Executive Summary

Washington Township is home to some of the most significant natural resources in Morris County. From agriculturally productive soils, to Trout Production streams and rivers, to habitat for State and federally listed threatened and endangered species, Washington's landscape is a rich mosaic of resource interlaced among a variety of areas.

Many of the regulations in the Township's ordinances are very effective at reducing threats to the environment. The Land Development Ordinance (LDO) deals with floodplain development and stream corridor protection, protection of steep slope areas and protection of farmland. However, additional ordinances may be necessary to adequately protect the wealth of natural resources bestowed upon the citizens of Washington Township to achieve conservation objectives. For example, one area that is not dealt with currently in the LDO is the regulation of woodlands and critical habitat management that should guide new development in the community. Through the LDO, the Township should fashion regulations designed to protect these natural resources.

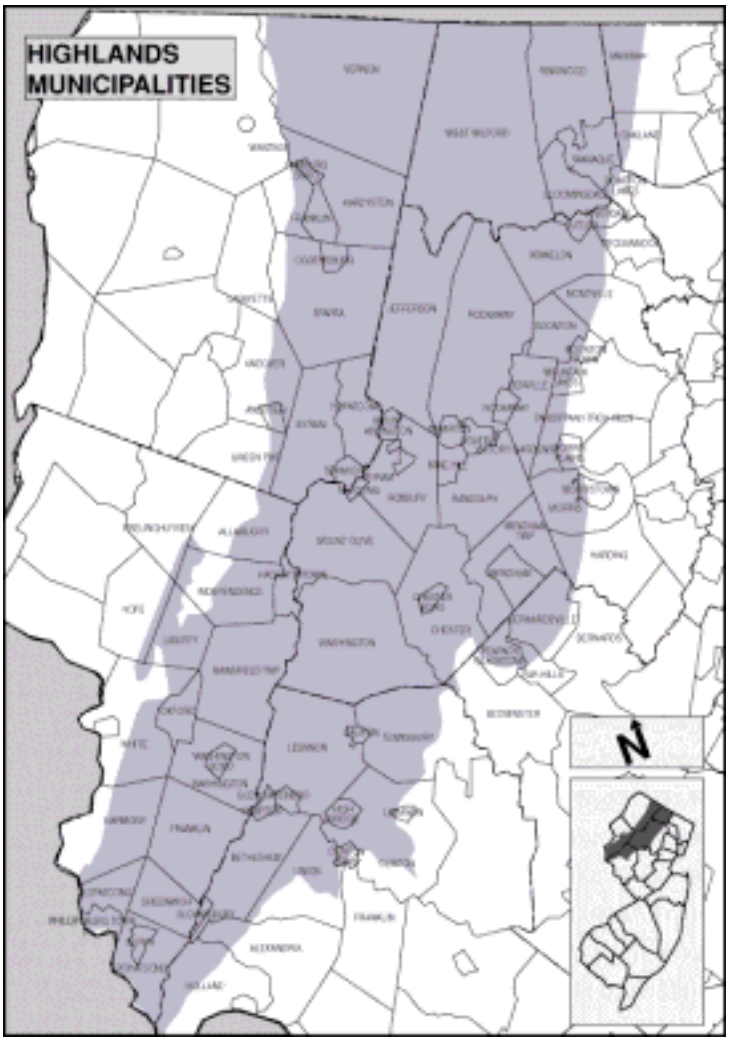
Perhaps the most effective means to promote the goal of conservation of critical environmental resources is through public education and the fostering of stewardship values. The land and water features that establish the essential character and sense of place of Washington Township are coincident with and defined by the natural resources that are present and the cultural landscape that has shaped the community over time. The Township is a haven for recreation in nature and a variety of opportunities that are uniquely suited and intrinsic to the landscape and quality of life Washington's citizens enjoy. No one knows this better than the person that lives in the Township.

By educating the public about the unique resources that are present, sense of place can be nurtured and promoted. Residents of the community can take ownership of the resources that they enjoy and take pride in making sure they are there for others to enjoy in the future. Education also brings residents into the process of developing planning policies for the Township and raises awareness of what their community leaders are doing to protect the community to address concerns they may have. This is crucial with respect to development and the preservation of natural resources. Even development that conforms to the standards of the LDO can still give people the impression that development is ruining the environment. That is why public education is a vital part of any effort to promote conservation benefits and preservation of the environment.

This natural resources inventory has been compiled by the Planning Board to document the environmental and land use characteristics of the community and educate Washington's citizens on the important issues confronting the Township. Through education, the Planning Board hopes to ensure that the essential character of Washington Township survives the challenges of the future and the persistent regional growth development pressures that threaten to forever alter its destiny. Through careful, well-reasoned and balanced land use policies and regulations, the prized landscape that defines Washington Township can be protected for today's residents and future generations to come.

Introduction

Washington Township is located in southern Morris County, bordering both Hunterdon and Warren Counties. Located in the New Jersey Highlands, a special resource area in the New Jersey State Development and Redevelopment Plan, it is a community with unique natural and scenic resources.



Washington Township is comprised of rolling hills, both forested and farmed, as well as steep slopes which lead to the plateau atop Schooleys Mountain. This plateau provides a vantage point for some of the most spectacular views in Morris County; views of the surrounding agricultural community, views of sprawling forests and views of traditional villages and hamlets that make up the countryside. It is these scenes and elements that are the subject of development pressure as well as preservation initiatives. For it is this land that is most desirable for both development and preservation.

Purpose and Objectives

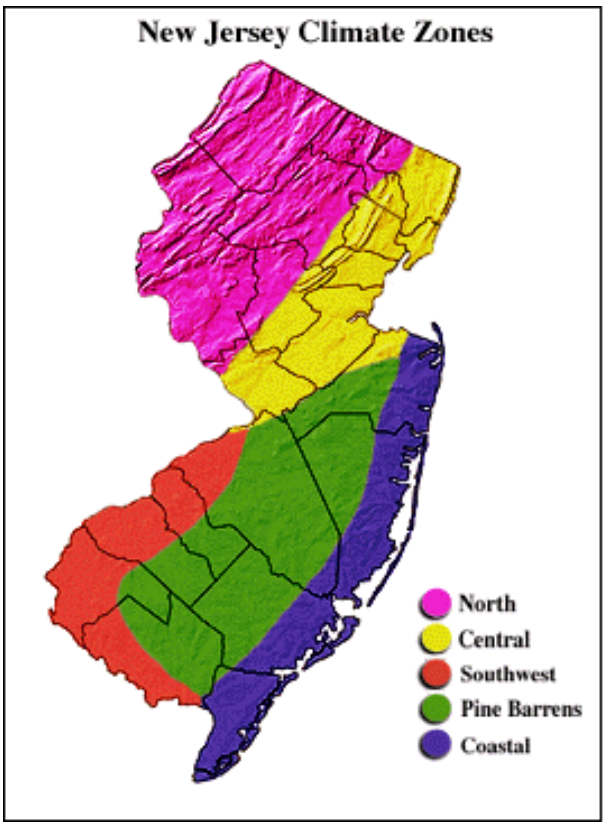
The Natural Resource Inventory (NRI) is a planning study that identifies, quantifies and describes the environmental resources present in a community. Through the presentation of mapping and accompanying narrative, the reader is given a sense of the elements of a community that comprise the natural resource base as well as the issues that surround them. Many of the natural resources identified are worthy of preservation efforts, some are worthy of simple highlighting and others are indicators of larger issues that require further study.

Geographic Information System (GIS) digital data has simplified the tasks of identifying, quantifying and describing particular resources that a community may have. Multiple layers of data can be viewed together within the context of a base map, providing both a comprehensive means and framework to analyze individual resources along with their role and importance in the overall ecosystem. In this fashion, both mutually exclusive and synergistic relationships amongst natural resources can be defined and explored. GIS has been used extensively in the preparation of this NRI.

Identification, quantification and description are the beginning phases of analysis for the preparation of the NRI. Many of the natural resources and factors that are present play a unique role in planning and community development, leading to the second role of the NRI; to describe the part that each natural resource plays in overall planning and community development.

The NRI is often the preliminary step in preparing for a master plan or conservation plan update. It is these documents that will draw on the information and assessment that the NRI provides and spell out goals, objectives and recommendations on policies required in order to protect the resources present in a community.

Climate



Washington Township is in the northern climate zone of New Jersey, comprised mainly of the northwestern quarter of the state and encompassing municipalities that are situated in the Appalachian Uplands. This area of the state is generally not influenced by the Atlantic Ocean, except in periods of east winds, and can therefore be categorized as having a continental type of climate. Prevailing winds are from the southwest in the summer and from the northwest in the winter. Generally, January is the coldest month with an average temperature of 25.3 degrees Fahrenheit and July is the warmest with an average temperature of 70.3 degrees Fahrenheit.

The continental type of climate means that Washington Township generally has colder temperatures and greater snowfall in winter, with a greater average annual precipitation overall as compared to the areas south and east. The average temperature in winter months ranges from 25.3 to 36.8 degrees Fahrenheit, about 10 degrees colder than coastal areas. Snowfall amounts average 36.5 inches annually, with 44 inches of precipitation throughout the year. Spring and summer months tend to experience temperatures consistent with those found in the rest of the state, averaging between 57 and 70 degrees Fahrenheit.

The overall weather pattern of the Township is influenced greatly by the highlands and mountains, where cloud formation and precipitation is greatly enhanced by orographic effects. With the passage of cold weather fronts, air rises over the mountains, forcing moisture to condense and form clouds, often times accompanied by precipitation. The northern climate zone experiences about twice as many thunderstorms in the spring and

summer months, as compared to the central, southerly and coastal zones, since the stabilizing effects of the Atlantic Ocean are not an influence.

The difference between the continental and coastal climate types also has profound effects on length of growing season, characterized by the dates of first and last killing frost. Varying within the region as well as from year to year, the growing season can be as short as 148 days to as long as 214 days. Areas within the northern climate zone have experienced killing frosts as early as September and as late as June.

Land Cover

Washington Township is characterized by a predominance of forested land cover, with 11,599 acres comprising 40.4% of the community. A majority of these forested areas are found in higher elevations, mostly over 600 feet above sea level. Figure 1 shows three distinct bands of forest, running from the northeast to the southwest border of the Township.

Urban or developed land makes up the next largest category of land cover, with 6,851 developed acres in the Township comprising 23.8% of the land area. Urban land is mostly made up of residential, commercial and industrial development, but is also characterized by utility and transportation facilities such as railroads and gas or electric easements. The urban landform is found interspersed throughout the Township, with more dense concentrations in the northern third.

Agriculture and wetlands make up a majority of the remaining land cover found in the Township, at 5,719 acres (19.9%) and 4,226 acres (14.7%) respectively. A majority of the agricultural operations are found in the Raritan River valley at the foot of Schooleys Mountain, where forested areas were cleared to expose the most viable agricultural soils (see Figure 5). Other agricultural operations exist outside of the fertile valley, mixed with the forested and developed areas. The ridge which forms the face of Schooleys Mountain acts as a separator between large contiguous farmland and other enclaves. A majority of the larger parcels north of the ridge on the plateau are generally wooded with soils of limited agricultural viability.

