Section II ~
The Natural Resources Inventory

Beaver Brook, From Old Allerton Road

"It is imperative that the community planner as well as citizens on local decision making boards and other officials who will influence planning policy and law, understand the natural function of natural resources and the importance of a natural resource management plan".

~ Natural Resources Inventory, 1976 ~

The Natural Resources Inventory

Introduction ~

The previous section described the methods by which natural resources are currently protected in Clinton Township, as well as how environmental projects and studies have strengthened local zoning and land development regulations.

The Natural Resources Inventory (NRI), Section II of this study, describes the importance of the resources (e.g., ecological, consumptive use, human health, and aesthetics) and illustrates the location and spatial distribution of these resources within the Township (Maps 6-16). Tables and other illustrations are included in this section to further define or qualify each resource. Key data associated with the Geographic Information System (GIS) mapping are presented herein. All GIS associated data are available for review at the Clinton Township municipal building.

The Ecological Reasons for Identifying and Protecting Natural Resources~

In the late 1970s, municipal master plans began including natural resource plans, however natural resources were commonly defined within the contexts of consumptive use, human health and safety, and economic gain. Resource maps included the location of natural features, however the narrative described how the resource presented constrains to cost-effective development (e.g., steep slopes, geologic features), constituted safety hazards (e.g., periodic flooding) or prevented economic return (e.g., soil fertility). In addition, the narrative in traditional resource plans often discussed associated hazards and potential safety concerns if a site with “environmental constraints” was developed.

Consequently, the recommendations for resource protection indirectly protected the biological and ecological significance of natural resources. For example, steeply sloping land exceeding 25% slopes is traditionally listed as a “natural resource worthy of protection”. However, the underlying reason for identifying the feature was that developing land on excessive slopes impeded cost-effective construction or led to structural failure. Environmental repercussions related to developing on steep slopes (e.g., damage to hillside habitat, soil erosion, sedimentation, increased stormwater runoff, and resulting nonpoint source water pollution) were rarely addressed or discussed.

Protecting the one-hundred year floodplain is another example. Floodplains were identified, mapped, and regulated, but safety concerns related to flooding were the common rationale for their protection. The ecological reasons for protecting floodplains (e.g., riparian wetland habitat supporting rare and endangered species, the importance of habitat corridors to certain wildlife) were rarely mentioned in traditional natural resource plans.

Fortunately, the definition of "natural resource protection" has evolved to include the ecological significance of our natural resources as well as how humans may design their communities in order to protect valuable resources.

We (humans) are unique in our ability to alter the environment and to realize the negative impacts associated with ill-planned development and community design. The following Natural Resources Inventory (NRI) is one tool to help Clinton Township Officials and landowners consider the potential environmental impacts associated with a land development proposal. The inventory should be used in concert with other tools (e.g., Master Plan, Zoning, Land Development Regulations, Best Management Design Practices) to assist in environmentally sound decision making.

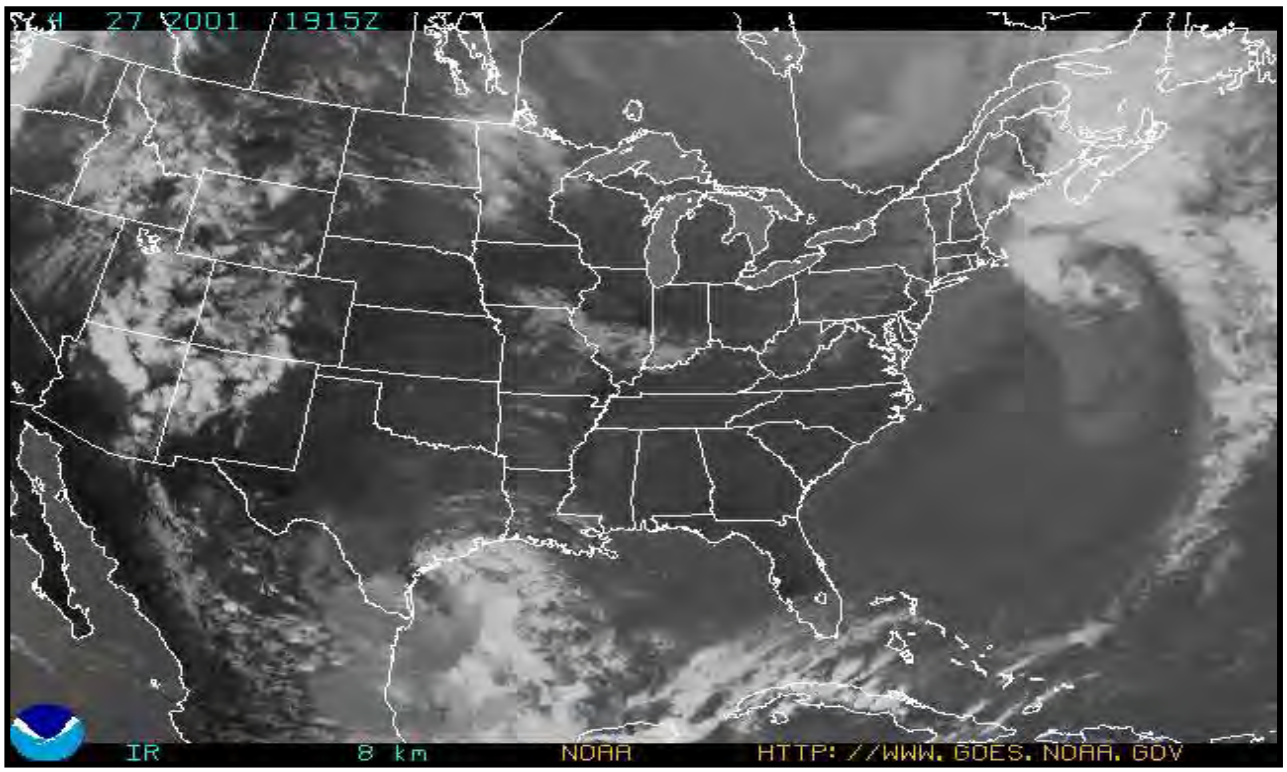
Creating sustainable communities is not simply a matter of avoiding a few wetlands, or saving a few acres of open space, or putting in place a few nonpoint source pollution best management practices. Rather, it is a matter of considering the ecological limits and environmental impacts in every aspect of community design.

~ Timothy Beatly, 2000 ~

Recent Residential Development, Clinton Township

Clinton Township Climate ~

Climate is an important component of a Natural Resources Inventory, and temperature is one the most important determinants of climate. Temperature affects all living organisms, through the reactions necessary for growth, development and decomposition. Precipitation and the duration of sunlight are other determinants of climate that affect a variety of environmental attributes such as vegetation growth and habitat composition. Clinton Township's climate is considered "continental" due to the significant difference in seasonal temperatures and considerable fluctuation in daily temperatures. These climatic fluctuations are due to the northwesterly prevailing winds originating in Canada and the moist tropical air masses originating in the Gulf of Mexico.



Source: The National Weather Service Website, Satellite Image, 4/27/01.

Since 1948, two weather stations operated by the National Climate Data Center (NCDC) have been collecting weather data in Clinton Township. The period of record for the first station is August 1, 1948 through June 25, 1970. The second station has been operating since 1967. Data for the two stations indicate that winter temperatures during the month of January average 28° to 32°F, while August temperatures average 69°F to 73°F. Annual average temperatures range between 50°F to 53°F. There are 174 frost-free days in Clinton Township; the average day for the last killing frost is May 12. Annual precipitation averages between 45-46 inches. July and August tend to be the wettest months whereas October and November are the two months during which the least amount of precipitation is experienced. The duration of daylight, as measured in

New Brunswick, NJ, ranges from a low of 9.5 hours in January, to a high of 15 hours in June. Between March and September, there is an average of 12 hours of daylight.

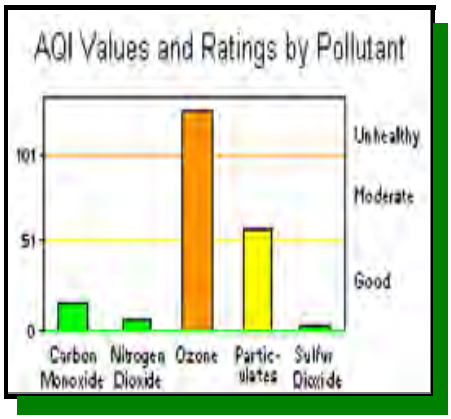
Clinton Township Air Quality ~

The negative effects of air pollution have been extensively documented by the USEPA and NJDEP. They include odor, low atmospheric visibility, corrosive damage to buildings, damage to plant and animal life, human respiratory system damage, and major ecosystem disruption. The USEPA has been regulating air pollutants since the 1970 Clean Air Act. They are regulated on a health-based criteria (science-based guidelines) as the basis for setting permissible levels. One set of limits (primary standard) protects health; another set of limits (secondary standard) is intended to prevent environmental and property damage. A geographic area that meets, or does better than the primary standard, is referred to as an attainment area. Areas that do not meet the primary standards are referred to as non-attainment areas.

Nationwide comparisons based upon EPA's National Air Quality Database document that, in general, New Jersey suffers from poor air quality. Air quality degradation is due to the type and density of industry, the density of population, and the overall reliance of the population upon automobiles. Hunterdon County has been designated by the Federal Environmental Protection Agency (EPA) as a severe ozone non-attainment area. The area was designated in the mid 1990's after 1997 revisions to the Clean Air Act reviewed current air quality standards for ground-level ozone (smog) and particulate matter. Serious human health problems are directly associated with impaired air quality, as are various environmental impacts. For instance, "smog" contributes to upper respiratory problems, crop damage and impacts the growth and distribution of native vegetation.

Recently, with the completion, extension and expansion of highway systems, a significant increase in truck and commuter traffic, and along with it, increased air pollution has been noted in the region. The planning document entitled "the Interstate 78 and Route 31 Corridor Infrastructure Needs Assessment", notes that "the completion of the "missing link" of I-78 through the Watchung Reservation in the mid 1980's induced an office and residential boom along the I-78 and Route 31 corridor that shows few signs of cessation." (Hunterdon County Planning Board, 1998).

The conclusions of that study illustrate a similar trend experienced throughout Hunterdon County in the last ten years, as large corporate offices and research complexes have spurred new residents and development in the area. Clinton Township, and adjacent municipalities, are particularly concerned with traffic congestion on Route 31, north and south of its intersection with Interstate 78. The study noted particular traffic and safety problems in the vicinity of Exits 15-18 and 20 along Interstate 78. The increased congestion, particularly during the morning "rush hour", results in additional air pollution and perpetuation of the area's non-attainment designation.



Source: NJDEP Air Quality Monitoring Website, 2000.

The air quality in Clinton Township was determined by accessing historical air quality monitoring data available from the NJDEP's air quality monitoring program. The air quality findings for the New York Metropolitan Statistical Area, Northern Delaware Valley Region are based on a national system called the Air Quality Index (AQI). The AQI (see general bar graph on left) compares pollutant levels to national health standards, takes into account multiple pollutants, and assigns an air quality rating ranging from good to unhealthy.

The pollutants considered in the AQI include carbon monoxide, nitrogen dioxide, ground-level ozone, particulates, and sulfur dioxide. The carbon monoxide health standard is 9 parts per million, while the health standard for ozone is 0.08 parts per million (NJDEP, Air Quality Monitoring Website, 2000).

The closest air quality monitoring station in the Clinton Township area is located at the Raritan Sewage Plant near Flemington, New Jersey. During the 1985-1999 time period, the national health standards for carbon monoxide were not exceeded at the Raritan Sewage Plant, Flemington monitoring station. Summary ground-level ozone data were also available for the 1988-2000 time period (NJDEP, Air Quality Monitoring Website, 2001). During that monitoring period, the ozone health standards were exceeded twenty-one (21) times during the spring and summer months. Daily records are maintained by NJDEP and may be accessed by contacting the NJDEP Bureau of Air Monitoring.

Clinton Township's Physiography & Geology ~

Topography & Slope

Sloping terrain and elevation fluctuations characterize much of Clinton Township and provide for outstanding view sheds and a variety of ecotypes. The lowest elevations occur along the rivers and floodplains (elevation < 100'), while the highest elevations (750'-1000') occur in the vicinity of Round Valley Reservoir. Derived from the variability in geological formations that shape the Township, the terrain varies from the rolling hills of the Raritan Valley Lowland in the Piedmont Province to the rugged uplands of the Highlands Province. The stream corridors throughout the Township are typically steeply sloped, ranging from narrow cuts in the Lowlands to gorges in the Highlands (Banisch Associates, 1991).

As stated in both the Open Spaces Biological Inventory (Grossmueller, 1995) and The Clinton Township Master Plan, the topography of land is a very important facet of municipal environmental planning. Identifying steeply sloping areas and then protecting them from development is important for a number of reasons.

The traditional development process replaces vegetated, permeable land areas with impermeable roadways, parking lots, driveways, and homes. The volume (or amount), of surface water and the rate of runoff, substantially increases as land development occurs. This in turn increases the rate of mobilization of pollutants such as soil, antifreeze, oil, pesticides, fertilizers and other contaminants, all of which can impact Clinton Township's wetland, stream, lake and groundwater resources.

In addition, the most steeply sloping areas are usually the last areas to be developed, due to inherent development constraints and construction costs. Therefore, they are often the only remaining vestiges of open space, scenic vistas, and wildlife habitats. This relationship is discussed in greater detail later in this section, and is also discussed in the recently completed biological inventory for Clinton Township (Grossmueller, 1995).

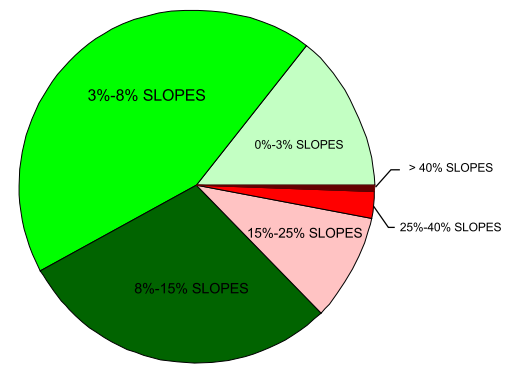
Map 6 presents the Township's topography as defined by slope categories. Although 57% of Clinton Township is slight to moderate (zero to eight percent) sloped, there are several areas of steep (25-40%) and very steep (> 40%) slopes. The steepest slopes are located along the northeast and southwest boundaries of Round Valley Reservoir and in the northwestern corner of the Township, just south of Route 639. Round Valley Reservoir, an area northeast of Mountain View Youth Correctional Facility, an area northeast of High Bridge Borough, and a small region west of Route 513 contain slopes in the twenty-five to forty percent range. The South Branch of the Raritan River, the South Branch of the Rockaway Creek and their tributaries all are characterized by adjoining lands having slopes ranging from eight to twenty-five percent.

Residential Development on Steep Slopes, Clinton Township, NJ

SLOPE PERCENTAGE SYMBOL LEGEND

KEY	SLOPE TYPE	ACREAGE	PERCENTAGE*
	0%-3% SLOPES	2751.53	14.40
	3%-8% SLOPES	8320.04	43.55
	8%-15% SLOPES	5606.18	29.34
	15%-25% SLOPES	1865.92	9.77
	25%-40% SLOPES	457.68	2.40
	> 40% SLOPES	104.36	0.55
TOTAL		19105.71	100.0

* PERCENTAGE CALCULATIONS ARE BASED ON TOTAL TOWNSHIP LAND AREA. THE SLOPE DATA IS CALCULATED FOR AREAS NOT COVERED BY WATER BODIES. ADDITIONALLY THE CLIPPING PROCESS, AND THE DATA RESOLUTION CAUSE SLIGHT DATA GAPS AT THE EDGES OF THE TOWNSHIP, WHICH CAUSES THE AREAS TO BE SLIGHTLY LESS.



PERCENTAGE OF TOWNSHIP BASED ON AREA

LEBANON TWP.
LEBANON TWP.
LEBANON TWP.
TEWKSBURY TWP.
TEWKSBURY TWP.
BOROUGH OF HIGH BRIDGE
SPRUCE RUN RESERVOIR
UNION TWP.
MOUNTAINVIEW YOUTH CORRECTIONAL FACILITY
LEBANON BOROUGH
READINGTON TWP.
TOWN OF CLINTON
FRANKLIN TWP.
ROUND VALLEY RESERVOIR
SOUTH BRANCH RARITAN RIVER
PRESCOTT BROOK
HUNTERDON CO. ARBORETUM
FRANKLIN TWP.
RARITAN TWP.
READINGTON TWP.
CLINTON TWP.

SYMBOL KEY

- TEXT Significant Place Names
- Primary Roads
- Tax Parcel Boundaries
- Lakes
- Networked Streams

30000 0 30000 Feet

Study Area

HUNTERDON COUNTY
SCALE 1:800,000

CLINTON TOWNSHIP NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000
Map Projection: State Plan of New Jesey, NAD 83, Feet

New Jersey, Department of Interior, Geologic Survey, GIS data Downloads, Digital Elevation Models of New Jersey.
Scale: 30 Meter Resolution
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

NOTES:
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2. THESE MAPS ARE PART OF A RESOURCE INVENTORY CONDUCTED FOR CLINTON TOWNSHIP AND SHOULD BE USED IN CONJUNCTION WITH THE COMPILED TEXT.

MAP 6: SLOPE PERCENTAGES

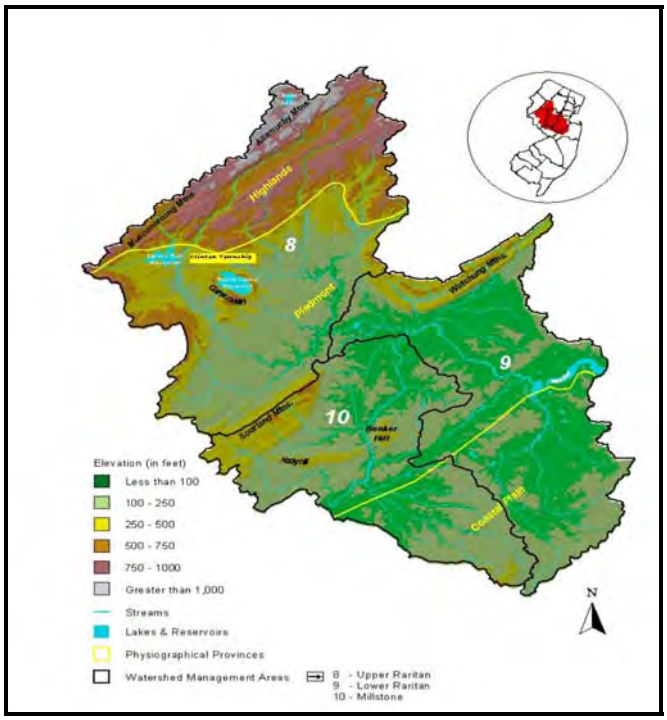
DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Physiographic Provinces

Physiographic provinces are classification groupings of landform, rock type and structure. The northern part of Clinton Township is located within the Highlands Physiographic Province, while the southern portion of the Township is within the Piedmont Physiographic Province. The Highlands are part of a larger geologic province, the New England Uplands. The Highlands Province is characterized by a series of parallel ridges and valleys. The ridges tend to be broad and massive while the valleys tend to have steep slopes but are relatively narrow. Rock outcroppings and glacial lakes occur frequently throughout this Highlands Province. The ridges are composed primarily of gneiss, a very hard and weather resistant rock. The presence of gneiss has resulted in the ridges being very resistant to erosive forces. In contrast, the valleys are composed of softer rocks including limestone and shale. The characteristics of the soils derived from gneissic parent rock vary depending on whether the underlying bedrock was covered by glacial drift. Parent rock differences lead to variations in relief, soil drainage and stoniness, all of which ultimately define the associated vegetative communities (Grossmueller, 1995).

The Triassic Lowlands Geologic Province (Piedmont Section) is located to the south of the Highlands in Clinton Township. This formation extends almost 1,000 miles from the Hudson River, southward through New Jersey and Pennsylvania. In New Jersey the Piedmont occupies approximately 1,500 square miles and is composed primarily of shale, sandstone and argillite formations. These formations are less resistant to erosion than the Highland gneiss rock formations (Grossmueller, 1995).



Source: Topography & Major Landforms Within the Raritan Basin, NJWSA, 2000.

Geologic Formations

The geologic features of Clinton Township (Map 7) interact with other physical (e.g., temperature, relief, drainage), biological (e.g., plant and animal interactions), chemical (e.g., pH, chemical cycling), and human (e.g., development, pollution) elements. With respect to vegetation and the wildlife associated with vegetation, the relief, drainage, soil and underlying rock formations will affect the diversity of plants and animals as well as habitat diversity. In addition, the surficial and underlying geology directly affects the availability of drinking water, development potential, and pollution vulnerability in the Township. The geology of an area may also present development density limitations. For instance, limestone formations (see Map 7) may underlie an area making it more vulnerable to groundwater pollution, important for groundwater recharge, or susceptible to ground subsidence. Groundwater and surface water resources, and pollution vulnerability are discussed in further detail in subsequent sections of this inventory.

