Chapter 2

Milestone 2
The Troy Brook Regional Stormwater Management Plan

Characterization and Assessment of the Regional Stormwater Management Planning Area for the Troy Brook Watershed

Completed by the
Rutgers Cooperative Extension
Water Resources Program
Under the guidance of Christopher C. Obropta, Ph.D., P.E.

CHARACTERIZATION AND ASSESSMENT OF THE REGIONAL STORMWATER MANAGEMENT PLANNING AREA FOR THE TROY BROOK WATERSHED

January 17, 2007

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Hydrologic and Hydraulic Modeling performed by TRC Omni Environmental Corporation

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I. Introduction

The New Jersey Stormwater Management Regulations have been used as a framework to present a functional characterization and assessment of the stormwater processes of the Troy Brook Watershed. This characterization and assessment is intended to represent areas of the watershed affected by the improper drainage of stormwater and to position the objectives of concerned parties with the purpose of creating solutions.

To identify features and processes within the watershed that could affect the stormwater drainage processes, various methods of analysis have been employed. Extensive field surveys, literature reviews, data collection and the use of Geographical Information System (GIS) were among the techniques used to qualify the watershed.

According to N.J.A.C. 7:8-3.4(a), the regional stormwater management plan shall include a characterization and assessment that covers a series of specific components, including the mapping and analysis of a watershed. These components have been outlined and presented in this text. Rationale for not including a component is determined by the committee if that component is not found to be appropriate for the regional stormwater management area.

II. Maps

A. Regional Stormwater Management Plan (RSWMP) Boundary

The Troy Brook Watershed, located in Morris County, New Jersey is approximately 16 square miles in size. The watershed system discharges to the Whippany River and eventually to the Passaic River. The Troy Brook Watershed is comprised of 24 miles of river and more than 400 acres of lakes. The largest bodies of water in the drainage area include Lake Parsippany of Parsippany-Troy Hills Borough and Mountain Lake of Mountain Lakes Borough.

The Regional Stormwater Management Planning Area Boundary was originally defined through the use of the United States Geological Survey's (USGS) delineation of HUC 14 boundaries. These drainage basins are denoted by the use of a 14-digit hydrologic unit code (HUC's) and are delineated from 1:24,000-scale (7.5-minute) USGS quadrangles.

A map representing the regional stormwater boundary of the Troy Brook Watershed depicting the upper and lower HUC 14 delineations can be found in Appendix B, Map 1. This boundary is also illustrated on Map 2, Appendix B, over the NJDEP 2002 Digital Orthophotos.

B. Land Use/Land Cover

The land use in the Troy Brook Watershed ranges from low density residential in Mountain Lakes, medium to high density residential through Parsippany-Troy Hills, to wetlands in the Troy Meadows section of Parsippany-Troy Hills. Hanover Township consists primarily of medium density and low density residential. Hanover Township also has a significant transitional area representing areas under development, where site preparation is present, but the future use has not been realized. Refer to Map 3 in Appendix B for the map of the Troy Brook Watershed's Existing Land Uses. Map 4 in the same appendix depicts the Open Space and Vegetation of the watershed.

According to data collected by the NJDEP, the land use of the Troy Brook Watershed is 53% urbanized. Land use information is shown in Table 1. Based on aerial photography taken in 1995, the NJDEP has created a data set describing land use across the state. This land use/land cover information is available in GIS and can be useful in the analysis of a watershed.

Table 1: NJDEP 1995/97 Land Use Data

Land Use	Area Square Miles	Percentage of Watershed Area %
Agriculture	0.08	0.5
Barren Land	0.05	0.3
Forest	3.37	20.9
Urban	**8.55**	**53.1**
Water	0.68	4.2
Wetlands	3.37	21.0
Total	*16.11*	*100.0*

The 53% urban land use can further be broken down to several subcategories.

Table 2 describes the different types of urban land within the Troy Brook watershed.

Table 2: NJDEP 1995/97 Urban Land Use Types

Urban Land Use Type	Area (Square Miles)	Percent of Urban Land Use (%)
Residential, Single Unit, Medium Density: Urban/suburban residences on 1/8 to ½ acre lots. Impervious coverage is approximately 30 to 35%.	**3.73**	**43.6**
Commercial/Services: Areas that contain structures used for the sale of products and services.	1.11	12.9
Residential, Single Unit, Low Density: Residences on ½ to 1 acre lots. Impervious cover is approximately 20 to 25%.	1.05	12.2
Other Urban or Built-Up Land: Generally characterized by intensive land uses.	0.86	10.0
Transportation/Communication/Utilities: Generally high percentage of impervious surface coverage.	0.57	6.6
Industrial: May include manufacturing, assembly, or processing of products or power generation. Generally have a high impervious coverage.	0.51	5.9
Residential, High Density, Multiple Dwelling: Contains either high density single units of multiple dwelling units on 1/8 to 1/5 acre lots. Impervious coverage is approximately 65%.	0.29	3.4
Recreational: Includes areas specifically developed for recreational activities, such as golf courses, picnic grounds, stadiums, and so forth.	0.18	2.1
Residential, Rural, Single Unit: Residences on 1 to 2 acre lots. Generally, impervious cover is between 15 to 20%.	0.15	1.8
Athletic Fields (Schools)	0.12	1.4
Total	*8.55*	*100.0*

Data Source: "A Land Use and Land Cover Classification System for Use with Remote Sensor Data", USGS Professional Paper 964, 1976; edited by NJDEP.

C. Projected Land Uses

Troy Brook Build Out Analysis

The methods and results used to determine and analyze the projected land uses assuming full development under the existing zoning conditions can be found in Section V of this Characterization and Assessment Report for the Troy Brook Watershed. Maps depicting the land uses before and after maximum build out conditions can be found on Map 3B, Appendix B.

D. Soil

The Troy Brook watershed may further be characterized by its soils. Within the Troy Meadows, soils are predominantly Carlisle muck. This soil series consists of very poorly drained and very deep soils formed in depressions of lake plains, outwash plains, moraines, and floodplains. The ponding duration is known to be long, from October through June, and the typical slopes range from 0 to 2 percent (USDA/NRCS, 2000). The remaining soils of the watershed are variable. The Parsippany series are mostly found up-gradient of the Troy Meadows and follow the stream corridor. The Parsippany series consist of deep, poorly drained soils in extinct lake basins and near streams. The Parsippany series are characterized by their slow infiltration rates, shallow water table, resistance to erodibility, and are usually subject to seasonal flooding. Potential for surface water runoff is considered high for this soil series (USDA/NRCS, 2002). The Riverhead soil series can be found in the northwest and north regions of the drainage basin. This series has been classified as having very deep, well-drained soils, derived from granitic material. Slopes can be extremely variable, from 0 to 50 percent slopes. Due to their well-drained nature, surface runoff potential is considered low to medium (USDA/NRCS, 2003). Spanning the north and middle section of the watershed are the Rockaway soil series. These soils can be categorized as being moderately well-drained, formed as till on uplands. Slope can range from 30 to 60 percent (USDA/NRCS, 2001). Finally, urban soil complexes exist throughout the center and northern regions of the watershed. Urban soils differ from soils that have formed over centuries and millenniums and thus have a uniform structure and known properties. Rather, urban soils range from being extremely variable in texture and structure to being uniformly heavily compacted soil material (Baumgartl, 1998). The dominant soil series within the Troy Brook Watershed are depicted in Figure 1.

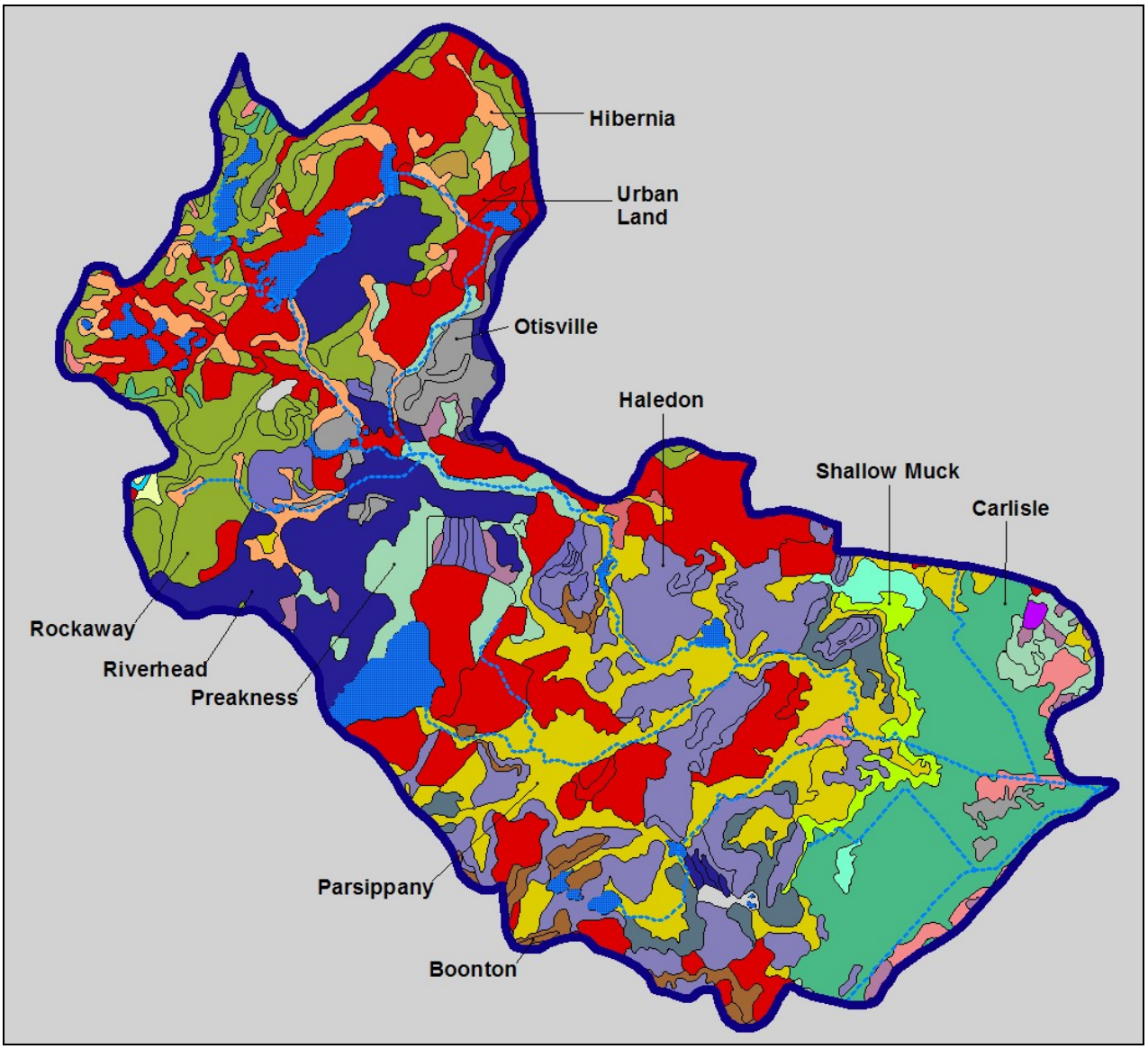

Figure 1: Dominant Soil Series in the Troy Brook Watershed

Soils can also be classified according to their potential to infiltrate water. The Natural Resource Conservation Service (NRCS) categorizes soils that have high infiltration rates, "A" soils, to those that have very slow infiltration rates, or "D" soils. The soils that possess intermediate qualities are classified in a continuum. Map 5 in Appendix B shows the soils of the Troy Brook Watershed as defined by their hydrologic soil group.

Furthermore, each soil type has a related erodibility factor which quantifies the susceptibility of the soil particles to detach and move with the interception with water. Erodibility factors, or k factors, below 0.23 depict soils with low erodibility, whereas those with a k factor above 0.36 would indicate soils with low resistance to erosion. Map 6 in Appendix B illustrates the erodibility potential of the soils within the Troy Brook Watershed. The mid to lower section of

the Troy Brook Watershed shows large areas of high erodibility, particularly along Eastmans and West Brook. This high erodibility strongly relates to the low infiltration rates of the surrounding area and other characteristics of the Haledon and Parsippany soils.

Together, with highly erodible soils, increased stormwater velocities will erode stream banks and downcut streams at a more rapid rate. In the Troy Brook Watershed, erosion is likely to occur in areas where the stream buffer is not well-vegetated or some form of channelization has occurred. Example of this may include the impact of road crossings, outfalls, and concrete channels. Areas of high erosion do exist in the Troy Brook Watershed, but are not rampant throughout. Regional stormwater management planning will effectively locate areas of high infiltration that can be used to decrease the amount of stormwater that is piped to the Troy Brook, thus lessening the chances of erosion and stream degradation. Figure 2 depicts two areas of eroded stream banks in the Troy Brook Watershed and overall high erodibility area. This discussion will continue in Sections IV and V.

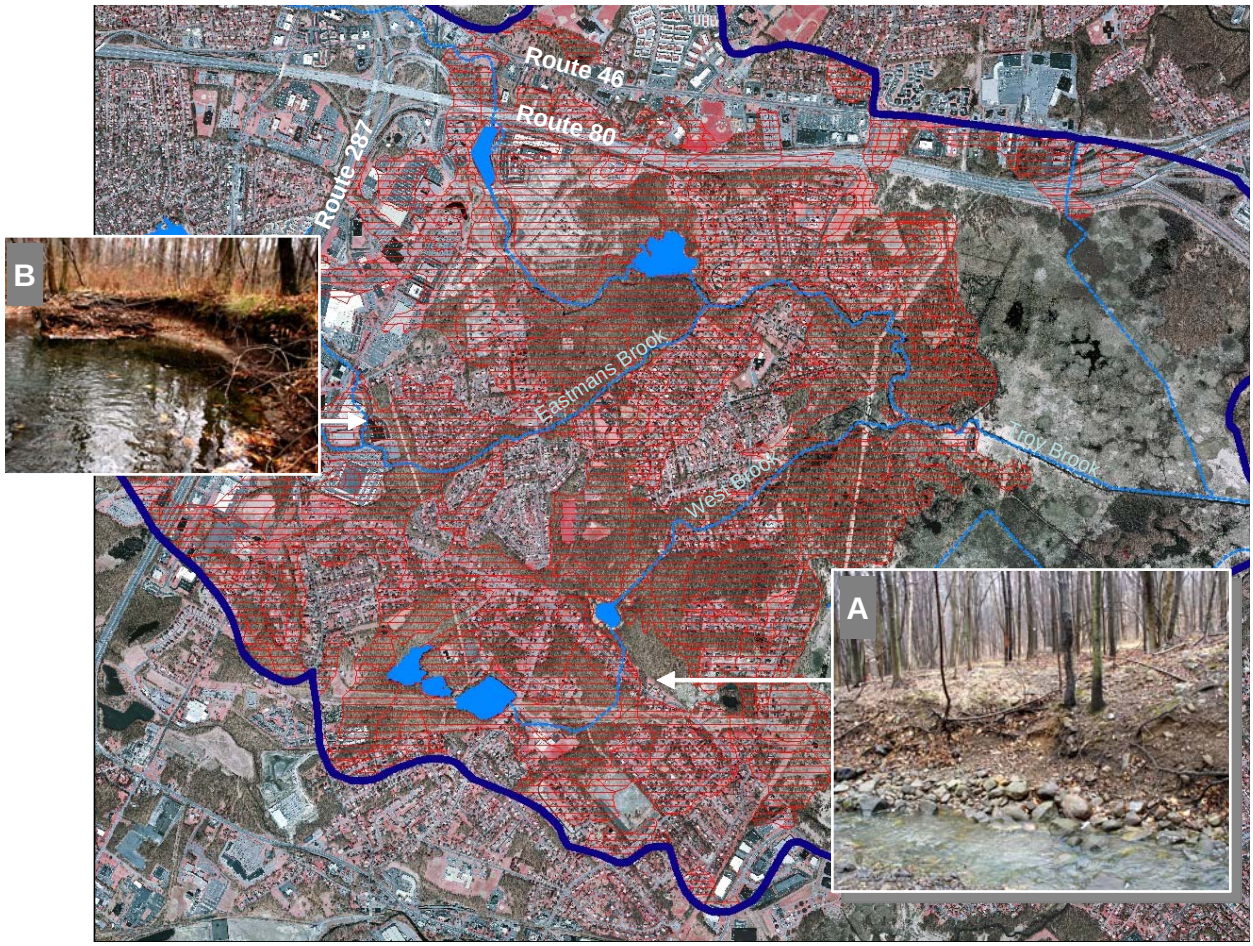

Figure 2: Highly Erodible Soils

A – Wooded Residential Area along Bee Meadow Parkway, Hanover Twp., tributary to West Brook
B – Wooded Area near intersection of East Halsey Road and Parsippany Road in Parsippany-Troy Hills Township along Eastmans Brook

In addition to soils that erode easily, increased velocity with the rapid introduction of stormwater will erode stream banks at an increased rate. Many areas of erosion are scattered throughout the Troy Brook Watershed. Effects of the erosion include downstream destruction of habitat due to siltation and reduction in water clarity. Figure 2 shows a sample of the many eroded streambanks in the Troy Brook Watershed. These considerations will be discussed in the Sections IV and V.