Wetland areas are found throughout the Township, however most are primarily on the plateau of Schooleys Mountain. Many of these wetlands coincide with forested areas, together forming the headwaters to many of the small tributary streams that flow into the Musconetcong, Lamington and South Branch of the Raritan rivers. There are also wetlands found along the corridors of these rivers, however, the wetlands along the Raritan River in the central portion of the Township are the most extensive.

Barren Land and Water make up the remaining 1.2% of the Township's acreage at 168 and 170 acres each. Barren land is generally lots that are in the process of being constructed at the time of interpretation or lands supporting quarry operations. The most significant piece of barren land is the Cleveland Industries site, located in the central portion of the Township on the eastern border with Chester Township. Water is

comprised mostly of lakes and does not represent the acreage of streams and rivers. There are a few lakes present in the Township dispersed randomly throughout the landscape.

Figure 2 depicts the land use/land cover of the Township in a more detailed fashion, expanding on the 6 general categories above. This breakdown details the types of forest, wetland, urban and agricultural land detailed in Figure 1 (barren and water are not further enumerated). The main points highlighted in Figure 2 are:

- A majority of the forestland in the Township is deciduous
- A majority of the wetlands are deciduous wooded
- Residential development is characterized as mostly rural and low density
- Commercial and industrial development occur along major road corridors and at crossroads

Geology

Geologic formation in this region of the state is what largely contributes to it being called the Highlands. The Highlands is characterized by the Reading Prong, a lithological unit that is a southwest extension of the Berkshire and Housatonic Highlands of New England. The Highlands is composed mostly of undifferentiated Precambrian gneisses. Many of the lower valleys in the highlands, like the Raritan River valley, have narrow bands of quartzite interspersed, as shown in Figure 3.

What follows is a detailed description of the geologic units found on Figure 3, in their proper lithological order and by the geologic time period of origin. These geologic descriptions have been gathered directly from the New Jersey Geological Survey CD Series, CD 00-1. This is considered to be the most up to date mapping from the Survey and provides the best information available.

Kittatinny Valley Sequence

Omb Bushkill Member (Middle Ordovician) (Drake and Epstein, 1967) - Interbedded medium- to darkgray, thinly laminated to thick-bedded shale and slate and less abundant medium-gray to brownish-gray, laminated to thin-bedded siltstone. To the southwest, fine-grained, thin dolomite lenses occur near base. Complete turbidite sequences (Bouma, 1962) occur locally, but basal cutout sequences (Tbcde, Tcde or Tde) dominate. Conformable lower contact is placed at top of highest shaly limestone; elsewhere, lower contact is commonly strain slipped. Correlates with graptolite *Climacograptus bicornis* to *Corynoides americanus* zones of Riva (1969, 1974) (Parris and Cruikshank, 1992). Thickness ranges from 1,250 m (4,100 ft) in Delaware River Valley to 457 m (1,500 ft) at New York State line.

Oj Jacksonburg Limestone (Middle Ordovician) (Kümmel, 1908; Miller, 1937) - Upper part is medium- to dark-gray, laminated to thin-bedded shaly limestone and less abundant medium-gray arenaceous limestone containing quartz-sand lenses. Upper part

thin to absent to northeast. Lower part is interbedded medium- to dark-gray, fine- to medium-grained, very thin to medium-bedded fossiliferous limestone and minor medium- to thick-bedded dolomite-cobble conglomerate having a limestone matrix. Unconformable on Beekmantown Group and conformable on the discontinuous sequence at Wantage in the Paulins Kill area. Contains conodonts of North American midcontinent province from *Phragmodus undatus* to *Aphelognathus shatzeri* zones of Sweet and Bergstrom (1986). Thickness ranges from 41 to 244m (135-800 ft).

Ow Sequence at Wantage (Middle Ordovician) (Monteverde and Herman, 1989) – Restricted, discontinuous sequence of interbedded limestone, dolomite, conglomerate, siltstone, and shale. Upper part is medium-yellowish-brown- to olive-gray-weathering, medium- to dark-gray, very fine to fine-grained, laminated to massive limestone and dolomite that grade down into underlying clastic rocks of lower part. Upper part locally absent. Lower part ranges from grayish-red, medium-gray, pale-brown, and greenishgray to pale-green mudstone and siltstone containing disseminated subangular to subrounded chertgravel, quartz-sand lenses, and chert-pebble conglomerate. Lower contact unconformable. Thickness ranges from 0 to 46 m (0-150 ft).

Beekmantown Group (Lower Ordovician) (Clarke and Schuchert, 1980)

Obu Upper part - Locally preserved upper beds are light- to medium-gray- to yellowish-gray-weathering, medium-light- to medium-gray, aphanitic to medium-grained, thin- to thick-bedded, locally laminated, slightly fetid dolomite. Medium-dark to dark-gray, fine-grained, medium-bedded, sparsely fossiliferous limestone lenses occur locally. Lower beds are medium-dark- to dark-gray, medium- to coarse-grained, mottled surface weathering, medium- to thick-bedded, strongly fetid dolomite that contains pods and lenses of dark-gray to black chert. Cauliflower-textured black chert beds of variable thickness occur locally. Gradational lower contact is placed at top of laminated to thin-bedded dolomite of the lower part (**Obl**) of the Beekmantown Group. Contains conodonts high in the *Rossodus manitouensis* zone to low zone D of the North American midcontinent province as used by Sweet and Bergstrom (1986). Upper beds are included in Epler Formation; lower beds are included in Rickenbach Dolomite of Drake and Lyttle (1985) and Drake and others (1985); entire upper part (**Obu**) is Ontelaunee Formation of Markewicz and Dalton (1977). Thickness ranges from 0 to 244 m (0-800 ft).

Obl Lower part - Very thin to thick-bedded, interbedded dolomite and minor limestone. Upper beds are light-olive-gray to dark-gray, fine- to medium-grained, thin- to thick-bedded dolomite. Middle part is olivegray-, light-brown-, or dark-yellowish-orange-weathering, dark-gray, aphanitic to fine-grained, laminated to medium-bedded dolomite and light-gray to light-bluish-gray-weathering, medium-dark- to dark-gray, fine-grained, thin- to medium-bedded limestone, that is characterized by mottling with reticulate dolomite and light-olive-gray to grayish-orange, dolomitic shale laminae surrounding limestone lenses. Limestone grades laterally and down section into medium-gray, fine-grained dolomite. Lower beds consist of medium-light- to dark-gray, aphanitic to coarse-grained, laminated to medium-bedded, locally slightly fetid dolomite having thin black chert beds, quartz-sand laminae, and oolites. Lenses of light-gray, very coarse

to coarse-grained dolomite and floating quartz sand grains and quartz-sand stringers at base of sequence. Lower contact placed at top of distinctive medium-gray quartzite. Contains conodonts of *Cordylodus proavus* to *Rossodus manitouensis* zones of North American Midcontinent province as used by Sweet and Bergstrom (1986). Unit **Obl** forms Stonehenge Formation of Drake and Lyttle (1985) and Drake and others (1985), upper and middle beds are included in Epler Formation, and lower beds are in Rickenbach Dolomite of Markewicz and Dalton (1977). Unit is about 183 m (600 ft) thick.

OCa Allentown Dolomite (Lower Ordovician and Upper Cambrian) (Wherry, 1909) – Very thin to very thick bedded dolomite containing minor orthoquartzite and shale. Upper part is medium-light- to medium-dark-gray, fine- to medium-grained, locally coarse-grained, medium- to very thick bedded dolomite. Floating quartz sand grains and two sequences of medium-light- to very light gray, thin-bedded quartzite and discontinuous, dark-gray chert lenses occur directly below upper contact. Rhythmically bedded lower dolomite beds alternate between light and dark gray weathering, medium and very light gray, fine and medium grained, and thin and medium bedded, which are interbedded with shaly dolomite. Ripple marks, crossbeds, edgewise conglomerate, mud cracks, oolites, and algal stromatolites occur throughout unit, but more typically in lower part. Shaly dolomite increases downward toward lower conformable contact with the Leithsville Formation. Oldest beds contain trilobite fauna of early Late Cambrian age; younger beds contain latest Cambrian fauna (Howell, 1945; Howell and others, 1950). Thickness about 580 m (1,900 ft).

Cl Leithsville Formation (Middle to Lower Cambrian) (Wherry, 1909) - Thin- to thick-bedded dolomite containing subordinate siliciclastic rocks. Upper part is medium- to medium-dark-gray, fine- to mediumgrained, pitted, friable, mottled and massive dolomite. Middle part is medium-gray, stylolitic, fine-grained, thin- to medium-bedded dolomite that is interbedded with shaly dolomite and, less commonly, varicolored quartz sandstone, siltstone, and shale. Lower part is medium-gray, medium-grained, medium-bedded dolomite containing quartz-sand grains in stringers and lenses near the contact with the Hardyston Quartzite. Archaeocyathids of Early Cambrian age suggest an intraformational disconformity separating rocks of Middle and Early Cambrian age (Palmer and Rozanov, 1976). Thickness approximately 305 m (1,000 ft).

Ch Hardyston Quartzite (Lower Cambrian) (Wolff and Brooks, 1898) - Medium- to light-gray, fine- to coarse-grained, medium- to thick-bedded quartzite, arkosic sandstone and dolomitic sandstone. Basal pebble to cobble conglomerate typically contains clasts of local basement affinities. Contains fragments of the trilobite *Olenellus thompsoni* of Early Cambrian age. Thickness approximately 0.5 to 62 m (1.6-200 ft).

Byram Intrusive Suite (Middle Proterozoic) (Drake, 1984)

Ybh Hornblende granite - Pinkish-gray- to medium-buff-weathering, pinkish-white or light-pinkish-gray, medium- to coarse-grained, gneissoid to indistinctly foliated granite and sparse granite gneiss composed principally of microcline microperthite, quartz,

oligoclase, and hornblende. Some phases are quartz syenite or quartz monzonite. Includes small bodies of pegmatite and amphibolite not shown on map. UPb age approximately 1,090 Ma (Drake and others, 1991b).

Ybs Hornblende syenite – Tan- to buff-weathering, pinkish-gray or greenish-gray, medium- to coarsegrained, gneissoid syenite and lesser amounts of quartz syenite containing microcline microperthite, oligoclase, quartz, and hornblende. Some phases are monzonite or monzodiorite.

Yba Microperthite alaskite – Pink- to buff-weathering, light-pinkish-gray or pinkish-white, medium- to coarse-grained, gneissoid to indistinctly foliated granite composed principally of microcline microperthite, quartz and oligoclase. Includes small bodies of amphibolite not shown on map.

Lake Hopatcong Intrusive Suite (Middle Proterozoic) (Drake and Volckert, 1991)

Ypg Pyroxene granite – Gray- to buff- or white-weathering, greenish-gray, medium- to coarse-grained, massive, gneissoid to indistinctly foliated granite containing mesoperthite to microantiperthite, quartz, oligoclase, and clinopyroxene. Common accessory minerals include titanite, magnetite, apatite, and trace amounts of pyrite. Some phases are monzonite, quartz monzodiorite, or granodiorite. Locally includes small bodies of amphibolite not shown on map.

