0331\Projects\033102\GIS\PFILES\Map15-CritHabitat.mxd</p>											
<p>Revisions</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Revisions</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> </tr> </tbody> </table>		Date	Revisions								
Date	Revisions										
<p><b>TOWNSHIP OF UNION</b></p> <p><b>HUNTERDON COUNTY, NJ</b></p> <p><b>NATURAL RESOURCE INVENTORY</b></p>											
<p>1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 RINGOES, NJ 08551 PH: (908) 237.5660 FAX: (908) 237.5666</p> <p><b>PH PRINCETON HYDRO, LLC</b></p>											
<p>PROJ #: 331.02</p>											

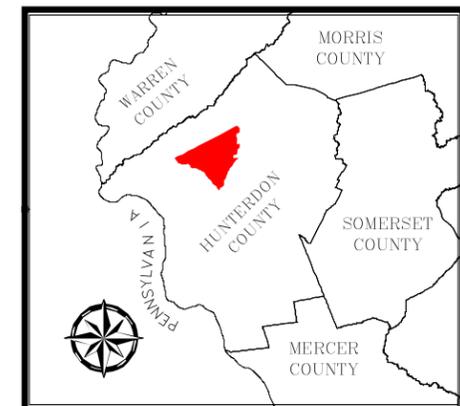


New Jersey Location Map

**New Jersey State Plan 2002**

**Description**

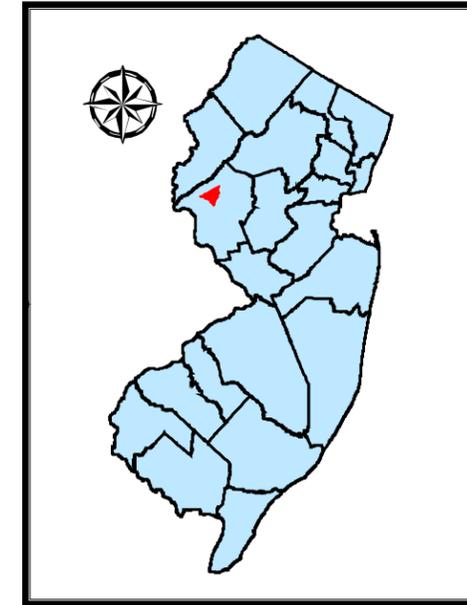
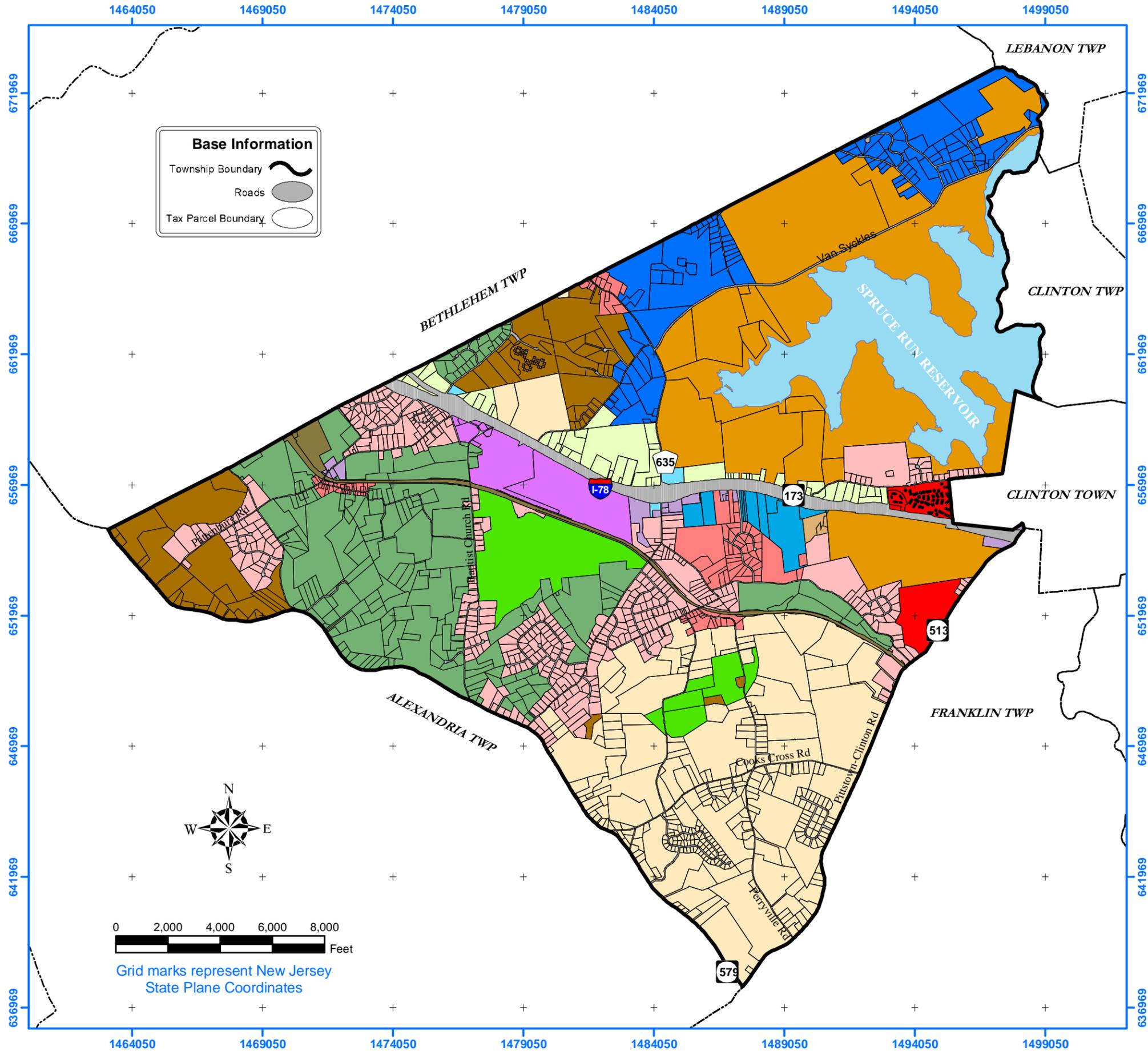
-  Environmentally Sensitive
-  Rural Environmentally Sensitive
-  State Park
-  Suburban
-  Water