E. Topography

The Troy Brook Watershed lies within two adjacent New Jersey physiographic provinces. Predominantly in the Piedmont Province of New Jersey, this province can be described as low rolling plains divided by a series of higher ridges. Additionally, the Troy Brook Watershed occupies an area within the Highlands Province. It is generally more rugged with rounded ridges and deep valleys. The boundary between these two provinces separates the northern region of the watershed from the bottom two-thirds. This divide is approximately from Lake Intervale and southwest to the watershed boundary. The intersection of these two provinces has been described as the intersection between crystalline rocks and younger sedimentary and igneous rocks (Dalton, 2003).

True to definition, the majority of steep slopes exist in the Highlands Province area of the Troy Brook Watershed. Based on the 10-meter contour information developed by the New Jersey Geological Survey/DEM Data, elevation changes from approximately 700 to 170 feet above sea level, upstream to downstream within the Troy Brook Watershed. The range of steep slopes vary from approximately 0 percent to 26 percent. Birchwood Lakes, Sunset Lake, and Crystal Lakes lie between two ridges, and on the opposing side, Mountain Lake lies between two ridges. These ridges are predominantly Mountain Lakes Borough, Boonton Township, and the north central portion of Parsippany-Troy Hills Borough.

Map 7 in Appendix B is the USGS Quadrangle map which contains contour lines that portray the shape and elevation of the land. This map also provides a wealth of information on lakes, rivers, and roads along with a variety of other natural and manmade features.

F. Waterbodies

There are numerous impoundments within the drainage basin. The largest waterbodies include Lake Parsippany and Mountain Lake. In addition, there are Crystal Lake, Sunset Lake, and Birchwood Lake within Mountain Lakes Borough and the cluster of lakes known as the Rainbow Lakes. Wildwood Lake, Lake Intervale, Forge Pond, and Bee Meadow Pond are also important resources and areas of storage for the watershed. Map 8 in Appendix B illustrates the locations of these waterbodies.

G. Freshwater Wetlands

Based on the NJDEP database, the locations of the wetlands that are contained in the Troy Brook Watershed can be viewed on Map 9 in Appendix B. Upon viewing this map, it is immediately obvious that the low lying area of Troy Meadows provides a large swath of land covered by deciduous scrub/shrub wetlands, wooded wetlands and herbaceous wetlands. This area is a significant environmental resource, providing a large storage of stormwater along with a variety of other benefits.

Many other areas of wetlands can be seen within the Troy Brook watershed. Despite the urban setting, these isolated wetlands provide important functions in the watershed, including the support of biodiversity, the protection of water quality, the storage of flood waters, and the maintenance of stream flow. They also provide natural areas for passive recreation, education and aesthetic enjoyment (Ehrenfeld, 2004).

H. Flood Hazard Areas

The NJDEP is in the process of mapping flood hazard areas based on delineations under the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq. Under this act, the Department is authorized to regulate the development of land in flood hazard areas and to protect the encroachment of streams. The area of delineation is based on the water surface elevation produced by the "flood hazard area design flood" used in State Adopted Flood Studies. This is the flood that is expected to result from the 100-year storm discharge increased by 25 percent.

Mr. John Scordato of the Dam Safety Division within the Department, advised Rutgers Water Resources Program on which maps were complete and available. The maps are available in paper format only, and can be obtained through the office of Dam Safety at the NJDEP. A digital representation of the flood hazard area is not currently available through the Department.

The hydraulic model that was prepared for this Regional Stormwater Management Plan was used to prepare flood area delineations with flows derived from the use of the 100-year design storm increased by 25 percent. The accuracy of this data is determined to be high due to the use of cross sections derived from past HEC-RAS models used by the NJ DEP for permitting requirements. The GIS representation of the Flood Hazard scenario can be found on Map 10 in Appendix B.

I. Groundwater Recharge/Wellhead Protection

Groundwater Recharge

GIS coverage of the groundwater recharge data was assembled by the New Jersey Geological Survey and can be found with the Troy Brook Watershed boundary in Map 11 in Appendix B.

Groundwater recharge is defined as that water that can penetrate the ground and will reach the groundwater table not considering the underlying geology. The methodology that is employed to calculate the potential recharge of a system is taken from the New Jersey Geological Survey report GSR-32, "A Method of Evaluating Ground-Water-Recharge Areas in New Jersey" (Charles, et al., 1993).

The recharge coverages were generated by overlaying the soil, land use/land cover (LULC) and the municipality coverages. The values that represent the ability of the ground to recharge precipitation were determined through the use of the following equation:

groundwater recharge = (recharge factor x climate factor) - recharge constant

The recharge factor and constant are established through the examination of the LULC and the soils series. The climate factor is governed by the location of the municipality and is a ratio of precipitation to potential evapotranspiration (French, 2003).

Wellhead Protection

The Wellhead Protection Area Map, Map 12 in Appendix B, denotes those areas where groundwater is drawn from in a two, five and twelve year period given a certain pumping rate. The delineation is performed by a qualified hydrologist by using several approved methods put forth in the open-file report put out by the New Jersey Geological Survey (Spayd and Johnson, 2003).

A large number of wells in the Troy Brook Watershed and significant pumpage to serve an increasing population density draw attention to this area critical to obtain sustainability in the future. Wellhead protection area within the Troy Brook Watershed covers 64% of the entire land mass within the watershed.

J. Environmentally Constrained and Critical Areas

The definition of "Environmentally Constrained" and "Environmentally Critical Areas" are contained in N.J.A.C. 7:8-1.2. Environmentally constrained areas refers to areas where the physical alteration of the land is in some way restricted, such as through regulation, easement or deed restriction. These could include floodplains, threatened and endangered species sites and parks and preserves, among others. An environmentally critical area defines an area that is of significant environmental value, such as stream corridors, large areas of contiguous open space or groundwater recharge areas.

In Appendix B, Map 13 depicts the Environmentally Constrained areas of the Troy Brook Watershed. Noted on this map are the easements received from Morris County regarding Parsippany-Troy Hills. A wetland buffer of twenty-five feet was prepared to denote the constrained area related to a wetland, as per the Freshwater Wetland regulations (N.J.A.C. 7:7A) regarding the FW2 waters. Those lands that ranked three and above for any Landuse Project Data was used to represent the Threatened and Endangered Lands that fell within the watershed boundary. For the Troy Brook Watershed, that meant Critical Forest Habitat and Critical Emergent Wetland Habitat. The Wood Turtle Habitat has also been included. The Morris County Park land information was gained through a GIS layer obtained through the Center for Remote Sensing and Spatial Analysis at Rutgers University. Map 13A provides the aerials of the Troy Brook Watershed with a single coverage of the Environmentally Constrained Areas in total.

Map 14 in Appendix B presents the Environmentally Critical Areas. To represent the locations that are of significant environmental value several GIS layers were evaluated. For the large areas of contiguous open space or upland forest, the critical habitat layer was used. In this layer, the NJDEP located all contiguous forest and bisected the areas by major road ways. However, this information is from 1995 land use and development since that time should be considered. Stream corridors are represented by a twenty-five foot buffer around the streams, using Stream Encroachment Regulations and the Flood Hazard Area Control Act for F2 non-trout waters. The Environmentally Critical Areas map also includes the Natural Heritage Priority Sites, which are outlined in Table 3. Map 14A provides the aerials of the Troy Brook Watershed with a single coverage of the Environmentally Critical Areas in total.

Table 3: National Heritage Priority Sites in the Troy Brook Watershed

Site Name	Area in the Troy Brook Watershed	Municipalities	County	Description	Boundary Justification	Biodiversity Significance Rank	Biodiversity Community
Passaic Meadows Macrosite	1906 acres	Lincoln Park Borough, Parsippany-Troy Hills Township, Montville Township, East Hanover Township, West Caldwell Borough, Roseland Borough, Hanover Township, Fairfield Borough	Essex, Morris	A series of large expansive wetland complexes adjacent to the Passaic and Whippany Rivers in a portion of the area once covered by the Glacial Lake Passaic. The wetlands are dominated by emergent marsh and shrub and forested swamps.	Primary boundaries are the important forest and wetland habitat identified in the Troy Meadows. Secondary boundaries drawn to include the Troy Meadows standard site and the Great Piece Meadows standard site and to include contiguous undeveloped marsh/swamp habitat.	B4 Macrosite: Moderate significance	Contains a large wetland complex and two standard sites of significance to State Endangered and State Threatened animals.
Troy Meadows	1843 acres	Parsippany-Troy Hills Township, East Hanover Township, Hanover Township	Morris	Troy Meadows is a remnant glacial lake in the Piedmont geological province. It includes forested wetlands with numerous ephemeral ponds on the edge of extensive emergent wetlands.	Primary boundaries drawn to include wetland complex habitats for rare animal species as identified in the Landscape Project analysis. Secondary boundary follows the outer edge of the wetland habitat.	B4 Standard Site: Moderate Significance	Site contains 3 State Endangered and 2 State Threatened animal species.

K. Wild and Scenic Rivers

In 1968, Congress created the National Wild and Scenic Rivers System to protect rivers that possess "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values." There are no waterways in the Troy Brook watershed that have been assigned this designation.

L. Waterbody Classification: N.J.A.C. 7:9B-1.15

The surface water classifications for the waters of the State of New Jersey can be found in N.J.A.C. 7:9B-1.15. The streams of the Troy Brook Watershed have been classified as FW2-NT. FW2 is a general surface water classification applied to those fresh waters that are not designated FW1 or Pinelands Waters (N.J.A.C. 7:9B-1.4). NT refers to the "Non-trout Water" status that waters are designated as per N.J.A.C. 7:9B-1.15(b) through (h) referring to waters that are considered trout production or trout maintenance. Map 15 in Appendix B presents the Waterbody Classification of the Troy Brook Watershed.

M. Water Quality Limited Surface Water

One goal of watershed management is to ensure that the existing water quality meets all water quality standards and criteria. Under the Federal Clean Water Act (CWA), Section 303(d) and 305(b), each state is mandated to identify impaired waters where designated uses of the waterway are not supported by the water quality. Pursuant to the CWA, the N.J.A.C. 7:9B Surface Water Quality Standards set the required water quality for each waterbody according to its designated use. The NJDEP then compares measured water quality data to the standards to determine which waterways are impaired and require the development of a Total Maximum Daily Load (TMDL). Through the TMDL process, the necessary reductions of the pollutant or pollutants will be calculated so that the designated uses can be met.

Pursuant to the Federal Clean Water Act, the NJDEP summarized water quality in the State in its biennial report entitled "New Jersey's Water Quality Inventory Report," or 305(b) report. The State also prepared a list of impaired waterbodies to meet 303(d) requirements; this report was entitled "Identification and Setting of Priorities for 303(d) requirements under Section 303(d)(1)(A) of the Federal Clean Water Act" and was most recently submitted in 1998.

In 2002, the USEPA recommended that each state produce an integrated list combining both 305(b) and 303(d). The resulting report is known as the *New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report* (Integrated Report). This report summarizes the Integrated List as it pertains to use classifications set for the waterbodies of New Jersey. The Integrated List is comprised of unique Sublists 1 through 5 and adds a priority recommendation to each impaired reach. Waterbodies are placed on Sublists based on NJDEP's results when they compare observed water quality data to water quality standards. The various Sublists are as follows:

Sublist 1 suggests that the waterbody is meeting water quality standards.

Sublist 2 states that a waterbody is attaining some of the designated uses, and no use is threatened. Furthermore, Sublist 2 suggests that data are insufficient to declare if other uses are being met.

Sublist 3 maintains a list of waterbodies where there exists a lack of data or information to support an attainment determination.

Sublist 4 lists waterbodies where use attainment is threatened and/or a waterbody is impaired; however, a TMDL will not be required to restore the waterbody to meet its use designation.

Sublist 4a includes waterbodies that have a TMDL developed and approved by the USEPA, that when implemented, will result in the waterbody reaching its designated use.

> **Sublist 4b** establishes that the impaired reach will require pollutant control measurements taken by local, state, or federal authorities that will result in full attainment of use.
>
> **Sublist 4c** states that the impairment is not caused by a pollutant, but is due to factors such as instream channel condition and so forth. It is recommended by the USEPA that this list be a guideline for water quality management actions that will address the cause of impairment.
>
> **Sublist 5** clearly states that the water quality standard is not being attained and requires a TMDL.

This report also includes a schedule of TMDLs and other actions to be undertaken in the following two-year period, a list of waterbodies delisted in 2004, and a Comparison Document, which summarizes changes between the 2002 and 2004 Sublists.