The geologic history of Clinton Township is well documented in previously completed regional geologic, hydro-geologic, and environmental planning studies. The state document entitled "Geology and Groundwater Resources of Hunterdon County, New Jersey" (NJDEP, Kasabach, 1966) extensively addresses the association of geologic formations, hydrologic characteristics of the formations, water use, and the quality of groundwater in the County. The Regional Natural Resources Inventory (South Branch Watershed Association, 1976) also links geology and groundwater hydrology. The Clinton Township Open Spaces Biological Inventory (Grossmueller, 1995) notes the relationship between geology and ecological succession. All three studies note that the oldest rocks in Hunterdon County were formed during the Precambrian (5 billion-600 million years ago) and Paleozoic Eras (600 million – 225 million years ago). The belt of Precambrian and Palaeozoic rocks extends from southwest New York State, across northwestern New Jersey to the Vicinity of Reading, Pennsylvania. It is called the "Highlands" in New Jersey, but is also referred to as the Reading Prong.

The major geologic formations in Clinton Township (Map 7) include those formed in the Precambrian Period (Losee, Hardyston Formations), the Ordovician Period (Kittatinny, Jacksonburg Formations) the Mesozoic Era (Stockton, Lockatong, Brunswick Formations), and the Triassic Period (Byram Formation). There are no rocks of the Jurassic period in New Jersey, because erosion was the dominant geologic process.

The Losee Formation is a metamorphic rock consisting of gneiss and occasional flakes of graphite. If the rock is exposed today, it is due to erosion of miles deep of Precambrian rock overlying the formation millions of years after its deposition. Although life was plentiful during the Precambrian Era, the primitive life forms were soft bodied. Therefore there is no fossil evidence in the gneiss. The Hardyston Formation is comprised of sands and gravel comprised primarily of quartzite a metamorphic rock. This formation was formed when sediments from the southeast were deposited in the basin and mechanically reduced to well-sorted sandstone, composed of quartz and feldspar.

Warm, shallow seas prevailed throughout much of the area at the end of the Cambrian and the beginning of the Ordovician Period. Calcium carbonate precipitated from the lime-based organisms and the quiet seas. The precipitate formed the dolomitic sedimentary limestone known as the Kittatinny Formation.

The Jacksonburg Formation lies on top of the Kittatinny, which occurred following uplift and a period of erosion. The resulting dark limestone contains a variety of fossils, which indicate favorable environmental conditions. At the conclusion of the Ordovician Period, there was a Taconic Disturbance (a period of mountain-building), and a period of uplift known as the Appalachian Revolution. The uplift resulted in Precambrian and Paleozoic rocks uplifted thousands of feet in mountains similar to ranges currently present in the Western United States. Clinton Township and Hunterdon County have experienced erosion since the end of this Period.

A border fault formed southeast of the New Jersey Highlands at the beginning of the Mesozoic Era forming block mountains surrounded by basins. Although long ago eroded, the basins occupied a belt extending from Canada to North Carolina along the eastern side of the Appalachian Mountains. The sedimentary rocks from this era include sandstone, argillite, and shale. In the valleys, coarse sand was deposited during wet seasons.

The sediments were deposited and composed primarily of feldspar sand later compacting and forming the *Stockton Formation* (sedimentary sandstone). When drainage was slow, large lakes and swamps formed containing the compacted clay of the Lockatong Formation. The Lockatong Formation contains a sedimentary rock called argillite. The Brunswick Formation was deposited when the Lockatong lakes overflowed with red mud. The Brunswick Formation, which covers over thirty percent of Hunterdon County, contains red sedimentary shale, and extends to depths of over one mile (NJGS, Carol S. Lucey, 2001).

The Triassic Period resulted in deep faults and igneous magma flows emanating from deep within the earth flowing out of the deep faults. Dikes and sills formed and lava poured out onto the earth's surface. The cooled and hardened lava formed the Byram Formation. The igneous rock diabase indicative of the Byram Formation is evident in the Watchung and Cushetunk Mountains. The Cushetunk Mountains are part of the Round Valley region of Clinton and Readington Townships.

As noted earlier, rocks from the Jurassic age are not evident in New Jersey due to erosive forces. The Pleistocene Epoch of the Quaternary Period is commonly linked with glaciation. The melting glacial waters deposited sediment in local river valleys. The clay, gravel and sand drift is evident in the Musconetcong, Raritan, and Delaware Rivers.

Surficial Geology and Locally Significant Geologic Features

The surficial geology of Clinton Township is reflective of rocks formed in the Precambrian, Paleozoic, and Mesozoic (225 – 70 million years) Eras. Surficial materials are the unconsolidated sediments that overlie bedrock formations. Surficial materials are the parent material for agronomic, or economically important soils. In Clinton Township, the surficial materials include stream, wetland, glacial, windblown, hill slope sediments, and weathered bedrock material. Weathered bedrock material may be as thick as 200 feet. Other sediments are generally less than 20 feet. Surficial materials range from coarse gravel to clay and peat. They affect the movement of groundwater from the surface into underlying bedrock aquifers, and are aquifers themselves in some places (NJ Geological Survey, 1999).

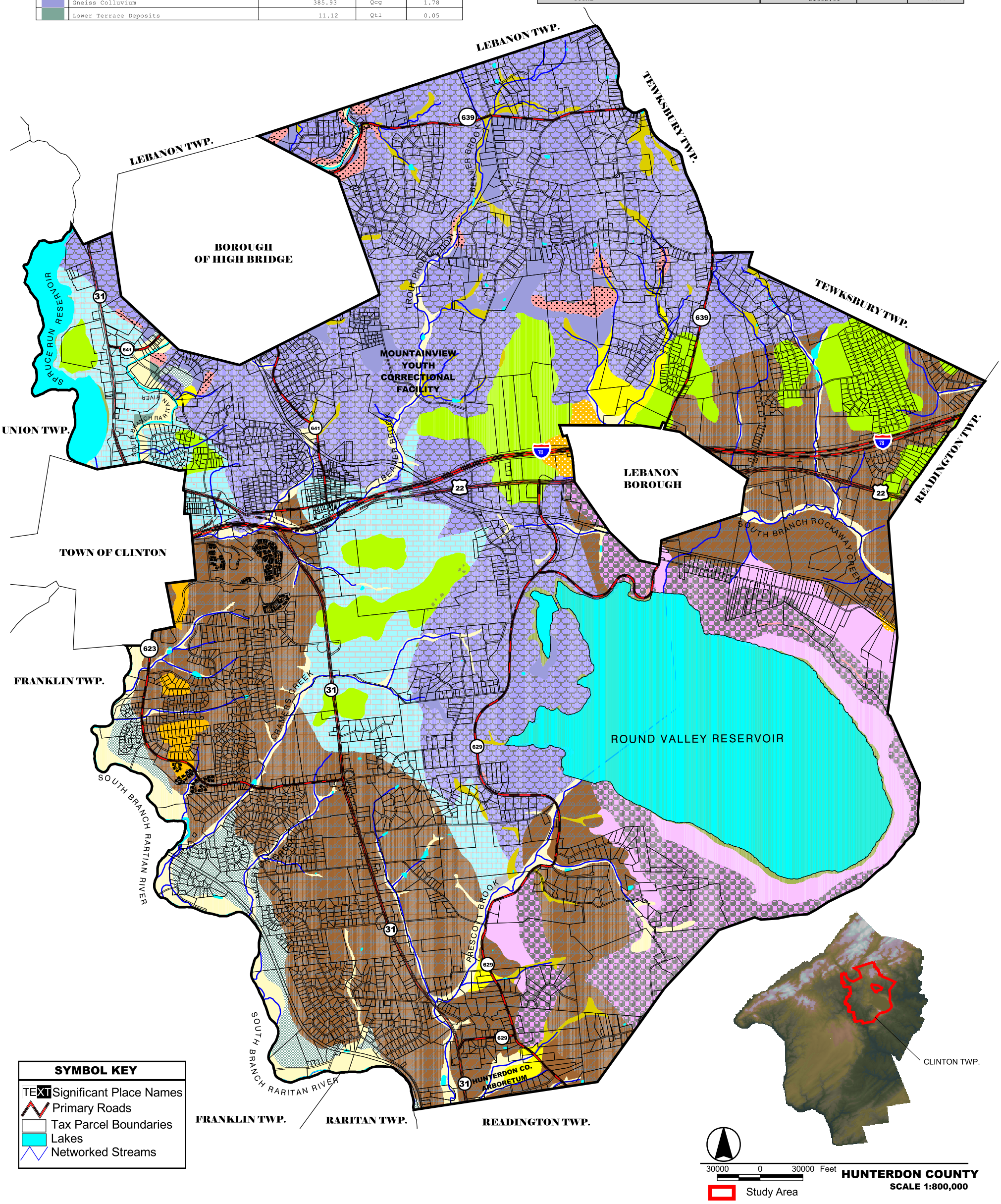
The geological processes experienced regionally resulted in locally significant geologic features. For instance, there are glacial features (e.g., eskers, drumlins), cavernous limestone formations, historic limestone kiln, and caves (e.g., Leigh Cave) located throughout Clinton Township. Eskers are long, sinuous ridges of sediment deposited by glacial melt water. Drumlins are long, streamlined hills made of till. Kilns were historically used as hardening ovens, and caves are underground hollows with an opening at the surface.

The Leigh Cave is an example of the interaction of geology and habitat in Clinton Township. The Leigh Cave (see photo below), located in the Leithsville Formation, is one of New Jersey's largest caves. It has more than 800 feet of passages. It is owned by the State of New Jersey, located on Molasses Hill Road near the Round Valley Reservoir. Two entrances lead to pits, crossings, and a "network pattern of multiple branching passages and closed loops. The cave has a bedrock floor and Gneiss ceiling. It is important habitat for bat species (Little brown myotis, Silver-haired, Eastern pipistrel, Red, Big brown, and Hoary bats). It attracts spelunkers and cave enthusiasts such as the Northern New Jersey Grotto (National Speleological or Caving Society).

Leigh Cave

KEY	Geologic Name	Acreage	Symbol	percntage
	Alluvium	1065.57	Qal	4.91
	Alluvium Fan Deposits	165.07	Qaf	0.76
	Alluvium and Colluvium	261.87	Qcal	1.21
	Carbonate-Rock Colluvium	5.10	Qccb	0.02
	Diabase Colluvium	695.94	Qcd	3.21
	Extensive Bedrock Outcrop	9.09	ebo	0.04
	Glaciofluvial Deposits	95.16	Qsdjf	0.44
	Glaciolacustrine Deposits	62.90	Qsdjd	0.29
	Gneiss Colluvium	385.93	Qcg	1.78
	Lower Terrace Deposits	11.12	Qtl	0.05

KEY	Geologic Name	Acreage	Symbol	percntage
	Scattered Bedrock Outcrop	152.35	sbo	0.70
	Shale, Mudstone, and Sandstone Colluvium	51.88	Qcs	0.24
	Swamp and Marsh Deposits	2.19	Qs	0.01
	Till	1386.04	Qtj	6.39
	Upper Terrace Deposits	408.20	Qtu	1.88
	Weathered Carbonate Rock	1500.02	Qwcb	6.91
	Weathered Diabase	1292.86	Qwd	5.96
	Weathered Gneiss	6100.46	Qwg	28.12
	Weathered Shale, Mudstone, ane Sandstone	5509.78	Qws	25.40
	Water	2531.28	H2O	11.67
	TOTAL	21692.91		100.00



CLINTON TOWNSHIP NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000
Map Projection: State Plan of New Jesey, NAD 83, Feet

New Jersey, Department of Interior, Geologic Survey, GIS data Downloads, Surface Geology of Hunterdon County New Jersey.
Scale 1:24,000
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

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MAP 7: GEOLOGIC RESOURCES

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Clinton Township Soil Resources ~

Soil Formation

The soils of Hunterdon County were 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. In Clinton Township, the soils are derived largely from the weathering of underlying Brunswick shale. However, the role of abiotic factors in the soil formation process is abetted by biotic factors. Soil characteristics such as texture (e.g., sand, silt, clay), water-holding capacity and nutrient content are factors that in part determine the resident biological community. In turn, plants, microorganisms, soil invertebrates (e.g., earthworms), and other animal life living in and on soils, are active factors that affect and contribute to soil formation.

These two-dynamic processes, which interact simultaneously, determine, in large part, the living natural resources that persist, and are sustained them in given locales. The interruption of this relationship, whether through excavation, development, or alteration of hydrologic regimes, will adversely affect the surrounding natural resources. Soil erosion, the loss of fertile agricultural soils, and nonpoint source water pollution are three closely related problems. The implementation of judicious conservation measures, will serve to minimize perturbations to the surrounding natural resources.

The United States Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) publication entitled "Soil Survey of Hunterdon County, New Jersey" (USDA, 1974) identifies 44 soil series present in Hunterdon County. Depending upon the USDA source used (hard copy or Internet) approximately 24 soil series and 50 phases (or mapping units) within these 44 countywide series occur in Clinton Township (See Soils Map, Map 8).

Soil Limitations

Soil erosion potential, or erosion hazard, is the propensity of a soil to become unstable as a result of natural weathering or anthropomorphic exacerbated events. The major factors that determine erosion potential are soil texture, organic matter content, soil structure, hydraulic conductivity, and to a lesser extent, slope. Soils are usually ranked (Table 3) according to their relative erosion potential (USDA, 1981).

Table 3, Soil Erodibility

Erosion Hazard	**Annual Soil Loss** (Metric tons per hectare) *Note: 2.471 acres in 1 hectare*
None	0 tons/hectare
Slight	<2.5 tons/hectare
Moderate	2.5 to 10 tons/hectare
Severe	10 to 25 tons/hectare
Very Severe	>25 tons/hectare

Source: USDA, 1981.

Under many circumstances, erosion is more closely related to the configuration of the soil surface than to other factors such as slope. Erosion potentials are meaningful only if the condition of the surface and the plant cover are given (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. Where applicable, soil surveys typically present an erosion hazard for those soil types that are likely to be used for purposes other than that of woodlot management (e.g., agriculture).

Most of the soils found in Clinton Township have a high water table and a moderate depth to bedrock. Depth to seasonal high water level is the distance between the surface and the highest recorded seasonal water level. Depth to bedrock is the distance between the surface of the soil and the upper surface of the rock layer. These characteristics, along with slope, stoniness, and permeability, largely determine the suitability of most soils for septic systems and building foundations. Development sites with a moderately high water table are typically drained or filled to alleviate this condition. Where rapidly permeable soils overlay fractured bedrock, a septic system will often appear to function efficiently, but groundwater contamination can occur from the movement of improperly filtered septic effluent into the aquifer. If the bedrock is shallow and un-fractured, insufficiently filtered effluent can run along the rock barrier and enter surface waters. This is of primary concern in areas containing limestone geology.

In addition, the permeability of the soil, the surficial geology, and underlying bedrock are all factors affecting groundwater recharge areas, aquifer entry points and other natural resource features. These factors, as they relate to groundwater availability, will be discussed in greater detail in the groundwater section of this Natural Resources Inventory. The following table (Table 4) is reproduced in part from the USDA Soil Series. This table summarizes the most relevant factors in determining the suitability of soil types for development.

Table 4, Development Limitations of Soils

Soil Series	Mapping Units Occurring in Clinton Township	Depth to Seasonal High Water Table	Depth to Bedrock (feet)	Erosion Potential	Septic System Limitations	Limitations for Building Foundations	
						With Basements	Without Basements
Abbottstown	AbA, AbB	0.5 to 1.5	3.5 to 5+	Slight	Severe	Severe	Moderate
Alluvial Land	Ac, Ae	1 to 3	4+	Slight	Severe	Severe	Severe
Annandale & Edneyville	ApB	5+	6 to 10+	Slight	Moderate	Slight to moderate	Slight
	ApC	5+	6 to 10+	Moderately severe	Moderate	Moderate	Moderate to Severe
Athol	AtB, AtC2	5+	4 to 7+	Slight to moderately severe	Moderate	Slight	Slight
Bedington	BaB BaC2	5+	4 to 5.5+	Slight	Moderate	Slight	Slight
Berks	BbB, BbC2, BbD2	3+	1.5 to 3.5	Slight	Severe	Moderate	Slight
Birdsboro	BdA, BdB, BcC2	3+	5 to 10+	Slight	Slight to severe	Slight	Slight
Bucks	BuB, BuC2	5+	3.5 to 5+	Slight to moderately severe	Moderate	Slight	Slight
Califon	CbB	0.5 to 2.5	6 to 10+	Slight	Severe	Severe	Moderate
Chalfont	CbB	0.5 to 1.5	3.5 to 6+	Slight	Severe	Severe	Moderate
Cokesbury	Co, Cp	0 to 1	3.5 to 5+	Slight	Severe	Severe	Severe
Duffield	Dub, DuC2, DuV2, DwD2	4+	4 to 7	Slight	Severe	Moderate	Moderate
Hazelton	HaC2	4+	4 to 5+	Slight	Severe	Slight	Moderate
Klinesville	KIC, KID	3 to 5+	1 to 1.5+	Severe	Severe	Severe	Moderate

Source: Soil Survey of Hunterdon County, New Jersey, USDA, 1974.

Table 4 ~ Continued, Development Limitations of Soils

Soil Series	Mapping Units Occurring in Clinton Township	Depth to Seasonal High Water Table	Depth to Bedrock (feet)	Erosion Potential	Septic System Limitations	Limitations for Building Foundations	
						With Basements	Without Basements
Lansdale	LaB, LaC2, LaD	5+ 5+ 5+	3 to 5+ 3 to 5+ 3 to 5+	Slight	Moderate Severe Severe	Slight Moderate Moderate	Slight Moderate Moderate
Lansdowne	LbB	1 to 2.5+	3.5 to 5+	Slight	Severe	Severe	Moderate
Lawrenceville	LeB, LeC2	1.5 to 3	3.5 to 7	Slight	Moderate	Moderate	Slight
Legore	LgC	4+	5 to 8+	Slight	Severe	Severe	Moderate
	LgD	4+	5 to 8+	Slight to moderate	Moderate	Slight	Slight
Lehigh	LhB, LhC2	0.5 to 2	3.5 to 5+	Slight	Severe	Moderate	Moderate
Mount Lucas	MoB	0.5 to 2.5	3.5 to 5+	Slight to moderate	Severe	Moderate	Moderate
Mt. Lucas-Watchung	MwB	0.5 to 2.5	4 to 8+	Moderate	Severe	Severe	Severe
Neshaminy	NeC2	5+	4 to 8+	Moderately severe	Moderate	Moderate	Moderate
	NhC	5+	4 to 8+	Moderately severe	Severe	Moderate	Moderate
	NhD, NhZ	5+	4 to 8+	Severe to very severe	Severe	Severe	Severe
Neshaminy-Mt. Lucas	NkC	5+ 0.5 to 2.5	4 to 8+ 4 to 8+	Slight	Severe Severe	Moderate Severe	Moderate Severe
Norton	NoB, NoC2	5+	4 to 10+	Slight	Severe	Moderate	Slight
	NoD2	5+	4 to 10+	Severe	Severe	Moderate	Moderate
Parker	PaC PaD	5+	3.5 to 8+	Slight	Moderate Severe	Moderate Severe	Slight Severe

Source: Soil Survey of Hunterdon County, New Jersey, USDA, 1974.

Table 4 ~ Continued, Development Limitations of Soils

Soil Series	Mapping Units Occurring in Clinton Township	Depth to Seasonal High Water Table	Depth to Bedrock (feet)	Erosion Potential	Septic System Limitations	Limitations for Building Foundations	
						With Basements	Without Basements
Pattenburg	PbB PbC PbD PbE	5+	3.5 to 8+	Slight	Moderate Moderate Severe Severe	Slight Moderate Moderate Severe	Slight Slight Moderate Severe
	PcB	5+	1.5 to 2.5	Slight	Severe	Severe	Moderate
Penn	PeB, PeC2	4+	1.5 to 3.5	Severe	Severe	Moderate	Slight
	PeD	4+	1.5 to 3.5	Slight	Severe	Moderate	Slight
Penn-Bucks	PfC2	4+ 4+	1.5 to 3.5 1.5 to 3.5	Moderately severe	Severe Moderate	Moderate Slight	Slight Slight
Raritan	RbA, RbB	1 to 2	5 to 7+	Slight	Severe	Severe	Moderate
Readington	RcC2	1.5 to 3	3.5 to 5+	Moderately severe	Moderate	Moderate	Slight
Reaville	REA, ReB, ReC2	1 to 2	1.5 to 3.5	Slight to moderately severe	Severe	Severe	Moderate
Riverhead	RgB, RgC	5+	10+	Slight	Slight	Slight	Slight
Rowland	Ro	1 to 2.5	4 to 6	Slight	Severe	Severe	Severe
Turbotsville	TuB	0.5 to 1.5	5 to 8+	Moderate	Severe	Severe	Moderate
Washington	WaB,WaC2	5+	5 to 8+	Slight	Slight	Slight	Slight

Source: Soil Survey of Hunterdon County, New Jersey, USDA, 1974.

In terms of soil limitations, Table 4 and the associated GIS maps (Maps 8 & 9) provide the following information:

- **Soils and limitations to building structures** – Soils will also present limitations when viewed in light of their ability to handle the weight of structures (e.g., homes). Approximately 39% of the soils in the Township present severe limitations to building structures (buildings with basements).