Yps Pyroxene syenite – Gray- to buff- or tan-weathering, greenish-gray, medium- to coarse-grained, massive, indistinctly foliated syenite composed of mesoperthite to microantiperthite, oligoclase and clinopyroxene. Contains sparse amounts of quartz, titanite, magnetite, and trace amounts of pyrite.

Ypa Pyroxene alaskite - Light-gray- or tan-weathering, greenish-buff to light-pinkish-gray, medium- to coarse-grained, massive, moderately foliated granite composed of mesoperthite to microantiperthite, oligoclase, and quartz. Common accessory minerals are clinopyroxene, titanite and magnetite. Locally includes small bodies of amphibolite not shown on map.

Metasedimentary Rocks (Middle Proterozoic)

Yk Potassium-feldspar gneiss - Light-gray- to pinkish-buff-weathering, pinkish-white to light-pinkishgray, fine- to medium-grained, moderately foliated gneiss and lesser amounts of granofels composed of quartz, microcline, microcline microperthite and local accessory amounts of biotite, garnet, sillimanite, and opaque minerals.

Yb Biotite-quartz-feldspar gneiss - Gray-weathering, locally rusty, gray to tan or greenish-gray, fine- to medium-coarse-grained, moderately layered and foliated gneiss that is variable in texture and composition. Composed of oligoclase, microcline microperthite, quartz, and biotite. Locally contains garnet, graphite, sillimanite, and opaque minerals.

Yp Pyroxene gneiss – White- to tan-weathering, greenish-gray, fine- to medium-grained, well-layered gneiss containing oligoclase, clinopyroxene, variable amounts of quartz, and trace amounts of opaque minerals and titanite. Some phases contain scapolite and calcite. Commonly interlayered with pyroxene amphibolite or marble.

Yq Quartzite - Light-gray, medium-grained, massive- to well-layered, vitreous, partly feldspathic quartzite having sparse flakes of graphite. Associated with potassium-feldspar gneiss (**Yk**), biotite-quartz-feldspar gneiss (**Yb**), pyroxene gneiss (**Yp**), Franklin Marble (**Yf**), and pyroxene-epidote gneiss (**Ype**).

Losee Metamorphic Suite (Middle Proterozoic) (Drake, 1984)

Ylo Quartz-oligoclase gneiss – White-weathering, light-greenish-gray, medium- to coarse-grained, moderately layered to indistinctly foliated gneiss and lesser amounts of granofels composed of quartz, oligoclase or andesine, and, locally, biotite, hornblende and (or) clinopyroxene. Contains thin amphibolite layers.

Ylb Biotite-quartz-oligoclase gneiss – White- to light-gray-weathering, light- to medium-gray or greenish-gray, fine- to coarse-grained, massive to moderately well layered, foliated gneiss composed of oligoclase or andesine, quartz, biotite, and, locally, garnet. Commonly interlayered with amphibolite.

Rocks of Uncertain Origin (Middle Proterozoic)

Yh Hypersthene-quartz-plagioclase gneiss – Gray- to tan-weathering, greenish-gray to greenishbrown, medium-grained, moderately well layered and foliated, greasy-lustered gneiss of charnockitic affinity composed of andesine or oligoclase, quartz, clinopyroxene, hornblende, hypersthene, and sparse amounts of biotite. Commonly interlayered with amphibolite and mafic-rich quartz-plagioclase gneiss.

Yd Diorite – Gray- to tan-weathering, greenish-gray to brownish-gray, medium- to coarse-grained, greasy-lustered, massive diorite containing andesine or oligoclase, clinopyroxene, hornblende, hypersthene, and sparse amounts of biotite and magnetite. Amphibolite layers common.

Ymg Monazite gneiss - Buff-weathering, light-greenish-gray to greenish-buff, fine- to medium-grained, moderately well-foliated, well-lineated gneiss composed of microcline microperthite, quartz, oligoclase, biotite, and monazite. Accessory minerals include hornblende, zircon and opaque minerals. Mapped in Fox Hill Range area.

Yma Microantiperthite alaskite – White-weathering, locally rusty, light-greenish-gray medium- to coarse-grained, gneissic granite and alaskite containing microantiperthite, quartz, oligoclase, and sparse amounts of hornblende, clinopyroxene, biotite, and magnetite.

Geology and lithology are the main determining factors in groundwater yields and suitability as recharge areas. The Morris County Municipal Utilities Authority studied a number of areas for potential groundwater resources. A portion of two of these study areas were within Washington Township. Generally, studies showed that the areas depicted in Figure 4 are "*important potential ground water sources*". The study indicated that the sand and gravel buried valley fill deposits had the potential of being a high producing aquifer, consistent with formations in the South Branch River valley and the Musconetcong River valley.

The Land Oriented Reference Data System (LORDS) report of 1974, published by the New Jersey Geological Survey and NJDEP, also identified potentially high recharge rates for some of the formations in Washington Township. Specifically, the LORDS report showed that the Kittatinny Limestone formations, specifically the Leithsville Formation, had the potential to recharge 350,000 gallons per day per square mile in a normal year and 225,000 gallons per day per square mile in a dry year. Jacksonburg Limestone and many of the other formations in the Kittatinny Valley Sequence are listed as having recharge rates of 300,000 gallons per day per square mile for normal years and 200,000 gallons per day per square mile in dry years. A number of other weathered Precambrian formations present in the Township experience similar recharge rates to the Kittatinny Valley Sequence.

The importance of identifying these potential aquifers and recharge areas is two-fold. The first is to review criteria for development and insure that they are compatible with the need to protect the areas that overlay these formations. *If development occurs at a density that is relatively low and impervious surfaces are reduced, the area will remain viable for aquifer recharge*. The second is to continue to pursue land preservation in order to limit future development potential and *preserve this regionally valuable resource*.

Soils

The United States Department of Agriculture, Natural Resource Conservation Service, has described four soil associations, at least 27 soil series and at least 46 soil phases in the Township of Washington. The four soil associations include the Califon-Annandale-Cokesbury, the Edneyville-Parker-Califon, the Parker-Edneyville and the Parsippany-Landsdowne-Watchung. All four of these soil associations were formed in old glacial deposits or in material weathered from bedrock. They are dominantly loamy and deeply weathered, having more clay in the subsoil than in the surface layer or substratum. These associations are typically found on the uplands and in valleys. The general characteristics of these three associations are described below.

Califon-Annandale-Cokesbury Association

The soils of this association formed in deeply weathered loamy glacial till, derived mainly from granitic gneiss. Bedrock is generally found at a depth greater than 10 feet in most areas. This association is well suited to general farming, dairy farming and most

community development. It is also well suited to open space activities and to wildlife habitat supporting extensive areas of woodland.

The minor soils of this association are in the Parker, Edneyville and Bartley series. Califon and Cokesbury soils are mainly found in depressions and waterways but are also present in seepage areas at the base of slopes. They are moderately well drained to poorly drained with a fragipan (a seemingly cemented layer low in organic matter and clay but high in silt and fine sand) layer in the lower part of the subsoil. This fragipan layer is the major contributing factor to poor drainage. The Califon and Cokesbury soils are also subject to the hazard of erosion on strong slopes.

Edneyville-Parker-Califon Association

The soils of this association formed in granitic material that was weathered in place or transported a short distance and redeposited in waterways. Bedrock is mainly found at a depth greater than 10 feet, but can outcrop on strong slopes. This association is split in terms of suitability for farming and community development. Well drained and excessively drained soils are limited by coarse fragments, steep slopes and the hazard of erosion, while the gently sloping soils are well suited to most farming and community development. Strongly sloping soils in this association are not suited to farming and community development but are well suited to open space and wildlife habitat.

The minor soils in the association are in the Annandale, Cokesbury, Bartley and Califon (friable subsoils variant) series. Edneyville and Parker soils are found on the tops and sides of ridges. Both are gently sloping to steep, but the Edneyville soils are well drained while the Parker soils are very gravelly and excessively drained. The Califon soils of this association are found in depressions, drainage ways and seepage areas and can be moderately well drained to somewhat poorly drained, with a fragipan layer in the lower part of the profile.

Parker-Edneyville Association

The soils in this association formed in gravelly to extremely stony material that was weathered in place from bedrock. Bedrock can be as shallow as four feet but is typically found at a depth greater than 10 feet. Most of the soils in this association are woodland, although some small areas have been cleared for pasture. Soils in this association are limited for farming and community development by steep slopes, stoniness and rock outcrops. They are, however, suited to open space activities and to watershed protection.

The minor soils in the association are in the Califon, Cokesbury, Netcong and Bartley series. Parker and Edneyville soils are found on the tops and sides of ridges. Parker soils are steep and excessively drained and are very gravelly. Edneyville soils are steep and well drained.

Bartley-Turbotville-Cokesbury Association

The soils in this association were formed in deeply weathered glacial till or colluvium of mixed mineralogy, derived largely from granitic gneiss. Bedrock is generally found at a

depth greater than 10 feet. While the soils in this association are limited by inadequate drainage, they are among the best in the county for farming. With the exception of the Cokesbury soils (poor drainage), the association is suitable for community development. Most of the association is in crops and pasture, but small poorly drained soils found along streams are generally woodland.

The minor soils in this association are in the Edneyville, Califon and Washington series. Also included in the association are alluvial and alluvial wet soils. Bartley soils are on terraces adjacent to floodplains. They are gently to strongly sloping and moderately well drained. They have a fragipan layer in the lower part of the subsoil. Turbotville and Cokesbury soils are in drainageways and depressions and also have a fragipan layer in the subsoil.

The following discussion describes the various factors that are related to soils, including farmland capability, septic suitability, depth to seasonal high water and depth to bedrock. All of these factors affect the environment and community development and their enumeration will help guide policy as it relates to both.

Figure 5 depicts the farmland capability of the soils in Washington Township, with better than 55% of the soils being of significant agricultural value. The following descriptions of prime farmlands, soils of statewide importance and unique farmland are taken from the "New Jersey Important Farmlands Inventory", prepared by the State Agriculture Development Committee in 1990. Farmland of local importance is not included in this description, as they do not occur in the Township.

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

Soils of Statewide Importance-Farmlands of statewide importance include those soils in Land Capability Classes 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 if conditions are favorable.

Unique Farmland –Unique farmlands are those soils that are being used for special crops, mainly peat and muck.

Overall, prime soils account for the largest percentage of soils in the Township at 40.4%. Statewide important soils comprise 15.8% of the soils, with unique farmland soils accounting for a mere 0.35%. Prime soils are farmed extensively in the belt of preserved

farms southeast of County Route 513 and in the southeastern corner of the Township. A majority of the prime farmland atop Schooleys Mountain, however, has been converted to residential development.