In assembling the Integrated List, the NJDEP reviews all existing and available data as required. The NJDEP is committed to using only data with acceptable quality assurance to develop the Integrated Report (NJDEP, 2003). Further information regarding the quality assurance needed for data inclusion in the Integrated Report can be found in the General Data Requirements section of *Integrated Water Quality Monitoring and Assessment Methods*

In the Troy Brook Watershed, there has been a limited amount of chemical monitoring data available for inclusion in the Integrated List. However, two active biomonitoring stations exist. These biomonitoring stations are two of approximately 800 stations monitored by the NJDEP's Bureau of Freshwater & Biological Monitoring known as the Ambient Biomonitoring Network (AMNET) (NJDEP, 2000). Data collected from these monitoring locations are used to evaluate streams for biological impairment as indicated by New Jersey Impairment Score (NJIS).

Table 4 lists these two AMNET locations and their assessment results. Assessment results can be defined as non-impaired, moderately impaired, and severely impaired.

> **Non-impaired** is defined by a benthic community comparable to other undisturbed streams within the region. The community is characterized by maximum taxa richness, balanced taxa groups, and good representation of intolerant individuals.
>
> **Moderately impaired** describes a macroinvertebrate community whose richness has been reduced, in particular pollutant-intolerant species. There may also be a reduced community balance and numbers of pollutant-intolerant taxa.
>
> **Severely impaired** refers to a benthic community dramatically different from those in less impaired situations; macroinvertebrates are dominated by a few taxa with many individuals and only pollutant-tolerant individuals are present (NJDEP, 2000).

Table 4: AMNET Locations in the Troy Brook Watershed

Site ID	Station Name	1993 Result	1998 Result
AN 236	Troy Brook at Lake Road in Mountain Lakes Borough	Moderately Impaired	Moderately Impaired
AN 237	Troy Brook at Beverwyck Road in Parsippany-Troy Hills Township	Moderately Impaired	Non-impaired

Though data has shown that Troy Brook at Lake Road is moderately impaired for benthic community, following NJDEP protocol, this estimated reach will need further data collection, and is therefore placed on Sublist 3 with a notice "further assessment required (NJDEP, 2003)."

As an extension of the Regional Stormwater Management Planning Process for the Troy Brook Watershed, the RCRE Water Resources Program conducted a biological assessment at six locations in the watershed. The results of this benthic survey are discussed later in this report.

As for the lakes of the Troy Brook Watershed, there are numerous waterbodies that have been identified as impaired by the NJDEP. Like streams, assessments for lakes are dependent on the designated use and the requirements of that use. A lake may be characterized according to the designated uses including aquatic life, recreational (human health and aesthetic quality), drinking water supply, shellfish harvesting, lake trophic status, fish consumption, industrial water supply, and agricultural water supply. Each designated use, therefore, has a specific assessment method and criteria determining the non-attainment, insufficient data, and full attainment status.

Table 5 has been derived from the Integrated Report. This table defines the use of the impaired lake and the determined pollutant or problem.

Table 5: Waterbodies in the Troy Brook Watershed Noted in the Integrated Report

Sublist	Station Name/ Waterbody	Site ID	Use	Parameters	Data Source
1	Birchwood Lake	Birchwood Lake	Recreational	Fecal Coliform	Montville Township Health Department
5	Intervale Lake	Lake Intervale	Recreational	Fecal Coliform	Parsippany Troy Hills Township Health Department
5	Mountain Lake	Mountain Lake	Recreational	Fecal Coliform, Fish-Mercury	Montville Township Health Department, NJDEP Fish Tissue Monitoring
5	Lake Parsippany	Lake Parsippany: Hoffman Beach and Johnson Beach, and Drewes Beach	Recreational	Fecal Coliform	Parsippany Troy Hills Township Health Department
5	Rainbow Lakes	Rainbow Lakes Comm. Club	Recreational	Fecal Coliform	Parsippany Troy Hills Health Department

As stated earlier in this section, Sublist 5 waterbodies are not meeting water quality standards, and a TMDL is necessary to determine pollutant removal needed for standards to be met. Map 16 in Appendix B of this report spatially describes the information given above.

N. Stormwater Conveyance

In November of 2000, the Borough of Mountain Lakes had the "Existing Drainage Facilities" for that municipality mapped by Anderson and Denzler Associates. These engineering plans were used to investigate the possibility of drainage from outside the delineated Troy Brook Watershed along with confirmation of manmade stormwater conveyance draining along topographic contours. These plans are available in hard copy format.

Parsippany-Troy Hills and Hanover Township did not have manmade stormwater conveyance plans to present to the committee. There are no digital files of stormwater conveyance available for this watershed. Hanover Township is currently processing maps to represent their stormwater infrastructure.

Stormwater conveyance is typically engineered to match the grading of the existing topography. The subbasins used in the aerial loading analysis were determined using the best available digital topography, and as such, it is expected that these basins represent the corresponding drainage systems. On occasion, engineers have been known to "buck grade" and transport stormwater uphill, but in field surveillance and in discussions with municipal engineers, none of that type of design has been identified.

Map 15 in Appendix B presents the thirty-one delineated subbasins of the Troy Brook Watershed. These drainage areas were used in the evaluation the stormwater runoff potential presented in Section IV of this report and are expected to represent. Map 19 in Appendix B shows these thirty-one subbasins with a sampling of culverts, outfalls, detention basins and swales are also geographically referenced on this map. This, however, is an incomplete inventory of the stormwater conveyance components.

O. Source Water Areas of Potable Public Surface Waters

There are no known potable public surface water supply intakes or public water supply reservoirs within the Troy Brook Watershed.

P. Jurisdictional Boundaries

The Troy Brook Regional Stormwater Management Planning Area has several agencies responsible for implementing stormwater management. The primary jurisdiction is the municipality. Similar boundaries are shown for the water purveyor who has sole responsibility for drinking water and may choose to play a part in the formation of the regional stormwater management plan. The municipalities and their extent are quantified in Table 6. The boundaries can be viewed on Map 17 in Appendix B.

Table 6: Municipal Land Area in the Troy Brook Watershed

Municipality	Total Area of Municipality	Area within the Watershed Boundary	Percent of Watershed Land Area Contributed by the Municipality	Percent of Municipality that includes the Troy Brook Watershed
	Square Miles	Square Miles	%	%
Township of Boonton	8.75	0.11	0.7	1.3
Denville Township	12.56	0.09	0.6	0.7
Town of Boonton	2.46	0.10	0.6	4.0
Mountain Lakes Borough	**2.90**	**2.59**	**16.1**	**89.5**
Parsippany-Troy Hills Township	**25.45**	**11.65**	**72.3**	**45.8**
East Hanover Township	8.19	0.19	1.2	2.3
Hanover Township	**10.75**	**1.38**	**8.5**	**12.8**
Total		16.11	100%	

Other entities that are considered relevant to the stormwater management planning of the Troy Brook Watershed cover the entire watershed. These entities include Morris County, Morris County Soil Conservation District, and the Whippany River Watershed Action Committee.

The Highlands Planning Area also fully covers the watershed. The Planning Area is separate from the Highlands Preservation Area and the effects of this designation on the Troy Brook Watershed are not entirely clear at this point in time. According to NJDEP, the municipalities that are located wholly or partially in the Highlands Planning Area can voluntarily amend their local master plans and development regulations to conform to the regional master plan and obtain the Highlands Water Protection Planning Council's approval of the revisions in order to qualify for financial assistance or other incentives offered through the Highlands Act. Map 17A in Appendix B shows the extent of the Highlands Preservation and Planning Area.

III. Identification of Physical Characteristics

Physical characteristics of the Troy Brook Regional Stormwater Management Planning Area that are pertinent to the management of the stormwater include significant slopes, swales and impoundments. Stream contours are also critically important when determining the hydraulics of

the system. Through a combination of GIS, field surveys and data acquisition, the physical characteristics of the Troy Brook Watershed have been mapped or modeled.

A map of the slopes within the Troy Brook Watershed can be found in Appendix B, Map 18. Steep slopes, greater than 15%, are present particularly in Mountain Lakes, where ordinances restricting construction on critical areas such as steep slopes is controlled.

The Troy Brook Watershed has several areas of stormwater detention/retention. Many of these areas were identified using permit application information obtained through the Soil Conservation District. Field surveys served to identify additional areas of detention. The Stormwater Conveyance map, Map 19 in Appendix B, shows where some areas of detention were determined. This map also represents a sampling of outfalls detected in the field during reconnaissance.

A key component to identifying the physical characteristics of the watershed was collecting the stream cross sectional data. This was achieved through a two pronged approach. After obtaining a digital elevation model of the topography of the watershed with a resolution of 10 meters, it was necessary to refine the contours of the stream reaches. The first step was to collect previously surveyed cross sectional data. This was done by contacting John Scordato of the NJDEP Bureau of Dam Safety and Flood Control and Vince Mazzei of the Land Use Regulation Program. These individuals assisted the Water Resources Program in obtaining a print out of previously run hydraulic models with surveyed cross sections that were performed for the state for earlier purposes of flood control or bridge construction. The second step was to field survey areas that were not available from NJDEP. These surveys were performed over a series of months and completed a data set that was used to perform a full hydraulic model of the Troy Brook Watershed.

IV. Water Quality, Groundwater Recharge, Water Quantity Hydrologic and Hydraulic Model or Analysis

Water Quality

As discussed previously, the *2004 Integrated List of Impaired Waterbodies* has enabled watershed managers to prioritize water quality problems according to high quality, readily available data with multiple data points and oftentimes a series of parameters. As demonstrated previously, the benthic community has been monitored twice in the past 12 years. Based on this information, the Troy Brook at Lake Road monitoring site (ANO236) has maintained its status as "moderately impaired." Conversely, according to the NJDEP, Troy Brook at Beverwyck Road in Parsippany-Troy Hills Township (ANO237) has seen a reduction in status from "moderately impaired" to "non-impaired (NJDEP, 2000)".

Though the 2004 Integrated List of Impaired Waterbodies includes no information on stream surface water quality, the majority of the lakes in the watershed have water quality information due to monitoring requirements for the lakes' recreational use.

Of these five monitored lakes, Birchwood Lake is the only lake meeting water quality standards for those parameters that have been evaluated, namely fecal coliform. Birchwood Lake is at the headwaters of the Troy Brook Watershed within Mountain Lakes Borough. The Borough has acknowledged the need for pet pick-up at this location and has taken an active role in preventing fecal pollution from pet waste. An example of measures that are being instituted at Birchwood Lake, bags and disposal are provided. The Borough also continues to maintain trails around the lake. This lake is a known, high priority to Mountain Lakes Borough due to the recreational uses and regular swimming at the lake.

Mountain Lake in Mountain Lakes Borough has been noted as impaired and requiring a TMDL. Mountain Lake is impaired for fecal coliform and mercury in fish tissue. This sampling has been conducted by the Montville Township Health Department and the NJDEP Fish Tissue Monitoring Program. Mountain Lake is also a high priority to the Borough, as it is a very large waterbody, within the municipality and it's resource to the residents who live at the lake.

In Parsippany-Troy Hills Township, Lake Intervale is regularly used by local residents for recreational purposes. According to the Integrated Report, however, this lake has been designated as impaired for fecal coliform. Currently, the lake association regularly samples Lake Intervale, though monitoring data was not submitted for inclusion in this Characterization and Assessment. According to earlier discussions with the lake association, goose management practices are underway at Lake Intervale. Still, according to NJDEP protocol, a TMDL will be necessary to remove Lake Intervale from Sublist 5.

Also in Parsippany-Troy Hills Township, Lake Parsippany is impaired for fecal coliform according to samples taken at Hoffman Beach, Johnson Beach, and Drewes Beach. Lake Parsippany is a large waterbody within the Township and is a high priority for the municipality. Due to the sedimentation that was ongoing at the lake, the Township has created sediment basins to trap sediment from entering the lake and carrying pollutants to the waterbody. Also, the Whippany River TMDL does mention the presence of Canada geese and an abundance of fecal matter at this lake. Ongoing data collection is important to determine pollution sources to the lake, and a TMDL specific to this lake will be required to remove Lake Parsippany from Sublist 5.

Rainbow Lakes are a collection of six waterbodies in Parsippany-Troy Hills Township near the border of Mountain Lakes Borough. According to the Parsippany-Troy Hills Health Department data, the Rainbow Lakes are impaired for fecal coliform and will require a TMDL to be completed for the lakes to be removed these from Sublist 5.

In addition, the Rainbow Lakes Community Group is involved in water quality testing of the six lakes that comprise Rainbow Lakes. This data collection effort should target specific sources of fecal coliform pollution and produce specific recommendations to address the problems.

Macroinvertebrate survey

The RCRE Water Resources Program performed a survey of the benthic macroinvertebrate community in the Troy Brook Watershed between Mountain Lakes and Troy Hills, Morris County, New Jersey was conducted on July 20-21, 2004. This survey was conducted as part of a watershed characterization for the Troy Brook Regional Stormwater Management Plan.

The NJDEP Bureau of Biological & Freshwater Monitoring maintains two Ambient Biomonitoring Network (AMNET) stations within the Troy Brook Watershed. Station AN0236, located on Troy Brook at Lake Road below the outlet of Mountain Lake was sampled on July 13, 1993 and again on July 20, 1998 by NJDEP (NJDEP, 1994; NJDEP, 2000). On both occasions, Troy Brook was assessed as being moderately impaired. Station AN0237, located on Troy Brook at Beverwyck Road in Troy Hills, on July 13, 1993 was assessed as being moderately impaired. On July 15, 1998, AN0237 was assessed as being non-impaired. Habitat assessments were conducted as part of the 1998 surveys; both locations were found to have optimal habitat characteristics.

Benthic macroinvertebrates were collected at six locations, A-F, within the Troy Brook Watershed. A map of the sampling locations can be found in Figure 3. Location A is situated on Troy Brook at the outlet of Mountain Lake at Lake Drive. This location corresponds to the established NJDEP AMNET Station AN0236. Location B is on an unnamed tributary to Troy Brook at Sherwood Drive and Intervale Road; this unnamed tributary originates from the outlet of Lake Intervale. Location C is situated on Troy Brook at the Waterview Park office complex, and Location D is located on Troy Brook at Smith Road. Location E is on Eastmans Brook, a tributary to Troy Brook, at Smith Road. Location F is situated on Troy Brook at Beverwyk Road. Location F corresponds to the established NJDEP AMNET Station AN0237.