- **Soils and on-lot septic system constraints** – Approximately 27% of the soils in Clinton Township present severe limitations to the placement of individual, on-lot septic systems. In addition, 29% present moderately severe limitations for on-lot septic systems.

- **Soils and land development erosion potential** – Approximately 2% of the soils in the Township present severe erosion potential, 37% moderately severe erosion potential, and 16% slight to moderately severe land development erosion potential.

Soil & Septic Suitability

According to the New Jersey Department of Environmental Protection, approximately 500,000 homes use individual, on-lot sewage disposal systems (OLDS) throughout the state. If properly designed, placed in the proper soils, and correctly maintained, on-lot systems typically have negligible adverse environmental effects. In fact, some communities view septic systems as a means of recharging groundwater. However, septic systems are recognized as potential pollutant sources, particularly with respect to groundwater and lake systems. Older communities, communities with high population densities, and areas having marginal or unsuitable soils are all documented instances where septic systems may negatively impact water resources. When systems fail, groundwater and drinking water wells may become contaminated with bacteria, nitrates, heavy metals, and other chemicals.

As per Township ordinance and State regulations N.J.A.C. 7:9, the type of soils in a given area *must* be considered as part of the design and placement of on-lot disposal systems. Unsuitable soils may include coarse sands and highly clay soils. The former allows leachate to percolate through the soil horizon too quickly to facilitate contaminant removal. In addition, they lack the organic binding sites critical for the adsorption of pollutants.

As a result, the wastewater cannot be hydraulically managed. This leads to the polluting of wastewater in the leach field, the formation of biomats, and surface “break out”. As such, if the soils are too coarse, they cannot adequately remove the wastewater, but if too dense they do not allow for adequate wastewater passage, thereby leading to the system’s hydraulic failure. State and local regulations determine which soils are suitable.

In fact, NJDEP has strict regulations requiring soil tests (e.g., pit-bailing, basin flooding, tube permeameter, piezometer, and soil permeability class rating tests) for subsurface sewage disposal systems (N. J. A. C. 7:9A-1 et seq.), and the Clinton Township regulations require that developers and landowners obtain the proper permits for on lot disposal systems (OLDS). Map 9 illustrates that approximately 27% of the soils in Clinton Township severely limit the use of OLDS. In these areas, the native soils are not conducive to the treatment, renovation and management of wastewater. In addition, approximately 23% of the soils in Clinton Township have slight limitations, and approximately 29% have moderate limitations to the use of OLDS.

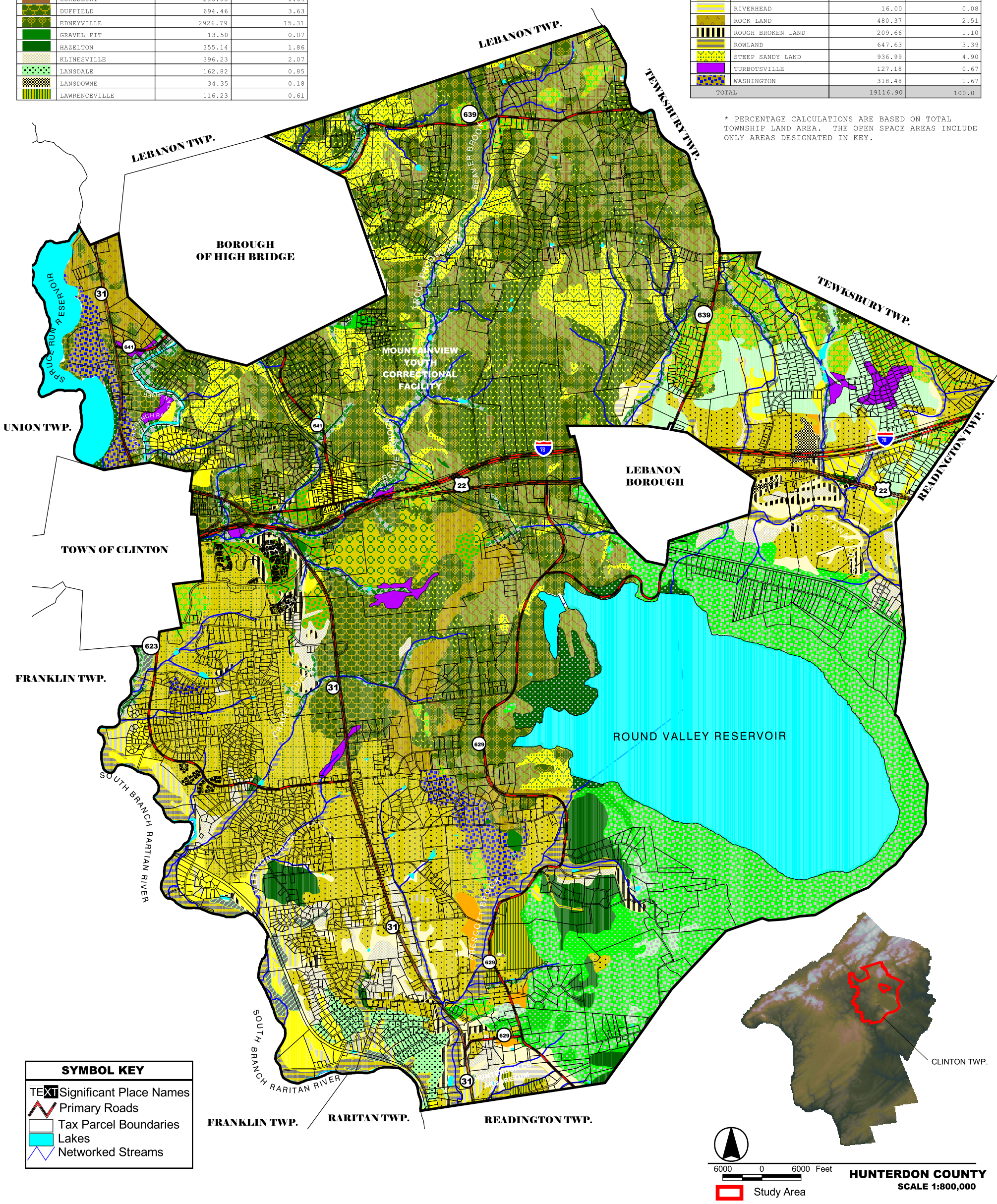
SOIL SERIES SYMBOL LEGEND

KEY	SERIES NAME	ACERAGE	PERCENTAGE
	ABBOTTSTOWN	309.65	1.62
	ALLUVIAL	529.95	2.77
	ANNANDALE	676.02	3.54
	ATHOL	472.82	2.47
	BEDINGTON	217.43	1.14
	BERKS	183.63	0.96
	BIRDSBORO	406.47	2.13
	BOWMANSVILLE	103.31	0.54
	BUCKS	50.76	0.27
	CALIFON	1266.80	6.63
	CHALFONT	17.63	0.09
	COKESBURY	295.35	1.54
	DUFFIELD	694.46	3.63
	EDNEYVILLE	2926.79	15.31
	GRAVEL PIT	13.50	0.07
	HAZELTON	355.14	1.86
	KLINESVILLE	396.23	2.07
	LANSDALE	162.82	0.85
	LANSDOWNE	34.35	0.18
	LAWRENCEVILLE	116.23	0.61

SOIL SERIES SYMBOL LEGEND (cont.)

KEY	SERIES NAME	ACERAGE	PERCENTAGE
	LEGORE	119.75	0.63
	LEHIGH	111.85	0.59
	MADE LAND	203.86	1.07
	MOUNT LUCAS	65.48	0.34
	NESHAMINY	2170.74	11.36
	NORTON	97.29	0.51
	PARKER	1229.18	6.43
	PATTENBURG	1346.29	7.04
	PENN	1551.90	8.12
	RARITAN	211.80	1.11
	READINGTON	7.67	0.04
	REAVILLE	35.34	0.18
	RIVERHEAD	16.00	0.08
	ROCK LAND	480.37	2.51
	ROUGH BROKEN LAND	209.66	1.10
	ROWLAND	647.63	3.39
	STEEP SANDY LAND	936.99	4.90
	TURBOTSVILLE	127.18	0.67
	WASHINGTON	318.48	1.67
TOTAL		19116.90	100.0

* PERCENTAGE CALCULATIONS ARE BASED ON TOTAL TOWNSHIP LAND AREA. THE OPEN SPACE AREAS INCLUDE ONLY AREAS DESIGNATED IN KEY.



CLINTON TOWNSHIP NRI, 2001

9000 0 9000 18000 27000 Feet

SCALE 1: 45,000
Map Projection: State Plan of New Jesey, NAD 83, Feet

New Jersey, Department of Environmental Protection, GIS data Downloads, USDA Soils Survey Information
New Jersey.
Scale 1:24,000
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

NOTES:
1. DATA ACCURACY IS LIMITED TO THE ACCURACY AND SCALE OF THE ORIGINAL DATA SOURCES.

2. THESE MAPS ARE PART OF A RESOURCE INVENTORY CONDUCTED FOR CLINTON TOWNSHIP AND SHOULD BE USED IN CONJUNCTION WITH THE COMPILED TEXT.

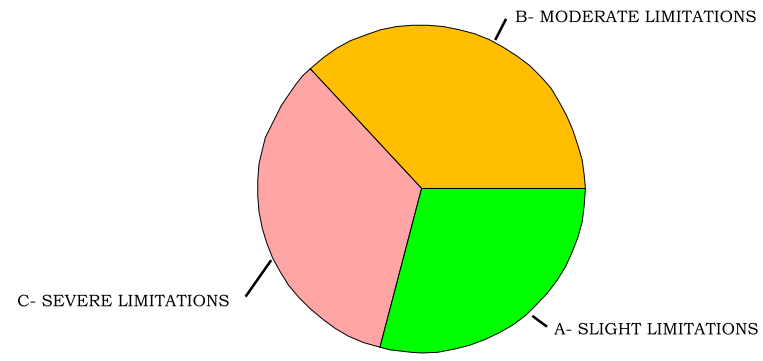
MAP 8: SOIL RESOURCES

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

SEPTIC SUITABILITY AREAS SYMBOL LEGEND

KEY	CLASSIFICATION	ACRAGE	PERCENTAGE
	A- SLIGHT LIMITATIONS	4943.29	22.78
	B- MODERATE LIMITATIONS	6271.87	28.92
	C- SEVERE LIMITATIONS	5795.74	26.72
	OTHER LIMITATION	4682.01	21.58
Total		21692.91	100.00



PERCENTAGE OF TOWNSHIP BASED ON AREA

LEBANON TWP.
TEWKSBURY TWP.
LEBANON TWP.
BOROUGH OF HIGH BRIDGE
SPRUCE RUN RESERVOIR
UNION TWP.
MOUNTAINVIEW YOUTH CORRECTIONAL FACILITY
BEAVER BROOK
TROUT PRODUCTION
TEWKSBURY TWP.
READINGTON TWP.
LEBANON BOROUGH
SOUTH BRANCH ROCKAWAY CREEK
TOWN OF CLINTON
FRANKLIN TWP.
CRAMERS CREEK
ROUND VALLEY RESERVOIR
SOUTH BRANCH RARITAN RIVER
PRESCOTT BROOK
HUNTERDON CO. ARBORETUM
FRANKLIN TWP.
RARITAN TWP.
READINGTON TWP.
CLINTON TWP.

SYMBOL KEY

- TEXT Significant Place Names
- Primary Roads
- Tax Parcel Boundaries
- Lakes
- Networked Streams

30000 0 30000 Feet

Study Area

HUNTERDON COUNTY
SCALE 1:800,000

CLINTON TOWNSHIP, NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000
Map Projection: State Plane of New Jesey, NAD 83, Feet

TMP, Supplied by Clinton Township.
Scale : Unknown
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

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MAP 9: SOIL RESOURCES & SEPTIC SUITABILITY

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Agriculture and Agricultural Soils

In the last two hundred and fifty years, farming, agriculture and agricultural business have changed significantly. Early on, subsistence farming was the norm. Little or no surplus was available for sale or trade. Through the years, the family farm provided surplus grain, dairy products, meat or meat animals for financial gain and investment (Hunterdon County Cultural and Heritage Commission, 1989).

When the first pioneers settled in Hunterdon County, the land was primarily forested. Therefore, it was very difficult for early settlers to actively farm large plots. Historic records indicate the average acreage of a family farm in the early 1800s was 103 acres. On the other hand, it was not difficult to acquire land for a family farm. Records also indicate that most tenant farmers became landowners rather quickly (Hunterdon County Cultural and Heritage Commission, 1989).

With regard to conservation practices, European farmers were quite critical of colonial farming practices. Records from the late 1700s indicate that when land was no longer fertile, farmers simply moved onto another piece of property. However, as land became scarcer, and information about soil fertility became available, better practices were gradually adopted. Early on, wood ash was a common fertilizer. Ash was gradually replaced with lime and pulverized gypsum. In the late 1800s use of commercial fertilizers became more common (Hunterdon County Cultural and Heritage Commission, 1989).

The creation of the Farm Bureau, in the early 1900s, was the direct result of many years of drought, exacerbated by an economic depression. As the economy improved, the government implemented soil conservation programs. During the early 1980s an increased sense of concern developed over retention of agricultural land, and preservation of farming as a way of life. Legislation was passed creating the State Agriculture Development Committee (UADC) and County Agriculture Development Boards (CADB). These entities were charged with the responsibility of delineating prime agricultural lands and establishing areas that should be preserved as agricultural open space. Two of the criteria used by the UADC and CADB for establishing prime agricultural lands were soil fertility and topography. The importance of conserving farmland and open space was discussed in the programmatic section of this inventory (Section I, Map 5). However, agricultural soils are best presented in the soils resources section.

The USDA/NRCS defines prime farmlands (prime agricultural soils) as those areas having the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. A Prime Farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained, high yields of crops when managed following accepted farming methods. The Hunterdon County Soil Conservation District lists twenty-three (23) prime farmland soils in Hunterdon County. According to the Soil Conservation District, Twenty (20) of these occur in Clinton Township.

The prime farmland soils in Hunterdon County are as follows:

- **ApB-** Annnandale and Edneyville gravelly loams, 3-8% slopes
- **AtB-** Athol gravelly loam, 2-6% slopes
- **BaB-** Bedington shaly silt loam, 2-6% slopes
- **BdA-** Birdsboro silt loam, 0-2% slopes
- **BdB-** Birdsboro silt loam, 2-6% slope
- **BuB-** Bucks silt loam 2-6% slopes
- **DuB-** Duffield silt loam, 2-6% slopes
- **EdB-**Edneyville gravelly loam, 3-8% slopes
- **LaB-** Lansdale loam, 2-6%
- **LeB-** Lawrenceville silt loam, 2-6% slopes
- **MoB-** Mount Lucas silt loam, 0-6% slopes
- **NoB-** Norton loam, 2-6% slopes
- **PbB-** Pattenburg Gravelly loam, 2-6% slopes
- **PcB-** Pattenburg gravelly loam, 2-6% slopes, moderately wet
- **PeB-** Penn shaly silt loam, 2-6% slopes
- **RbA-** Raritan silt loam, 0-2% slopes
- **RbB-** Raritan silt loam, 2-6% slopes
- **RgB-**Riverhead gravelly sandy loam, 2-6% slopes
- **TuB-** Turbotville loam, 2-6% slopes
- **WaB-**Washington loam, 2-6% slope

The Siegel Farm, Sand Hill Road

Farmlands of Statewide Importance (Soils of Statewide Importance) include those soils in land capability Class II and III that do not meet the criteria as Prime Farmland. These soils are nearly Prime Farmland and economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce yields as high as Prime Farmland when favorable growing conditions exist.

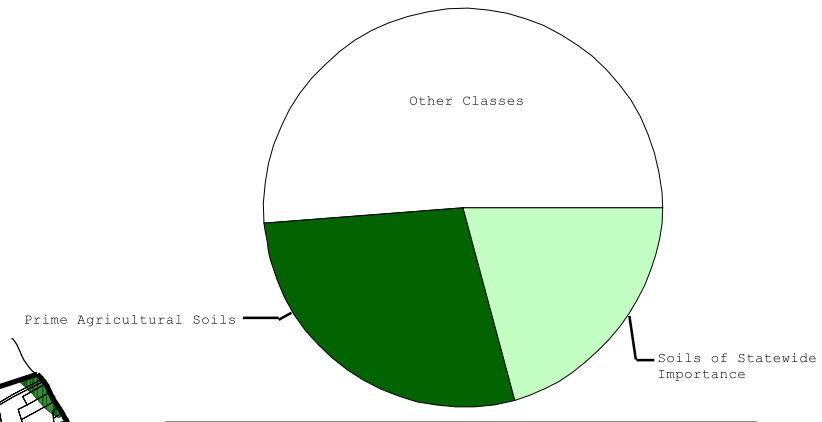
As per the HCSCD, there are forty (40) Soils of Statewide Importance in the County (HCSCS, 1990). Clinton Township contains the following Soils of Statewide Importance:

- **AbA** – Abbottstown silt loam, 0 to 2 % slopes
- **AbB-** Abbottstown silt loam, 2 to 6% slopes
- **ApC** – Annandale & Edneyville gravelly loams, 8 to 15% slopes
- **AtC2** – Athol gravelly loam, 6 to 12% slopes
- **BaC2**-Bedington shaly silt loam, 6-12% slopes, eroded
- **BbB**-Berks shaly loam, 2-6% slopes
- **BbC2**- Berks shaly loam, 6-12% slopes, eroded
- **BuC2** – Bucks silt loam, 6 to 12% slopes, eroded
- **DuC2-** Duffield silt loam, 6-2%, slopes eroded
- **HaC2**- Hazleton channery loam, 6-12% slopes, eroded
- **LaC2-** Lansdale loam, 6-12% slopes, eroded
- **LhB**- Lehigh silt loam, 2-6% slopes
- **LgC –** Legore gravelly loam, 6 to 12% slopes
- **LhC2-** Lehigh silt loam, 6 to 12% slopes, eroded
- **NeC2 –** Neshaminy silt loam, 6 to 12% slopes, eroded
- **NoC2 –** Norton loam, 6 to 12% slopes, eroded
- **PbC2-** Pattenburg gravelly loam, 6-12% slopes, eroded
- **PeC2 –** Penn shale silt loam, 6 to 12% slopes, eroded
- **PfC2-** Penn-Bucks complex, 6 to 12% slopes, eroded
- **RcC2 -** Readington silt loam, 6 to 12% slopes, eroded
- **ReA -** Reaville silt loam, 0 to 2% slopes
- **ReB -** Reaville silt loam, 2 to 6% slopes
- **ReC2 –** Reaville silt loam, 6 to 12% slope
- **WaC2-**Washington Loam, 6-12% eroded

The agricultural soils map (Map 10) illustrates that of the Township's total land area, approximately 28% meets the designation of Prime Agricultural Soil and 21% meet the designation of Soils of Statewide Importance. Additional information on the agricultural capabilities of these soils, including their official series descriptions may be obtained from the Hunterdon County Soil Survey (USDA, 1974), and are presented in reports available through HCSCD, the Clinton Township Master Plan Addendum 2000, and the Clinton Township Open Spaces Biological Inventory (June 1995).

AGRICULTURAL SOILS AREAS SYMBOL LEGEND

KEY	CODE	ACREAGE	PERCENTAGE
	Other Classes	11114.61	51.24
	Prime Agricultural Soils	6057.95	27.93
	Soils of Statewide Importance	4520.35	20.84
TOTAL		21692.91	100.0



PERCENTAGE OF TOWNSHIP BASED ON AREA

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LEBANON TWP.
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SPRUCE RUN RESERVOIR
UNION TWP.
TOWN OF CLINTON
FRANKLIN TWP.
MOUNTAINVIEW YOUTH CORRECTIONAL FACILITY
LEBANON BOROUGH
TEWKSBURY TWP.
READINGTON TWP.
ROUND VALLEY RESERVOIR
SOUTH BRANCH RARITAN RIVER
CRAMERS CREEK
PRESCOTT BROOK
SOUTH BRANCH ROCKAWAY CREEK
HUNTERDON CO. ARBORETUM
FRANKLIN TWP.
RARITAN TWP.
READINGTON TWP.
CLINTON TWP.

SYMBOL KEY

- TEXT Significant Place Names
- Primary Roads
- Tax Parcel Boundaries
- Lakes
- Networked Streams

30000 0 30000 Feet

Study Area

HUNTERDON COUNTY
SCALE 1:800,000

CLINTON TOWNSHIP, NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000
Map Projection: State Plane of New Jesey, NAD 83, Feet

New Jersey, Department of Interior, Geologic Survey, GIS data Downloads, Monochromatic Bitmap Geographic Images of Hunterdon County, New Jersey.
Scale 1:24,000
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

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MAP 10: AGRICULTURAL SOILS RESOURCES

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Limitations and Uncertainties of Soil Survey Data

It is important to understand the limitations of a typical USDA Soil Survey, particularly when using these data to formulate or implement natural resource management decisions. For example, although the USDA may have conducted some ground-truthing for the presence of established soil series in the Township, the majority of the mapped data, including that included herein, have not been field-verified. Although soil boundaries are based on some limiting ground-truthing, available soil data and maps are largely based on the interpretation and extrapolation of data, as well as interpretation of aerial photos and similar information sources.