Agriculturally productive soils are a finite resource that once converted to developed uses, are unlikely to be recuperated for agricultural use. In addition, agricultural soils and the farming that they support are part of the fabric of the Township and lend to its unique character. Agriculture and the development pattern associated with it defines part of the rural character of the Township, lending to the country appeal that is prized by residents as well as visitors. This is apparent in Long and Middle valley along County Route 513, where a belt of preserved farms defines the essential character of this part of the Township.

Figure 6 categorizes the soils in the Township based on their ability to dispose of effluent on-site utilizing a septic system. Better than 50% of soils in Washington have severe limitations for on-site disposal of effluent and are found throughout the Township. Factors that contribute to the presence of severe limitations include seasonal high water at depths of 0 to 4 feet, perched water tables, extreme stoniness, slopes between 15% and 25%, slow permeability in the subsoil, rapid permeability through the soil profile and frequent flooding. Severe limitations, as categorized by the USDA in the Morris County Soil Survey, indicate that soil properties are so unfavorable and difficult to overcome that soil reclamation, special design and intensive maintenance will likely be required. Often the costs of corrective measures are exorbitant and even if used, could create problems in the future due to the nature of the limitations. Engineers will promise a system designed to overcome these limitations, however, this is not an assurance that a proper routine maintenance plan will be followed by the homeowner.

Soils with moderate limitations for septic disposal comprise 33.8% of soils and are found scattered throughout Schooleys Mountain and the southeastern corner of the Township. Moderate limitations are considered unfavorable, but with careful planning, design and management may be overcome. Engineering practice can often easily address unfavorable conditions, but homeowner maintenance is once again the key to successful mitigation of potential problems. Factors that contribute to moderate limitations include slope, hazard of groundwater pollution, bedrock at depths of 4 to 10, soils that are very stony, rapid permeability and slow permeability in the fragipan layer.

Soils with slight limitations make up only 11.9% of those found in the Township. Slight limitations indicate that factors are minor and easily overcome. Soils of this classification generally have water tables at a depth greater than 4 to 5 feet, bedrock at depths greater than 5 or 6 feet and good permeability (not too fast, not too slow). In Washington Township, these soils are found along the Musconetcong and Raritan rivers and in pockets in the southeastern corner.

In 1999, the New Jersey Department of Environmental Protection (NJDEP) authored and the legislature adopted *Standards for Subsurface Sewage Disposal Systems*, part of the State of New Jersey Administrative Code, 7:9A. These new standards for septic systems

were meant to update the standards that had been adopted in 1990, based on the evolution of engineering practice and the ability to design more efficient systems. The adoption of the new standards in 1999 sought to limit the installation of septic systems where public sewer was reasonably available, to protect potable water supplies and therefore human health, to insure the proper siting and installation of septic systems and to limit groundwater pollution from improperly functioning systems. (The NJDEP Subchapter 8 Water Quality Management Planning Rule amendments were invalidated by the Court in April 2002, on the basis of a procedural deficiency in their adoption. The substance of the amendments were not overturned by the Court. The DEP has indicated that the same rule will be readopted in conformance with procedural requirements in the near future.)

The mapping that is presented in Figure 6 represents the classification of soils from the *Soil Survey of Morris County*. As part of the new groundwater quality standards, new classifications were instituted, but only with respect to the type of system that may be required in order to overcome the inherent limitations of certain soils in New Jersey. The application of these standards is meant to be based on specific site investigation through on-site percolation testing and soil profile determination. Often times, a prospective developer will not want to go through this cost prior to purchase of land. However, soil percolation tests are needed to carefully manage the Township's natural resource objectives on a case-by-case basis so that development is arranged to protect priority areas. In general, and for planning purposes, the Soil Survey may be used in order to gain a general sense of the potential limitations that a property may present.

Once detailed site investigation begins, the standards for septic installation contained in the new standards govern the type of system that is necessary in order to overcome limitations of soil for safe disposal of effluent. Appendix D in N.J.A.C. 7:9A outlines the soils of New Jersey based on suitability classes and the depths of potential limiting zones that could be identified under detailed investigation. Typical limitations include fractured or excessively course substrata, massive rock or hydraulically restrictive substrata, hydraulically restrictive horizon or permeable substratum, excessively coarse horizon and regional and perched zones of saturation. "Perched zone of saturation" means a zone of saturation which occurs immediately above a hydraulically restrictive horizon and which is underlain by permeable horizons or substrata which are not permanently or seasonally saturated. "Regional zone of saturation" means a zone of saturation which extends vertically without interruption below the depth of soil borings and profile pits.

In any of the above events, the depth of the type of limiting zone is what determines the type of system that must be used. The types of systems include conventional, soil replacement, mound or mounded soil replacement. Seven feet is required from finished grade to the bottom of the zone of treatment, and a four foot zone of disposal consisting of permeable soil or fractured rock substrata is required. This means that generally speaking, a depth to bedrock of greater than 10 feet and a depth to seasonal high water of greater than 7 feet is required for the installation of a conventional septic system under the new regulations. This provides background for the next two sections on bedrock and seasonal high water.

Figure 7 depicts depth to seasonal high water for the soils found in the Washington Township. Depth to seasonal high water indicates the highest level below the surface that groundwater reaches in most years, typically occurring between December and April. Depth to seasonal high water is important in determining limitations for development. Potential impacts from a shallow depth to seasonal high water include flooding of basements, weakening of foundations and serious limitations for on-site disposal of effluent. Shallow seasonal high water tables, while presenting limitations for development, also support diverse plant and wildlife communities. Therefore, these factors are a good determinant for lands which deserve protection in order to limit destruction of property and fostering of diverse plant and animal communities that may support critical habitat for threatened and endangered species.

Of the soils in the Washington, 17.1% have generally shallow depths to seasonal high water. This category is comprised of soils ranging from 0 to 1.5 feet. A majority of the soils in this category are located along the Raritan River valley, where the most fertile farmland is. Most notable in Figure 7 are the soils located along the Raritan River and those that are atop Schooleys Mountain. These seasonally high water tables support wetland systems associated with the river system as well as the deciduous wooded wetlands that make up the headwaters for numerous streams.

Shallow depth to seasonal high water presents numerous limitations for development, most notably installation and maintenance of septic systems. Even with soil replacement and other engineering measures, septic systems placed in high water tables have the potential to pollute groundwater. And as most of the soils with shallow depths to seasonal high water are located around streams, there is also the potential for surface water contamination in periods of flooding. If a system is maintained improperly and ceases to function, effluent from the leach field that rises to the surface can be carried off in surface water. Even in times when flooding is not prevalent, a failing septic system with surface contamination can be introduced into surface water by runoff.

A fair number of the soils in the Township, 15.1%, have variable tendencies, ranging in depth from 0.5 to 4 feet. These soils, however, may be more inclined to have shallow depths to seasonal high water. A majority of the soils with variable tendencies are found on Schooleys Mountain, with a limited number around the Raritan River and in the southeastern corner of the Township. Soils with variable tendencies are difficult to categorize in terms of limitations, as in certain periods they don't exhibit tendencies that could severely limit community development activities. The soils in this category are most likely better categorized as having shallow depths in wet years and moderate depths in dry years.

A majority of the soils in the Township, 53.5%, have generally deep depths to seasonal high water at greater than 4 and even greater than 10 feet. While these soil types are found throughout Washington, there are large contiguous areas in the southeastern corner of the Township that are categorized as such. Most of the soils with deep depths to seasonal high water coincide with agriculturally productive soils of prime classification and are currently in agricultural production. The soils in this category are least

susceptible to potential problems related to development and any of the minor limitations that may be present can be overcome.

A mere 5.2% of the soils in Washington are classified as having moderate depth to seasonal high water. These soils generally exhibit depths of 2.5 to 5 feet to seasonal high water. Moderate depths to seasonal high water present difficulties in the installation of septic systems as well as the installation of foundations.

Figure 8 depicts the depth to bedrock for soils found in the Township. A vast majority of these soils have deep depths to bedrock, comprising 79.2% of all soils. Depth to bedrock is one of the many components that determine suitability for septic disposal of effluent, indicating the amount of soil that is present in the profile. The depth (profile) of the soil has a direct relationship on its ability to process effluent effectively, as soils remove the nitrates and other organic compounds present in human waste. The more soil present, the better its processing capabilities. Depth to bedrock also influences other community development factors such as septic system installation, road construction, basement and foundation construction, landscaping and drainage. The soils that are classified as being deep generally exhibit characteristic depths to bedrock that are greater than 6 and often time greater than 10 feet.

None of the soils in the Township are classified as having shallow depth to bedrock, however, 18.3% of soils exhibit variable tendencies. Of these, 6.7% are too variable to estimate. Soils that are classified as variable exhibit a range of depth to bedrock between 3.5 to 10 feet. Those on the shallower end of the spectrum could be seen as having moderate depths, but since the high end of the potential range approaches 10 feet, it is difficult to classify them as such. The mapping presented in Figure 8 is meant to indicate general ranges of depth to bedrock and only site specific investigation should be applied to regulatory measures.

The United States Department of Agriculture, Natural Resources Conservation Service rates soils based on their potential for erosion by wind and water. This is referred to as the “Highly Erodible Lands” class. For Washington Township, all of the soils are rated not highly erodible for wind and are therefore not mapped. They are, however, rated for erodibility by water, which is depicted in Figure 9.

Of the soils in Washington, 5,574 acres or 19.4% are rated as “Highly Erodible Lands” in the Soil Survey of Morris County. This indicates that the soil will erode when exposed to water, such as heavy rain or surface water runoff. A comparison of the location of “Highly Erodible Lands” and the steep slope mapping in Figure 15 shows that most all of the “Highly Erodible Lands” are in the areas of slope greater than 15%. A soil classified as “Highly Erodible Lands” almost always has a slope greater than 12%. Most of the soils in this category are of the Edneyville and Parker Series, some with rock outcroppings. This suggests that disturbance of these soils should be avoided and the underlying slopes regulated sufficiently to minimize soil loss and potential surface water quality impairment and maximize groundwater and aquifer recharge.

Of the remaining soils in the Township, 68.6% or 19,661 acres are categorized as "Potentially Highly Erodible". This indicates these soils do not have the component of slope that "Highly Erodible Lands" do, but do have similar texture and surface properties and will experience erosion from heavy rain and swift moving surface water. Only 7.4% or 2,112 acres are classified as "Not Highly Erodible". This class is primarily comprised of the Califon and Annandale series, as well as many of the soils found along the banks of the South Branch of the Raritan River.

Surface Water

Surface waters represent opportunities for recreation and the enjoyment of nature for Washington Township residents as well as visitors. The river and stream system and their associated wetlands provide habitat for native populations of spawning trout as well as habitat for other amphibians, birds and wildlife. Additionally, these water resources can be enjoyed by hikers, those with canoes and other small boats, bird watchers and many others.