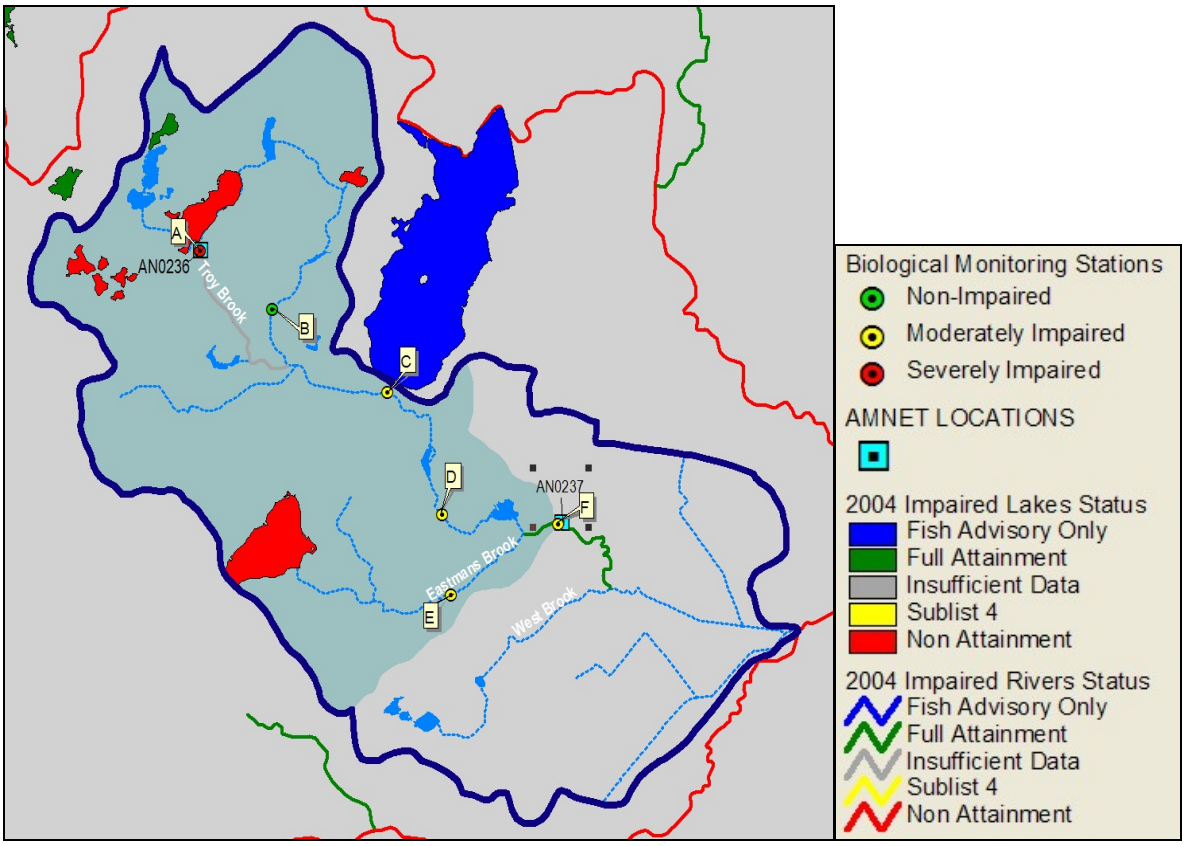

Figure 3: Benthic Macroinvertebrate Sampling Locations

The scoring criteria developed by Kurtenbach (1994) and currently used by the NJDEP Bureau of Freshwater & Biological Monitoring are outlined in Table 3 of Appendix E. Non-impaired sites have total scores ranging from 24 to 30, moderately impaired sites have total scores ranging from 9 to 21, and severely impaired sites have total scores ranging from 0 to 6. It is important to note that the entire scoring system is based on comparisons with reference streams and a historical database consisting of 200 benthic macroinvertebrate samples collected from New Jersey streams. While a low score indicates "impairment," the score may actually be a consequence of habitat or other natural differences between the subject stream and the reference stream.

Impairment scores for Locations A-F are provided in Appendix E. Location A had total score of 6 and was assessed as being severely impaired. Location B had a total score of 24 and was assessed as being non-impaired. Locations C, D, E, and F had total scores of 18, 12, 9, and 21, respectively and were assessed as being moderately impaired.

For the most part the Troy Brook Watershed, between Mountain Lake and Troy Hills, supports a moderately impaired benthic macroinvertebrate community. Based on a comparison of the 1998 to 2004 scores at the two AMNET stations, there has been a decline in biological condition since 1998.

Troy Meadows trap shoot

A field reconnaissance survey through the Troy Meadows section of the Troy Brook Watershed led to the discovery of an area that was previously used as a clay pigeon target range (Figure 4: Trap Shoot Range in Troy Meadows). The remnants of clay pigeons covered well over one-half an acre, with the depth unable to be determined. Such a large area of previously painted clay waste may be a cause for some concern. In several discussions with Patrick Strickland, Project Manager at Frontier Geosciences, Inc., the main concern regarding the site would be the spent shot waste, which could contain heavy metals. The clay pigeons were also at one time painted with an orange paint that has weathered with time. The presence of the paint and shot could indicate potential contamination of groundwater in an aquifer that is likely downstream of the Troy Brook Watershed boundary.

Figure 4: Trap Shoot Range in Troy Meadows

Sanitary Survey of the Whippany River

In a June 2004 report, George Van Orden of the Township of Hanover Health Department provided a survey of the Whippany River Watershed for the purpose of identifying nonpoint source pollution (Van Orden, "Sanitary Survey of the Whippany River Basin to Evaluate It's Sanitary Quality and to Identify Non-Point Sources of Contamination" , 2004). As a part of the survey, several water quality monitoring events took place at sites within the Troy Brook Watershed. The three sites that were tested were the Bee Meadow Pond outfall in Hanover Township, the West Brook at South Beverwyck Road and the Troy Brook at Troy Road. These three sites were evaluated for land use and fecal coliform/fecal streptococcus ratio which was intended to identify the source of fecal contamination as being from the human and/or animal population. It was pointed out that land use that supports a large waterfowl/Canada goose population. Initial analysis may suggest that animal sources contribute to the reduced water quality of the areas.

Aerial Loading Analysis

In the Troy Brook Watershed, as in other watersheds, the quality of the water is affected by both point and nonpoint sources. Point sources are regulated by the New Jersey Department of Environmental Protection (NJDEP) and must meet stringent water quality standards. Stormwater sewers, however, have long been considered non-point sources because the origin of the

stormwater and accompanying pollutants is typically a large land area. Stormwater, which is water that flows overland as a result of a storm event, is often discharged through manmade stormwater conveyance facilities directly into streams and can carry high levels of pollutants including nutrients, pathogens, metals, and organic chemicals. NJDEP currently regulates municipal separate sewer systems (MS4s) as point sources through a general New Jersey Pollutant Discharge Elimination System (NJPDES) permit program. The effect of non-point source (NPS) pollution and storm sewer pollution on water quality is vital to the understanding of the watershed and to the development of a cogent watershed restoration plan.

As a portion of the water quality analysis, an Aerial Load Analysis was conducted on the Troy Brook Watershed using the Army Corps of Engineers' HEC-GeoHMS hydrological modeling software to delineate the watershed into six subbasins that represent areas draining to significant tributaries or significant reaches of the stream. Figure 5 represents the subbasin delineation used for the purpose of aerial loading evaluations.

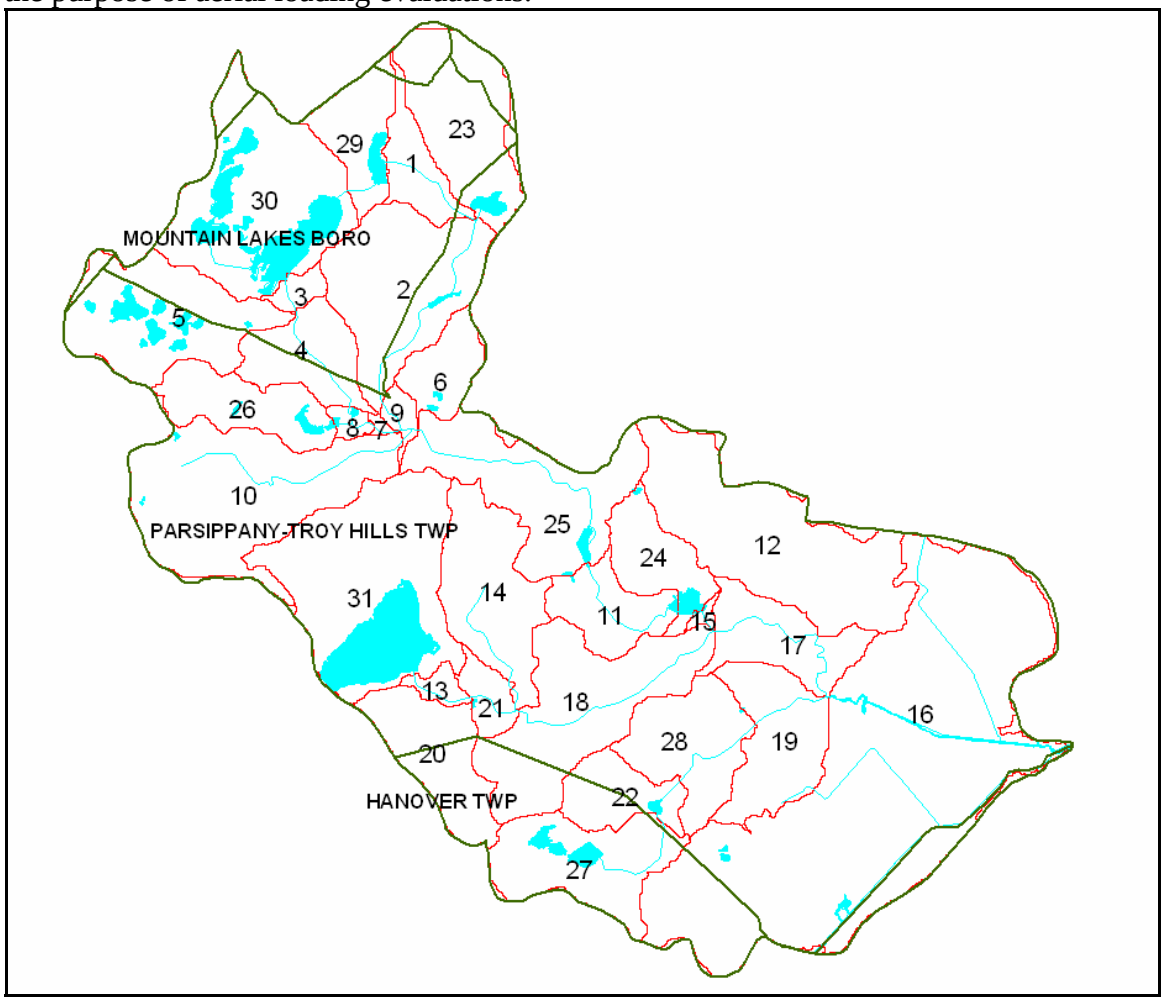

Figure 5: Troy Brook Subbasin Delineation used for Aerial Loading Analysis

The Aerial Load Analysis was based on aerial pollutant export loading coefficients, UL_c. These coefficients were used to estimate pollutant loads for various land uses within the Troy Brook

Watershed. The pollutant export loading coefficient for each pollutant and each land use are shown in Appendix D. These values were compiled from the New Jersey Stormwater Best Management Practices Manual and from current literature sources (NJDEP, 2004b). The parameters that were evaluated as a part of this process are as follows: total phosphorus (TP), total nitrogen (TN), total suspended solids (TSS), ammonia nitrogen (NH_3-N), lead, zinc, copper, cadmium, biochemical (biological) oxygen demand (BOD), chemical oxygen demand (COD), and nitrite plus nitrate ($NO_2 + NO_3$). The land use maps for each subbasin are from the 1995/97 NJDEP GIS layer. Annual NPS loads for each subbasin were then calculated using the loading equation:

$$Load = UL_c \times Area$$

Load is in units of pounds of pollutant per year (lbs/yr), UL_c is in units of pounds per acre per year (lbs/acre/yr) for each specific land use, and *Area* is in acres for each specific land use. The loading equation provides an approximation for annual NPS loads on a subbasin basis. This allows for the comparison of pollutant loading between subbasins and provides a method by which to prioritize subbasins for restoration and/or preservation. Table 7 presents the total estimated pollutant load from land use within the subbasin.

Table 7: Total Annual Pollutant Loading from Subbasin

			Existing Total (lbs/year)									
Acres	Sq Miles	Basin	TP	TN	TSS	NH3-N	LEAD	ZINC	COPPER	BOD	COD	NO2+NO3
133.29	0.21	1	106.7	1219.6	12478.7	72.8	75.1	52.3	55.0	3142.9	14371.1	178.9
475.00	0.74	2	399.5	4512.8	44884.2	197.0	120.6	116.6	141.5	8775.6	47101.0	526.2
39.58	0.06	3	42.1	453.8	4407.6	18.8	9.1	10.1	13.6	787.5	4398.3	50.1
209.51	0.33	4	193.1	2148.0	22366.6	142.9	145.7	115.0	100.2	5282.7	36877.9	307.2
436.53	0.68	5	327.8	3905.4	40892.1	188.8	176.4	155.7	144.9	8848.3	47345.7	489.6
133.63	0.21	6	114.2	1296.8	13022.2	93.8	79.8	58.2	56.0	3237.6	25024.3	193.8
8.43	0.01	7	11.9	129.6	1220.4	7.0	3.3	3.4	4.0	235.4	1999.6	15.6
26.55	0.04	8	33.7	362.0	3492.6	33.0	26.9	19.5	17.5	920.0	9575.7	59.3
35.92	0.06	9	30.7	344.7	3340.2	20.0	12.7	11.0	11.9	713.7	5505.5	44.7
644.92	1.01	10	354.1	3876.6	42416.4	228.4	239.6	178.0	174.1	9455.6	51813.3	526.7
180.66	0.28	11	69.0	1130.1	13649.2	41.5	39.5	30.3	29.7	3172.8	11948.7	138.2
650.81	1.02	12	544.6	6336.1	66767.5	416.8	374.0	271.9	266.6	16113.9	107193.4	917.1
37.04	0.06	13	25.9	281.1	2797.4	23.8	22.9	16.1	14.6	756.5	6180.6	46.3
355.23	0.56	14	372.9	3971.2	41693.1	277.5	346.5	265.5	220.8	10366.1	62678.8	597.9
12.46	0.02	15	4.5	68.5	1082.1	2.0	4.2	2.6	2.5	228.0	237.3	8.3
1885.39	2.95	16	350.7	3973.2	45760.7	265.8	425.8	285.0	252.4	12830.3	39507.1	659.2
234.01	0.37	17	133.5	1853.9	27033.1	46.3	65.5	47.7	50.4	5009.5	8290.7	194.3
523.80	0.82	18	400.9	4742.8	54904.6	166.6	166.3	150.9	156.3	10302.3	37218.7	512.6
287.59	0.45	19	139.6	2399.7	30540.0	73.2	104.2	70.8	72.8	7433.9	13346.8	305.9
262.79	0.41	20	199.5	2135.5	25774.3	114.1	176.6	138.5	113.3	5485.5	22577.4	277.5
74.54	0.12	21	77.7	844.3	10367.2	40.6	108.3	90.1	61.9	2505.4	4374.8	118.0
161.13	0.25	22	76.6	1063.2	14770.9	16.7	26.8	22.2	25.8	2588.4	3323.2	92.5
374.69	0.59	23	285.3	3309.6	34367.7	143.3	125.0	111.3	115.7	7063.5	32262.4	395.0

185.60	0.29	24	43.1	742.1	10457.8	21.0	33.8	23.1	21.7	2351.7	4097.6	90.4
453.44	0.71	25	407.0	4407.3	44241.8	375.7	368.6	254.4	233.7	12090.7	94880.7	734.0
218.49	0.34	26	200.0	2252.2	25049.4	155.1	227.7	175.0	135.4	6531.3	34054.2	349.7
340.06	0.53	27	204.7	2371.4	29687.2	141.2	203.7	130.8	124.5	7284.2	22670.9	358.6
289.94	0.45	28	200.1	2742.4	32368.7	95.6	103.5	78.2	87.1	7117.8	19125.3	329.4
183.95	0.29	29	243.8	3218.9	39106.0	106.7	116.5	90.2	101.2	8064.3	21987.5	366.3
621.21	0.97	30	267.2	3536.1	44126.2	105.8	105.4	88.3	99.9	8490.0	25621.5	372.2
716.50	1.12	31	587.9	6581.0	64030.6	327.3	221.1	192.9	226.0	13421.9	77200.6	823.2

Since each of the subbasins varies in size, the loading results presented in Table 7 may appear to focus on the larger pollutant loads given the larger areal extent of the subbasins. Therefore, each constituent was normalized to the area within the subbasin, to give an overall "subbasin loading coeffiecient", as seen in Table 8.