Specifically soil boundaries are based on topography, landscape features, historical land use patterns, and visual interpretations. The USDA, (1981, 430-V, Issue 1), also used information on horizon designations, hydraulic conductivity classes, and soil-water relations to amend, to a certain extent, the boundaries and data presented in the 1974 soil survey report.

Another major factor that can affect soil mapping is the methodology by which soil series are assigned. Although soil series provide the user with distinct boundaries between soil characteristics, soils exhibit great variability within a series, and therefore represent more of a gradient of characteristics rather than a distinct type. For many "marginal" soils that exhibit characteristics of one or more established series, the USDA may arbitrarily assign these soils to a particular series even though the soil complex may not meet all of the series' criteria. Furthermore, soil types that do not exhibit characteristics typical of any established soil series, may be arbitrarily assigned, by the USDA, to any number of the more inclusive soil series. Finally, due to their scale, most soil maps cannot accurately display contrasting soil types that are less than 3 to 4 acres in size. As a result, soil types that encompass less than 3-4 acres are usually grouped together with the adjacent soil types. These limitations reveal the importance of ground-truthing soil survey data as part of the decision-making process.

Johnson Farm, Just East of Route 31

Clinton Township Significant Flora, Fauna and Habitat ~

The Importance of Habitat Protection

Most people feel that the presence of plants and wildlife significantly improves the quality of their surroundings. Others understand that there is a direct correlation between protecting habitat and protecting wildlife. However, many do not understand that urban growth results in the fragmentation and loss of natural wildlife habitat, and that continued regional development has a cumulative negative impact on natural ecosystems. Although the ecological literature shows that ecosystems adapt to naturally occurring changes (Slobokin 1967) it is probable that new conditions caused by residential and commercial construction have long-term, and often irreversible, effects upon individual plants, wildlife, aquatic biota, and supporting habitats.

The traditional ecological literature notes that the greater the diversity in habitat types, the greater the diversity in the resulting biological communities (Odum, 1953). However, there is also great ecological value in communities displaying qualities other than diversity. Such areas may display low habitat and species diversity but may serve to function as a "keystone" element for the surrounding communities on a local or regional context. Besides satisfying the habitat requirements for a portion of an organism's life history, certain ecosystems may ameliorate the effects of erosion or flooding, provide temporary nesting or resting areas for migratory species, and afford pleasure and psychological well-being for humans.

Landscape ecology is a newer discipline. It is the study of the importance of spatial variation in landscapes. The discipline includes the biophysical and societal causes *and consequences* of landscape heterogeneity. One focus of landscape ecology is to make comprehensive land use planning and sound land use policy the rule rather than the exception. Specifically, landscape ecology focuses on the structure and function of ecosystems and the impacts of landscape alteration over time (McGarigal, 1994, 1995). Studies noting the importance of preserving a "mosaic" of large, connected, and diverse habitat types, dominate the landscape ecology literature.

The following locate and describe remaining and high priority, grassland, forested, and wetland habitats in Clinton Township. In addition, confirmed and unconfirmed sittings of threatened and endangered flora and fauna are discussed, as well as locally significant wildlife and habitat features.

Early European colonists had an abundance of wildlife to serve subsistence needs. Seemingly endless flocks of ducks, geese, and swans; and abundance of wild turkeys, deer, and bison; green clouds of Carolina parakeets and millions of passenger pigeons; and a bounty of fish and shellfish. This abundance quickly established a viewpoint that the New World's wildlife resources were inexhaustible.

~ Milton Friend, Inventory & Monitoring of Wildlife Habitat ~

Landscape Level & Critical Area Mapping Information

In 1994, the New Jersey Division of Fish and Wildlife (Endangered and Non-game Species Program), adopted a landscape level approach to the protection of rare species. The "landscape level perspective" is based upon large areas called landscape regions that support ecologically similar plant and animal communities. New Jersey's landscape regions include: the Delaware Bay, the Pinelands, the Piedmont Plains, the Skylands, and the Atlantic Coastal areas. Clinton Township is part of the Skylands Landscape Region. The Skylands Landscape Region encompasses portions of Hunterdon, Sussex, Warren and Passaic Counties. The region contains contiguous and extensive tracts of forests that support diverse animal populations such as red-shouldered hawks, goshawks, cerulean warblers, timber rattlesnakes, bog turtles, long-tailed salamanders, great blue herons and other State and Federally listed plant and animal species. The recently completed scientific mapping program is described the following way:

> The Landscape Project provides an innovative mechanism for the stewardship of New Jersey's important wildlife habitat. Using Geographic Information Systems (GIS), the Project establishes accurate boundaries around critical wildlife habitats and then comparatively ranks them to offer prioritization options for varying levels of conservation and management. The mapping is uniquely comprehensive, because it categorizes all significant patches of forest, wetland and open field, not just those with known important elements of biodiversity.
> (NJDEP, Lawrence J. Niles, PhD, 2001).

The program goal is to protect biological diversity and functioning ecosystems. The philosophy of the program is that protection of threatened, endangered and rare species can only be accomplished if the habitat supporting the species is protected. Priority species include all state and federally listed wildlife. In some cases, selected non-listed, area-sensitive species are included (e.g., neotropical migrant land birds) but assigned less priority.

Map 11 combines rare species location information with land use/land cover classification data. The GIS coverages identify and map areas of critical habitat for rare species within each landscape region. According to NJDEP, the project's underlying methodology has undergone a rigorous academic and professional peer review, and the information provides a highly accurate, reliable and scientifically sound basis for habitat protection within each landscape. Each critical area classification (e.g., wetland, grassland, and forest) contains five (5) priority ratings ranging from "lower priority" to "higher priority". The habitat mapping for Clinton Township (Map 11) indicates that there are several critical forest, wetland, and grassland habitats located within the Township boundaries. A total of 3,888 acres of priority grassland, 4,723 acres of priority forested, and 739 acres of priority wetland habitat occur in Clinton Township. Additional habitat descriptive information is noted in the following section, as well as on Map 11. It should also be noted that during the production of this inventory, the habitat maps and forested emergent wetland ranking system were formally released and then slightly amended. Although these data have been integrated to the fullest extent possible in this NRI, the State's final, amended maps were not available for cross-referencing in time for completion of this inventory.

Critical Forest Habitat

The following critical forested areas are located throughout Clinton Township. Critical forested areas contain priority species, are adjacent to conserved areas, and contain contiguous forests undivided by major roads. There are approximately 4,722 acres of critical forest habitat in the Township. This habitat generally occurs in the following areas of Clinton Township (See Map 11):

- **Round Valley Reservoir Area**
- **East of Route 629 and south of Stanton Mountain Road**
- **South of Route 22/East of Route 31/West of Route 629**
- **West of Route 31**
- **Spruce Run Reservoir Area**
- **Northern Portion (North of Interstate 78/West of Route 639) of Township**

Beaver Brook, Priority Forested Habitat, North of Interstate 78

Critical Grassland Habitat

Critical areas for grassland-dependent species and open habitat are those areas containing priority species, are adjacent to conserved areas, and contain contiguous grassland habitat undivided by major roadways. In general, the 3,887 acres of critical grassland habitat are located in the following areas of the Township (See Map 11):

- **South Branch Rockaway Creek Area**
- **Prescott Brook Area**
- **South of I-78 and East and West of Route 31**
- **Vicinity of Mountainview Youth Corrections Property**
- **Spruce Run Reservoir and Route 31 Area**
- **Region East of Route 639 and North of Interstate 78**

Tine Road, Critical Grassland Habitat

Critical Wetland Habitat

Priority is given to forested wetlands associated with documented threatened and endangered species, adjacent to preserved areas, and containing buffer areas adequate enough to support certain wetland species (e.g., Wood turtle). The 738 acres of high priority forested wetlands are located in the following areas of Clinton Township (See Map 11):

- **South Branch Raritan River and Tributary Area**
- **South Branch Rockaway Creek and Tributary Area**
- **Round Valley Reservoir Area**
- **Beaver Brook Area**

South Branch Raritan River, Priority Wetland Habitat

Threatened, Endangered, and Rare Wildlife & Plant Species; The Natural Heritage Index Maps

Endangered species are those facing extinction, whereas threatened species are those potentially enroute to endangered status. Reasons for species extinction include natural causes, unregulated hunting, introduction of predators, introduction of exotic, non-native species, habitat modification and habitat loss. Federal, legislative actions to protect and conserve threatened and endangered species have included the Migratory Bird Treaty Act (1918), the National Environmental Policy Act (1969), the Endangered Species Act (1966 and later), and the Fish and Wildlife Conservation Act (1980). Management of endangered and threatened species includes locating existing species, identifying preferred habitat, control of predators and competitors, and habitat preservation (Robinson & Bolen, 1984). State actions to protect species have included the State Endangered and Nongame Species Conservation Act (1973), The Freshwater Wetlands Protection Act (1988), the Endangered Plant Species List Act (1989), and the Natural Areas System Act (1961).

In New Jersey, records noting the location of Federally and State listed plants and animals, as well as the locations of ecologically critical or unique habitat, are recorded by the NJDEP. As part of the research for this document, the Natural Heritage Program database was used to obtain the most recent information on threatened and endangered species. However, due to the sensitive nature of threatened and endangered species locational information, the Natural Heritage Group will *not* provide the exact location of species. Rather information is provided on those species located in the vicinity of a particular site or in the surrounding area. The information is supplied on quadrangle maps. Map 11 includes the boundaries of the State's reference quadrangles. According to the New Jersey Natural Heritage Database, as of February 2001 (Table 5), a total of one (1) endangered and three (3) threatened bird species, one (1) endangered and two (2) threatened amphibian and reptile species, and two (2) significant invertebrate species have been reported for the Township (Map 11, Table 5).

The information obtained from the Natural Heritage Database also lists one (1) cave aquatic community, one (1) cave terrestrial community, and one (1) bat hibernaculum. The cave habitats are associated with the softer valley rocks including limestone and shale, which result in a karst topography. As ground water moves through the limestone, the limestone slowly dissolves, which can form caves or undermine the heavier upper layers of soil thereby creating sinkholes.

The Leigh Cave, located in the Round Valley Reservoir area of the Township, is the second largest cave in New Jersey. It harbors a unique community of organisms specifically adapted to subterranean environments. The Bat Hibernacula, located in the Leigh Cave is a secluded area where bats rest during non-feeding periods. Worldwide, bat populations are declining at a rapid rate. This is due in large part to the destruction of feeding and roosting habitats and the misuse of toxic pesticides. According to the NJ Division of Fish, Game and Wildlife, human interactions with bats have also contributed to their decline. All information from the State Natural Heritage database is included in Table 5 and Table 6.

Table 5, Natural Heritage Index Threatened & Endangered Wildlife Species

Scientific Name	Common Name	Federal Status	State Status	Number of Sightings	Date Last Observed
Birds					
Ammodramus savannarum	Grasshopper Sparrow	NA	Threatened/Stable	1	July 2000
Asio otus	Long-eared Owl	NA	Threatened	1	February 1992
Dolichonyx oryzivorus	Bobolink	NA	Threatened	2	July 2000
Haliaeetus leucocephalus	Bald Eagle	Formally Threatened	Endangered	1	June 1996
Reptiles/Amphibians					
Clemmys insculpta	Wood Turtle	NA	Threatened	5	July 1997
Clemmys muhlenbergii	Bog Turtle	Formally Threatened	Endangered	3	July 1993
Eurycea longicauda	Longtail Salamander	NA	Threatened	1	May 1910
Invertebrates					
Alasmidonta undulata	Triangle Floater	NA	NA	2	August 2000
Enallagma basidens	Double-striped Bluet	NA	NA	1	August 1993

Source: State Natural Heritage Database, February 2001.

Notes: According to Clinton Township Environmental Commission members, additional, More Recent Local Sightings of Bobolink (Dolichonyx orizivorus), Grasshopper Sparrow (Ammodramus savannarum), Vesper Sparrow (Pooecetes gramineus), Coopers Hawk (Accipiter cooperi), and Wood Turtle (Clemmys insculpta) have been sighted by Environmental Professionals.

The Special Plants of New Jersey list was also requested for this NRI update. In 1989 the New Jersey Endangered Plant Species List Act was adopted. The New Jersey Legislature directed the Division of Parks and Forestry to develop and adopt a list of endangered state plants. An endangered plant is defined as any native plant species whose survival in the State or nation is in jeopardy (N.J.A.C, 7:5C-1.1. et.seq.). The list, adopted in 1990, is intended to facilitate the conservation and protection of New Jersey's endangered and plant species of concern. The following table (Table 6), notes the threatened and state endangered plant species present in Clinton Township.

Table 6, Natural Heritage Index Threatened & Endangered Plant Species

Scientific Name	Common Name	Federal Status	State Status
Carex oligocarpa	Few Fruited Sedge	NA	**Endangered**
Carex pallescens	Pale Sedge	NA	NA
Carex willdenowii	Willdenow's Sedge	NA	NA
Castilleja coccinea	Scarlet Indian Paintbrush	NA	NA
Cercis Canadensis	Redbud	NA	**Endangered**
Cheilanthus lanosa	Hairy Lipfern	NA	NA
Chenopodium simplex	Maple Leaved Goosefoot	NA	NA
Crataegus calpodendon	Pear Hawthorn	NA	**Endangered**
Crataegus dogei	Dodge's Hawthorn	NA	NA
Crategus holmesiana	Holmes Hawthorn	NA	NA
Crateagus succulenta	Fleshy Hawthorn	NA	**Endangered**
Cuscuta cephalanthi	Button Bush Dodder	NA	**Endangered**
Cynoglossum virginianum	Wild Comfrey	NA	NA
Cystopteris protrusa	Lowland Brittle Fern	NA	NA
Desmodium humifusum	Trailing Tick-Trefoil	NA	**Endangered**
Dicentra canadensi	Squirrel Corn	NA	**Endangered**
Draba reptans	Carolina Willow Grass	NA	**Endangered**
Ellicia nyctelea	Aunt Lucy	NA	**Endangered**
Eragrostis frankii	Franks Lovegrass	NA	NA
Hybanthus concolor	Green Violet	NA	**Endangered**
Hydrpophyllum canadense	Broad-Leafed Waterleaf	NA	**Endangered**
Hypericum pyramidatum	Great St. John's-Wort	NA	NA
Jeffersonia diphylla	Twinleaf	NA	**Endangered**
Kuhnia eupatoriioides	False Boneset	NA	**Endangered**
Lathyrus venosus	Smooth Veiny Peavine	NA	**Endangered**
Lechea intermedia	Narrow-Leaved Pinweed	NA	NA
Lemna Valdiviana	Pale Duckweed	NA	**Endangered**
Linum sulcatum	Grooved Yellow Flax	NA	**Endangered**
Panicum oligosanthes	Few-Flowered Panic Grass	NA	NA
Panstemon Laevigatus	Smooth Beard Tongue	NA	**Endangered**

Table 6 Continued, Natural Heritage Index Threatened & Endangered Plant Species

Phlox pilosa	Downy Phlox	NA	**Endangered**
Pinus pugens	Table Mountain Pine	NA	**Endangered**
Prunus alleganiensis	Allegheny Plum	NA	**Endangered**
Prunus pumila var depressa	Low Sand Cherry	NA	NA
Ptela trifoliata	Water Ash	NA	**Endangered**
Pycnanthemum clinopodioides	Basil Mountain Mint	NA	**Endangered**
Pycnanthemum torrei	Torrey's Mountain Mint	NA	**Endangered**
Ranunculus micranths	Rock Crowfoot	NA	NA
Rhynchospora globularis	Grass-Like Beaked Rush	NA	**Endangered**
Ribes missouriense	Missouri gooseberry	NA	**Endangered**
Rudbeckia fulgida	Orange Coneflower	NA	**Endangered**
Salix lucida	Shining Willow	NA	NA
Scutellaria nervosa	Veined Skullcap	NA	NA
Sedum telephioides	Allegheny Stonecrop	NA	NA
Selaginella ruestris	Ledge Spike-Moss	NA	NA
Solidago rigida	Stiff Goldenrod	NA	**Endangered**
Stachys tenuifolia	Smooth Hedge Nettle	NA	NA
Stellaria pubera	Star Chickweed	NA	**Endangered**
Triosteum angustifolium	Narrow-Leaved Tinker's Weed	NA	**Endangered**
Valerianella radiata	Beaked Corn-Salad	NA	**Endangered**
Verbena simplex	Narrow-Leaved Vervain	NA	**Endangered**
Viscia caroliniana	Carolina Wood Vetch	NA	**Endangered**
Viola canadensis	Canada Violet	NA	**Endangered**

Source: New Jersey DEP Natural Heritage Program, 2001.

Notes: The endangered plant taxa are those native New Jersey plant species whose survival in the State or Nation is in jeopardy.

Habitat Requirements of Threatened and Endangered Species

The previous sections defined landscape ecology, cited studies addressing the importance of preserving a "mosaic" of large connected and diverse habitat types, identified priority habitats remaining in Clinton Township, and noted those wildlife and plant species identified as threatened, endangered, and rare. The following subsection further describes the threatened and endangered species in relation to their preferred habitat. Additionally, the importance of protecting preferred habitat is discussed. The natural resource vulnerability section of this study (Part III) will locate those habitats vulnerable to development and associated environmental

impacts. The conservation management plan (Part IV) will list specific tools for preserving, conserving, and managing vulnerable habitat.

Threatened and endangered grassland birds are present in Clinton Township. The Grasshopper Sparrow (*Ammodramus savannarum*) and the Bobolink (*Dolichonyx oryzivorus*) are identified on the Natural Heritage Database, while the Vesper Sparrow (*Pooecetes gramineus*) was identified during a recent land development review as part of the required Threatened and Endangered Species Report. The three birds require open grassland habitat for survival, however they have species-specific preferences during the breeding season. For instance, the Grasshopper Sparrow requires large, dry, open fields with little or no woody growth, the Vesper Sparrow prefers dry weedy fields along road edges, and the Bobolink requires lush, moist fields. All three grassland bird species require some structure (e.g., fencepost or natural structure) in their habitat to serve as an elevated perch for singing males (Peterson, J.G., 1970).

Grassland Habitat at Windy Acres, Old Mountain Road

The two raptors on the threatened (Long-Eared Owl, *Asio otus*) and endangered (Bald Eagle, *Haliaeetus leucocephalus*) list for Clinton Township both prefer woodland habitat areas. Again, their preferred habitats differ. The Long Eared Owl is a bird of deep woods, and is usually found in dense stands of coniferous or mixed hardwood areas. In contrast, the Bald Eagle prefers wooded areas along streams, rivers or lakes where fish are abundant. They normally nest in the top of the tallest tree of such areas (Peterson, 1975).

The threatened and endangered amphibians and reptiles, and invertebrates on the Natural Heritage list for Clinton Township prefer open water and wetland habitat for survival. The Wood Turtle (*Clemmys insculpta*) is often found on land in open woodlands, meadows and floodplains bordering gravel–bottomed rivers. It is known to wander across drier woods, meadows, and farmlands during the summer months, but return to the water and swampy areas

for mating, nesting, and hibernation (Carroll, 1991). The Bog Turtle (*Clemmys muhlenbergii*) is found in open canopy, groundwater-fed, and muck-bottomed fens, marshes, bogs, and wet meadows. The Bog Turtle commonly basks on sedge tussocks and matted vegetative litter (NJ Division Fish and Wildlife, 2001). The Long Tailed Salamander (*Eurycea longicauda*) prefers small brooks, springs, seepage areas and river bottom swamps or other small water bodies where fish are absent or at a minimum. They are found under rotting logs, under stones and frequently in caves and ponds in the limestone belt of northwestern New Jersey (Grossmueller 1995).

The Double-striped Bluet is a damselfly belonging to the *Coenagrionidae* family, the Narrow Winged Damselflies. The genus *Enallagma* is the largest in this family. These damselflies are typically found in ponds and lakes. The adults are relatively feeble fliers. When they alight they usually hold their body horizontal with the wings together over their body. The majority of the species in the genus are light blue with black markings. The distinguishing characteristic of the nymphs is that the anal gills are non-tapering (NJ Division of Fish & Wildlife, 2001).

Other Wildlife Present in Clinton Township

Habitat present in Clinton Township also supports numerous species of non-threatened wildlife. The New Jersey Division of Fish and Wildlife reports that at the present time Clinton Township supports a vibrant population of Mountain Beaver (*Castor canadensis*), Black Bear (*Ursus americanus*), Coyote (*Canus latrans*), and Wild Turkey (*Meleagris gallopavo*). In addition, there are also more commonly occurring species such as White-tailed deer (*Odocoileus virginianus*), woodchuck (*Marmota monax*), Eastern Gray Squirrel (*Sciurus carolinensis*), Eastern Cottontail (*Sylvilagus floridanus*), Eastern Chipmunk (*Tamias striatus*), Raccoon (*Procyon lotor*), Striped Skunk (*Mephitis mephitis*) etc.