The South Branch of the Raritan River is the principle surface water body in the Township, ultimately receiving the flow of streams draining 56.4% of the Township. The other major receiving surface water bodies are the Musconetcong, draining 24.8% of the Township and the Lamington River, draining 18.8% of the Township. The South Branch of the Raritan River is located in the central portion of Washington, flowing from the northeast to the southwest and meandering along Mill Road. The Musconetcong River forms that Township's northwestern boundary with Warren County and the Lamington River and its tributaries form the Township's southeastern border with Chester Township. Overall, there are 58.51 miles of streams and rivers located with the Township's borders, draining approximately 43 sub watershed areas. The surface waters of Washington are depicted on Figure 10.

The tributaries to the three main rivers in the Township make up approximately 53% of the surface waters in Washington. These tributaries are Bungalow Brook, Cataract Brook, Drakes Brook, Electric Brook, Herzog Brook, Mine Brook, Rinehart Brook, Rockaway Creek, Schooleys Mountain Brook, Stephensburg Brook, Stony Brook, Tanners Brook and Trout Brook. The South Branch of the Raritan River accounts for 29.8% of the surface water flowing in Washington Township, with 17.44 miles. The Musconetcong accounts for 11% at 6.4 miles and the Lamington River comprises 4.2% or 2.44 miles. Table 1 lists the surface waters in the Township and their length and percentage of total mileage.

Table 1
Surface Waters

Name	Length(miles)	Percentage
Un-coded tributary (Catarack?)	0.70	1.2
Bungalow Brook	2.53	4.3
Drakes Brook	0.55	0.9
Electric Brook	4.28	7.3
Herzog Brook	0.8	1.4
Mine Brook	4.89	8.4
Rinehart Brook	2.59	4.4
Rockaway Creek	0.93	1.6
Schooleys Mountain Brook	2.92	5.0
Stephensburg Brook	2.28	3.9
Stony Brook	4.83	8.3
Tanners Brook	3.51	6.0
Trout Brook	1.42	2.4
Lamington River	2.44	4.2
Musconetcong River	6.4	11.0
South Branch of the Raritan River	17.44	29.8
Total	**58.51**	**100.0**

Surface Water Quality

In 1998, the New Jersey Department of Environmental Protection (NJDEP), Division of Environmental Planning, adopted new Surface Water Quality Standards,(N.J.A.C 7:9B). With these new standards, NJDEP has applied several different classifications to the surface waters that are present in the Township. These designations relate to the current quality of the water body, as well as a variety of uses and maintenance standards that will ensure its perpetuity as such. The classifications are depicted on Figure 11 and the uses are enumerated in the following discussion. (Note: text appearing in italics is directly excerpted from the standards)

Washington Township has within its borders miles of high quality waters. These are streams and rivers that are classified as FW2-TP (C1), or Trout Production Waters, and are depicted on Figure 11. These include the entire South Branch of the Raritan River, portions of the Musconetcong River and portions of the Lamington River. Many of their tributaries are also classified as high quality waters.

The “FW2” portion of the FW2-TP (C1) designation *means the general surface water classification applied to those fresh waters that are not designated as FW1 or Pinelands Waters*. As a frame of reference, "FW1" *means those fresh waters, as designated in N.J.A.C. 7:9B-1.15(h) Table 6, that are to be maintained in their natural state of quality*

(set aside for posterity) and not subjected to any man-made wastewater discharges or increases in runoff from anthropogenic activities. These waters are set aside for posterity because of their clarity, color, scenic setting, other characteristic or aesthetic value, unique ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s). The possible uses described for FW2 waters include:

1. Maintenance, migration and propagation of the natural and established biota;
2. Primary and secondary contact recreation;
3. Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
5. Any other reasonable uses.

The TP portion of the designation FW2-TP (C1) denotes Trout Production status. Trout Production indicates that a waterway may support populations of native reproducing trout, provided that enabling environmental characteristics are sufficiently protected and managed. This indicates the need to implement appropriate development and environmental regulations to ensure the long-term viability of these surface water bodies as a pristine water source.

The (C1) portion of the FW2-TP (C1) status indicates a Category 1 anti-degradation policy, as follows: "*Category One Waters shall be protected from any measurable changes (including calculable or predicted changes) to the existing water quality. Water quality characteristics that are generally worse than the water quality criteria, except as due to natural conditions, shall be improved to maintain or provide for the designated uses where this can be accomplished without adverse impacts on organisms, communities or ecosystems of concern. Therefore, these waters are protected from changes in water quality.*" They are considered to possess exceptional aesthetic, ecological, recreational, and/or fishing value. Planning policies related to these waterways should respond to the need to preserve these values or to reestablish them in any instances where they have been lost.

A number of streams and rivers in the Township are classified as FW2-TM(C2). The TM denotes Trout Maintenance status, whereby a water body supports populations of trout, although none reproduce in those waters. The C2 indicates a Category 2 anti-degradation policy, as follows: *"For Category Two Waters, water quality characteristics that are generally better than, or equal to, the water quality standards shall be maintained within a range of quality that shall protect the existing/designated uses, as determined by studies acceptable to the Department, relating existing/designated uses to water quality. Where such studies are not available or are inconclusive, water quality shall be protected from changes that might be detrimental to the attainment of the designated uses or*

maintenance of the existing uses. Water quality characteristics that are generally worse than the water quality criteria shall be improved to meet the water quality criteria."

Trout Production and Trout Maintenance differ from a planning perspective, as they carry different anti-degradation policies. Since Trout Production carries the C1 designation, the high quality of these waters must be maintained, and "shall be protected from any measurable changes" (NJDEP, 1998). The policy pertaining to Trout Maintenance waterways, carrying a C2 designation, is slightly less restrictive, requiring that they "shall be protected from changes that might be detrimental to the attainment of the designated uses or maintenance of the existing uses." Nevertheless, it is noted that the Division of Water Resources classification of the streams and rivers in the Township are clearly intended to promote careful conservation; application of the anti-degradation policy may even imply restrictive use of, and restrictive development around, Trout Production waters located in Washington.

The Surface Water Quality Standards adopted in 1998 also established strict guidelines for the presence of numerous contaminants, both man made and naturally occurring. Included in these categories are items such as fecal coliform, enterococci, dissolved oxygen, floating colloidal solids, petroleum hydrocarbons, phosphorus, suspended solids, total dissolved solids, sulfates and taste and odor producing substances. Also important, especially to areas of trout maintenance and trout production, are alterations to temperature and the addition of toxic substances.

There are only two tributaries in the Township of Washington that are designated FW2-NT (C2). These are Drakes Brook, in the northeastern corner of the Township and Tanners Brook, which runs parallel to the South Branch of the Raritan River but drains to the Lamington River. These waters carry the Non-Trout (NT) designation, meaning they are surface waters which cannot support trout populations. They are, however, subject to the Category 2 anti-degradation policy of the Surface Water Quality Standards and are therefore afforded some protection. A common misconception is that waterways carrying the TP (trout production) and TM (trout maintenance) designations should be scrutinized for planning purposes, applying stricter standards pertaining to development practices. And while this is entirely appropriate, all surface waters, regardless of designation, should be afforded the same consideration if critical habitat is to be protected and a diversity of species is to be encouraged.

Figure 11 also indicates theoretical buffers that would be required on the Trout Production and Trout Maintenance streams and rivers within the Township in accordance with State regulations. Trout Production streams and rivers are considered "exceptional resource value" waterways. In addition, any wetland that drains into a Trout Production stream or river is also considered to by of "exceptional resource value". This means they are afforded a 150 foot transition area under the Freshwater Wetlands Protection Act Rules adopted in 2001.

Trout Maintenance streams and rivers are also afforded some amount of protection under State regulations. Trout Maintenance streams are considered to be waterways of

"intermediate resource value" and require a 50 foot transition area. Wetlands draining to a Trout Maintenance waterway are also afforded this same protection and are designated as of "intermediate resource value", thereby receiving a 50 foot buffer. These transition areas serve to buffer sensitive wetlands, providing some filtration of pollutants and providing space between human activities and wildlife.

The protection of these lands through the Surface Water Quality Standards and the Freshwater Wetlands Protection Act Rules have far reaching impacts on land use in the Township. As depicted in Figure 11, buffers stretch out into the properties surrounding many of the wetlands on Schooleys Mountain, the South Branch river valley and the Musconetcong river valley. These buffers impact landowners and serve to organize development away from resources to be protected under the anti-degradation policies in the State regulations. They will also, however, promote the protection of the valuable water resources of the Township and the State.

Enhanced storm water quality treatment systems and practices such as bioretention basins or extended detention basins to create a shallow marsh that may yield far higher pollutant removal efficiencies while blending into the natural surroundings. Another appropriate strategy is to protect the riparian woodland canopies that effectively regulate water temperatures in watercourses that support trout propagation and trout habitat. Enhanced stream corridor buffering may be indicated based upon a variety of physical characteristics and management objectives. A 1989 study published by Cook College, Watershed management Strategies for New Jersey presents recommendations for buffering of up to 200' for sediment control, nutrient pollutant removal and stream temperature control. Additionally a buffer of up to 300' may be indicated for wildlife habitat protection.

Sub watersheds

Sub watershed boundaries reflect the drainage basins of smaller and intermittent streams in the in the Township. Knowledge of these drainage basins is especially important since the basins will implicitly define the area from which contamination found in their respective surface water bodies originates. Accurate knowledge of the drainage basins is an important consideration from a land use perspective, if the Township's goals of maintaining high water quality in particular drainage basins are to be achieved.

The sub-watershed boundaries for the Township are depicted on Figure 12. Washington is divided into 43 sub-watershed areas, draining to three main rivers with 10 smaller tributaries. This divides the Township into three distinct watershed areas for the Musconetcong, Lamington and Raritan rivers.

The Musconetcong River sub-watersheds drain off of Schooley's Mountain, flowing to the northwest. Tributaries to the Musconetcong include Mine Brook, Bungalow Brook and Stephensburg Brook. As stated previously, all of these are high quality waters with Trout Production or Trout Maintenance status.

The Lamington River sub-watersheds drain to the southeast off of Fox Hill Range. Tributaries to the Lamington in the southeastern corner of the Township include Rockaway Creek, Rinehart Brook and Tanners Brook. Only Tanners Brook is not a Trout Production waterway.

The South Branch of the Raritan River has the most extensive drainage area in Washington Township, draining approximately 16,200 acres. The tributaries to the South Branch in the central portion of Washington include Stony Brook, Drakes Brook and the Electric Brook. All the surface waters that drain to the South Branch with the exception of Drakes Brook are Trout Production waters.

Most all of the sub-watersheds depicted in Figure 12 deserve special consideration with respect to planning policies related to surface water. These sub-watersheds drain directly into Category 1 Trout Production and Category 2 Trout Maintenance surface waters. It would be reasonable for the Township to fashion stricter storm water management guidelines for development occurring in these areas. This could include use of water quality and bio-retention basins, reduction in the amount of paved surfaces and decreasing density of development.

Stricter standards provide a means to maintain the high quality of surface waters in the Township. A public information campaign designed to raise awareness of these standards and their implications would be a logical step as well. Many people feel a sense of stewardship when they know that the land they have is special, which includes much of the land in Washington Township.