Table 8: Pollutant Loading from Normalized to Subbasin Area

			Existing Total: lbs/acre/yr									
Acres	Sq Miles	Basin	TP	TN	TSS	NH3-N	LEAD	ZINC	COPPER	BOD	COD	NO2+NO3
133.29	0.21	1	0.8	9.1	93.6	0.5	0.6	0.4	0.4	23.6	107.8	1.3
475.00	0.74	2	0.8	9.5	94.5	0.4	0.3	0.2	0.3	18.5	99.2	1.1
39.58	0.06	3	1.1	11.5	111.4	0.5	0.2	0.3	0.3	19.9	111.1	1.3
209.51	0.33	4	0.9	10.3	106.8	0.7	0.7	0.5	0.5	25.2	176.0	1.5
436.53	0.68	5	0.8	8.9	93.7	0.4	0.4	0.4	0.3	20.3	108.5	1.1
133.63	0.21	6	0.9	9.7	97.4	0.7	0.6	0.4	0.4	24.2	187.3	1.5
8.43	0.01	7	1.4	15.4	144.8	0.8	0.4	0.4	0.5	27.9	237.2	1.9
26.55	0.04	8	1.3	13.6	131.5	1.2	1.0	0.7	0.7	34.6	360.6	2.2
35.92	0.06	9	0.9	9.6	93.0	0.6	0.4	0.3	0.3	19.9	153.3	1.2
644.92	1.01	10	0.5	6.0	65.8	0.4	0.4	0.3	0.3	14.7	80.3	0.8
180.66	0.28	11	0.4	6.3	75.6	0.2	0.2	0.2	0.2	17.6	66.1	0.8
650.81	1.02	12	0.8	9.7	102.6	0.6	0.6	0.4	0.4	24.8	164.7	1.4
37.04	0.06	13	0.7	7.6	75.5	0.6	0.6	0.4	0.4	20.4	166.9	1.2
355.23	0.56	14	1.0	11.2	117.4	0.8	1.0	0.7	0.6	29.2	176.4	1.7
12.46	0.02	15	0.4	5.5	86.8	0.2	0.3	0.2	0.2	18.3	19.0	0.7
1885.39	2.95	16	0.2	2.1	24.3	0.1	0.2	0.2	0.1	6.8	21.0	0.3
234.01	0.37	17	0.6	7.9	115.5	0.2	0.3	0.2	0.2	21.4	35.4	0.8
523.80	0.82	18	0.8	9.1	104.8	0.3	0.3	0.3	0.3	19.7	71.1	1.0
287.59	0.45	19	0.5	8.3	106.2	0.3	0.4	0.2	0.3	25.8	46.4	1.1
262.79	0.41	20	0.8	8.1	98.1	0.4	0.7	0.5	0.4	20.9	85.9	1.1
74.54	0.12	21	1.0	11.3	139.1	0.5	1.5	1.2	0.8	33.6	58.7	1.6
161.13	0.25	22	0.5	6.6	91.7	0.1	0.2	0.1	0.2	16.1	20.6	0.6
374.69	0.59	23	0.8	8.8	91.7	0.4	0.3	0.3	0.3	18.9	86.1	1.1
185.60	0.29	24	0.2	4.0	56.3	0.1	0.2	0.1	0.1	12.7	22.1	0.5
453.44	0.71	25	0.9	9.7	97.6	0.8	0.8	0.6	0.5	26.7	209.2	1.6
218.49	0.34	26	0.9	10.3	114.7	0.7	1.0	0.8	0.6	29.9	155.9	1.6
340.06	0.53	27	0.6	7.0	87.3	0.4	0.6	0.4	0.4	21.4	66.7	1.1
289.94	0.45	28	0.7	9.5	111.6	0.3	0.4	0.3	0.3	24.5	66.0	1.1

183.95	0.29	29	1.3	17.5	212.6	0.6	0.6	0.5	0.5	43.8	119.5	2.0
621.21	0.97	30	0.4	5.7	71.0	0.2	0.2	0.1	0.2	13.7	41.2	0.6
716.50	1.12	31	0.8	9.2	89.4	0.5	0.3	0.3	0.3	18.7	107.7	1.1

This data provides watershed managers with an estimation of the potential pollutant contribution from a particular subbasin. This data is useful primarily for preliminary observations and assessments because of the generalities inherent in the 1995/97 land use maps and the land use based pollutant load estimations. The analysis does, however, provide a starting point for targeting sensitive areas for restoration.

SUBBASIN CHARACTERIZATION

The thirty-one subbasins that were analyzed using the aerial loading calculations were ranked to determine the relative contribution of expected nonpoint source pollution that is expected to emanate from each subbasin. This was performed by separately ranking each subbasin by a single contaminant relative to the other subbasins. Once all subbasins were separately ranked, the rankings were totaled to allow for an overall ranking. The top ten basins that were determined to contribute to overall loading to the waterways are shown in Table 9.

Table 9: Top Ten Ranking of Subbasins Modeled to Contribute Highest Overall NPS Pollution

		Basin Number	
Ranking of basin		Overall NPS	TP+TN+TSS only
Highest NPS source:	1	31	31
	2	12	12
	3	25	18
	4	10	25
	5	16	2
	6	14	16
	7	2	14
	8	5	10
	9	18	5
	10	30	30

Given that the larger subbasins are expected to contribute a higher overall amount of nonpoint source contamination, the subbasins were further ranked after the load was divided by the acreage of the subbasin to provide a pollutant contribution per acre per year. This calculation can provide the watershed manager with those subbasins most likely to benefit from the implementation of BMPs.

Table 10: Top Ten Ranking of Subbasins Normalized to Area Modeled to Contribute to NPS Pollution

		Basin Number	
Ranking of basin		Overall NPS	TP+TN+TSS only
Highest NPS source:	1	8	29
	2	14	7
	3	29	8
	4	26	21
	5	13	14
	6	21	3
	7	25	26
	8	4	4
	9	6	25
	10	12	12

Field Reconnaissance: Lakes and Streams

Field reconnaissance was used to assess the physical characteristics of the waterways within the Troy Brook Watershed. Observations included numerous areas of streambank erosion, eutrophication/algal growth, and large areas of connected imperviousness that contribute to the increased velocity of the stream and also contributes to lower water quality. Specific observations are presented in Section IX C.

Groundwater Recharge

The groundwater that serves the residents of the Troy Brook Watershed lies in a complex system of bedrock, gravel and sand aquifers. The main aquifer is the Passaic River Basin in which lies the most productive areas named the Buried Valleys. The subbasin of the Passaic River Basin that contains the upper two thirds of Mountain Lakes is the Highland Area, where the remaining area of the Troy Brook Watershed lies over the Central Passaic River Basin. The NJDEP refers to the Buried Valley as a Sole Source Aquifer, as defined by guidelines set forth by the U.S. Environmental Protection Agency (USEPA) as authorized in section 1424(e) of the Safe Drinking Water act of 1974. Sole Source Aquifers are defined as those aquifers that contribute more than half of the potable water to a specific area, and that source would be impossible to replace if the aquifer became contaminated.

In a 1994 New Jersey Geological Survey report by Jeffery Hoffman and John Quinlan, hydrographs of observation wells and information from water allocation hearing records were used to evaluate groundwater levels in the Central Passaic River Basin (Hoffman and Quinlan, 1994). It was concluded that groundwater levels were decreasing due to pumpage. In the most intense area of groundwater use, Millburn Township, the drop was presumed to be as much as eighty feet.

One of the USGS's observation wells is located within the Troy Brook Watershed. This well, "#270020 Troy Meadows 1 Obs", is an 89 foot deep observation well with data beginning to be collected in 1965. A preliminary analysis of the ground water levels detected at this site appears to show a measure of sustainability, although it is noted that there is a slight downward trend. A simple linear regression of the data reported was used to ascertain trends over the period of time of operation. This data is shown in Figure 6. This is certainly not meant to be conclusive, as accurate trends can only be determined through the use of a longer set of data from a greater number of wells.

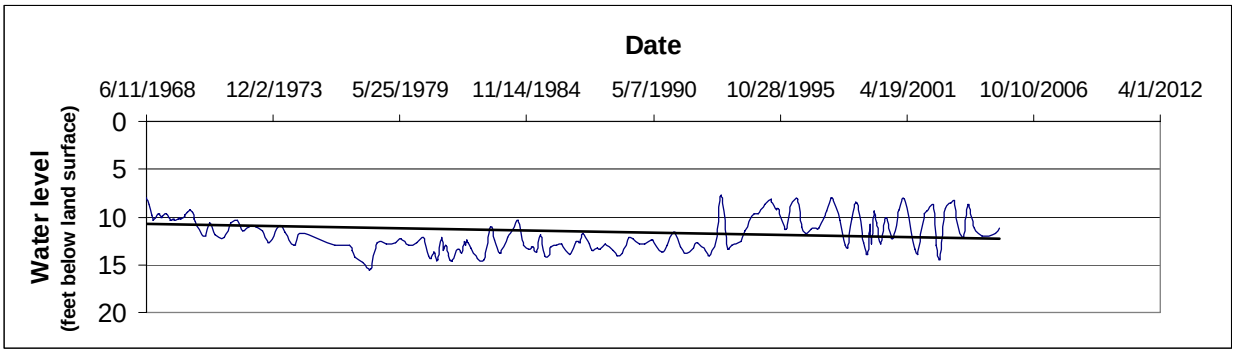

Figure 6: Groundwater level at the USGS Troy Meadows Obs 1 Well

An analysis of the groundwater table is dependent on two variables, namely pumpage and recharge. For several decades, the population within the Troy Brook Watershed has been steadily increasing (Table 11). With this increase in population comes the requirement for additional water use and increased impervious area. It is not the purpose of this plan to address

the consumption and conservation of potable water sources, which are obviously needed. The focus here will be to assess recharge capability of the watershed for purposes of aquifer recharge and baseflow maintenance.

Table 11: Population served all or in part from the Central Passaic River Basin Aquifer

Municipality	**1930**[1]	**1960**[1]	**1990**[2]
Hanover Township	946	4,379	9,926
Mountain Lakes	2,132	4,037	3,847
Parsippany-Troy Hills	6,631	25,557	48,478

1 US census data reported in NJ Department of Labor, 1984
2 US census data reported in NJ State League of Municipalities, 1991

The sustainability of the groundwater resource clearly depends on use and recharge. Recharge is heavily dependent on precipitation amounts which are beyond the control of this plan. Assessment of the recharge capability provides critical guidance to attain confidence in the ability of the groundwater to provide for the community.

Refer to Groundwater Recharge Map of the Troy Brook Watershed, Map #11 in Appendix B. This GIS layer was overlaid on the land use to determine areas within the watershed that could provide recharge to the aquifers.

Field reconnaissance and GIS provides information leading to the accurate assessment of the recharge capabilities of the watershed. Many areas of significant groundwater recharge have been identified. The Borough of Mountain Lakes presents a large tract of land that recharges nine to twenty two inches of precipitation a year. This finding is particularly noteworthy due to the fact that residential density is comparatively low and therefore is more conducive to accepting recharge. The area of Parsippany-Troy Hills and Hanover also depicts a fair amount of land that shows good recharge potential; however, the residential and commercial density of the area is likely to reduce the amounts expected by this analysis. Map 11 in Appendix B shows the recharge capability of the watershed in its entirety. Maps 11A through 11G show seven different areas of high recharge capability with close range aerials. The land use in these aerials will require close evaluation for future development.

The Mountain Lakes section of the Troy Brook watershed minimizes the use of curbing on the residential streets. This disconnection of impervious surfaces allows the stormwater a greater chance of infiltration.

Parsippany-Troy Hills and Hanover Township have relied heavily on stormwater conveyance via street curbing directly to storm sewers. This traditional routing of stormwater bypasses the potential of infiltration by directing the stormwater over only impervious surfaces.

Water Quantity

(The following is taken from the final Hydrologic and Hydraulic Report prepared by TRC Omni Environmental Corporation)

For the purposes of identifying critical areas subject to flood according to different design storms, and to evaluate environmentally sound and cost effective measures to minimize damages under certain conditions, hydrologic and hydraulic models were developed for the Troy Brook Watershed by TRC Omni Environmental Corporation. An approach using two models, The Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS), and the Hydrologic Engineering Center's River Analysis System (HEC-RAS), both developed by the United States Army Corps of Engineers, was used to identify surface runoff originating in different areas of the watershed, routing stream flow and producing water surface elevation profiles under various hypothetical storm events.

This model delineated the Troy Brook Watershed to a total of twenty-eight subbasins. For each individual subbasin in the Troy Brook watershed, a composite curve number and initial abstraction were estimated using the SCS curve number infiltration loss method and similarly time lags were estimated using the Snyder unit hydrograph method for runoff transform. The curve number is a function of land use, hydrologic soil group and available soil moisture. The 1995 land use land cover data coverage available from the NJDEP GIS database, and the NRCS SSURGO soils were used to determine average soil moisture condition curve numbers for each land use and soil combination in the Troy Brook watershed. The composite (area weighted average) curve numbers were obtained using spatial analysis techniques and spatial databases within GIS.

One of the many reasons for this modeling study was to identify the critical areas subject to flooding for different storm events and to assess opportunities to reduce flooding impacts through various storm water management strategies. The results of the steady state simulation for different design storms defined areas subject to flooding throughout the various segments of the Troy Brook watershed. The areas that were inundated for the design storm simulations (2, 10 and 100-year) were identified as critical areas of concern and were the focus of the initial analyses. For this initial analysis, 18 subbasins were selected in the upper reaches of the watershed where flooding impacts have the greatest impact on private property. In the selection of subbasins for analysis, those sub watersheds discharging to Troy Brook through a major lake were not considered. The discharge from these areas is controlled by outlet structures and any storm water management strategies would have minimal effect on volume discharge or time of concentration. Figure 7 shows the various subbasins selected for the initial analysis.