The Mountain Beaver populations in Clinton Township are located along the Township's rivers; however, beaver will disperse when populations become too dense. Competition may sometimes push beaver populations out of one river valley and into another. In fact, beaver have been known to cross sizeable ridges in an attempt to colonize less competitive river habitats. Wild turkey require a patchwork of woodland and field habitat for survival. Populations are stable in Clinton Township. Multiple sightings of both Black Bear and Coyote have been reported throughout the grasslands, farm fields, woodlands, and wetland areas in Clinton Township. Although their movement is not actively tracked, both species are known to travel along ridgelines, and may travel more than thirty miles each day during mating season or when food is scarce. The Division of Fish and Wildlife notes that sightings have increased in recent years and that problems will sometimes occur when Black Bear wander into residential areas or Coyote are found in agricultural areas in search of food. As the natural habitat for these mammals are developed, more sightings will occur due to increased competition for food, cover, and breeding areas.

According to the New Jersey Division of Wildlife, Clinton Township is located in Deer Management Zone 7, which has an average deer density rate of sixty-three deer per square mile. Since Clinton Township is approximately thirty-four square miles, there are approximately 2,142

deer within the Township. The home range for deer is approximately 1 square mile. White-tailed deer populations continue to grow in the Township. The NJ Fish and Wildlife staff notes that they have experienced increasing deer problems as human populations in the area have increased.

Deer often enter residential areas to feed on landscape plants, or forage in agricultural fields, or in soybean, corn, and pumpkin fields. Deer herds may also take advantage of available browse along well-traveled roadways, increasing the opportunity for motor vehicle accidents.

Immature Bald Eagle, North Shoreline Round Valley

STATE NATURAL HERITAGE INDEX MAP LEGEND **
(STATE THREATENED AND ENDANGERED SPECIES LIST)

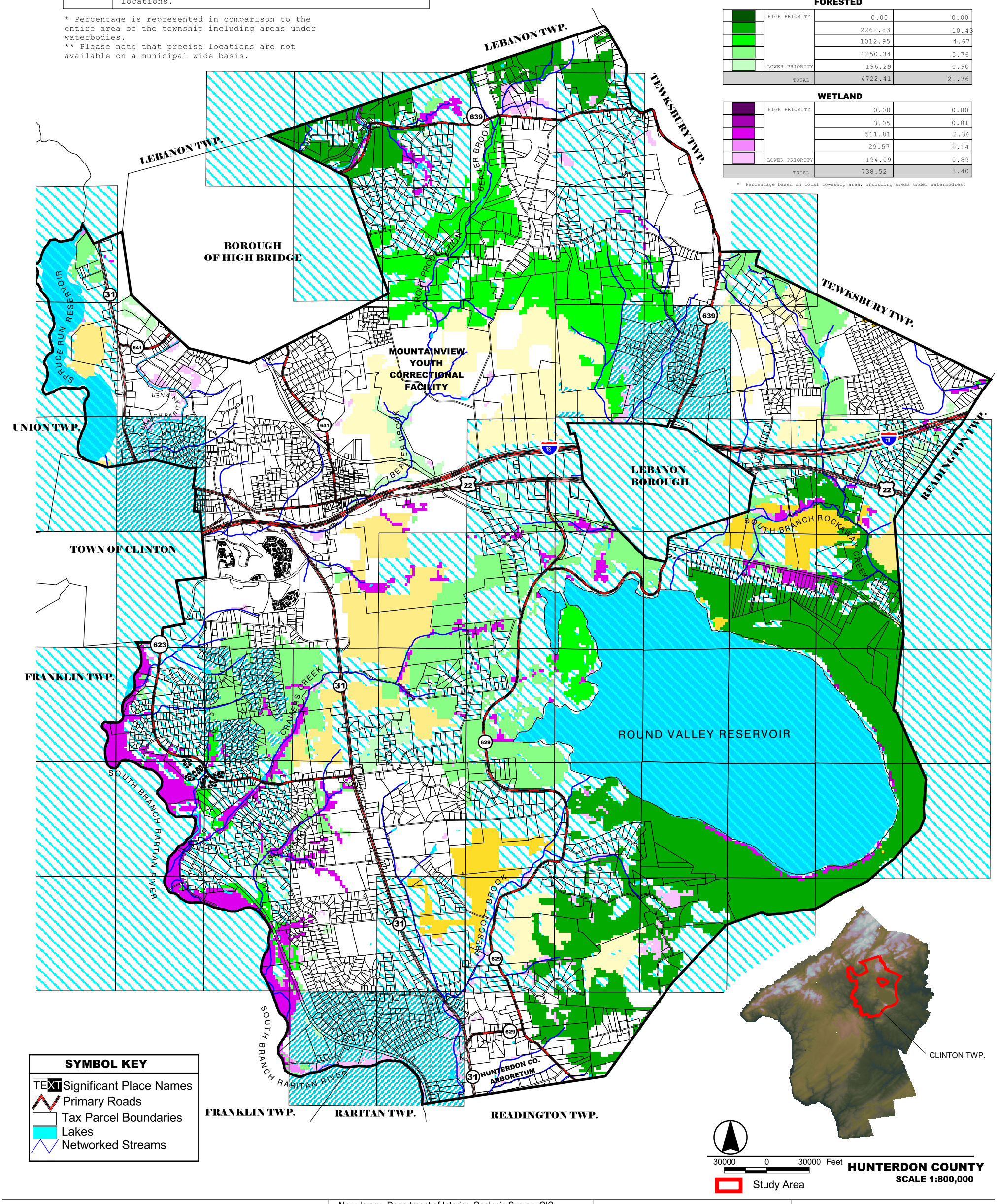
KEY	DESCRIPTION
	Precise Location of Threatened and Endangered Species, locations known within 200 feet of actual organism locaitons, seconds accuracy.
	Threatened and Endangered Species with known locations within 1.5 miles or minutes accuracy of the actual locations.

* Percentage is represented in comparison to the entire area of the township including areas under waterbodies.
** Please note that precise locations are not available on a municipal wide basis.

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION LANDSCAPE PROGRAM, CONSERVATION PRIORITY SYMBOL LEGEND

KEY	VALUE	ACREAGE	PERCENTAGE*
GRASSLAND			
	HIGH PRIORITY	0.00	0.00
		1.92	0.01
		317.64	1.46
		543.09	2.50
	LOWER PRIORITY	933.56	4.30
	TOTAL	3887.68	12.65
FORESTED			
	HIGH PRIORITY	0.00	0.00
		2262.83	10.43
		1012.95	4.67
		1250.34	5.76
	LOWER PRIORITY	196.29	0.90
	TOTAL	4722.41	21.76
WETLAND			
	HIGH PRIORITY	0.00	0.00
		3.05	0.01
		511.81	2.36
		29.57	0.14
	LOWER PRIORITY	194.09	0.89
	TOTAL	738.52	3.40

* Percentage based on total township area, including areas under waterbodies.



CLINTON TOWNSHIP, NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000
Map Projection: State Plane of New Jesey, NAD 83, Feet

New Jersey, Department of Interior, Geologic Survey, GIS data Downloads, Monochromatic Bitmap Geographic Images of Hunterdon County, New Jersey.
Scale 1:24,000
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000
State of NJ, DEP State Natural Hertiage Index, informaiton complied from information pulished in hard copy from the state.
Scale 1:24,000

NOTES:
1. DATA ACCURACY IS LIMITED TO THE ACCURACY AND SCALE OF THE ORIGINAL DATA SOURCES.

2. THESE MAPS ARE PART OF A RESOURCE INVENTORY CONDUCTED FOR CLINTON TOWNSHIP AND SHOULD BE USED IN CONJUNCTION WITH THE COMPILED TEXT.

MAP 11: CRITICAL HABITAT

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Historical & Cultural Features of Clinton Township ~

Some important, but non-environmental elements of the Clinton Township NRI, are historic and cultural features. As these features are often protected by federal, state or local regulation, they can serve as a constraint to development. In addition, Historic Sites, historic districts, and historic corridors all contribute to an enhanced environment. The following section of the NRI includes information about the area's earliest inhabitants, as well as narrative and location information noting the historic features of the Township.

Much of the history of an area finds expression in the sites and structures of the times, and these sites and structures are elements of the areas quality of life.

~ Communities of Place, the NJ Development and Redevelopment Plan, 1992 ~

Early Inhabitants

The Lenape Indians called New Jersey "Scheyechbi" or in the English translation "Land Along the Water". Unfortunately, little remains of the Lenape culture. Nearly 100 Revolutionary War battles were fought in New Jersey as Washington's army crisscrossed New Jersey to intentionally confuse the British in Philadelphia and New York (NJ State Planning Commission, SDRP, 1992).

According to local historic sources, the first known inhabitants of the area were the Lenape ("original people") Indians. Although the settlement pattern was sparse in the area, local documents note some very significant Native American Sites. For instance, Round Valley was a place for hunting and gathering as well as a burial ground for Tribal chiefs. Archeological evidence and local place-names are still in use (e.g., Raritan, Musconetcong, Minisink).

A survey conducted between 1912 and 1915 noted four-hundred and sixty-two Native American camps within Hunterdon County with principal concentrations in the Delaware River Valley, Flemington area, Oldwick area and the High Bridge area (Hunterdon County Cultural and Heritage Commission, 1990). The articles found (including arrow and spear points, knives, scrapers, hammers, axes, net sinkers and pottery) tell us much about the daily habits and customs of the Lenape. For instance, many articles have been unearthed along river and tributary corridors.

One can therefore determine the location of several major and minor Lenape travel corridors. An important trail was the *Raritan path* linking the Raritan River to Bound Brook to the forks of the Raritan leading ultimately to the forks of the Delaware at Easton. This important trade route passed right through High Bridge and was used later by early explorers (NJ State Planning Commission, SDRP, 1992).

With regard to local populations, archeological evidence shows a vibrant population before the explorers and colonists arrived, however writings of the time noted a comparatively small population in what is now Hunterdon County. The writings note that much smaller populations of indigenous people existed in East Jersey than in other neighboring Atlantic Coastal colonies. The population figures range from 800 to several thousand depending on the perspective of the writer living in the area in the late sixteen hundreds.

An archeological study in the early nineteen hundreds lists 462 native, prehistoric sites in Hunterdon County. The "Cultural Resources Investigation of Windy Acres Development" (Richard Grubb and Associates, Inc., August 2000) noted a prehistoric camp, procurement camp, and lithic workshop in the vicinity of the Windy Acres Development. The study also states that native sites were plentiful at the base of the Cushtunk Mountain range during the late Archaic Period or approximately 9000 years ago. Currently, approximately eighty-two documented artifacts have been recovered from the Windy Acres site and on the south bank of the South Branch Rockaway Creek. The artifacts include projectile points, stone knives, multipurpose tools, and hammerstones.

The Early Explorers and European Colonists

Some of the earliest written records describing the Hunterdon County area were those of Sir Edmond Ployden, recorded by Beauchamp Plantagenet in the early 1600s. Ployden traveled with the Lenape for seven years, exploring land that is now part of Hunterdon County. He and other explorers from England were looking to colonize the area with people loyal to the Church of England and opposed to the new democratic political philosophies arising in England. Some historians believe that Ployden's writings describe Round Valley (Hunterdon County Cultural and Heritage Commission, 1990).

The West India Company soon followed with local investigations just above the Delaware Water Gap in the Pahaquarry Copper mines. Quakers and additional explorers from England soon followed. The English decided early on to acknowledge that the land was owned by the indigenous inhabitants, therefore purchasing land for very small amounts and "thus extinguishing the Indian title without trouble or hard feelings." In 1664 the English (King Charles II) seized the area, along with the rest of "New Netherlands" from the Dutch. The land lying between the Delaware River and the Connecticut River was deeded to James, Duke of York. The Duke deeded land that is now New Jersey, to Sir John Berkely and Sir George Cateret. Ten years later in 1674, the land was granted to John Fenwick who eventually gave the land to William Penn and two other Quakers. In 1676, the Province of New Jersey was divided into East Jersey and West Jersey. The Quaker proprietors began governing east and west Jersey in 1680. Most of the land in what is now Hunterdon County was divided into farmsteads, and the wilderness was transformed into an agricultural colony farmed predominantly by Quakers (Hunterdon County Cultural and Heritage Commission, 1990).

From 1704 to 1724 a large influx of Dutch, and German settlers arrived by way of the Raritan River and from the south. By the mid 18th century, Germans were in the majority with settlements occurring in Stockton, Lambertville, Hopewell, Amwell, Pleasant Run and Three Bridges. In the early eighteenth century, a group of affluent families formed the West Jersey Society and purchased 4,600 square miles of land. This purchase included what is presently Clinton Township. James Alexander, father of Lord Sterling of Revolutionary War fame, purchased 10,000 acres from the society and made his home at Round Valley. The German settlers purchased parcels of land from the West Jersey Society and established family farms (Hunterdon County Cultural and Heritage Commission, 1990).

The American Revolution and More Recent History

Clashes occurred during the American Revolutionary War where some residents ("Tories"), were in agreement with the idea of a United States free from European influence, while others were loyal ("Loyalists") to the English. For example, *Beaver Brook Farm* in Annandale village was the home of a prominent patriot, Captain Thomas Jones. Folklore sites Captain Jones as one of the local militia officers who gathered and hid the vessels used by General George Washington to cross the Delaware River from Pennsylvania to Trenton in 1776. Captain Jones' tavern was located on the New Brunswick-Easton Turnpike, ("Jersey Turnpike") which was the main route across the state in the 1700s. In 1841 local residents met at Jones' tavern to form Clinton Township and its first government. The population of the Township was 2,000 in 1841 (Marsh, Clinton Township Historical Association, 2001).

In the 1840's there were numerous mills and hamlets (planned settlements) along the South Branch of the Raritan River and its tributaries. The Jersey Central railroad was completed through the Township to what is now Annandale Station in 1852, bringing growth and new industry. It was on the Jersey Central line that a funeral train carried the body of General George W. Taylor back to the Township in 1862. Taylor, commander of the First Jersey Brigade and Hunterdon's only Civil War General, was killed by Stonewall Jackson's troops at the Second Battle of Manassas (Marsh, Clinton Township Historical Association, 2001).

Annandale Historic District, West Street

Clinton Township continued as an agrarian community through the end of the 19th century and well into the 20th. Mid 20th century brought major highways and the residential development of farmland. At the close of the 19th century there were 170 farms in the Township. One hundred years later there were fewer than 10 operating farms. The Township switched from a three-member Township Committee to a Faulkner Act mayor-council government in 1974, with four elected Council members and a directly elected mayor (Marsh, Clinton Township Historical Association, 2001).

Existing Historic Features

There are numerous Historic Sites, Historic Districts, and Historic Corridors located in Clinton Township (Map 12). The map illustrates the 6 Historic Districts, 72 state registered Historic Places, and over 200 locally significant Historic Sites. The Township's list includes those historic farmsteads, dwellings, and structures over 50 years old that exhibit historic significance. The sites on the Township list reflect information obtained from both the Hunterdon County and the Clinton Township Historic Commissions:

There are six (6) state registered *Historic Districts* in Clinton Township. A Historic District is comprised of one or more Historic Sites that are united historically. A district may also comprise individual elements that are geographically separated. However, historic association must link them. The state registered historic districts in Clinton Township are described below and located on Map 12:

- **Allerton Historic District-** This community is located at the intersection of County Route 623 and Allerton Road. It was named for the Aller family, which maintained mills there as early as 1834. In 1860, the settlement was called Allerville. Eight years later the town constructed a Baptist Church, steam sawmill, store, chair factory, and a few dwellings.

- **Annandale Historic District-** This settlement is located in the center of Clinton Township (State Route 31 and County Roads 633 & 626). This village grew as Clinton Station, a depot of the New Jersey Central Railroad. Named for a town in Scotland, the population reached 380 people by 1880. A fairly dense and well-defined village, it is composed of 12 blocks and approximately 150 structures. The one church in town is the Reformed Church, located on the corner of Beaver Avenue and West Street. The vast majority of the structures are single-family, detached homes dating from 1840-1910.

- **The Cokesbury Historic District-** This district is located on the boundary line between Tewksbury and Clinton Townships on County Route 639. There was an iron furnace constructed in 1754. Local historians claim the town was named after two Methodist bishops, Coke and Ashbury. By 1881, Cokesbury included a hotel, store, blacksmith shop, wheelwright shop, two churches and fourteen dwellings.

- **The Hamden Historic District-** Hamden is located in the southwestern part of Clinton Township along the South Branch Raritan River, just west of Allerton Road. The district was part of the 100 acre Hamden tract purchased by Philip and John Grandin in approximately 1760. The 1873 maps show a store, blacksmith shop, three mills, and five dwellings.

- **Potterstown Historic District-** The Potterstown Historic District is located on the border between Clinton and Readington Townships, off U. S. Route 22. A map dated 1872 indicates over a dozen dwellings and a store existed in this section of Clinton.

- **The Turnpike Historic District-** This district is a small village sandwiched between U.S. Route 22 and Interstate 78 in the center of Clinton Township. It contains an outstanding farm complex including individual structures, a primary dwelling unit, tenant house, out-kitchen, springhouse, frame wagon house and a barn.

State registered Historic Sites refer to any real property, man-made structure, natural object or configuration or any portion or group of the foregoing formally designated by the state, county or municipality or documented as being of historical, archeological, cultural, scenic or architectural significance (NJ State Planning Commission, 1992).

The state registered and locally significant Historic Sites in Clinton Township include dwellings, farmsteads, and structures throughout the Township. These sites are located on the following map (Map 12) and are listed on an associated Geographic Information System (GIS) database table. Please contact the Clinton Township Planning Office for the associated database and the Clinton Township Historical Commission and the Hunterdon County Historical Commission for more detailed descriptive information.

The Immaculate Conception Church, From Old Allerton Road

HISTORIC RESOURCES

STATE REGISTERED HISTORIC DISTRICTS

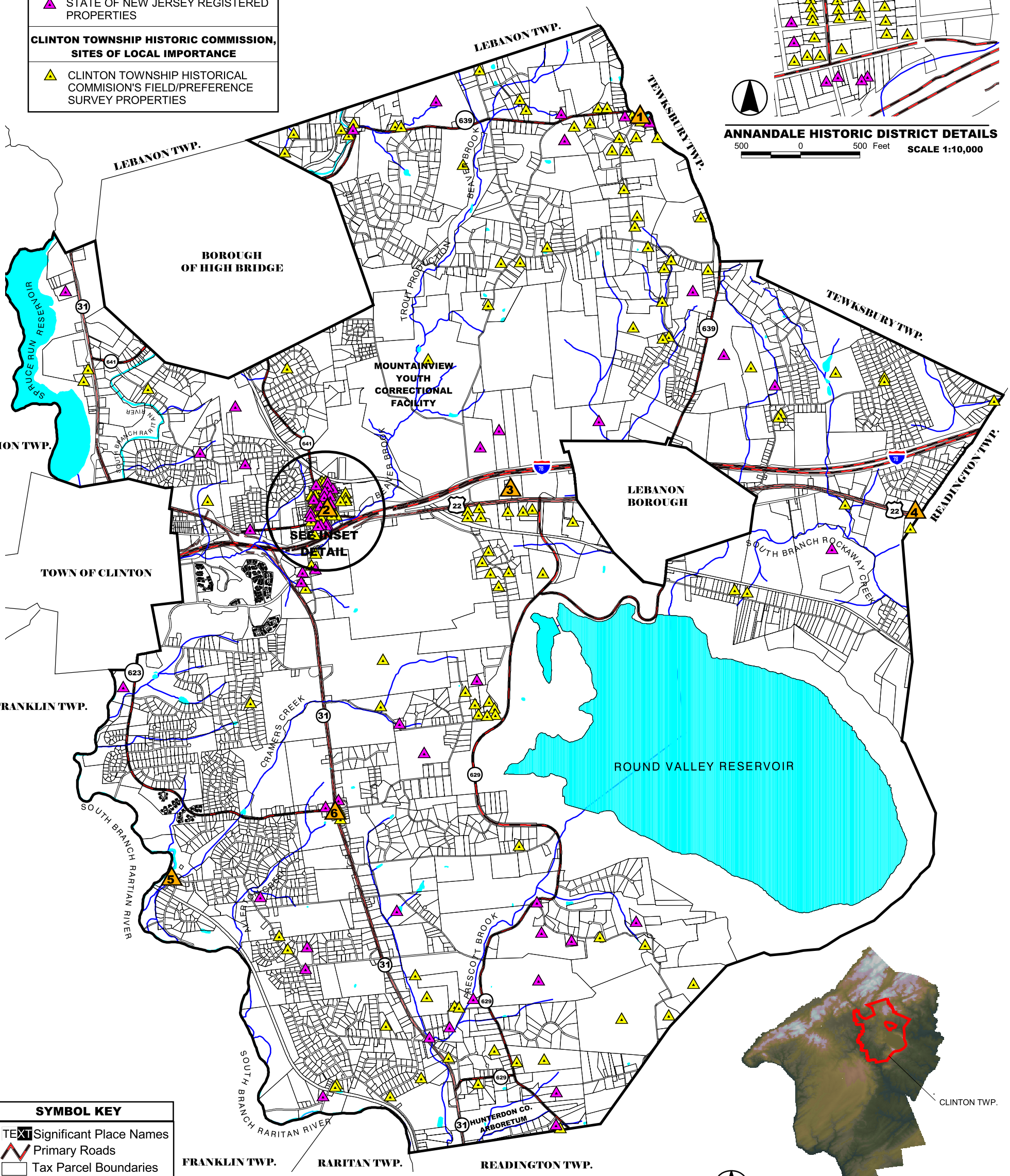
1 - COKESBURY DISTRICT
2 - ANNANDALE DISTRICT
3 - TURNPIKE DISTRICT
4 - POTTERSTOWN DISTRICT
5 - HAMDEN DISTRICT
6 - ALLERTON DISTRICT

STATE REGISTERED HISTORIC STRUCTURES

STATE OF NEW JERSEY REGISTERED PROPERTIES

CLINTON TOWNSHIP HISTORIC COMMISSION, SITES OF LOCAL IMPORTANCE

CLINTON TOWNSHIP HISTORICAL COMMISION'S FIELD/PREFERENCE SURVEY PROPERTIES



SYMBOL KEY

TEXT Significant Place Names
Primary Roads
Tax Parcel Boundaries
Lakes
Networked Streams

CLINTON TOWNSHIP, NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000
Map Projection: State Plane of New Jesey, NAD 83, Feet

Historic Locations generated from tabulated information, supplied by Clinton Township Historic Commission and State registers, Hunterdon County, New Jersey.
Scale: NA
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

NOTES:
1. DATA ACCURACY IS LIMITED TO THE ACCURACY AND SCALE OF THE ORIGINAL DATA SOURCES.