Regional Location Map

<b>Map 15</b> <b>STATE PLANNING</b> <b>AREA MAP</b>	Date: 05/01/03 Drawn by: JPB Checked by: SS, KM Revision No: 01 Revision Date: N/A
	File: P:\0331\Projects\033102\GIS\FILES\Map15 - StatePlan.mxd
<b>TOWNSHIP OF UNION</b> <b>HUNTERDON COUNTY, NJ</b> <b>NATURAL RESOURCE INVENTORY</b>	Revisions Date
1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 RINGOES, NJ 08551 PH: (908) 237.5660 FAX: (908) 237.5666	<b>PH</b> <b>PRINCETON</b> <b>HYDRO, LLC</b>
PROJ #: 331.02	

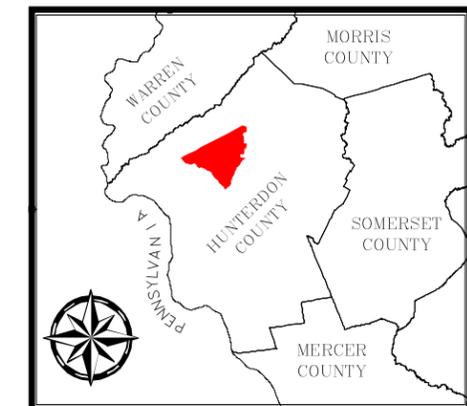
Notes:  
 1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.  
 2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION



New Jersey Location Map

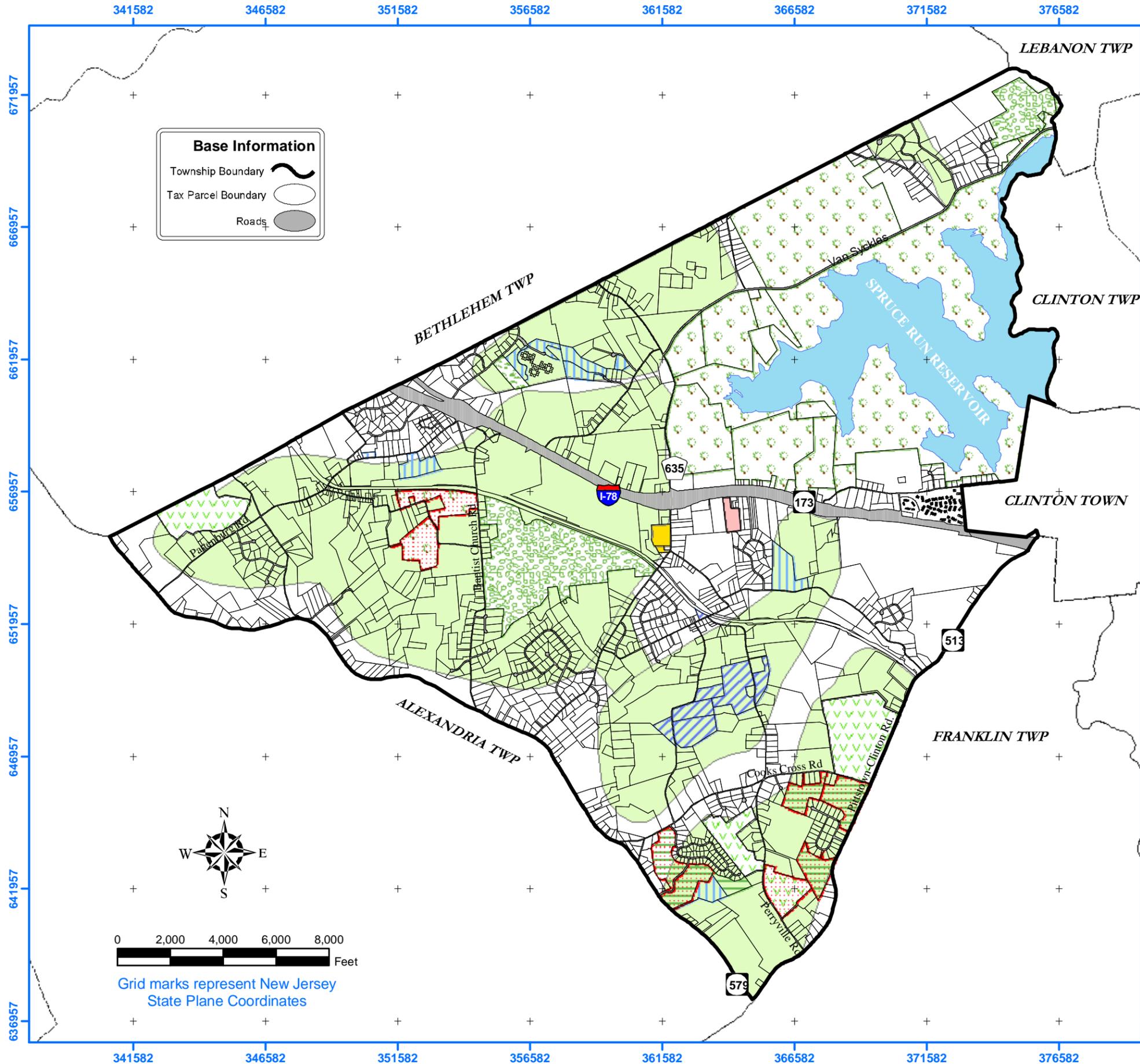
**Zoning Codes**

- AP1, Agricultural Preservation 1
- AP2, Agricultural Preservation 2
- CM, Conservation Management
- CR, Country Residential
- INS, Institutional
- LI, Light Industrial
- OR, Office Research
- P, Parkland
- PC, Planned Commercial
- Q, Quarry
- RM, Multifamily Residential
- SC, Special Commercial
- U, Utility
- VC, Village Commercial
- VR, Village Residential
- WM, Watershed Management