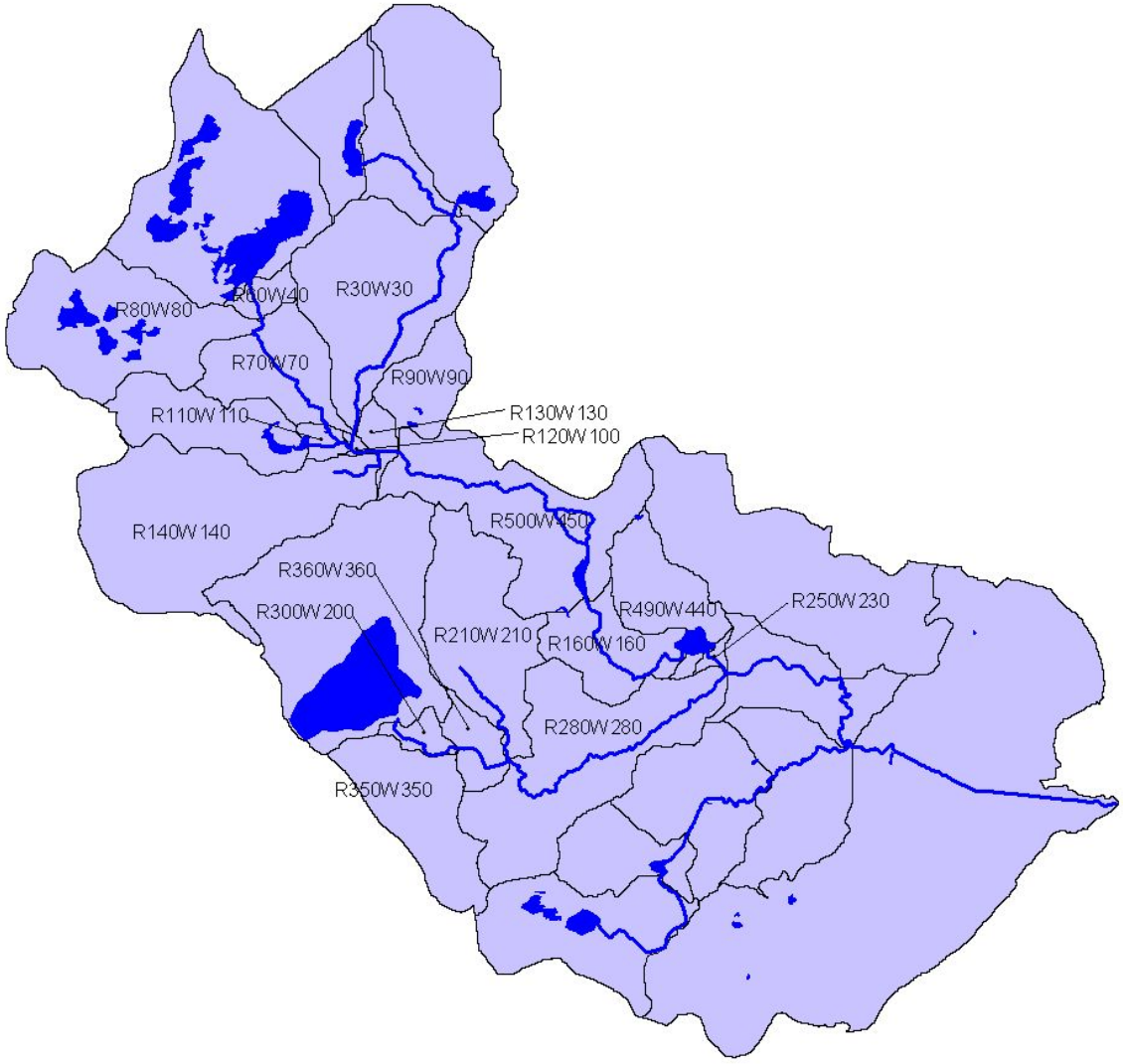

Figure 7: Subbasin Delineation Employed for Hydrologic Analysis

The basins were ranked based on total area, peak flows and discharge volumes. The six basins with the largest area, volume, and peak flow contributions with a direct discharge to Troy Brook were selected for further storm water management analysis (Figure 8).

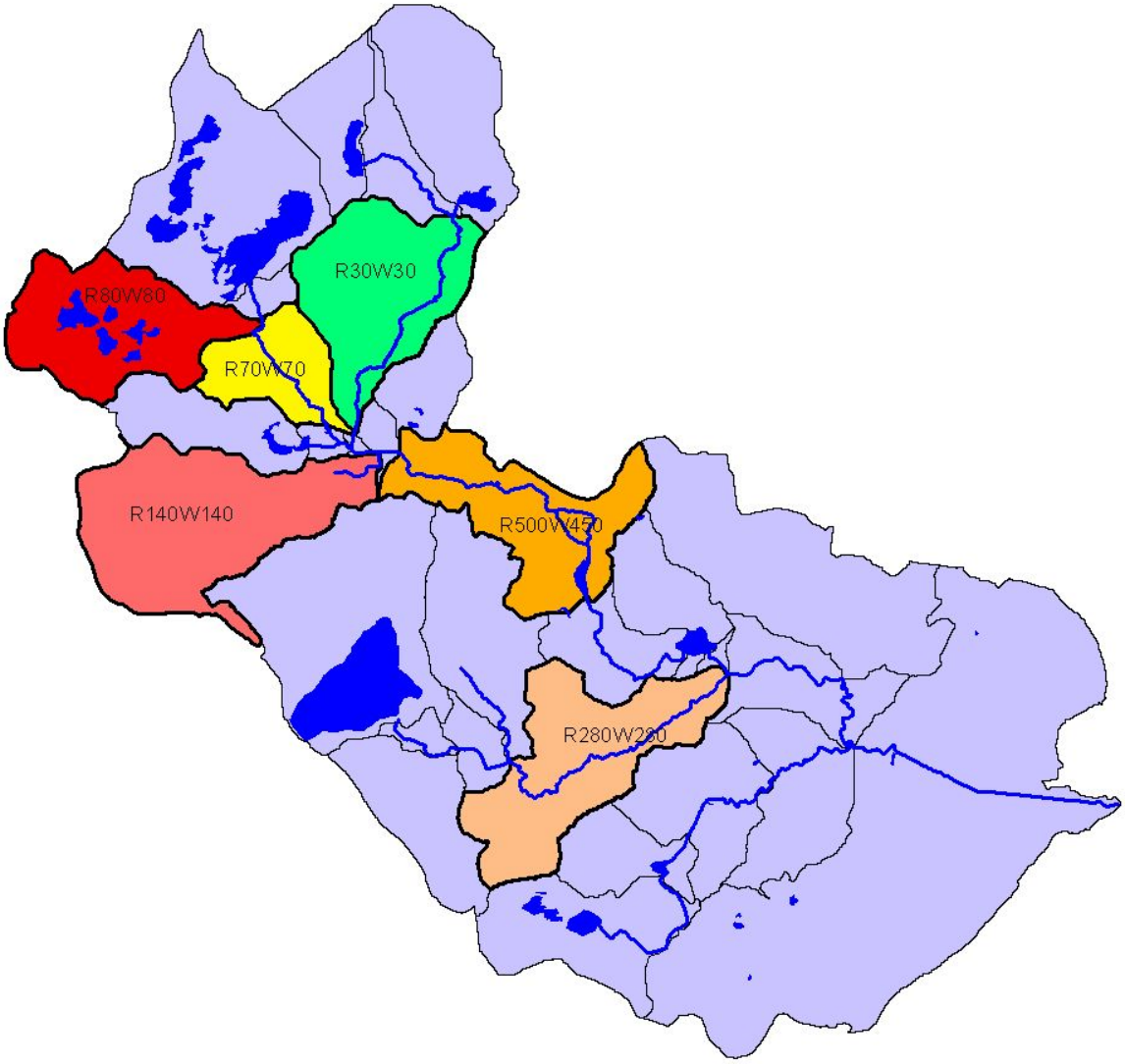

Figure 8: Selected Subbasins for Stormwater Management Analysis

For the stormwater management analysis, two different scenarios were defined in each of these six watersheds. For scenario one, the area weighted curve number was increased by 10% and peak flow and volume discharges were recalculated; and for scenario two, the area weighted curve number was decreased by 10% and peak flow and volume discharges were recalculated. For the analysis of the Troy Brook Watershed, it was assumed that a 10% change in the curve number was a practically achievable goal. For scenario one, the increase in the curve number represents an increase in the percentage of impervious surfaces in the selected sub watersheds should future residential or commercial development occur. Respectively, in scenario two, the decrease in curve number simulates the implementation of stormwater management strategies in the selected sub watersheds that would effectively control surface runoff reducing peak flows and volumes.

These scenarios were simulated by modifying the area weighted curve number for each selected subbasin within the HEC-HMS hydrologic model. The curve number is a hydrologic parameter used to describe the stormwater runoff potential within a given drainage area. Using the composite curve number for each sub watershed, HEC-HMS then simulates runoff and calculates peak flow discharge and volume. Details of the HEC-HMS simulation are mentioned in Section III of this report.

Since the goal of the Troy Brook watershed flow model was to simulate the impact of flooding according to standard design storms, the SCS hypothetical storm precipitation method was selected. The SCS hypothetical storm method implements four synthetic rainfall distributions developed by the Natural Resources Conservation Service (NRCS) from observed precipitation events. Each distribution contains rainfall intensities arranged to maximize the peak runoff for a given total storm depth (U.S. Army Corps of Engineers, 2001).

A type III storm that represents the Atlantic coastal areas of the United States was selected. Storm depths corresponding to the 2, 10, and 100 year storms were entered as model parameters. Table 12summarizes 24-hour rainfall depths for Morris County for different design storms.

Table 12: Morris County Rainfall Depths for Standard Design Storms

TYPE III STORM	24-HR RAINFALL (INCHES)
2-Year Storm	3.3
2-Year Storm (revised January 2005)	3.5
10-Year Storm	5.2
100-Year Storm	7.5
100-Year Storm (revised January 2005)	8.3

Table 13,Table 14, and Table 15 show the peak flows and volumes generated by HEC-HMS for the selected sub watersheds. The analysis was generated for the 2-year, 10-year and 100-year design storms for the existing conditions in the selected sub watersheds and the 10% increase and 10% decrease in the curve numbers. The tables also show the percent change in the peak flows and volume of runoff for each scenario with respect to the existing conditions in the watershed.

Table 13: Peak flows and volumes for different scenarios for a 2-year storm

				Decrease 10%		Existing Conditions		Increase 10%	
Watershed	Area wt CN	CN + 10%	CN - 10%	Peak Flow (cfs)	Total Vol (Ac-ft)	Peak Flow (cfs)	Total Vol (Ac-ft)	Peak Flow (cfs)	Total Vol (Ac-ft)
R30W30	75	82	67	56.332	30.261	93.023	46.648	135.180	65.477
R70W70	81	89	73	44.578	19.230	69.303	28.301	97.933	39.361
R80W80	85	93	76	93.154	45.832	143.100	68.057	196.020	94.129
R140W140	76	84	69	77.624	44.283	120.590	65.466	177.470	93.874
R280W280	83	91	75	97.710	51.032	146.840	74.138	204.550	103.160
R500W450	85	94	77	94.866	48.626	140.680	70.150	197.550	99.618
				Percent Change				*Percent Change*	
				-39%	-35%			45.32%	40.36%
				-36%	-32%			41.31%	39.08%
				-35%	-33%			36.98%	38.31%
				-36%	-32%			47.17%	43.39%
				-33%	-31%			39.30%	39.15%
				-33%	-31%			40.43%	42.01%

Table 14: Peak flows and volumes for different scenarios for a 10-year storm

				Decrease 10%		Existing Conditions		Increase 10%	
Watershed	Area wt CN	CN + 10%	CN - 10%	Peak Flow (cfs)	Total Vol (Ac-ft)	Peak Flow (cfs)	Total Vol (Ac-ft)	Peak Flow (cfs)	Total Vol (Ac-ft)
R30W30	75	82	67	140.61	70.342	196.02	95.055	250.96	120.48
R70W70	81	89	73	98.051	40.221	131.01	52.711	164.14	66.447
R80W80	85	93	76	191.11	91.444	254.76	120.91	311.39	151.54
R140W140	76	84	69	184.59	99.96	246.86	130.98	320.2	168.96
R280W280	83	91	75	204.97	103.86	269.04	135.04	333.91	170.18
R500W450	85	94	77	192.48	96.282	249.96	124.5	310.79	159.07
				Percent Change				*Percent Change*	
				-28%	-26%			28.03%	26.75%
				-25%	-24%			25.29%	26.06%
				-25%	-24%			22.23%	25.33%
				-25%	-24%			29.71%	29.00%
				-24%	-23%			24.11%	26.02%
				-23%	-23%			24.34%	27.77%

Table 15: Peak flows and volumes for different scenarios for a 100-year storm

				Decrease 10%		Existing Conditions		Increase 10%	
Watershed	Area wt CN	CN + 10%	CN - 10%	Peak Flow (cfs)	Total Vol (Ac-ft)	Peak Flow (cfs)	Total Vol (Ac-ft)	Peak Flow (cfs)	Total Vol (Ac-ft)
R30W30	75	82	67	331.58	160.24	407.9	195.66	473.78	228.52
R70W70	81	89	73	210.07	84.485	250.31	100.93	285.26	117.42
R80W80	85	93	76	390.21	185.24	464.71	222.72	520.22	257.72
R140W140	76	84	69	421.1	222.69	504.04	265.99	591.24	314.71
R280W280	83	91	75	425.66	213.63	502.59	253.97	569.55	295.19
R500W450	85	94	77	389.32	193.68	455.69	229.23	515.35	268.68
				Percent Change				*Percent Change*	
				-19%	-18%			16.15%	16.79%
				-16%	-16%			13.96%	16.34%
				-16%	-17%			11.95%	15.71%
				-16%	-16%			17.30%	18.32%
				-15%	-16%			13.32%	16.23%
				-15%	-16%			13.09%	17.21%

Table 16 shows the average percentage changes in the peak flow and volume of runoff from the sub watersheds for 10% increase and decrease of curve number for all the three design storms.

Table 16: Flow and volume change with alteration of curve number

	Decrease 10%		Increase 10%	
Storm Event	Peak Flow (cfs)	Total Vol (Ac-ft)	Peak Flow (cfs)	Total Vol (Ac-ft)
2-Year Storm (3.5 inches/24 hours)	-35.28%	-32.34%	41.75%	40.38%
10-Year Storm (5.2 inches/24 hours)	-25.07%	-23.92%	25.62%	26.82%
100-Year Storm (8.3 inches/24 hours)	-16.19%	-16.48%	14.30%	16.77%

Table 13 shows that for a 2-year design storm of 3.5 inches of rainfall over a 24 hour period, with a reduction of 10% in the curve number for the selected sub watersheds, the peak flow decreased by 35% and the volume of runoff decreased by 32%. Also with the increase of 10% curve number for the selected sub watersheds, the peak flow increased by 42% and the volume of runoff increased by 40%. For a 10-year design storm, the reduction of 10% in the curve number resulted in the reduction of 25% of the peak flows and 23% of the volumes of runoff, whereas, the increase in 10% of the curve number resulted in the increase of peak flows by 26% and increase of the volume of the runoff by 27%. Finally, for a 100-year design storm, the reduction in the curve number resulted in the reduction of peak flow and volume of the runoff by 16%, whereas the increase of 10% of the curve number increased the peak flow and volume by 14% and 16%, respectively.