2. THESE MAPS ARE PART OF A RESOURCE INVENTORY CONDUCTED FOR CLINTON TOWNSHIP AND SHOULD BE USED IN CONJUNCTION WITH THE COMPILED TEXT.

MAP 12: HISTORIC RESOURCES

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Surface Water Resources ~

Clinton Township lies within the North and South Branch Raritan Watershed Management Area and in the NJDEP Raritan Water Region. The following section of the NRI locates and describes valuable surface and groundwater resources within Clinton Township including streams, lakes, ponds, wetlands, floodplain areas, and aquifers.

Watershed Resources

A watershed is the drainage basin, catchment, or other area of land that drains water, sediment, and dissolved materials to a common outlet (NJ State Planning Commission, 1992). In local context, the area of land surrounding the Allerton Creek, Beaver Brook, Cramer's Creek, North Branch Rockaway Creek, South Branch Rockaway Creek, Prescott Brook, South Branch Raritan River, Round Valley Reservoir, Spruce Run Reservoir, and Cramers Lake is a watershed.

Point sources of water pollution originate from a distinct source or location. An example of point source pollution is the treated wastewater discharged into a river from a specific outfall. Nonpoint sources of water pollution are more ubiquitous in their origin and are not usually associated with a distinct, specific source. This type of water pollution is associated with common land use activities such as farming, earth disturbance, and lawn fertilization. The type and intensity of land use can significantly impact Clinton Township's rivers, creeks, and lakes. The following section describes the Township's surface water features and summarizes available water quantity and quality information pertaining to surface water resources.

The Statewide Water Quality Management Program Plan guides water quality planning in New Jersey. The plan originally divided New Jersey into twelve (12) water quality-planning areas; however, there are now twenty (20) watershed management areas in the state. Clinton Township is within the North and South Branch Raritan Watershed Management Area, and the NJDEP is the lead agency authorized to carry out water quality planning within the area. The Raritan River Basin is the largest basin located entirely within the State of New Jersey. It contains approximately 2,000 miles of mapped flowing streams and is divided into 16 large hydrologic units, generally corresponding to individual watersheds (e.g., South Branch Raritan) or subdivisions of larger watersheds. The United States Geological Society (USGS) has developed a system of numerical hydrologic unit codes (HUCs) describing the 16 hydrologic units (NJ Water Supply Authority, 2001).

In order to better manage the quality of surface water resources, the NJDEP has further classified each major watershed into Watershed Management Areas (WMAs). The North and South Branch Raritan River Basin is comprised of the North and South Branch Raritan WMA (WMA 8), the Lower Raritan WMA (WMA 9), and the Millstone WMA (WMA 10). Clinton Township is located within the North and South Branch Raritan Watershed Management Area (WMA 8).

It is important to note that the New Jersey Water Supply Authority recently completed a study entitled "The Surface Water and Riparian Areas of the Raritan River Basin: A Technical

Report for the Raritan Basin Watershed Management Project" (NJDEP & NJWSA, 2001). This very comprehensive basin study includes hydrologic and ecologic information specific to the three Watershed Management Areas of the Raritan Basin and should be consulted for additional information.

NJDEP North and South Branch Raritan Watershed Management Area

Table 7 provides information on the watershed area acreage surrounding each surface water resource as well as the length of the major streams and tributaries within Clinton Township (WMA 8). All surface water resources are illustrated on Map 13.

Table 7, Subwatershed Areas & Stream Length

Subwatershed Areas	Watershed Area (Acreage/ Square miles)	Stream Length (Linear feet/ miles)
Allerton Creek	**1,610 / 3**	**111,52 l / 2**
Beaver Brook	**4,031 / 6**	**62,7855 / 12**
Cramers Creek	**1,239 / 2**	**20,835 / 4**
South Branch Rockaway Creek	**4,761 / 7**	**102,421 / 19**
Prescott Brook	**3,160 / 5**	**53,082 l / 10**
South Branch Raritan River	**2,106 / 3**	**64,030 / 12**

*Source: NJDEP / NJWSA, 2001 & **pH** GIS Mapping, 2001.*

Stream Classification

Assessing the quality of surface water resources involves an understanding of the various types of environmental data used to determine water quality. Some of these data are obtained by assessing physical features (e.g., stream depth, stream flow), chemically testing water samples (e.g., dissolved oxygen, temperature, pH), and investigating the biota (e.g., macro-invertebrates, fish, and bacteria). Once the data is obtained and analyzed, water quality can be interpreted and regulatory and non-regulatory management options chosen. This section provides an overview of stream quality based on the physical, chemical, and biological data presently available.

The New Jersey Surface Water Quality Standards (NJAC 7:9) are intended to improve impacted or degraded surface waters, and to protect and maintain the quality of unimpaired surface water resources. The regulations classify all major surface water bodies and establish standards for each of the State's classified lakes and streams and their tributaries. Primary regulatory goals include maintaining and protecting exceptional waterways, and improving degraded waterways through pollution discharge limitations (e.g., anti-degradation). New Jersey Pollution Discharge Elimination System (NJPDES) permits are required for the discharge of pollutants (e.g., treated sewage effluent, some stormwater) into surface waters. The goal of the NJPDES permit program is to prohibit and/or properly manage activities that degrade water quality.

The surface water habitats within the State are classified in part on their ability to support trout and other species of fish. Streams classified as Trout Production (TP) are indicated on Map 13. Trout production streams are those used by trout for spawning and/or nursery purposes, those classified as Trout Maintenance (TM) are those waters with the potential for supporting trout year round, and Non-Trout (NT) waters are those not suitable for trout, but can support a wide variety of other species of fish. There are seven classified streams and two reservoirs in Clinton Township, that were previously described in the Clinton Township Open Spaces Biological Inventory (Grossmueller, 1995) as follows:

- **Allerton Creek –** Allerton Creek is classified as non-trout for its entire length.

- **Beaver Brook –** Beaver Brook is classified as trout production from its source to downstream of the Reformatory Sewage Treatment Facility. Effluent from the treatment facility degrades the water quality to such an extent that no trout reproduction occurs below the point of the discharge. Other species noted in Beaver Brook include white sucker, creek chub, black nosed dace and long nosed dace. Brown trout reproduction has been documented.

- **Cramer's Creek-** Cramer's Creek is classified as non-trout for its entire length until its confluence with the South Branch Raritan River. Species noted in the creek include white sucker, creek chub, black nosed dace and long nosed dace.

- **Rockaway Creek, South Branch-** South Branch Rockaway Creek is classified as trout maintenance over its entire length. Other species inhabiting this creek include: bluegill sunfish, white sucker, creek chub, common shiner, spot tail shiner, black nosed dace, and tessellated darter.

- **Rockaway Creek –** Rockaway Creek is classified as trout maintenance from the confluence of the north and south branches downstream to the Lamington River. The Division of Fish, Game & Wildlife stock the Rockaway annually with brook and rainbow trout. Other species inhabiting the Rockaway include: small mouth bass, largemouth bass, rock bass, pumpkinseed, redbreast sunfish, brown bullhead, white sucker, fallfish, common shiner, spot tail shiner, satin fin shiner, golden shiner, bridled shiner, American eel, and brook lamprey.

- **Prescott Brook –** Prescott Brook is classified as trout maintenance for its entire length. Species inhabiting the brook include: small mouth bass, pumpkinseed sunfish, white sucker, creek chub, fallfish, common shiner, black nosed dace, long nosed dace, and tessellated dace.

- **Raritan River, South Branch –** The South Branch Raritan River is classified as trout maintenance from the confluence with Electric Brook in Long Valley, downstream to the far end of Packers Island. The river is classified as non-trout from the downstream end of Packers Island to the confluence of the North Branch. Portions of the South Branch are stocked annually with brook, rainbow, and brown trout. A small portion of the Ken Lockwood Wildlife Management Area lies within the Clinton Township. This section of the river is classified as Category 1 (originating in parks & wildlife lands).

Brook Trout, Salvelinus fontinalis

Table 8 contains the classification and the quality criteria associated with the rivers and streams in Clinton Township.

Table 8
Surface Water Classification & Designated Uses

Surface Water Resource	Classification	Notes
Allerton Creek	FW2-NT	Fresh Water Category 2, Non-Trout entire length
Beaver Brook	FW2-TM/TP*	Fresh Water Category 2, Trout Maintenance Water
Cramer's Creek	FW2-NT	Fresh Water Category 2, Non-Trout entire length
Rockaway Creek, tributary to North Branch	FW2-TM	Fresh Water Category 2, Trout Maintenance Waters
Rockaway Creek, South Branch	FW2-TM	Fresh Water Category 2, Trout Maintenance
Prescott Brook	FW2-TM	Fresh Water Category 2, Trout Maintenance Water
South Branch Raritan River	FW2-TM	Fresh Water Category 2, Trout Maintenance Waters

Source: NJDEP, Office of Environmental Planning, 2001.
*Note: *A portion of the Beaver Brook is considered Trout Production (TP) in the segment north of the Reformatory Road Wastewater Treatment Facility.*

Surface Water Flow

Stream water flow is defined as the velocity of water as it flows through a cross-sectional area of a stream channel. In general, as the volume of water in a stream or river increases, the water increases in velocity (begins to move faster). The flow of water in a stream also increases with stream order size (NJ Water Supply Authority, 2001).

Changes in surface water hydrology occur for many different reasons. Base flows may be reduced as a result of dense development patterns and associated groundwater withdrawals. Other changes take place when streams are impacted by diversions or dams. The Clinton Township Environmental Commission has expressed concern over the amount of development, the density of development in vulnerable areas (e.g., groundwater recharge areas), and the increased amount of impervious surface (e.g., parking lots, homes, roads) associated with the Township's development. For instance, when impervious cover is placed over permeable soils, the amount of water infiltrating into the ground is reduced. Since groundwater supplies base flow to streams, impermeable cover contributes to reduced flow. Increased impermeable cover also results in additional surface water runoff, especially after intense storm events. Many of the aquatic and semi-aquatic organisms found of Clinton Township's streams and floodplains rely upon adequate base flow and seasonal fluctuations of base flow for ecological stability. Alterations of stream hydrology can cause significant, irreversible changes in biotic composition.

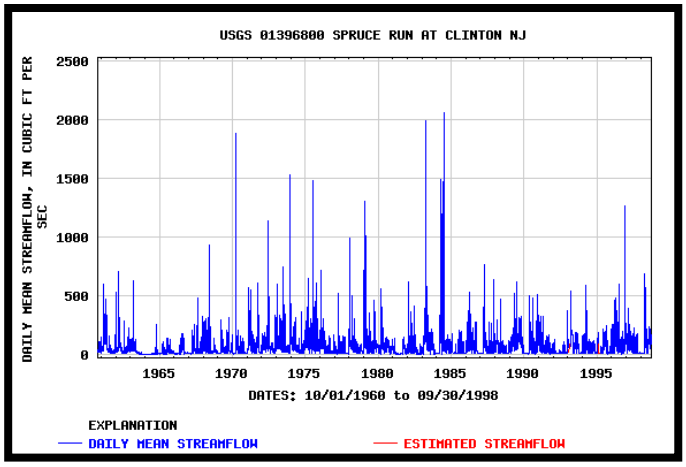
In order to assess regional flow, minimum, maximum and low flow data were obtained from USGS monitoring efforts. This information was accessed from USGS stream gauging stations located throughout the Raritan Basin.

Table 9, Surface Water Flow Data

Location	Min. Flow (cfs)	Max Flow (cfs)	Mean Flow (cfs)
Spruce Run at Clinton, NJ #01396800	**-**	**-**	**6,320 cfs (At flood stage)**
SB Raritan R at Clinton, NJ #01396810	**5.3 cfs**	**685 cfs**	**345 cfs (38 years)**
SB Raritan River at High Bridge, NJ #01396500	**33 cfs**	**2,288 cfs**	**1,161 cfs (78 years)**

Source: USGS Daily Mean Discharge Data, 2001.

In order to ensure an adequate water supply for humans and to continue to provide habitat for important aquatic species, long-term flow data is needed. A graphic depiction of daily mean stream flow is presented below for the Spruce Run Monitoring Station. The graph below presents streamflow from 1965 through 1995. The peak daily mean streamflow was recorded in 1984, and the daily low mean streamflow was recorded in 1963. Overall, these data demonstrate the "flashy", erratic nature of the Township's waterways; the data also demonstrate the seasonal influence of precipitation and runoff on stream flow. These data suggest that the streams within the Township have a marginal capacity to ameliorate increases in peak flows. Some of this is likely a function of the soils and geology of the watershed but is also determined by the geometry of the streams, and the extent of their floodplain.



Source: USGS Monitoring Station at Spruce Run, Clinton NJ USGS Website, 2001.

Additional surface water flow information for the North and South Branch Raritan WMA is included in the Surface Water and Riparian Areas of the Raritan River Basin Study (New Jersey Water Supply Authority, Draft 2001). The report notes the importance of obtaining low flow data and defines low flow as "the flow of a stream that is less than an average minimum flow for a given number of consecutive days." The report also notes that the increased frequency of low flows may signify an impairment of the water body and can affect its ability to satisfy designated uses.

Table 10 lists stream flow from 21 New Jersey Department of Environmental Protection and United States Geological Survey monitoring stations located throughout the Raritan Basin. All sites listed may not be located in Clinton Township proper, but the data is indicative of low stream flow data experienced throughout the Raritan Basin.

Table 10, USGS 7-Day, 10-year Low Flow Data, Raritan Basin

USGS Site Number	Site Name	Low Flow (Ft^3 / Sec)
01396280	South Branch Raritan, Middle Valley	15
01396535	South Branch Raritan River, Arch Street, High Bridge	18
01396588	Spruce Run, Near Glen Gardner	2.2
01396660	Mulhockaway Creek, Van Syckel	2.2
0139700	South Branch Raritan, Stanton	46*
01397400	South Branch Raritan, Three Bridges	46*
01398000	Neshanic River, Reaville	.27
01398260	North Branch Raritan, Chester	.80
01399120	North Branch Raritan, Burnt Mills	6.8
01399500	Lamington River, Pottersville	5.3
01399700	Rockaway Creek, Whitehouse	5.7
01399780	Lamington (Black River) at Burnt Mills	12
01400500	Raritan River, Manville	95*
01400540	Millstone River, Manalapan	2.9
01400650	Millstone River, Grovers Mill	4.0
0140100	Stony Brook, Princeton	.22
01401600	Beden Brook, Rocky Hill	.13
01402000	Millstone River, Blackwells Mills	17
01403300	Raritan River, Queens Bridge, Bound Brook	74*
01405302	Matchaponix Brook, Mundy Avenue, Spotswood	4.5
01405340	Manalapan Brook, Federal Road, Manalapan	5.8

Source: NJ Water Supply Authority, Surface Water and Riparian Areas of the Raritan River Basin, 2001.
** Indicates sites that were calculated using streamflow records after 1963 (When streamflow regulation commenced at Spruce Run & Round Valley Reservoir)*

Surface Water Quality

Historic water quality monitoring information was obtained from the United States Geologic Survey (USGS) and the New Jersey Department of Environmental Protection (NJDEP). Water quality information was also obtained from other sources including the 1976 Clinton Township NRI, the New Jersey Surface Water Quality Inventory Reports, and the Surface Water and Riparian Areas of the Raritan River Basin Report (NJ Water Supply Authority, Draft, 2001).

The 1976 Clinton Township NRI concluded that based on the water quality parameters tested (e.g., inorganic chemical ions, phosphate, nitrate, coliform bacteria, dissolved oxygen, biological chemical demand); the streams in Clinton Township had "good surface water quality" (South Branch Watershed Association, 1976).

The 1995-2000 New Jersey Water Quality Inventory Reports contain additional water quality data including attainment of designated uses, long-term trends, and shellfish consumption advisories. Fourteen reports have been completed since 1976, however, not all streams have been monitored since program inception. USGS and NJDEP monitoring stations in the Raritan Basin are illustrated below, while those within Clinton Township are included on Map 13.

The water quality parameters for the 1998 NJDEP Water Quality Inventory (303d List) reports include: dissolved oxygen, temperature, nutrients, bacteria, heavy metals, and pH. Data obtained through the NJDEP reports indicate that overall water quality is good in Clinton Township although some problems are evident. For instance, warm summertime temperatures threaten aquatic life, especially in the trout maintenance (TM) portions of the waterways. In addition, phosphorus is slightly elevated and sanitary quality is marginally acceptable. Data also indicate that elevated lead levels may be threatening the aquatic life.

In 1991, the NJDEP Bureau of Freshwater and Biological Monitoring established the Ambient Bio-monitoring Network (AMNET). The program was designed to obtain long-term monitoring data, and to support future regulatory and policy decisions. The primary data relied upon for the AMNET program is biological. Biological impairment may be caused by several major factors including nutrient enrichment, habitat degradation, or toxic chemicals.

Water quality impairment has a direct impact upon the distribution, abundance and diversity of macroinvertebrates. Therefore, the presence of pollution-tolerant macroinvertebrates (e.g., midges and worms) allows biologists and regulators to draw conclusions about water quality. The NJDEP's definitions for impairment of New Jersey waterways are as follows:

- **Non-impaired:** Benthic community comparable to other undisturbed streams within the region. A community characterized by maximum taxa richness (number of different families in a sample), balanced taxa groups and good representation of intolerant individuals.

- **Moderately impaired:** Macroinvertebrate richness is reduced, in particular EPT taxa (Ephemeroptera, Pecoptera and Tricoptera orders). Taxa composition changes results in reduced community balance and pollutant intolerant taxa become absent.

- **Severely impaired:** A dramatic change in the benthic community has occurred. Macroinvertebrates are dominated by a few taxa, which are very abundant. Tolerant taxa are the only individuals present.

An extensive amount of macroinvertebrate analysis has been performed in the North and South Branch Raritan watershed management area. Conditions are noted to improve as the waters travel downstream to Clinton where waterways indicate nonimpaired conditions. In 1999, 67 monitoring stations were sampled in Watershed Management Area #8 (WMA) of the North and South Branches of the Raritan River. The macroinvertebrate (bioassessment) data results indicated that 73.1% of the sites in the WMA were non-impaired, 25.4% were moderately impaired, and only one site 1.5% was rated as severely impaired. Comparison of results from 1994 show habitat trends remain fairly constant, and at near optimum levels. Thus, while there may be some localized degradation from agricultural or residential sources, stream biotic the NJDEP has reported that integrity is generally quite favorable.

The New Jersey Water Supply Authority includes similar information, but for the entire Raritan Basin (1,100 square miles). Biological data included in the draft report includes information on 144 AMNET sites. The report states that of the 144 sites that were sampled between 1993 and 1994 in the Raritan Basin, 37.5% were rated as non-impaired, 56.9 % were rated as moderately impaired and 5.6% were rated as severely impaired (NJ Water Supply Authority, Draft, 2001). More information may be obtained from that study.

Floodplain & Riparian Corridors ~

Floodplains

Floodplains are transitional ecosystems comprised of both aquatic and terrestrial organisms. Floodplains contain a diverse array of vegetation and wildlife associated with open water and land. They are valuable in terms of their ecological, aesthetic, recreational, and economic benefits. During storm events floodplains absorb water, recharge aquifers, trap sediments, and help to ameliorate the erosive forces of floodwaters on stream banks. Floodplain areas also are important habitat linkages often providing travel corridors for wildlife between aquatic, terrestrial and wetland ecosystems.

Floodplain & Riparian Buffer Area, Cramers Creek

Clinton Township contains approximately 21,693 acres of floodplain resources (Table 11). They are adjacent to Township rivers and lakes and are illustrated on Map 13.

Table 11, Floodplain Resources

Surface Water Resource	River Length (Mi)	Floodplain Area (Acres)
South Branch, Raritan River	**12**	**391**
South Branch, Rockaway Creek	**19**	**102**
Beaver Brook	**12**	**125**
Prescott Brook	**10**	**112**
Allerton Creek	**2**	**51**
Cramer's Creek	**4**	**49**

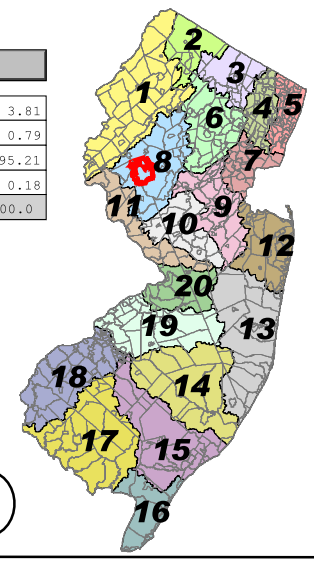
Source: pH Map 13 and associated GIS data, 2001.