Wetlands

Wetland habitats generally occur between well-drained upland areas that rarely receive floodwater and low-lying, permanently flooded waters of lakes or streams. Wetlands characteristically include swamps, bogs, marshes and bottomland areas. Although they usually lie along rivers and lakes, wetlands may occur on slopes where they are associated with groundwater seeps. Wetlands depicted on Figure 13 are taken from the New Jersey Department of Environmental Protection's Land Use/Land Cover information from 1995. Wetlands were photo-interpreted from Color Infrared aerial photography.

The importance of wetlands is multi-faceted, particularly as they serve as aquifer recharge areas and as areas that trap and filter pollutants through natural bio-chemical processes. The filtering capabilities of wetlands are particularly useful along the trout production and trout maintenance waters of the Township. Wetlands here may serve as a buffer to harmful non-point source pollutants. Wetlands also serve as headwaters to many of the tributary streams that are within Washington.

The NJDEP wetland mapping in Figure 13 indicates that 4,226.47 acres of wetlands exist in the Township of Washington. The predominant wetland type is deciduous wooded, comprising just over 79% of the total wetlands at 3,348 acres. The wetlands found along

the South Branch of the Raritan are mixed; mostly deciduous wooded wetlands, but with a mix of deciduous shrubby and herbaceous wetlands. This bodes well for the continuation of trout production and maintenance waters in this area, as a buffer is set up affording some protection from development. Additionally, the wooded areas along stream and river corridors also offer protection from temperature fluctuations.

The other significant deciduous wooded wetlands are found atop Schooleys Mountain. These wetlands are significant habitat and aquifer recharge areas, also acting as headwaters to tributaries that feed into the Musconetcong and South Branch rivers.

Nine wetland types are identified in Figure 13, including herbaceous, coniferous wooded, deciduous shrubby, successional, disturbed, managed, agricultural and wetland right of way. The table below lists the wetlands by type and the acreage and percentage of each found within the Township.

Table 2
Wetland Types

Type	Acres	Percentage
Agricultural Wetlands	278.54	6.6
Coniferous Wooded Wetlands	19.15	0.5
Deciduous Shrubby Wetlands	281.47	6.7
Successional Wetlands	18.31	0.4
Deciduous Wooded Wetlands	3,348.11	79.2
Herbaceous Wetlands	157.72	3.7
Disturbed Wetlands	49.23	1.2
Managed Wetlands	60.82	1.4
Wetland Right of Way	13.13	0.3
Total	**4,226.47**	**100.0**

Most of the wetlands that are found in Washington are designated as Palustrine and are typically described as marshy, boggy or swampy. The types of Palustrine wetlands in the Township are further defined according to the dominant types of vegetation found in each, or according to the form and composition of the substrate material of each wetland. The Palustrine Forested Broad Leaf Deciduous wetland, for example, is at least 50% forested and forested predominately with deciduous trees having broad leaves, such as oak or maple.

The other classifications of palustrine wetlands include emergent, open water and scrub/shrub broad leaved deciduous. The open water classification refers to wetland areas that appear wet, as in a ponded area. The emergent designation means that most of the characteristic vegetation is rooted in shallow water. Small trees and shrubs dominate the scrub/shrub type of wetland.

Although State regulations afford a fair amount of protection for wetlands, it is prudent to consider additional environmental resource protection strategies that can build upon these State protections. More and more, the importance of wetlands in flood control and water quality is becoming known. The importance for careful management of wetlands and their environs was highlighted by Hurricane Floyd in 1999, which destroyed millions of dollars worth of property and even claimed lives. It is careful planning and consideration that can avoid loss from disasters such as Hurricane Floyd in the future.

FEMA Flood zones

The Federal Emergency Management Agency (FEMA) maps the 100-year floodplain that occurs along all of the streams and rivers in the Township, as depicted on Figure 14. This mapping is done in order to provide information to homeowners, floodplain managers, engineers and flood insurance providers on the risk associated with dwellings and structures as it pertains to flooding.

Washington Township participates in the National Flood Insurance Program (NFIP), whereby the Township adopted standards regarding development in the floodplain. A Flood Hazard Study was completed for the Township in 1983, initiating their participation in the Program. Washington Township has implemented development regulations to prohibit or limit development in the floodplain in order to reduce the risk of damage occurring due to flooding, thereby protecting public safety. When a structure that was in the floodplain prior to the Township joining NFIP applies for a building permit for substantial improvement (greater than 50% of the market value), the Township will require the structure to come into compliance with the development regulations as they pertain to floodplains. This usually means that the structure would have to be raised above the predicted level of a flood. Homeowners that have flood insurance may be eligible for up to $20,000 to help defray the costs of this requirement. The Township and County have also condemned property in the floodplain in order to eliminate the potential for damage due to flooding.

FEMA strongly recommends that all persons within a special flood hazard area shown on the Flood Insurance Rate Maps (FIRM) purchase flood insurance. They also recommend that even those not directly in a flood hazard area purchase insurance, as flood damage can occur outside the flood hazard areas as well.

The flood plain along the South Branch of the Raritan River occurs in variable spans, as small as 300 and as large as 1500 feet in width. The flood plain along the Mine Brook in the northwestern corner of the Township is also extensive, at some points spanning 1,000 feet from one side of the brook to the other. This is due to the relatively large upstream area that drains to Mine Brook and its proximity to the Musconetcong River. The 100-year floodplain for the other brooks in the Township are comparatively limited, and average 100 to 200 feet from side to side.

The mapping of the 100-year floodplain that occurred through FIRM is essential, due to the hazard of flood associated with these areas. Clearly the extent of the 100-year flood

plain imposes severe limitations on development and a sound policy is to prohibit development throughout these mapped areas, as the Township generally tries to do. Figure 14 depicts the general location of the 100 Year and 500 Year floodplain as indicated by the Federal Emergency Management Agency data.

Steep Slopes

The underlying geology and rivers and streams had much to do with the formation of the current landform in Washington Township. Most of the land in the Township is on relatively flat ground, with steep slopes occurring in the transition areas between the river valleys and the higher elevations of Schooleys Mountain, Fox Hill Range and Hacklebarney, near the Lamington River. This is apparent in Figure 15, which depicts slopes that are greater than 15% in the Township and surrounding area.

The steep slopes of Washington occur in four distinct bands, representing transition areas of the landscape. The general topography of the Township is depicted on Figure 15. The first transition is from Schooleys Mountain to the Musconetcong River valley in the northwestern part of the Township. Many of the slopes in this area are greater than 30%. The second transition is from Schooleys Mountain to the South Branch River valley. This transition is more abrupt than that to the Musconetcong, appearing as a more defined ridge with great elevation changes in a small distance. Certain areas of the ridge experience 400 feet of vertical change in just 1,000 feet, with slope greater than 40%.

The third area of transition occurs from the South Branch river valley to the Fox Hill Range. Most of the steep slopes in this area are to the west of Tanners Brook and most of the slopes here are between 15% and 25%. There is another valley between the Fox Hill Range and the Lamington River valley, where the fourth area of steep slopes occurs in the Township. Many of the slopes in the southeastern corner of Washington along the Lamington River are greater than 25%. Here slopes commonly exceed 50% running down to the banks of the Lamington.

Steep slopes have a number of implications on community development and the environment. Slopes in excess of 25% present serious limitations for development, often times requiring extensive and costly engineering and construction. Development on slopes in excess of 15% presents implications pertaining to degradation of the environment, if not properly managed. Since most slopes occur in and around the banks of streams and rivers, clearing these areas for development creates the potential for erosion and stream sedimentation. With many of the steep slopes in the Township occurring near the banks of rivers and streams, concurrent with high quality Trout Production and Trout Maintenance streams, protection of steep slope areas becomes more critical. The clearing of trees and vegetation that stabilizes the slope not only causes erosion and sedimentation problems, it can also contribute to increased water temperatures in streams and rivers.

Due to the concurrence of high quality surface waters and steep slopes, continuation of regulatory measures through the Land Development Ordinance is paramount to the

protection of water quality in Trout Production and Trout Maintenance waterways. A steward program should also be initiated in order to alert landowners to the importance of these considerations when undertaking activities on their land. A regulatory framework should be maintained to limit clearing in these areas. Limiting clearing of vegetation on slopes greater than 15% assures that steep faces will not be subject to erosion and carry sediment to streams and rivers. Vegetative buffers should be required and maintained through the land development ordinance, establishing areas to slow potential sedimentation, filtering it from water prior to reaching streams and rivers.

Forested Areas

Including wooded wetlands, Washington Township has over 15,000 acres of forested areas. This is just over 50% of the total acreage of the Township, representing a fairly significant portion of land cover. An overwhelming part, 10,294 acres or 67.5%, is deciduous forest. Combined with deciduous wooded wetlands, over 90% of the forested areas in Washington are deciduous in nature. Table 3 below lists the forest types depicted on Figure 17 and the percentage that each type represents.

Table 3
Forest Types

Forest Type	Acres	Percentage
Brush Covered Field	817.59	5.4
Coniferous Forest	83.49	0.5
Coniferous Wooded Wetlands	19.15	0.1
Deciduous Forest	10,294.77	67.5
Deciduous Wooded Wetlands	3,627.83	23.8
Mixed Forest	309.99	2.0
Mixed Wooded Wetlands	1.75	0.0
Plantation	93.20	0.6
Total	**15,247.76**	**100.0**

The forested areas of Washington Township play a vital role in many ecosystem functions, including the following:

- Habitat for threatened and endangered species
- Regulate stream temperatures to support Trout Production and Trout Maintenance of streams and rivers
- Stabilization of steep slopes and reduction of erosion and sedimentation
- Wooded wetlands act as headwaters to tributary streams of the Lamington, South Branch and Musconetcong rivers
- Conversion of CO2 to oxygen
- Dissipate heat and provide shade
- Regulate building temperatures and reduce reliance on heating and cooling systems

- Reduce pollution
- Reduce noise pollution
- Provide privacy and screening
- Enhanced groundwater recharge capacities

"The net cooling effect of a young, healthy tree is equivalent to ten room-size air conditioners operating 20 hours a day." -U.S. Department of Agriculture

"Trees can boost the market value of your home by an average of 6 or 7 percent." -Dr. Lowell Ponte

"Landscaping, especially with trees, can increase property values as much as 20 percent." -Management Information Services/ICMA

"One acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen. This is enough to meet the annual needs of 18 people." -U.S. Department of Agriculture

"There are about 60-to 200- million spaces along our city streets where trees could be planted. This translates to the potential to absorb 33 million more tons of CO2 every year, and saving $4 billion in energy costs." -National Wildlife Federation

"Trees properly placed around buildings can reduce air conditioning needs by 30 percent and can save 20 - 50 percent in energy used for heating." -USDA Forest Service

"Trees can be a stimulus to economic development, attracting new business and tourism. Commercial retail areas are more attractive to shoppers, apartments rent more quickly, tenants stay longer, and space in a wooded setting is more valuable to sell or rent." -The National Arbor Day Foundation

"Shade from trees could save up to $175 per year (per structure) in air conditioning costs." -Dr. Lowell Ponte

"Healthy, mature trees add an average of 10 percent to a property's value." -USDA Forest Service

"The planting of trees means improved water quality, resulting in less runoff and erosion. This allows more recharging of the ground water supply. Wooded areas help prevent the transport of sediment and chemicals into streams." -USDA Forest Service

"In laboratory research, visual exposure to settings with trees has produced significant recovery from stress within five minutes, as indicated by changes in blood pressure and muscle tension." -Dr. Roger S. Ulrich Texas A&M University

The benefits of trees are fairly well documented, fostering a healthier environment for humans and animals while simultaneously providing economic benefits. Therefore it is important for the Township to continue to encourage the preservation and wise use of

forest resources within Washington. This can be achieved through the development review process, establishing strong limits of clearing and making tree and forest preservation a known priority of the Planning Board. However, woodland clearing on large wooded tracts should be limited to ensure that forest health is maintained and the benefits that accrue to other natural resources, such as protection of critical habitat are assured.