Regional Location Map

<b>Map 16</b> <b>UNION TOWNSHIP</b> <b>ZONING</b>	Date: 05/01/03 Drawn by: JPB Checked by: SS, KM Revision No: 01 Revision Date: N/A								
	Notes: 1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES. 2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION. File P:\0331\Projects\033102\GIS\PFILES\Map16-Zoning.mxd								
<b>TOWNSHIP OF UNION</b> <b>HUNTERDON COUNTY, NJ</b> <b>NATURAL RESOURCE INVENTORY</b>	Revisions <table border="1"> <thead> <tr> <th>Date</th> <th>Revisions</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> </tbody> </table>	Date	Revisions						
Date	Revisions								
1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 RINGOES, NJ 08551 PH: (908) 237.5660 FAX: (908) 237.5666	<b>PH</b> <b>PRINCETON</b> <b>HYDRO, LLC</b>								
PROJ #: 331.02									

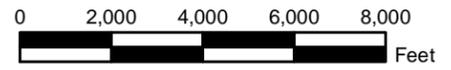


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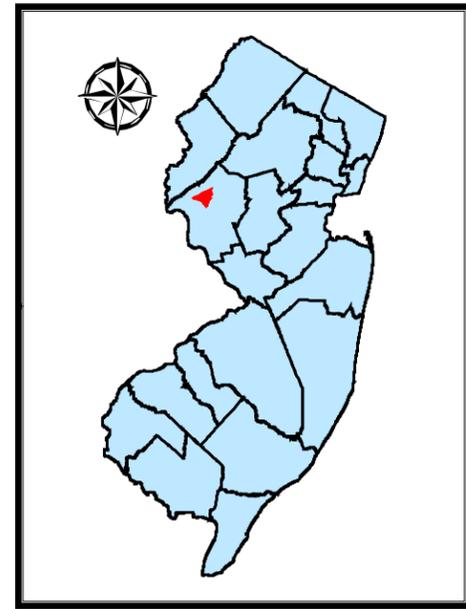
Township Boundary

Tax Parcel Boundary

Roads



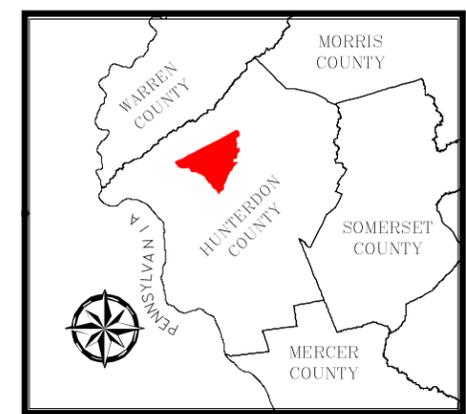
Grid marks represent New Jersey State Plane Coordinates



New Jersey Location Map

**Legend**

- Farmettes
- Greenways
- Hunterdon County Preserved Farmland
- Board of Education
- Common-Owned Open Space
- County Parkland
- Farmland Conservation Areas
- Municipal Parks and Open Space
- Non-Profit Conservation Lands
- Private Open Space
- State Parks and Preserved Open Space
- Reservoir



Regional Location Map

Map	<b>17</b>
<b>OPEN SPACE WITHIN UNION TOWNSHIP</b>	
Date:	05/01/03
Drawn by:	JPB
Checked by:	SS, KM
Revision No.:	01
Revision Date:	N/A