From these scenarios it can be concluded that any changes in these watersheds that affect runoff have a significant impact during storms of lower intensities than the storms of higher intensities. The simulations show that stormwater management in these sub watersheds can significantly

reduce peak flow rates and volumes discharging to Troy Brook that contribute to flooding concerns during smaller storms events. It is these smaller, more frequent storms that contribute the majority of the rainfall in the state of New Jersey over a given year.

The peak flows generated from HEC-HMS can then be imported into HEC-RAS and simulation performed to generate water surface elevations for all the cross-sections of the river network. Figure 9 shows the selected sub watersheds along with the locations where the surface elevations were compared to the above-mentioned scenarios with the existing conditions for all the design storm events.

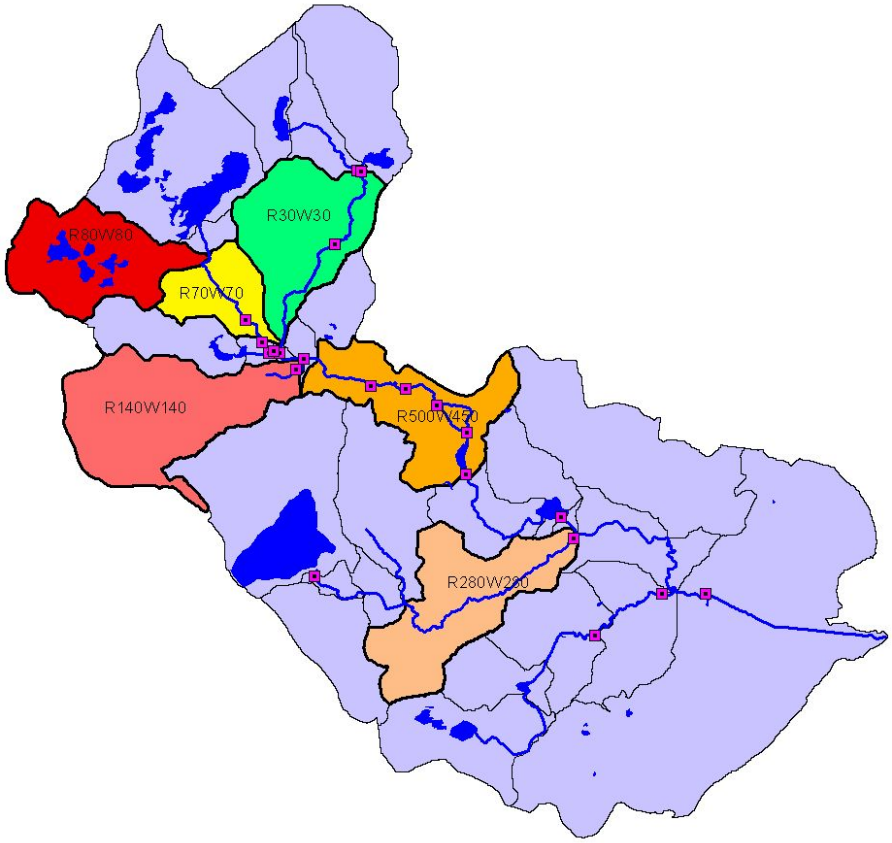

Figure 9: Locations for the Comparison of the Water Surface Elevations

Tables 17, 18 and 19 show the changes in water surface elevations at different locations in the Troy Brook watershed for a 10% increase and reduction of the curve number for all the selected watersheds for the 2-year, 10-year and 100-year design storms, respectively. These tables also include the streambank elevation which indicates the water surface elevation required before the banks are breeched.

Table 17: Water surface elevations for a 2-year storm

		Water Surface Elevation in Feet						
STREAM_ID	LOCATION	2YR	2YR NEW	2YR N-CN	2YR N+CN	Difference -CN	Difference +CN	Bank Elevations
R1	Ball Terrace	372.01	372.09	372.09	372.09	0.00	0.00	376.5
R2	Lake Dr	366.95	367.05	367.05	367.05	0.00	0.00	371.1
R3	Manor Lake	353.39	353.47	353.47	353.47	0.00	0.00	360.0
R3	Intervale Gardens	304.03	304.51	304.27	305.55	-0.23	1.04	309.6
R4	Cherry Hill Rd Basin	334.62	335.12	333.55	337.86	-1.57	2.74	338.3
R4	Cherry Hill Office Park	310.80	311.10	310.02	312.50	-1.08	1.41	313.4
R6	Upper Pond Tributary at BASF	307.57	307.81	307.12	308.48	-0.69	0.66	310.0
R600	Parking lot Opp Intervale Gardens	306.07	306.26	305.74	306.76	-0.51	0.50	308.3
R8	Sparton Ave	304.08	304.29	303.62	305.07	-0.66	0.79	307.8
R9	Police Station	302.38	302.67	302.00	303.46	-0.67	0.79	304.0
R9	Parsippany Blvd	300.31	300.44	300.14	300.78	-0.30	0.33	297.8
R9	Rt 287	290.41	290.46	290.09	291.21	-0.37	0.75	292.7
R9	Rt 80	274.25	274.58	273.77	275.68	-0.82	1.10	274.7
R9	Lake at Sheraton Hotel	273.75	273.94	273.40	274.49	-0.54	0.54	273.2
R9	Forge Pond	226.86	227.05	226.60	227.55	-0.45	0.50	227.5
R10	Parsippany lake	279.23	279.29	279.29	279.29	0.00	-0.01	281.9
R12	Eastmans Brook	211.40	211.51	211.34	212.14	-0.18	0.62	211.8
R14	West Brook at Beverwyck Rd	178.44	178.52	178.52	178.52	0.00	0.00	180.0
R14	West Brook at Troy Meadow Rd	171.61	171.82	171.67	172.33	-0.15	0.51	170.0
R15	Troy Brook at Troy Meadows	170.54	170.58	170.55	170.69	-0.03	0.12	170.3

Table 18: Water surface elevations for a 10-year storm

		Water Surface Elevation in Feet					
STREAM_ID	LOCATION	10YR	10YR-CN	10YR+CN	Difference -CN	Difference +CN	Bank Elevations
R1	Ball Terrace	373.62	372.60	372.60	-1.02	-1.02	376.5
R2	Lake Dr	368.35	367.94	367.94	-0.41	-0.41	371.1
R3	Manor Lake	354.32	354.09	354.09	-0.23	-0.23	360.0
R3	Intervale Gardens	306.86	306.30	307.75	-0.57	0.89	309.6
R4	Cherry Hill Rd Basin	342.72	338.20	347.73	-4.51	5.01	338.3
R4	Cherry Hill Office Park	314.51	312.66	316.66	-1.85	2.15	313.4
R6	Upper Pond Tributary at BASF	309.61	308.97	310.14	-0.64	0.53	310.0
R600	Parking lot Opp Intervale Gardens	307.62	307.14	308.05	-0.49	0.43	308.3
R8	Sparton Ave	306.05	305.33	306.87	-0.71	0.83	307.8
R9	Police Station	304.33	303.93	304.88	-0.40	0.55	304.0
R9	Parsippany Blvd	301.20	301.00	301.45	-0.19	0.26	297.8
R9	Rt 287	292.29	291.77	293.05	-0.53	0.75	292.7
R9	Rt 80	277.53	276.49	279.26	-1.04	1.73	274.7
R9	Lake at Sheraton Hotel	274.94	274.68	275.20	-0.27	0.26	273.2
R9	Forge Pond	227.99	227.78	228.20	-0.20	0.21	227.5
R10	Parsippany lake	279.81	279.81	279.81	0.00	0.00	281.9
R12	Eastmans Brook	212.47	212.47	212.47	0.00	0.00	211.8
R14	West Brook at Beverwyck Rd	179.13	179.13	179.13	0.00	0.00	180.0
R14	West Brook at Troy Meadow Rd	172.91	172.78	173.07	-0.13	0.16	170.0
R15	Troy Brook at Troy Meadows	170.95	170.87	171.04	-0.07	0.09	170.3

		Water Surface Elevation in Feet						
STREAM_ID	LOCATION	100YR	100YR NEW	100YR N-CN	100YR N+CN	Difference -CN	Difference +CN	Bank Elevations
R1	Ball Terrace	376.35	376.35	376.35	376.35	0.00	0.00	376.5
R2	Lake Dr	371.98	372.12	372.12	372.12	0.00	0.00	371.1
R3	Manor Lake	355.68	355.81	355.81	355.81	0.00	0.00	360.0
R3	Intervale Gardens	309.48	309.87	309.58	310.45	-0.29	0.58	309.6
R4	Cherry Hill Rd Basin	350.13	350.20	350.13	350.20	-0.07	0.00	338.3
R4	Cherry Hill Office Park	321.80	322.69	321.43	323.50	-1.26	0.80	313.4
R6	Upper Pond Tributary at BASF	311.29	311.33	311.30	311.48	-0.03	0.15	310.0
R600	Parking lot Opp Intervale Gardens	309.48	309.57	309.52	310.61	-0.05	1.05	308.3
R8	Sparton Ave	309.30	308.79	309.22	309.53	0.43	0.75	307.8
R9	Police Station	305.92	306.37	306.00	306.94	-0.37	0.57	304.0
R9	Parsippany Blvd	301.95	302.11	301.98	302.33	-0.12	0.22	297.8
R9	Rt 287	295.30	295.93	295.41	297.16	-0.51	1.23	292.7
R9	Rt 80	284.50	286.97	284.94	290.40	-2.03	3.43	274.7
R9	Lake at Sheraton Hotel	275.62	275.77	275.64	275.92	-0.13	0.15	273.2
R9	Forge Pond	228.61	228.76	228.64	228.90	-0.12	0.14	227.5
R10	Parsippany lake	280.51	280.86	280.86	280.86	0.00	0.00	281.9
R12	Eastmans Brook	213.17	213.08	213.08	213.69	0.00	0.61	211.8
R14	West Brook at Beverwyck Rd	179.79	179.98	179.98	179.98	0.00	0.00	180.0
R14	West Brook at Troy Meadow Rd	173.54	173.70	173.61	173.82	-0.09	0.12	170.0
R15	Troy Brook at Troy Meadows	171.29	171.57	171.48	171.70	-0.09	0.13	170.3

Table 19: Water surface elevation for a 100-year storm

From the above tables, it can be concluded that the changes in the water surface elevation were more significant during smaller storm events than during the larger storm events when changes in these six sub watersheds alters runoff discharging to Troy Brook. The difference in water surface elevation was relatively consistent during each storm event, but as the water surface elevation was much lower during smaller storm events, this difference was much more dramatic and in some cases can eliminate nuisance flooding during the smaller storms. This again adds more depth to the argument that storm water management could have a significant impact in the reduction of the flooding in the Troy Brook for smaller storm events, which, as mentioned above, contribute the majority of the rainfall for a given year in the State of New Jersey. From this analysis, bridges and culverts crossing Troy Brook were identified where the capacity of the opening was exceeded during one of the storm analyses. Table 20 provides detail on where specific flooding problems would likely occur during various storm events.

Table 20: Flooded Bridges and Culverts ("yes" indicates flood elevation reached)

BRIDGE/CULVERT LOCATION	100 Yr New	10 Yr	2 Yr New
Entrance Road from Route 46 to Mountain Lakes Office Parks	Yes	No	No
Route 46 Culvert	Yes	No	No
Culvert at Meadow Brook Apartments	Yes	No	No
Cherry Hill Road Culvert	Yes	No	No
Parsippany Boulevard	Yes	Yes	Yes
Ramp to Littleton Road near Route 287	Yes	Yes	Yes
Private Pedestrian Bridge between Littleton Road and Smith Road	Yes	Yes	Yes
Littleton Road Bridge	Yes	No	No
Access Road to Municipal Park from Route 46 near Route 80	Yes	Yes	Yes

Table 21: Key of Subbasin Identities used in Report

Original HMS basin title	Revisd subbasin ID	Area of Subbasin (sq mi)
R80W80	5	0.682
R560W510	30	0.971
R90W90	6	0.209
R350W350	20	0.411
R540W490	29	0.287
R20W10	1	0.208
R480W430	23	0.585
R30W30	2	0.742
R60W40	3	0.062
R70W70	4	0.327
R510W460	26	0.341
R130W130	9	0.056
R120W100	7	0.013
R110W110	8	0.041
R140W140	10	1.008
R500W450	25	0.708
R570W520	31	1.12
R210W210	14	0.555
R300W200	13	0.058
R360W360	21	0.116
R160W160	11	0.282
R490W440	24	0.29
R250W230	15	0.019
R220W180	12	1.017
R280W280	18	0.818
R550W420	22	0.252
R520W470	27	0.525
R390W240	16	2.952
R310W330	19	0.449
R530W480	28	0.453
R290W260	17	0.366

The hydrologic and hydraulic models explained in the Troy Brook Regional Stormwater Management Plan Characterization and Assessment are not officially calibrated models. Much of the data collected for the models was obtained from sources that have their own internal calibration, such as previous HEC-1 and HEC-2 output files obtained from the NJDEP. The output accuracy of the models was also checked with municipal engineers and participants in watershed associations to confirm the extent and location of problem areas. Due to these facts, results depicted here should be considered theoretical in nature, but highly useful in comparing various output scenarios. Models will be made available to the state and involved municipalities. These models should not be used in the permitting process. All aspects of design should be undertaken with a licensed engineer. All scenarios developed with these models should be individually calibrated.

V. Build Out Analysis

Introduction

At 49% urban land use area, the Troy Brook Watershed can be considered highly developed. Though the watershed is near build out, there are open spaces where development can proceed and others where the intensity of land use may increase. To evaluate the potential impact from this projected development, a build out analysis was performed for the Troy Brook Watershed. Both the increase in impervious cover as well as the increase in pollutant loading to the Troy Brook was calculated. The methodology used to prepare the build out analysis and results of this analysis are presented below.

Methods

The build out analysis was completed using ArcGIS. Zoning data were obtained from the Morris County Planning Board. The municipality boundaries and the existing land use/land cover were obtained from NJDEP's GIS 1995/97 database. These data sets were merged into an ArcGIS file so that data could easily be manipulated to account for build out conditions.

The first step in the build out analysis was to correlate the various municipal zones to land use characteristics that are consistent within the ArcGIS database. Table 22 shows the correlation of zones with the NJDEP GIS land use code, type, and description. As shown in this table, the relationships of zoning to land use code is not a one-to-one relationship. Several zones are grouped into each of the NJDEP GIS land uses due to varying specificity of zoning ordinances and the lack of coverage of all land uses within the NJDEP classification system. Since several municipalities use the same zoning label but have different zoning descriptions, the municipality was identified with the description for zoning labels that are repetitive. It was important to use the NJDEP GIS land uses because aerial loading coefficients for the pollutant loading analysis are readily available for the NJDEP GIS land uses.

The zoning layers were also given a maximum allowable percent imperviousness, which was obtained from each municipality's zoning ordinances. The majority of zoning descriptions include a maximum percent imperviousness within their bulk requirements; if an impervious cover limit was not given in the zoning ordinances, a value for maximum allowable percent imperviousness was used from a similar ordinance.