AMNET BIOLOGICAL MONITORING SITES (2000) SYMBOL LEGEND

KEY	SITE ID	STREAM NAME	LOCATION
	AN0320	WILLOUGHBY BROOK	ROUTE 31
	AN0322	SOUTH BRANCH RARITAN RIVER	ROUTE 173 & ROUTE 513
	AN0323	BEAVER BROOK	HERMAN THAU ROAD
	AN0324	BEAVER BROOK	LEHIGH STREET
	AN0325	CAKEPOULIN CREEK	LOWER LANSDOWN ROAD
	AN0326	SOUTH BRANCH RARITAN RIVER	STATION ROAD
	AN0327	PRESCOTT BROOK	STATION ROAD
	AN0367	ROCKAWAY CREEK, SOUTH BRANCH	WINDY ACRES FARM

FEMA FLOODPLAIN SYMBOL LEGEND

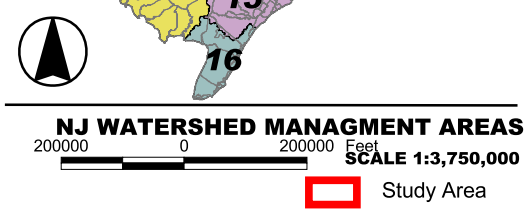
KEY	ZONE	DESCRIPTION	ACREAGE	PERCENTAGE
	A	AREAS OF 100 YR. FLOOD: FACTORS NOT DETERMINED	827.00	3.81
	AE	AREAS OF 100 YR. FLOOD: BFE'S DETERMINED	171.98	0.79
	X	AREAS OF MINIMAL FLOODING	20654.12	95.21
	X500	AREAS OF 500 YR. FLOOD	39.80	0.18
		TOTAL	21692.90	100.0



MAJOR WATERSHEDS OF CLINTON TOWNSHIP

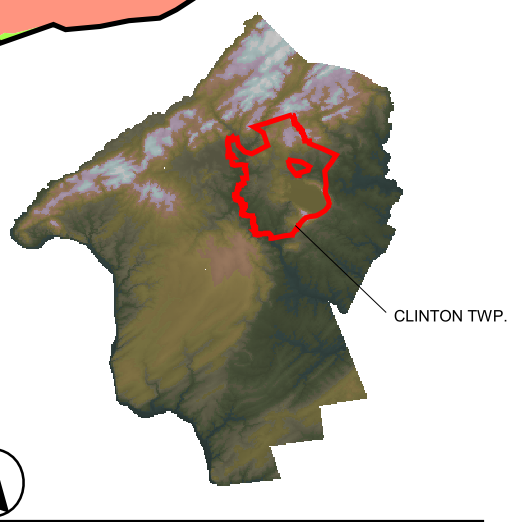
- Beaver Brook (Clinton)
- Holland Brook
- Pleasant Run
- Prescott Brook / Round Valley Reservior
- Raritan R SB(Prescott Bk to River Rd)
- Raritan R SB(River Rd to Spruce Run)
- Raritan R SB(Spruce Run-StoneMill gage)
- Raritan R SB(StoneMill gage to Califon)
- Rockaway Ck (RockawaySB to McCrea Mills)
- Rockaway Ck (above McCrea Mills)
- Rockaway Ck SB
- Spruce Run Reservior / Willoughby Brook

LEBANON TWP.
TEWKSBURY TWP.
LEBANON TWP.
BOROUGH OF HIGH BRIDGE
SPRUCE RUN RESERVOIR
UNION TWP.
MOUNTAINVIEW YOUTH CORRECTIONAL FACILITY
LEBANON BOROUGH
TEWKSBURY TWP.
READINGTON TWP.
TOWN OF CLINTON
FRANKLIN TWP.
ROUND VALLEY RESERVOIR
SOUTH BRANCH RARITAN RIVER
HUNTERDON CO. ARBORETUM
FRANKLIN TWP.
RARITAN TWP.
READINGTON TWP.
3405050002A
3405050001A
3405050004A
3405050010A
3405050016A
3405050003A
3405050020A
3405050015A
BEAVER BROOK
TROUT PRODUCTION
ROCKAWAY CREEK
CRAMERS CREEK
PRESCOTT BROOK
639
641
31
22
78
629
623



SYMBOL KEY

- TEXT Significant Placenames
- Primary Roads
- Tax Parcel Boundaries
- Lakes
- Networked Streams
- ### FEMA Panel Information



USGS SURFACE WATER MONITORING LOCATIONS SYMBOL LEGEND

KEY	USGS ID	LATITUDE	LONGITUDE	LOCATION
	1396800	40de 38' 21"	74de 54' 58"	SPRUCE RUN AT CLINTON, NJ
	1396810	40de 38' 09"	74de 54' 45"	SPRUCE RUN AT CLINTON, NJ
	1396500	40de 40' 40"	74de 52' 46"	SOUTH BRANCH RARITAN RIVER AT HIGH BRIDGE, NJ

30000 0 30000 Feet
Study Area

HUNTERDON COUNTY
SCALE 1:800,000

CLINTON TOWNSHIP, NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000
Map Projection: State Plane of New Jesey, NAD 83, Feet

New Jersey, Department of Interior, Geologic Survey, GIS data Downloads, Monochromatic Bitmap Geographic Images of Hunterdon County, New Jersey.
Scale 1:24,000
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

NOTES:
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2. THESE MAPS ARE PART OF A RESOURCE INVENTORY CONDUCTED FOR CLINTON TOWNSHIP AND SHOULD BE USED IN CONJUNCTION WITH THE COMPILED TEXT.

MAP 13: SURFACE WATERS, WATERSHED & FLOODPLAIN RESOURCES

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

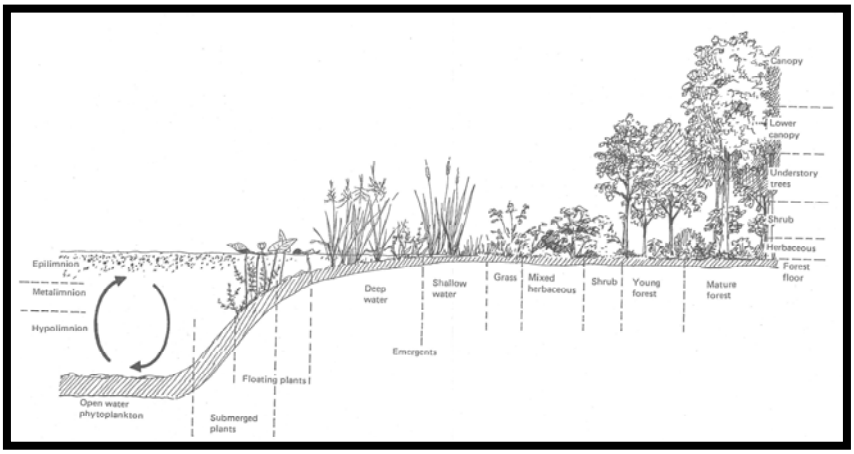
pH

Riparian Corridors

The riparian zone of a river, stream, or other body of water is the land adjacent to the body of water that is, at least periodically, influenced by flooding Riparian habitats are among the most productive environments in the northeastern United States. Fertile soils, periodic disturbances, frequent influxes of nutrients and organic matter, and abundant moisture contribute to create diverse, complex plan communities that provide habitat for many types of wildlife. When there are large, contiguous riparian habitats, they are considered riparian corridors (Mitch & Gosselink, 1986).

An adequate riparian corridor habitat is important for a variety of reasons. Ecologically, the riparian zone is an extremely complex ecosystem. The vegetated riparian zone provides important nesting and feeding habitat for wildlife and provides a travel corridor for wildlife movement. In fact, riparian corridors provide habitat for a wide variety of fish, mammals, reptiles, amphibians, and invertebrates. They are also useful as dispersal corridors and are often a refuge for large mammals. In addition, riparian corridors often provide travel corridors for migratory birds.

Vegetated riparian corridors are also useful to humans. For instance, recreational trails are a possibility in stream buffer areas, especially if the buffer areas join other buffered corridors. The riparian zone also reduces the impact of periodic flooding because the vegetation in the buffer zone reduces the amount of runoff reaching the channels. The soil and vegetation in the buffer zone act as a storage area for flooded waterways. A vegetated riparian zone can be effective in removing excess nutrients and sediment from surface runoff and shallow groundwater. Riparian corridors also amend the effects of some pesticides and directly provide dissolved and particulate organic food needed to maintain high biological productivity and diversity in the adjoining stream.



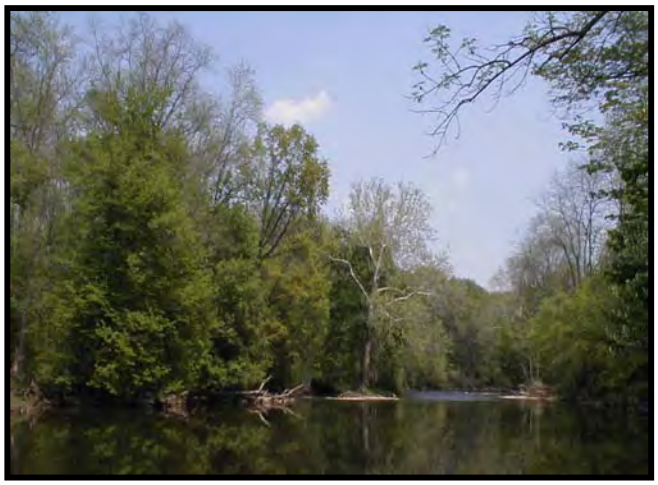
Source: The Riparian Zone, USEPA, 1996.

Wetlands

Wetlands are among the most important ecosystems, supplying a variety of important functions. They are sometimes described as the kidneys of the landscape for the pollutant filtering functions they perform (Mitch & Gosselink, 1986). Wetlands absorb floodwaters, protect shorelines, provide habitat for a wide variety of plants and animals, recharge groundwater aquifers, and cleanse polluted waters.

Wetlands do more to safeguard both water quality and quantity than any other land feature on an acre-for-acre basis. Wetlands, which include swamps, marshes, bogs, and similar areas, act as natural catchment basins during floods and storms by retaining excessive waters and gradually releasing them into the ground or nearby surface waterways. During the dry season, wetlands also release waters to ground and surface water sources, thus helping to maintain relatively stable flows during low flow periods. In addition, wetlands purify the quality of water by filtering, assimilating and recycling pollutants.

Clinton Township has over 3,600 acres of agricultural, forested, and herbaceous wetlands (Map 14). The map includes the following NJDEP wetland categories: modified agricultural, deciduous scrub/shrub wetlands, disturbed, herbaceous, managed modified, and right-of-ways (modified). The majority of wetlands in the Township are ecologically categorized as "riparian" (deciduous wooded & deciduous scrub/shrub wetlands), because they are located next to the streams and rivers (Mitch & Gosselink, 1986). The National Wetlands Inventory (NWI) mapping equivalent category (Cowardin et al., 1979) is Palustrine. Palustrine wetlands are distinguished by their unique and valuable combination of high species diversity, high species densities, and high productivity. This characterization is due to the abundance of water, periodic flooding, and rich alluvial soils. As a result, there are frequent ecological and physical interactions between open water, riparian, and upland terrestrial species.

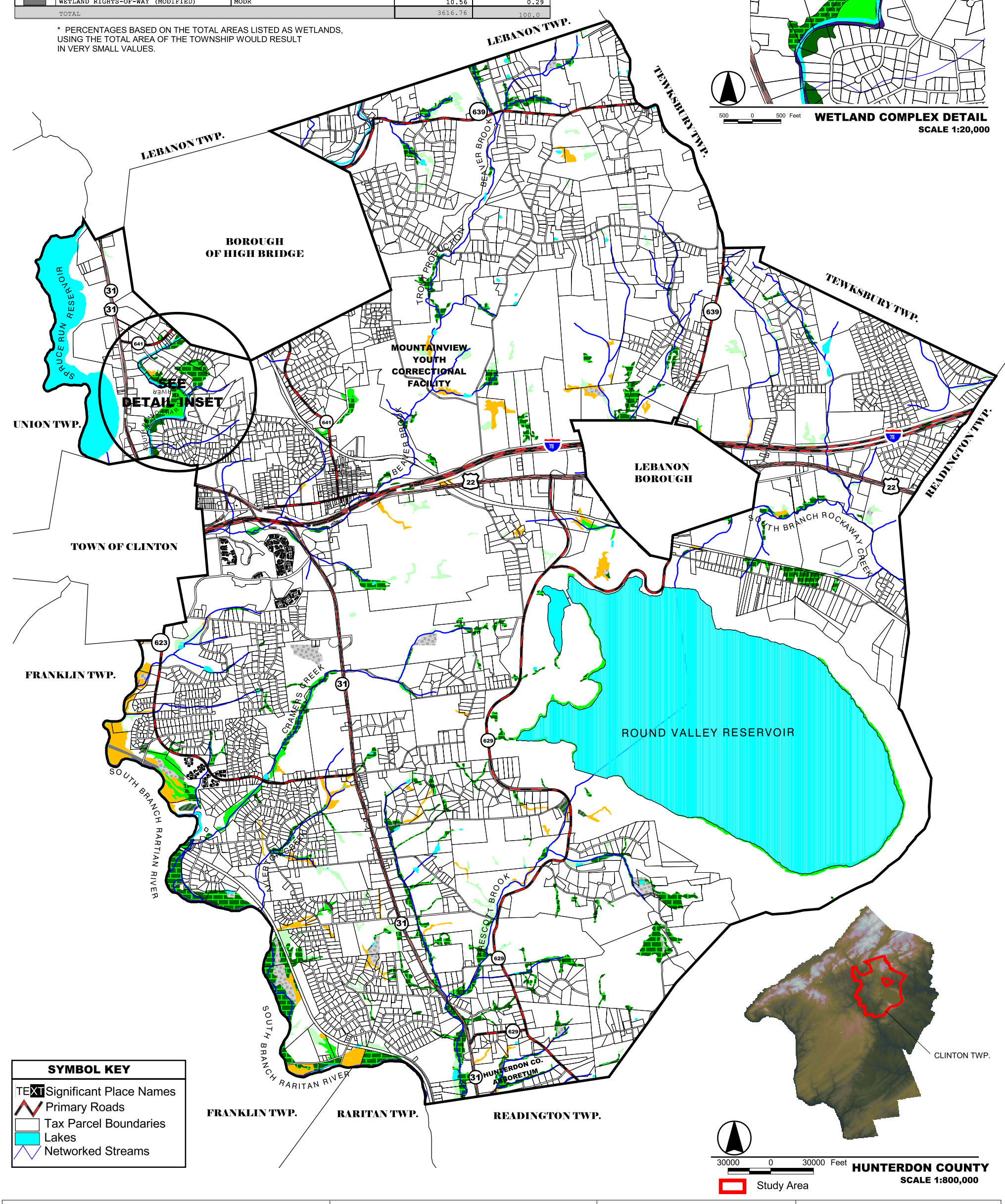


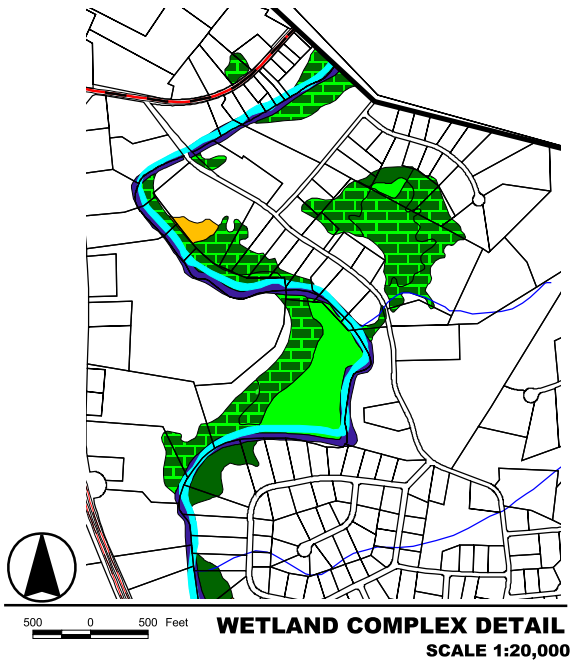
Palustrine Wetlands Adjacent to South Branch Raritan River

WETLAND DELINATION SYMBOL LEGEND

KEY	DESCRIPTION	COWARDIN	ACREAGE	PERCENTAGE*
	AGRICULTURAL WETLANDS (MODIFIED)	MODAg	198.14	5.48
	ARTIFICIAL LAKES	L20WHh, POWHh, POWHx	2253.03	62.29
	DECIDUOUS SCRUB/SHRUB WETLANDS	PSS1A, PSS1B, PSS1C, PEM1B, PFO1B	201.37	5.57
	DECIDUOUS WOODED WETLANDS	PFO1B, PEM1B, PSS1B, PFO1C, PEM1C, PFO1E, PFO1B, PFO1A	626.19	17.31
	DISTURBED WETLANDS (MODIFIED)	MODD	14.57	0.40
	HERBACEOUS WETLANDS	PEM1B, PSS1B, PEM1Bh, L2US1Ah, PEM1C	158.33	4.38
	MANAGED WETLANDS (MODIFIED)	MODL	22.10	0.61
	STREAMS AND CANALS	R20W, R3UB1, R30W	51.30	1.42
	UPLANDS	UPLAND	81.17	2.24
	WETLAND RIGHTS-OF-WAY (MODIFIED)	**MODR**	**10.56**	**0.29**
	TOTAL		3616.76	100.0

* PERCENTAGES BASED ON THE TOTAL AREAS LISTED AS WETLANDS, USING THE TOTAL AREA OF THE TOWNSHIP WOULD RESULT IN VERY SMALL VALUES.





CLINTON TOWNSHIP, NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000
Map Projection: State Plane of New Jesey, NAD 83, Feet

New Jersey, Department of Interior, Geologic Survey, GIS data Downloads, Monochromatic Bitmap Geographic Images of Hunterdon County, New Jersey.
Scale 1:24,000
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

NOTES:
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MAP 14: WETLAND RESOURCES

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Groundwater Resources, Quantity, and Quality ~

An aquifer is a geologic formation capable of supplying water through wells. A geologic formation that contains water in useable amounts is an aquifer. As noted in the figure below, Clinton Township is underlain by the Newark regional and Highland crystalline aquifers.

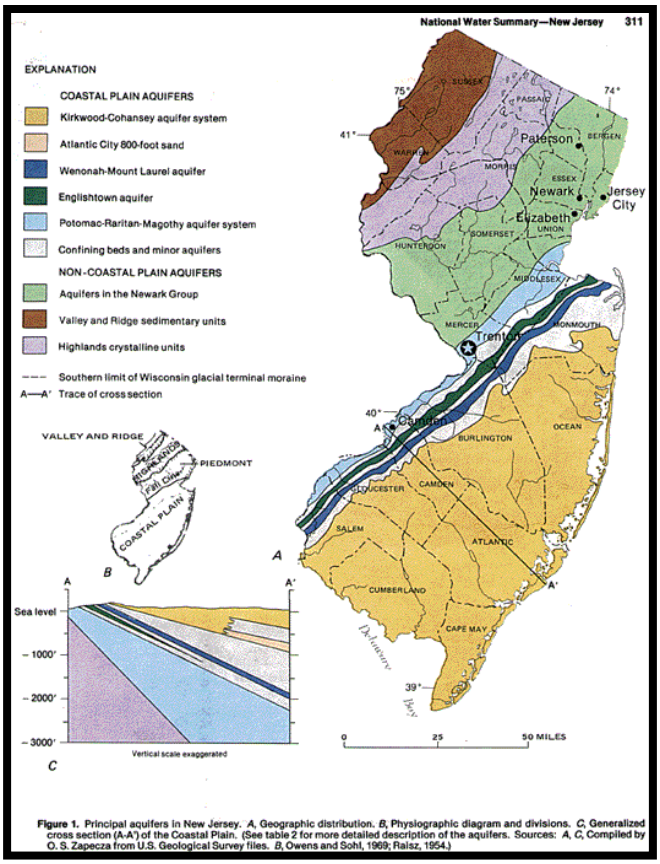


Figure 1. Principal aquifers in New Jersey. A, Geographic distribution. B, Physiographic diagram and divisions. C, Generalized cross section (A-A') of the Coastal Plain. (See table 2 for more detailed description of the aquifers. Sources: A, C, Compiled by O. S. Zapecza from U.S. Geological Survey files. B, Owens and Sohl, 1969; Raisz, 1954.)

Source: Coastal and Non-Coastal Plain Aquifers, USGS, 1969.

The geology and geologic resources of Clinton Township were presented earlier in Section II. Geologic formations play an integral role in the physical location and the yield of groundwater aquifers.