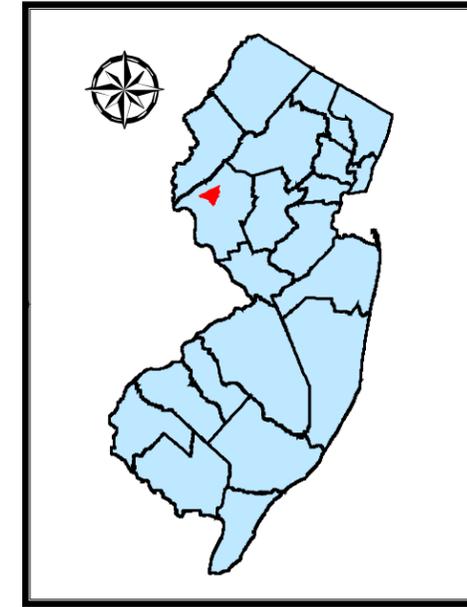
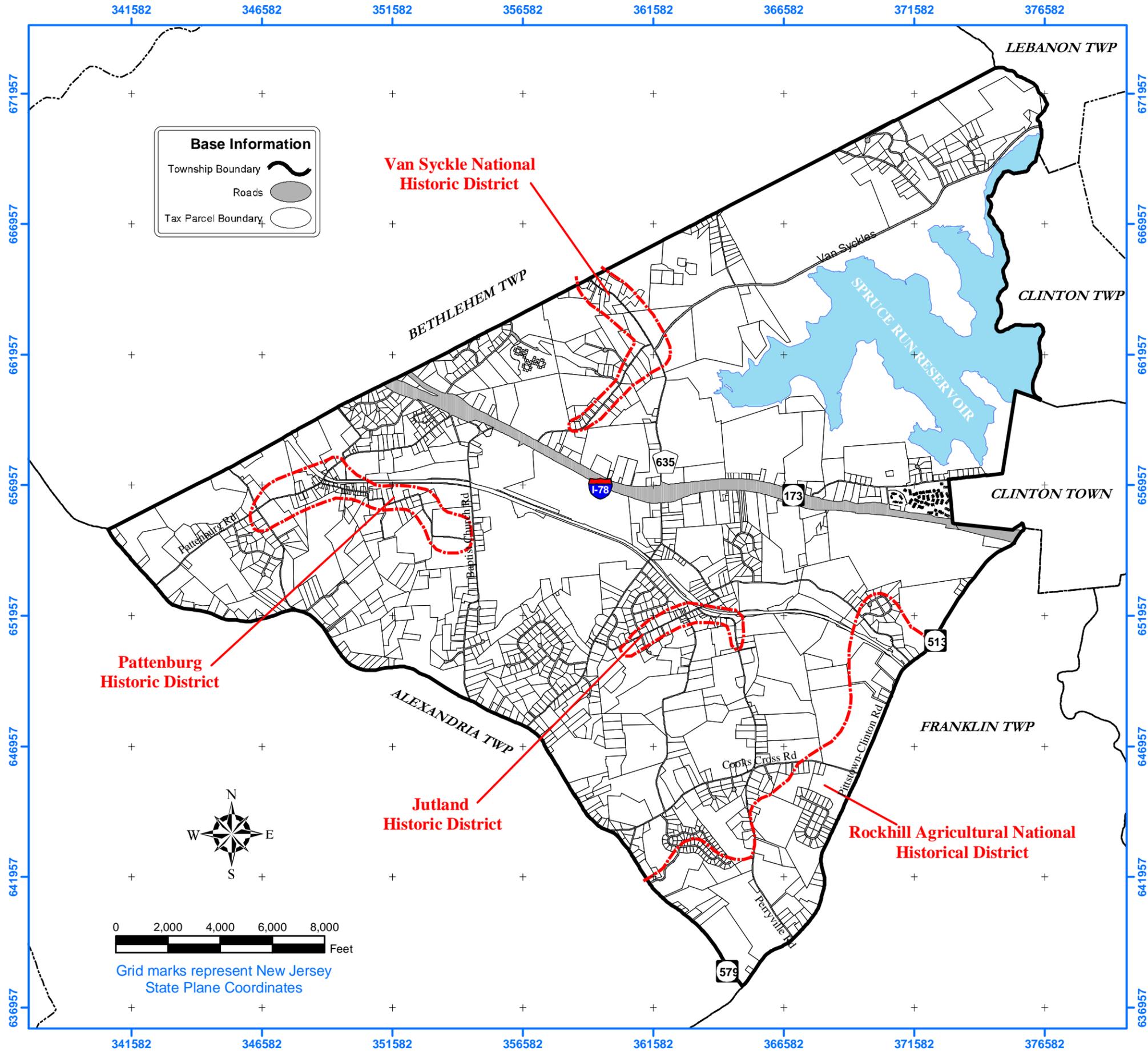
Notes:	
1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.	
2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.	
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Date	Revisions

**TOWNSHIP OF UNION  
HUNTERDON COUNTY, NJ  
NATURAL RESOURCE INVENTORY**

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PH: (908) 237.5660  
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**PH PRINCETON HYDRO, LLC**