Many communities have instituted a permitting process for individual landowners who wish to cut down trees, requiring an application that allows a regulatory board or agency insight into tree cutting activities. Often times, this is unpopular with residents if it adds an unnecessary level of bureaucracy. Another approach may recognize legitimate reasons for tree removal such as for residential site amenities including garages, pools, tennis courts, etc., while instituting a regulatory framework for large parcels with critical habitat woodland resources. Given public sentiment on measures such as tree cutting ordinances, the best approach is often a public education campaign that explains the benefits of trees and how they are a vital part of the ecosystem and establishing provisions allowing a modest amount of tree clearing without a permit requirement. Given the high quality of many of the ecosystems in the Township, an overall approach promoting stewardship of all resources is likely the best way to address the need to regulate critical habitat environment. This should include the preparation of a tree conservation plan that seeks to manage critical forest habitat and promote forest health while protecting landowner rights.

Agricultural Lands

Washington Township has just under 7,000 acres of land that can be categorized as agricultural in nature, as depicted in Figure 18. This represents about 25% of the Township's total land area. The other three categories depicted in Figure 17 represent liberal interpretation of the NJDEP land use/land cover data from 1995. Agricultural wetlands are often areas that are actively farmed and not necessarily wetlands in the usual sense. Most times they would not be identified as wetlands in field delineation and therefore are usually better categorized as agricultural land. The brush covered field category could be interpreted two ways. The first is as an agricultural field that has not been actively farmed for more than two years and is now undergoing the early stages of succession. It could, however, with minor attention, be returned to active production rather quickly. The second potential interpretation is as an agricultural field that has been converted to part of a residence now undergoing the early stages of succession. In this case, it is likely that it will be untouched and continue the trend toward a forested area. The plantation category presented in Figure 18 is indicative of nursery crop production. This is recognized as a form of agriculture, although not conforming to the traditional definition that comes to the mind of most people when they hear the term agriculture.

A majority of land that is truly agricultural in nature is found in the valley of the South Branch of the Raritan River. A belt of rich agricultural soils is present on the floor of the valley, representing some of the most productive soils in the County (Soil Survey of Morris County, USDA NRCS). There are, however, other areas of agriculture spread

throughout the Township, although not in as great a concentration as found in the valley. The other concentrations are located east of the Fox Hill Range in the southeast corner of the Township and then in smaller pockets on Schooleys Mountain. The Musconetcong River valley also has very fertile soils and is home to agricultural operations. These other agricultural areas are a significant resource in the community that should be protected where possible. The Township should preserve agricultural areas wherever possible, particularly when the conversion of farmland to a non-agricultural use is proposed. The township's mandatory clustering ordinance that requires the set aside of at least 50% of a parcel of land when subdivided, is designed to protect agricultural areas. This ordinance should be reexamined periodically to ensure that areas set aside are maximizing farmland retention.

Wildlife and Critical Habitat

In 1993, the New Jersey Department of Environmental Protection Endangered and Non-game Species Program (ENSP) initiated a move to a landscape level approach for endangered species protection. With suburbanization and development occurring in all areas of the State, an increasing amount of habitat that could potentially support threatened and endangered species was being lost daily.

In order to address habitat loss, ENSP needed to grasp the extent and suitability of remaining resources in the State. To accomplish this, they partnered with the Center for Remote Sensing and Spatial Analysis (CRSSA) at Cook College, Rutgers University. Utilizing LandSat Thematic Mapper satellite imagery, CRSSA mapped land cover for the entire State of New Jersey, broken down into 20 different habitat/land cover types. After generalized cover types were classified, detailed methodologies were developed to address the habitat suitability issues for each focus category, including beach/dunes, emergent landscapes, forested wetlands, forested areas and grasslands.

After reclassifying data based on standards developed for each category, the habitat data was intersected or combined with the Natural Heritage Program's Biological Conservation Database (BCD). This database is a Geographic Information System (GIS) coverage that provides information on the sighting of threatened and endangered species, based on the field work of ENSP scientists and sightings reported by members of the public. It is the most comprehensive data available in digital form on the location of threatened and endangered species.

The combination of these two data sets resulted in the data that is depicted in Figures 19 and 20. The Landscapes Program data provides users with scientifically sound, peer-reviewed information on the location of critical habitat based on the conservation status of the species that are present. Habitats are ranked on a scale of 1 to 5, based on the following criteria:

Table 4
NJ Landscapes Program Ranking System

Rank	Indication
1	Suitable habitat, no special concern, threatened or endangered species sighted
2	Habitat patch with species of special concern present
3	Habitat patch with State threatened species present
4	Habitat patch with State endangered species present
5	Habitat patch with Federal threatened or endangered species present

Washington Township is rich in habitat that is suitable to support populations of threatened and endangered species. In fact, there isn't much of the Township that isn't suited as habitat for threatened and endangered species. Four of the five Landscapes Project categories are represented in the Township including forested wetland, emergent, forest and grassland habitat. Most of these habitat types have documented presence of State threatened and endangered species. Species include the wood turtle, bog turtle, barred owl, timber rattlesnake and the Cooper's hawk.

Schooleys Mountain contains significant amounts of contiguous forest habitat with the presence of State endangered species documented. The forested areas here stretch north and south of the Township and are part of the vast contiguous forest resources that characterize the Highlands region. Schooleys Mountain also possesses grassland habitat with documented State threatened and endangered species. This combination, along with the Trout Production and Trout Maintenance streams, defines the importance of the need for preservation initiatives in this area.

The same is true for the Hacklebarney area in the southeastern corner of the Township. The steep slopes in the area of the Lamington River valley are forested and contain State threatened and endangered species. Hacklebarney State Park makes up about half of this forested area, assuring that it will be preserved for the future and remain intact, continuing to provide habitat.

The South Branch River valley is home to many State threatened and endangered as well as federally listed threatened and endangered species. The agricultural activities in the valley are particularly well suited to the provision of grassland habitat for nesting and migrating birds. This is represented fairly well on Figure 19. Also shown are two patches of habitat with federally listed threatened and endangered species. The first sits just below the ridgeline northeast of the river along Mill Road. The second is in the southwest corner of the valley, just below the ridgeline adjacent to Mill Road. This grassland habitat extends into Lebanon Township in Hunterdon County and is most likely home to a bird species.

The farmland of the Musconetcong valley also contains habitat that contains State threatened species. As mentioned previously, some agricultural activities, especially the production of hay and other grain crops, is uniquely compatible with the needs of bird species. Often the times of year that harvesting takes place occurs after birds have completed their reproductive cycles and continued with migration.

Figure 20 depicts the forested wetland and emergent habitat that was identified through the New Jersey Landscapes Program. Much of the forested wetland habitat present on Schooleys Mountain is only suitable to the presence of threatened and endangered species, with only limited sightings of state threatened species in confined patches. The same holds true for the Fox Hill Range near Tanners Brook. The South Branch River valley, though, is a different story altogether.

Close inspection of Figure 20 shows that the South Branch has vast amounts of habitat with federally listed threatened and endangered species. The section north of Long Valley has both forested wetland and emergent habitat. The same is true for the stretch just north of Lebanon Township. The remaining habitat depicted along the South Branch is home to State threatened species. This data alone indicates the need to fashion strict preservation based guidelines for the South Branch pertaining to the protection of critical resources, the arrangement of development and strict standards limiting clearing and requiring enhanced storm water management. In combination with the Trout Production status of the waterway, the South Branch represents one of the most pristine waters in the Township.

The Landscapes Program data was intended to aid municipalities, County and State governments, conservation agencies and citizens in determining the extent of critical habitat within their respective jurisdictions and communities. After identifying critical habitat, a variety of means can be employed to protect it, including the following:

- Prioritizing open space acquisitions based on the presence of habitat for threatened and endangered species
- Adopting regulations aimed at protecting critical habitat
- Adopting management policies for open space that are consistent with protection of critical habitat
- Permitting flexibility in development techniques that can accommodate the protection of critical habitat
- Promoting land stewardship practices that are consistent with the protection of critical habitat

Groundwater Contamination[1]

Figure 21 depicts the New Jersey Department of Environmental Protection data for the Currently Known Extent (CKE) of ground water pollution for Washington Township. CKE areas are geographically defined areas within which the local ground water resources are known to be compromised because the water quality exceeds drinking water and ground water quality standards for specific contaminants. Historically, a number of the CKEs have also been identified as Well Restriction Areas (WRAs). The regulatory authority for developing CKEs is in N.J.A.C. 7:1J, entitled Processing of Damage Claims Pursuant to the Spill Compensation and Control Act. CKEs are used by NJDEP staff, water purveyors, and local officials to make decisions concerning appropriate treatment and/or replacement of contaminated drinking water supplies.

The CKE areas, as shown, are intended to provide information to the public about contaminated ground water areas in the state. Unless precautionary measures are taken to protect potable users, well installation should be avoided. This information is made available so informed decisions can be made on well location, design, or treatment before wells are proposed, permitted, and installed.

NJDEP is currently engaged in the reassessment and investigation of existing CKEs; however, it is important to note that CKEs are approximations of the actual aerial extent of ground water contamination and the boundaries presented here may change over time as new information is developed. At this time, the records of the CKEs do not include a list of the specific ground water contaminants. Also, it should be noted that CKE areas might overlap with other CKEs and Classification Exception Areas (CEAs). Revisions and additions will be used to update the CKE database as new information is received and processed.

In Washington Township, there are two known groundwater contamination sources. The first is the Combe Fill South Landfill in Chester Township, with a generalized extent of approximately 2,900 acres. The second is the Cleveland Industrial Center, with a generalized extent of 3,200 acres. These two known extents overlap each other in the vicinity of Black River Road.