Clinton Township is underlain by a multitude of geological formations; in fact, nine of the twelve mapping units included in the "Geologic Map of Hunterdon County" are found within the Township. Different groundwater yields are associated with each geologic formation. Approximately thirty-four percent (34%) of the Township water supply is obtained from the igneous and metamorphic rock aquifer, followed by the Brunswick Aquifer, Stockton Formation Conglomerate and Jacksonburg, Limestone, Kittatinny Supergroup and Hardyston Quartzite (Clinton Township Master Plan, 1999).

All groundwater occurs in cracks, solution openings, or small-interconnected spaces between individual grains in the rock. Permeable rock contains spaces between interconnected grains of porous rock where water may travel more or less freely from opening to opening. The amount of porosity depends primarily upon the shape of the grains (the more spherical the better) and the degree of sorting (the more uniform the better). Permeability on the on the other hand depends less on the sorting or shape than on the amount and nature of the cementing material. Rocks, such as argillite, shale, limestone, diabase and gneisses, for all practical purposes, are considered non-porous.

Ground water unable to travel through the space between grains must travel through fractures, joints and solution openings found throughout the whole formation. A well in these rock types must, if it is to yield water, intersect open, water-bearing fractures. Review of some of these well records near Clinton Township shows that both very poor and very prolific wells are located in Kittatinny Limestone. However, groundwater development with moderate to high capacity wells can be satisfactorily achieved in most areas underlain by the Brunswick Shale, the Stockton Formation, the Kittatinny Limestone and in a few small areas in the valleys of the Precambrian Highlands.

The potable water in Clinton Township is supplied either by individual groundwater wells or community groundwater wells supplied to neighborhoods via the Town of Clinton Water Department. The Town of Clinton Water Department has community, groundwater wells in Clinton Point, Beaver Brook, Deer Hill Road in Potterstown, and Lilac Drive below Hibbler Road. Another production well is located on Gray Rock Road in the Borough of High Bridge. The three wells within Clinton Township are in the Jacksonburg Limestone, Martinsburg, and Brunswick Formations (Map 15).

The Town of Clinton Water Department supplies groundwater to the following: Beaver Brook development, along portions of Regional Road, areas along Hamden Road, Wellington Drive and Lilac Drive, and extending from Annandale along Route 78 to Cokesbury Road. The service areas include much of the higher density residential development in the Township including: Annandale (Studer and Gray Rock Roads), Beaver Brook and associated residential areas (Regional Road west of Route 31), and Potterstown and the Blossom Hill Road area (Banisch Associates, 1992). For areas reliant upon groundwater for drinking, a sustainable groundwater supply is imperative. Therefore, planning for a sustainable, potable groundwater supply is important to the citizens of Clinton Township.

Groundwater Quantity

Different groundwater yields are associated with each geo-hydrologic class. The following table (Table 12) illustrates the well yields associated with three major aquifers in Hunterdon County.

Table 12, Summary of Hunterdon County Domestic Well Yield

Aquifer/Formation	Number of Wells	Average Yield (gpm)	Median Yield (gpm)
Diabase Intrusives & Basalt Flows	65	8	5
Brunswick Shale	528	19	15
Lockatong Formation	186	12	6
Stockton Formation	162	20	18
Border Conglomerates	94	15	12
Baked Brunswick Shale	64	9	6
Argillite, siltstone, and gray shale (within Brunswick)	32	10	7
Martinsburg Shale	23	17	12
Kittatinny Limestone	70	17	15
Precambrian & Hardyston	203	14	15

Source: Geology & Groundwater Resources of Hunterdon County, NJ, Bureau of Geology, 1966.

Data illustrating long-term groundwater well quantity is available through the United States Geologic Society (USGS) and the New Jersey Department of Environmental Protection (NJDEP, Water Resources of NJ Homepage, 2001). For instance, a USGS test well is located at the Hunterdon County Arboretum (Route 31, Clinton Township). The drilled observation well (# 190276) has a depth of 175 feet and is within the Stockton Formation.

Digital water level recordings (60 minutes) are available for the March 29, 1994 to the present period of record. The period of record indicates the highest water level at 8.44 feet below land surface (March 29, 1994) and the lowest water level at 12.75 feet below land surface (August 11, 1995). Monitoring information for the ten-year period is presented in the graph below. Long-term monitoring information, as presented below, is useful to water supply planners. In fact, long-term water level information helps resource planners determine the adequacy of groundwater resources available to existing and projected populations.

USGS MONITORING WELLS

KEY	USGS ID	WELL NAME	FORMATION	LONGITUDE	LATITUDE	WELLUSE
	515201	Rolling Hills Cave	Stockton	74de 51' 52"	40de 35' 32"	Unused
	540901	Camp Carr Residence	Stockton	74de 54' 09"	40de 35' 56"	Domestic
	561901	Clinton Prison	Ordovician system	74de 56' 19"	40de 37' 33"	Public Supply
	543301	HB Zellman	Kittatinny	74de 54' 33"	40de 39' 23"	Public Supply

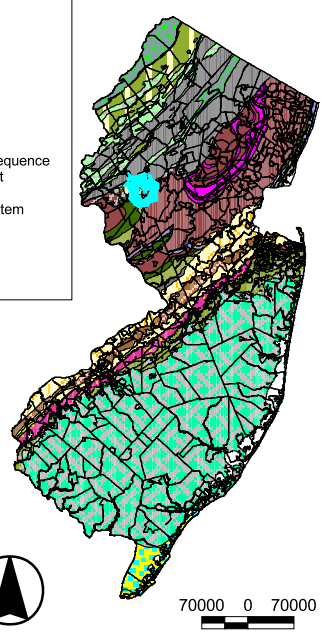
COMMUNITY WELL SYMBOL LEGEND

KEY	WELL #	USGS_ID	LONGITUDE	LATITUDE	ELEV.	WELLUSE
	527	190079	74de.48'01"	40de.39'04"	370	PUBLIC COMMUNITY
	547	190307	74de.52'24"	40de.34'54"	150	PUBLIC COMMUNITY
	564	190315	74de.53'49"	40de.38'12"	220	PUBLIC COMMUNITY
	577	190300	74de.54'33"	40de.39'22"	205	PUBLIC COMMUNITY
	585	190316	74de.53'46"	40de.38'24"	230	PUBLIC COMMUNITY

AQUIFER SYMBOL LEGEND

KEY	ABBR.	RANK	AQUIFER NAME	ACREAGE	PERCENTAGE
	ba	C	Brunswick Aquifer	4428.03	20.41
	bac	C	Brunswick Aquifer Conglomerate	608.18	2.80
	db	E	Diabase	1923.06	8.86
	imr	D	Igneous and Metamorphic Rocks	7404.42	34.13
	jkh	C - B	Jacksonburg Limestone, Kittatinny Supergroup, and Hardyston Quarzite	2821.45	13.02
	mfjs	D	Martinsburg Formation and Jutland Sequence	462.29	2.13
	sf	C	Stockton Formation	1089.12	5.02
	sf	C	Stockton Formation Conglomerate	2956.39	13.63
Total				21692.94	100.0

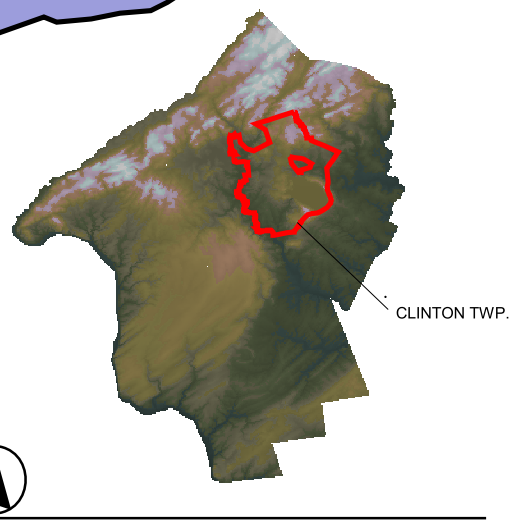
SYMBOL KEY
- Basalt
- Brunswick aquifer
- Brunswick aquifer conglomerate
- Composite confining unit
- Composite confining unit aquifer
- Diabase
- Englishtown aquifer system
- Holly Beach water-bearing zone
- Igneous and metamorphic rocks
- Jacksonburg Limestone, Kittatinny Supergroup, and Hardyston Quarzite
- Kirkwood-Cohansey aquifer system
- Lockatong Formation
- Lockatong Formation conglomerate
- Marshalltown-Wenonah confining unit
- Martinsburg Formation and Jutland Sequence
- Merchantville-Woodbury confining unit
- Mt. Laurel-Wenonah aquifer
- Potomac-Raritan-Magothy aquifer system
- Rocks of the Green Pond Mt. Region, Kittatinny Mt., and Minisink Valley
- Stockton Formation
- Stockton Formation conglomerate



BECROCK AQUIFERS OF N.J.
Study Area
SCALE 1:3,500,000

LEBANON TWP.
TEWKSBURY TWP.
BOROUGH OF HIGH BRIDGE
UNION TWP.
TOWN OF CLINTON
FRANKLIN TWP.
LEBANON BOROUGH
READINGTON TWP.
RARITAN TWP.
MOUNTAINVIEW YOUTH CORRECTIONAL FACILITY
ROUND VALLEY RESERVOIR
SPRUCE RUN RESERVOIR
BEAVER BROOK
TROUT PRODUCTION
SOUTH BRANCH ROCKAWAY CREEK
CRAMERS CREEK
ALLERTON CREEK
PRESCOTT BROOK
SOUTH BRANCH RARITAN RIVER
HUNTERDON CO. ARBORETUM
639
641
31
22
78
623
629

SYMBOL KEY
- TEXT Significant Place Names
- Primary Roads
- Tax Parcel Boundaries
- Lakes
- Networked Streams



30000 0 30000 Feet
Study Area
HUNTERDON COUNTY
SCALE 1:800,000

CLINTON TOWNSHIP, NRI, 2001

2000 0 2000 4000 6000 8000 Feet
SCALE 1: 45,000
Map Projection: State Plane of New Jesey, NAD 83, Feet

New Jersey, Department of Interior, Geologic Survey, GIS data Downloads, Bedrock Aquifers and Public and Municiple Wells of New Jersey.
Scale 1:50,000
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

NOTES:
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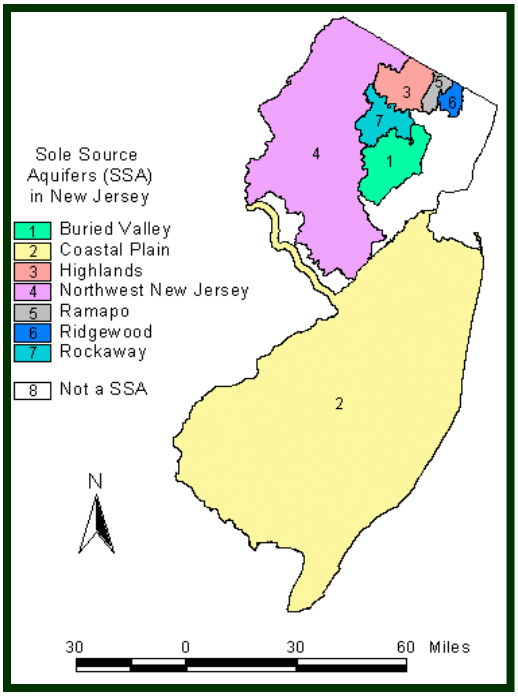
MAP 15: AQUIFER & COMMUNITY WELLS MAP

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Sole Source Aquifers

The aquifers beneath Clinton Township are federally designated (Safe Drinking Water Act, Section 1424e) *Sole Source Aquifers*. Sole Source Aquifers (SSA) are those aquifers contributing more than fifty percent (50%) of the drinking water to a specific area.



Source: Sole Source Aquifers in NJ, NJDEP, 1988.

The designation is designed to protect groundwater supplies in areas with few or no alternative sources of potable ground water. If groundwater contamination were to occur, using an alternative potable drinking water source would be extremely difficult and most likely intensely expensive. Clinton Township is within the designated SSA area known as the *Northwest New Jersey Fifteen Basin Aquifer System* (NJDEP SSA Petition Documentation, 1988).

The SSA designation requires the United States Environmental Protection Agency (USEPA) to review all federally funded projects in areas that could impact the SSA. The review includes projects that could affect areas contributing to aquifer recharge (recharge zone) as well as impact areas that are upstream and contributing to aquifer recharge (stream flow source zone).

Recognizing the importance of aquifer recharge areas, the Clinton Township Environmental Commission completed a Groundwater Recharge Study (GeoEnvironmental Resources, 1997). The study resulted in a technical report and a map that located recharge areas throughout the Township (Map 16). Groundwater Recharge was defined as recharge that infiltrates into the ground to a depth below the root zone, based on a monthly soil-water-budget approach. The map was prepared by ranking land use/land cover (LULC) categories and by grouping the various soil types based on groundwater recharge potential in accordance with the New Jersey Geologic Survey (NJGS) guidance document entitled "A Method for Evaluating Ground-Water Recharge Areas in New Jersey" (NJGS, 1993).

The 1999 report stresses that the recharge potential was mapped irrespective of the aquifer materials present in the subsurface. The three recharge ranges (low, moderate, and high) are based upon the groundwater recharge of the land surface in Clinton Township (range 0-28.44 in/yr.) and are simplified for mapping purposes. They are therefore based on the distribution of recharge against land surface area. These data suggest that the Township is dominated by moderate groundwater recharge, although areas of high recharge are scattered throughout the Township.

KEY	RANK	ACREAGE	PERCENTAGE*
	HIGH	4827.89	27
	MODERATE	10158.71	57
	LOW	2841.31	16
TOTALS		178287.91	100

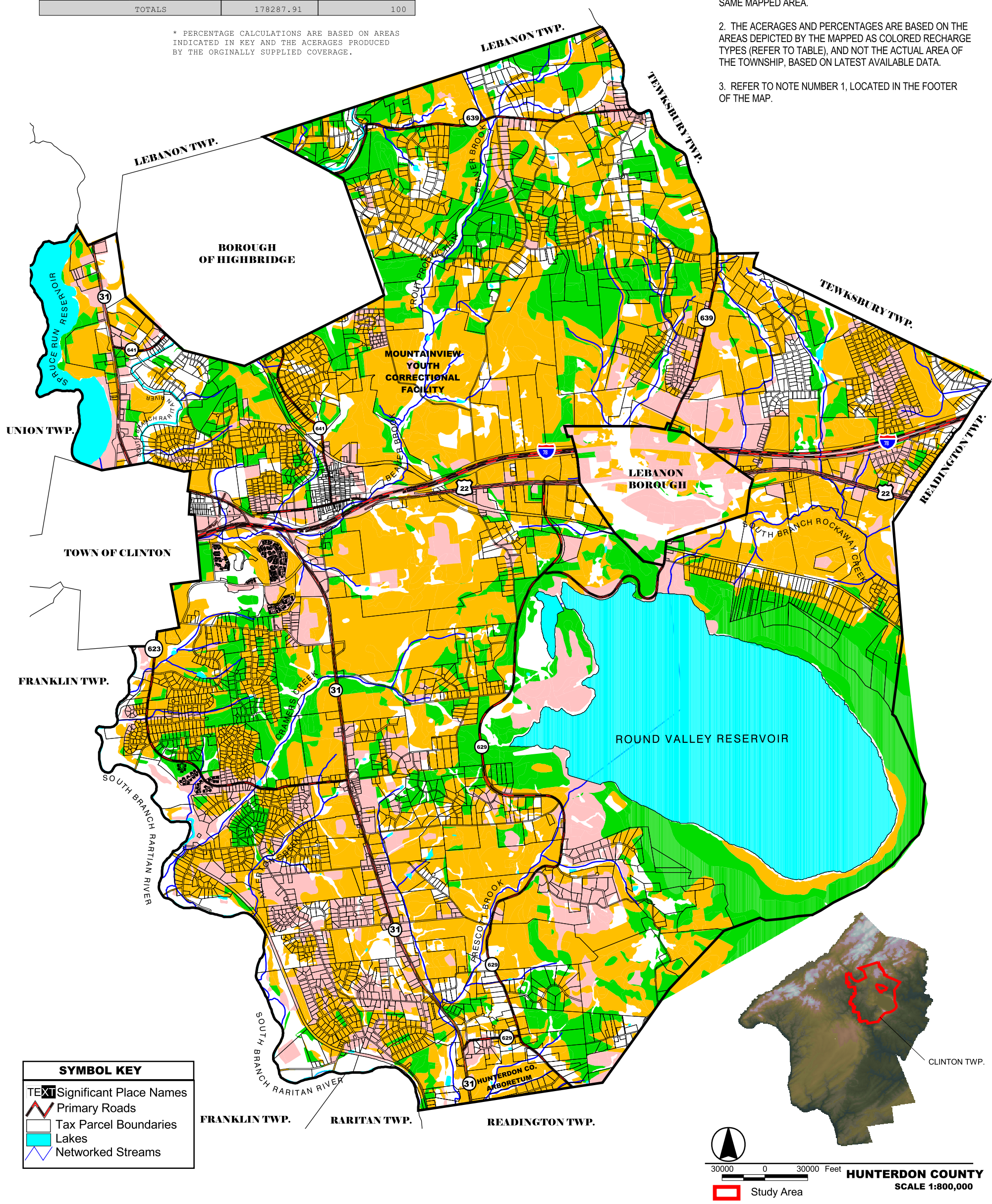
* PERCENTAGE CALCULATIONS ARE BASED ON AREAS INDICATED IN KEY AND THE ACERAGES PRODUCED BY THE ORGINALLY SUPPLIED COVERAGE.

RECHARGE DATA NOTES:

1. GAPS AND OVER-RUNS OF RECHARGE DATA INFORMATION ARE ATTRIBUTED TO THE VARIYING SCALES WITH THERE ACCOMPANIED ACCURACIES BEING COMBINED INTO THE SAME MAPPED AREA.

2. THE ACERAGES AND PERCENTAGES ARE BASED ON THE AREAS DEPICTED BY THE MAPPED AS COLORED RECHARGE TYPES (REFER TO TABLE), AND NOT THE ACTUAL AREA OF THE TOWNSHIP, BASED ON LATEST AVAILABLE DATA.

3. REFER TO NOTE NUMBER 1, LOCATED IN THE FOOTER OF THE MAP.



CLINTON TOWNSHIP, NRI, 2001

2000 0 2000 4000 6000 8000 Feet

SCALE 1: 45,000

Map Projection: State Plane of New Jesey, NAD 83, Feet

Clinton Township, Groundwater recharge Mapping, 1997, as Completed by GeoEnvironmental Research.
Scale 1:24,000
New Jersey, Department of Environmental Protection, GIS data Web Site Downloads State Municipalities of New Jersey
Scale 1:100,000

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MAP 16: GROUNDWATER RECHARGE RESOURCES

DRAWN BY:	KJM
CHECKED BY:	CK, SF

Project No.: 215.01

Groundwater Quality

Groundwater quality is a concern in densely populated regions of New Jersey. In areas with concentrated development, domestic drinking water may be negatively affected due to the presence of nonpoint sources of pollution (e.g., failing septic systems, leaking storage tanks) in aquifer recharge areas, and the presence of toxic substances (e.g., poly-chlorinated bi-phenyls), trace elements, pathogens, and natural radioactivity. Some regional groundwater quality information (e.g., nitrates, pesticides, total volatile organic compounds, and natural radium) is available through the United States Geologic Survey (USGS). The vitality and health of these uses depends on the quality of the water. The USGS also has a groundwater quality database for five (5) wells within Clinton Township Groundwater Site Inventory Database (GWSI). The data is from well drillers' records submitted to the NJDEP, Bureau of Safe Drinking Water in observance of the State's well permitting program. The GWSI also contains information from well permits and other sources.

Two (2) of the wells in the GWSI database are located in Clinton Township and within the environmentally sensitive Jacksonburg Limestone (Kittatinny Supergroup), and Hardyston Quartzite formation. The remaining wells are located in the Stockton Formation, Brunswick Aquifer, and Martinsburg Formation. Groundwater quality parameters include the following: dissolved oxygen, pH, specific conductivity, temperature, alkalinity, calcium, magnesium, potassium, sodium, fluoride, sulfate, nitrogen, phosphorus, total dissolved solids, arsenic, barium, beryllium, boron, cadmium, chromium, copper, iron, lead, lithium, manganese, molybdenum, nickel, selenium, silver, strontium, and natural uranium. Of the parameters monitored, groundwater quality was well within the NJDEP's specific groundwater quality criteria (Class IIA and Practical Quantitation Levels). Table 13 provides an overview of information on the wells monitored by the NJDEP in Clinton Township, (Map 15).

Table 13, Groundwater Well Information

USGS Well Number Well Name	Site-ID	Formation	Location (Latitude/Longitude)
527	403532074515201 Rolling Hills Care MW-1	Brunswick Aquifer	40°39'04" / 74°48'01"
547	403556074540901 Camp Carr Residence	Stockton Formation	40°34'54" / 74°52'24"
564	403733074561901 Clinton Prison	Martinsburg Formation and Jutland Sequence	40°38'12" / 74°53'49"
577	403923074543301 High Bridge Zellman 8	Kittatinny Limestone	40°39'22" / 74°54'33"
585	403936074482401 4-Potterstown	Kittatinny Limestone	40°38'24" / 74°53'33"

Source: Groundwater Site Inventory Database, USGS, 2001.