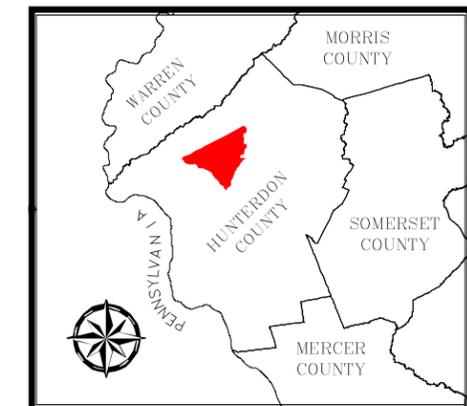
PROJ #: 331.02



New Jersey Location Map

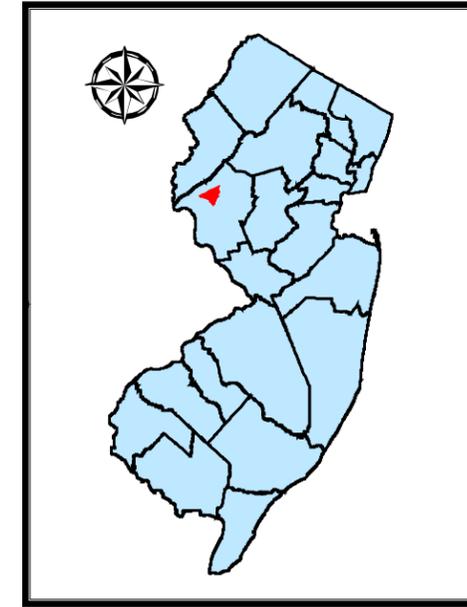
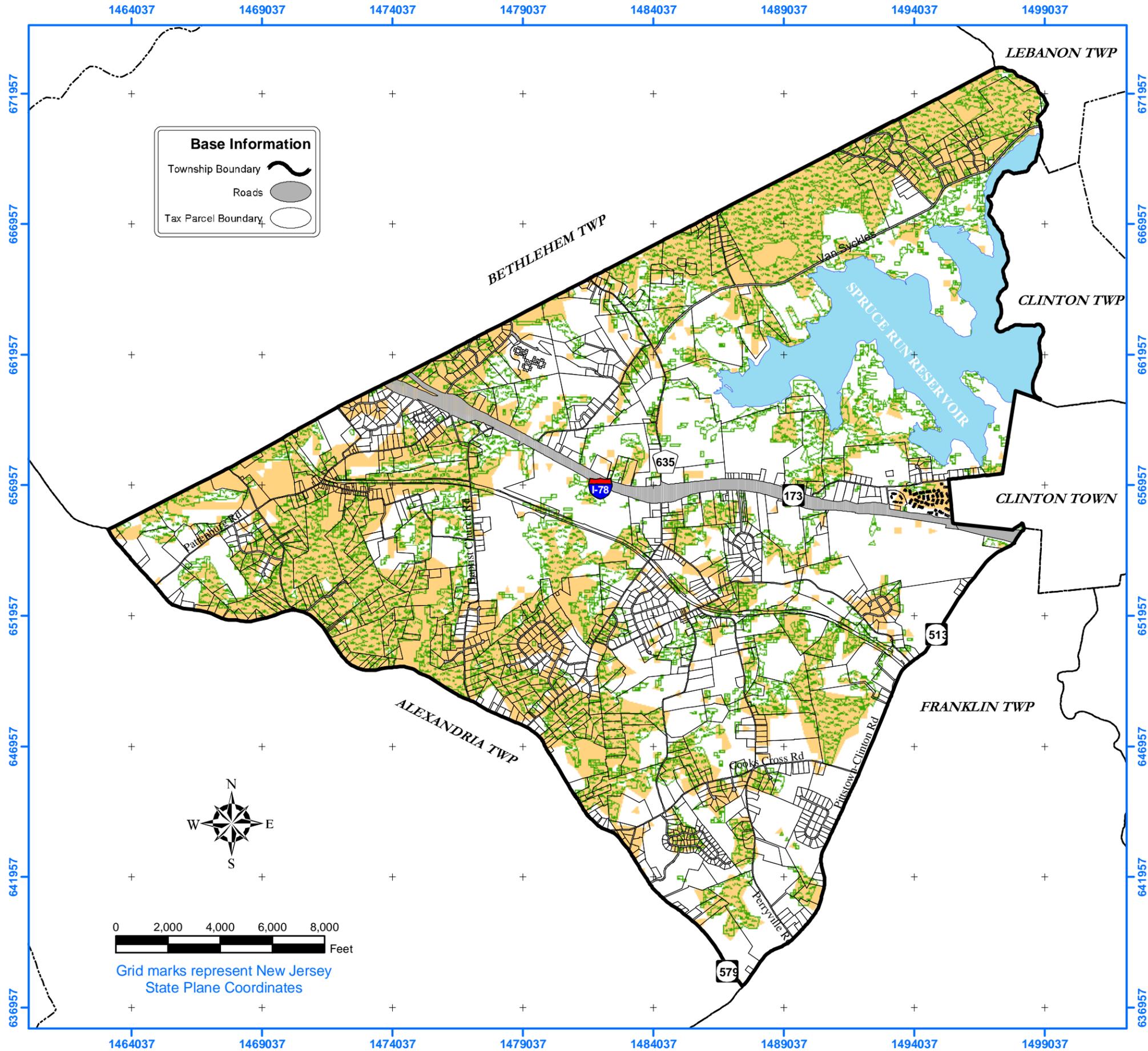
**Legend**