Known Contaminated Sites[2]

Figure 22 shows the Known Contaminated Sites (KCS) List for Washington Township, dated 2001. KCS are those sites and properties within the state where contamination of soil or ground water has been identified or where there has been, or there is suspected to

[1] *NJDEP Currently Known Extent of Groundwater Contamination (CKE) for New Jersey*, New Jersey Department of Environmental Protection (NJDEP), Site Remediation Program (SRP), John Defina (ed.), 12/15/2001

[2] *NJDEP Known Contaminated Site List, 2001,* Department of Environmental Protection (NJDEP), Division of Publicly Funded Site Remediation, Site Remediation Program (SRP), John Defina (ed.), 11/13/2001

have been, a discharge of contamination. This list of Known Contaminated Sites may include sites where remediation is either currently under way, required but not yet initiated or has been completed. It is important to note that some of the cases listed may have been fully remediated and should no longer be listed as known contaminated sites. Additionally new contaminated sites have been identified since the creation of this list and are not included here.

Sites identified in the Known Contaminated Sites in New Jersey report can undergo a variety of activities, ranging from relatively simple "cut and scrape" removals to highly complex remedial activities. The sites included in this data-set are handled under various regulatory programs administered by the NJDEP's Site Remediation Program, including the following state and federal statutes:

I. State

1. Brownfield and Contaminated Site Remediation Act
2. Industrial Site Recovery Act
3. Solid Waste Management Act
4. Spill Compensation & Control Act
5. Underground Storage of Hazardous Substances Act
6. Water Pollution Control Act

II. Federal

1. Comprehensive Environmental Response, Compensation and Liability Act
2. Superfund Amendments and Reauthorization Act
3. Resource Conservation and Recovery Act Corrective Action Program

III . A site can be regulated under more than one of these regulatory programs.

1. As a result, more than one case can be associated with a site.
2. A case is an administrative designation based on the regulatory authority under which an entire contaminated site or area of concern is being addressed.
3. Sites with complex contamination issues can have several cases to address various sources of pollution found.
4. A site and each associated case(s) is classified as either active, when the site is assigned to a specific remedial program area, or pending, when the site has yet to be assigned to a specific remedial program area.

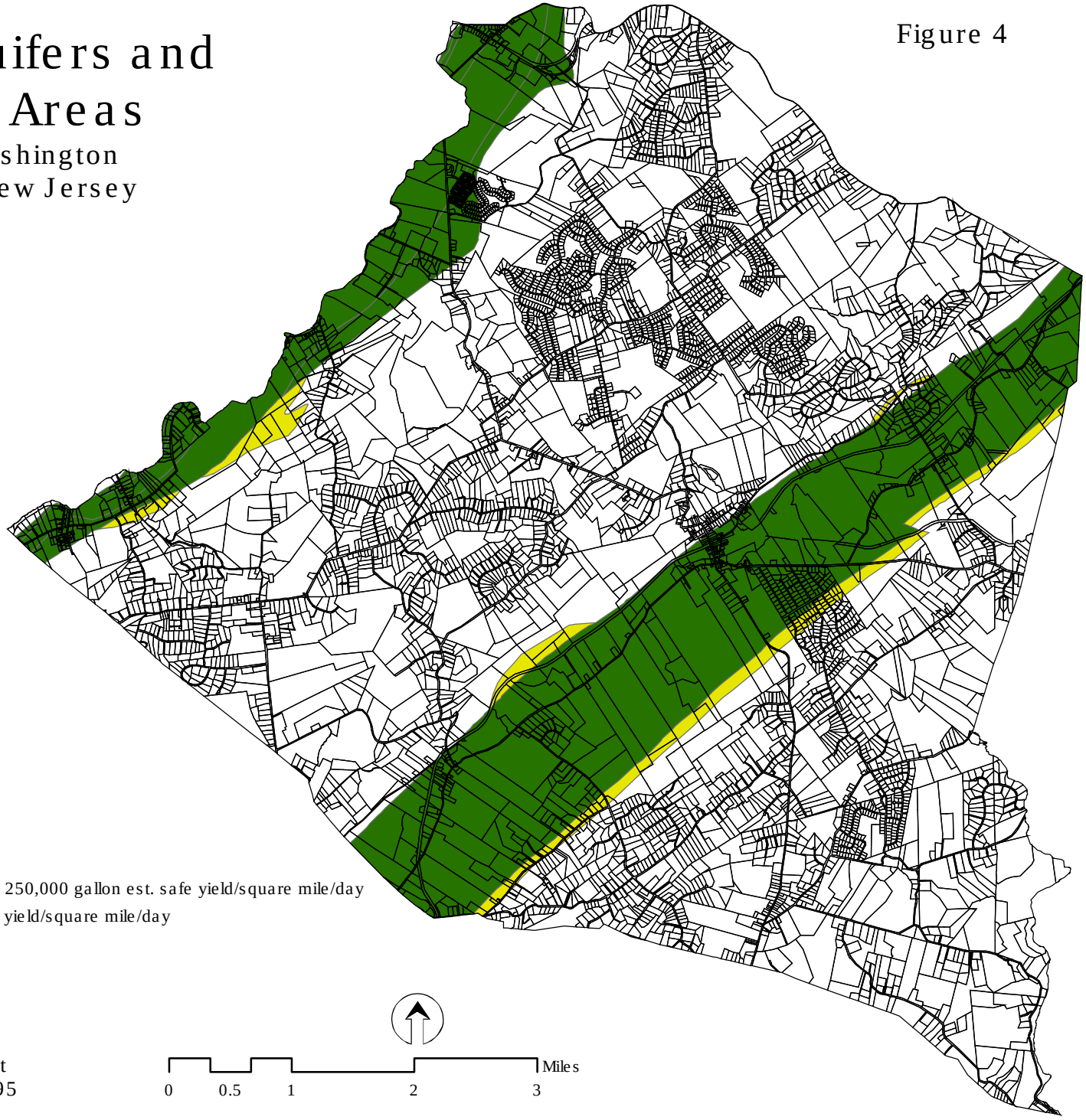
As a public service, the Site Remediation Program administers the Site Information Program that offers general information on known contaminated sites to prospective homebuyers and sellers, real estate agents, environmental and legal professionals, lending institutions and other governmental agencies. The program also makes referrals to appropriate contacts and provides detailed information about Superfund and other high-profile sites. Summary descriptions from the annually produced Publicly Funded Cleanups Site Status Report are available and the reports for the Cleveland Industrial and Combe Fill South Landfill are appended to the end of this section.

A person should not use this data on the Known Contaminated Sites in New Jersey as a sole source when conducting a due diligence investigation into whether or not a particular site is contaminated. If a site of interest is not listed, it does not alleviate a prospective purchaser from performing a due diligence search.

Potential Aquifers and Recharge Areas

Township of Washington
Morris County, New Jersey

Figure 4



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

Legend

- Dolomite, limestone, sandstone and siltstone - 250,000 gallon est. safe yield/square mile/day
- Hardyston Quartzite - 100,000 gallon est. safe yield/square mile/day

BANISCH
Associates, Inc.
Planning/Design
PO Box 154, Sergeantsville, New Jersey 08857
(908)782-0835/7636 fax banisch@earthlink.net

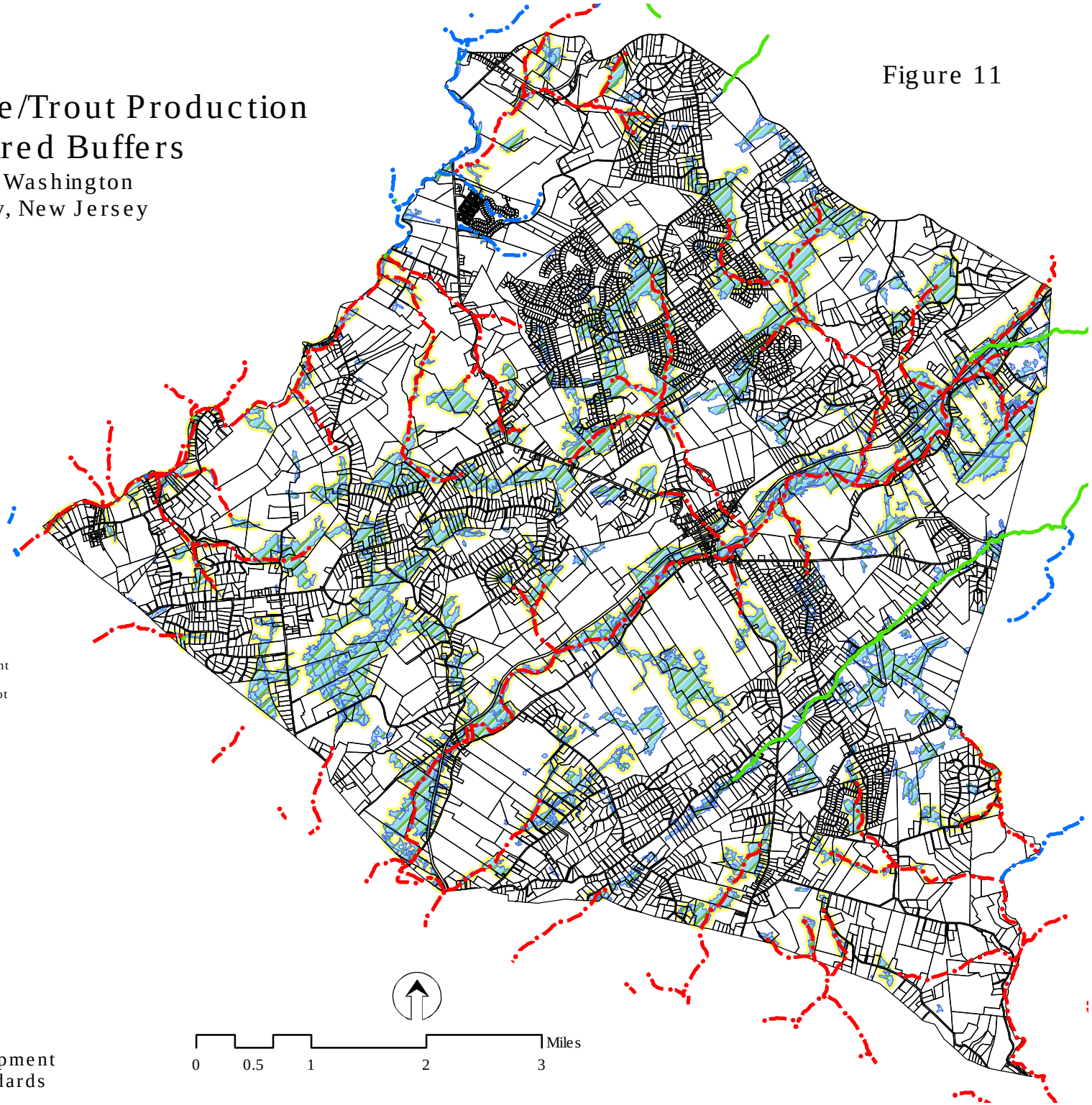
Data Sources:
Morris County Planning and Development
Township of Washington Master Plan-1995
NJGS

0 0.5 1 2 3 Miles

Figure 11

Trout Maintenance/Trout Production with Required Buffers

Township of Washington
Morris County, New Jersey



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

Legend

- Trout Production Waters
- Trout Maintenance Waters
- Non-Trout Waters
- Wetlands
- Required Wetland Buffer

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Data Sources:
Morris County Planning and Development
NJDEP Surface Water Quality Standards

0 0.5 1 2 3 Miles