--- Historic Districts



Regional Location Map

<b>Map 18</b>	<b>HISTORIC FEATURES</b>
	Date: 05/01/03 Drawn by: JPB Checked by: SS, KM Revision No: 01 Revision Date: N/A
<b>Notes:</b> 1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES. 2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.	
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Revisions	
Date	
<b>TOWNSHIP OF UNION</b> <b>HUNTERDON COUNTY, NJ</b> <b>NATURAL RESOURCE INVENTORY</b>	
1108 OLD YORK ROAD SUITE 1, P.O. BOX 720 PRINCETON, NJ 08551 <b>PH PRINCETON HYDRO, LLC</b> PH: (908) 237.5660 FAX: (908) 237.5666	
PROJ #: 331.02	

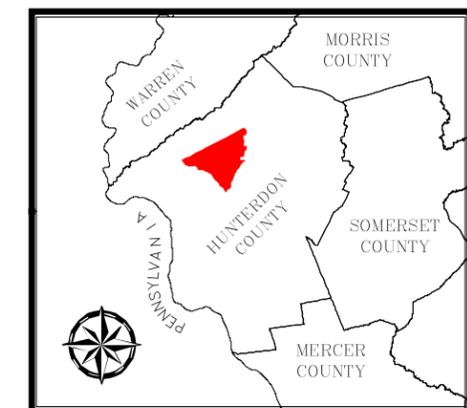


New Jersey Location Map

**Historic Upland Forest Comparison**

- 1972 Upland Forest Cover
- 1995 Upland Forest Cover

The 1972 and 1995 Upland Forest Data obtained from the Center for Remote Sensing & Spatial Analysis (CRSSA), Rutgers University. This data is interperated from satellite imagery and is not field verified.



Regional Location Map

**Base Information**

- Township Boundary
- Roads
- Tax Parcel Boundary

Grid marks represent New Jersey State Plane Coordinates

<b>Map</b>	<b>19</b>
<b>HISTORIC UPLAND FORESTS</b>	
<p><small>Notes:</small></p> <ol style="list-style-type: none"> <li>1. DATA ACCURACIES ARE LIMITED TO THE ACCURACY AND SCALES OF THE ORIGINAL DATA SOURCES.</li> <li>2. DIGITAL MAPS ARE PERIODICALLY UPDATED AND THE USER IS RESPONSIBLE FOR VERIFYING AND OBTAINING THE LATEST VERSION.</li> </ol>	
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<small>Drawn by:</small>	JPB
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<small>Revision No.:</small>	01
<small>Revision Date:</small>	N/A
<p><b>TOWNSHIP OF UNION</b>  <b>HUNTERDON COUNTY, NJ</b>  <b>NATURAL RESOURCE INVENTORY</b></p>	
<p>1108 OLD YORK ROAD          SUITE 1, P.O. BOX 720          RINGOES, NJ 08551          PH: (908) 237.5660          FAX: (908) 237.5666</p>	
<p>PROJ #: 331.02</p>	