Table 22: Correlation between Municipal Zones and NJDEP's Land Use Codes and Type for the Troy Brook Watershed

LAND USE AND ZONING RELATIONSHIPS IN THE TROY BROOK WATERSHED				
Future LU95 Assigned	**Future Land Use Type**	**Future Land Use Description**	**Zone**	**Zoning Label**
1110	Urban	Residential, high density, multiple dwelling	AHD-1	Affordable Housing District -1
			R-1B	Residence District
			R-3	Residential District (15,000 sq. ft.)
			R-3(RCA)	Residential District
			RC-3	Residential Zone - Single Family Clustering Option
			R-M	Multi-Family Residences
			RM-3	Age-Restricted Townhouse
			T-3	Townhouse
1120	Urban	Residential, single unit, medium density	R-1	Residential District (40,000 sq. ft.) (Parsippany Troy Hills)
			R-1	Residential Zone - Single Family (Mountian Lakes)
			R-10	Single Family Residential (10,000 sq. ft.)
			R-120	Single Family Residential (3 Acre Density)
			R-15	Single Family Residences (15,000 sq. ft.)
			R-1A	Residential District
			R-2	Residential District (30,000 sq. ft.) (Parsippany Troy Hills)
			R-2	Residential Zone - Single Family (Mountian Lakes)
			R-20	Residence District
			R-25	Single Family Residences (25,000 sq. ft.)
			R-2M	Mixed Use Option
			R-4	Residential District (6,000 sq. ft.)
			R-40	Single Family Residences (40,000 sq. ft.)
			R-A	Residential Zone - Single Family
			R-AA	Residential Zone - Single Family
			RC-1	Residential Zone - Single Family Clustering Option
			RC-2	Residential Zone - Single Family Clustering Option
1130	Urban	Residential, single unit, low density	PRD-2	Planned Residential Development
			R-5	†Residential District - 5 Acres
1140	Urban	Residential, rural, single unit	R-1/RCW	Residential (40,000 sq. ft.)/Recreation, Conservation, Wild
1200	Urban	Commercial/ Services	B	Business Zone
			B-1	Business District (120,000 sq. ft.)
			B-2	Business District (40,000 sq. ft.) (Parsippany Troy Hills)
			B-2	Highway Business (Denville and Mountain Lakes)
			B-4	Business District
			COD	Corporate Office District
			I-P2	Industries, Offices & Labs

			O-1	Office, Engineering, Professional District (40,000 sq. ft.)
			O-3	Office, Engineering, Professional District (120,000 sq. ft.)
			OL-1	Office, Light Industrial Zone
			OL-2	Office, Light Industrial Zone
			OL-2/R-1	Office, Light Industrial Zone/R-1 Residential Overlay
			O-S	Business District (8,000 sq. ft.)
			POD	Planned Office District
			R-2M	Mixed Use Option
			ROL	Research, Office, Laboratory
1300	Urban	Industrial	SED-3	Specialized Economic Development District - 3 Ac.
			SED-3A	Specialized Economic Development District - 3 Ac.
			SED-5	Specialized Economic Development District - 5 Ac.
			SED-5A	Specialized Economic Development District - 5 Ac.
1400	Urban	Transportation/ Communication/ Utilities	I-2	Industrial
1700	Urban	Other Urban or Built-Up Land	COD	Corporate Office District
			PU	Public Uses
			R-2M	Mixed Use Option
1800	Urban	Recreational Land	RCW	Recreation, Conservation, Wildlife District
			C-2	Conservation Zone - Active Recreation
4120	Forest	Deciduous Forest (>50% Crown Closure)	C-1	Conservation Zone - Passive Recreation
			POS	Public Open Space
4410	Forest	Old Field (<25% Brush Covered)	C-1	Conservation Zone - Passive Recreation

[†]Although R-5 is a low density residential zone, current development in this zone is at a high density.

The build out analysis only considers developable lands or increased density in lands that are already developed. Lands that have been defined as "environmentally constrained" were not considered developable and therefore were eliminated from the build out analysis. The NJDEP has defined environmentally constrained areas as the following:

> *"Environmentally constrained area" means the following areas where the physical alteration of the land is in some way restricted, either through regulation, easement, deed restriction or ownership such as: wetlands, floodplains, threatened and endangered species sites or designated habitats, and parks and preserves* (N.J.A.C. 7:9?).

Any parcels of land that were identified as developable were changed to the most intensive land use for the particular zone where the developable parcel was located. For example, if a parcel of land was currently forested but located in Zone R-1 (residential zone – single family home), the land was converted to medium density residential (NJDEP Land Use Code 1120). If a parcel is already developed at a lower density than the zoning ordinances allow, the build out analysis

assumes that that parcel of land will be redeveloped at a higher density. For example, if a 45,000 square foot parcel of land is located in Zone R-3 (residential zone – 15,000 square foot lots) and only contains one single family home, the build out analysis assumes that that parcel of land will be subdivided into three 15,000 square foot lots, each with a single family home (i.e., high density residential, NJDEP Land Use Code 1110).

To calculate the increase in impervious cover that results from build out, the zoning ordinances were used to determine the maximum impervious cover for each parcel including the parcels that are already developed. For example, if a parcel was already developed with single family homes with 35% impervious cover and the zoning ordinance allows for impervious cover to be as high as 50% for that particular zone, the build out analysis would have converted the impervious cover for that parcel from 35% to 50%. The NJDEP 1995/97 GIS database provides existing impervious cover for all land uses. These impervious cover percentages for the existing land uses were determined by NJDEP through interpretation of the aerial photographs.
Aerial loading analysis on the predicted future build out land use was performed with the methods explained in Section V of this document, using the same aerial loading coefficients that are located in the table in Appendix D.

Results

Build Out Effects on Land Use

The calculated changes in land use that result from the build analysis are shown in Figure 10 and Table 23. It is important to note that 40% of the watershed was classified as constrained areas, based on the definition given above. As stated, these areas have been assumed to remain under the same land use, which oftentimes, is single unit, low density residential. As for the 60% of the watershed that will undergo land use change, the major impact is seen on forested areas, specifically deciduous forest with greater than 50% crown closure. Thirty-three percent of existing forested area, or 722 acres, will be altered to urban land use. Urban land use, mostly high density, multiple dwelling residential, will increase in the watershed by approximately 14%, increasing to 58% of the watershed's landscape (see Figure 11). It is important to note that although the build out analysis assumed that any parcel that is zoned as high density, multiple dwelling residential will become this land use, it may be unlikely to assume that large portions of the single family homes in the watershed will be converted to high density, multiple dwellings.

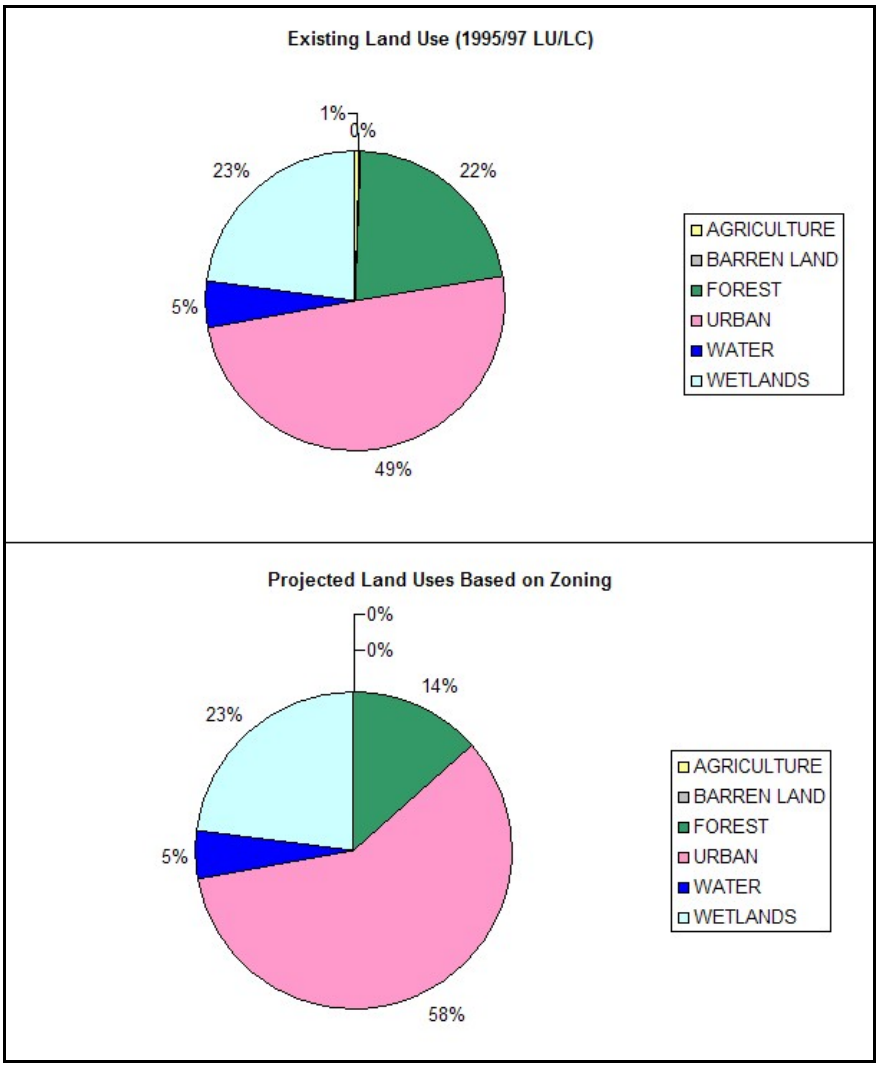

Figure 10: Percent Land Use Changes before and after Build Out

Table 23: Changes in Land Use Category from Existing to Build Out

Land Use Category	Existing Land Use/ Land Cover (1995) Area (acres)	Future Land Use/ Land Cover (based on zoning) Area (acres)	Change in Land Use from 1995 to Build Out Area (acres)
High/Medium Residential	2,543.42	3,782.27	1,238.85
Low/Rural Residential	760.57	161.20	-599.37
Commercial	696.16	665.77	-30.39
Industrial	315.73	697.36	381.63
Mixed Urban	1,120.77	917.77	-203.00
Agriculture	53.18	8.98	-44.19
Forest, Water, Wetlands	4,644.22	3,921.65	-722.58
Barren Lands	*56.80*	*35.85*	*-20.95*
Total (acres)	*10,190.85*	*10,190.85*	
Total (square miles)	*15.92*	*15.92*	

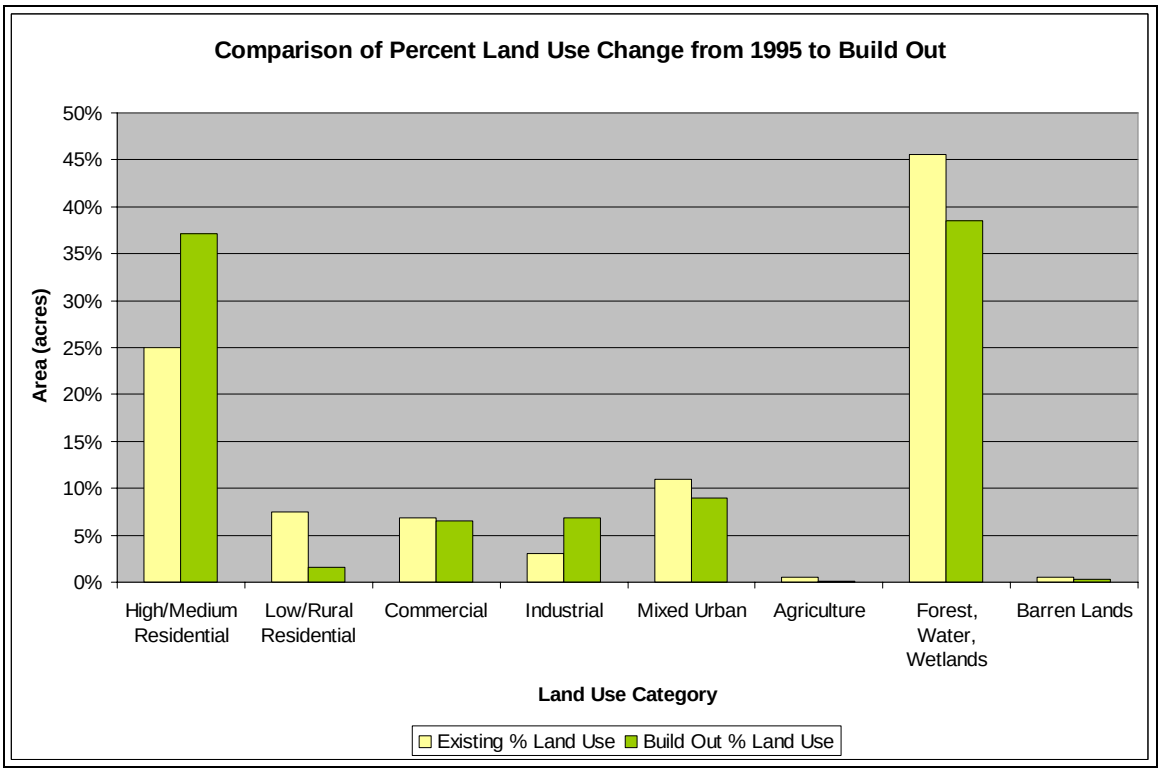

Figure 11: Changes in Land Use Categories from Existing to Build Out

With build out, the intensity of land use increases across the watershed. This is evident in the change in industrial areas. Industrial land use increases by more than double in the Troy Brook Watershed under existing zoning.

Although agricultural lands will decrease by 80%, existing agricultural land use in the watershed was relatively small (only 55 acres). Agricultural lands that remain unchanged in this analysis have been identified as constrained due to their inclusion as easements, threatened or endangered species habitat, wetland buffer area, or existence within the 100-year floodplain. According to the New Jersey Department of Agriculture Farmland Preservation GIS data (2002), no farmland preservation areas exist within the Troy Brook Watershed.

Impervious Surface Analysis

Impervious surfaces can be defined as any material that restricts or prevents water from infiltrating into the soil. Increases in impervious cover may result in increased flooding, impact to water quality, reduction in groundwater storage, and a loss of habitat and species diversity for aquatic and terrestrial species (Arnold and Gibbons, 1996). Aquifer supply and yield is critical for an area where the communities depend on groundwater storage for drinking water; such is the case for the Troy Brook Watershed. Furthermore, increasing and unmanaged impervious cover creates more surfaces for debris and pollutants to settle, therefore increasing the pollutant concentrations within stormwater.

Overall, impervious surface increases by 23% to a total percent impervious equal to 42% across the watershed. Of course, some subwatershed areas see a larger increase in imperviousness than others due to the intensity of development at build out. For instance, Basin 27 in Hanover Township will experiences a 70% increase in impervious surface, the largest increase in the watershed. Subbasin 21, in Parsippany Troy Hills, will have the highest percent imperviousness of the watershed after build out. This is one of the smaller subbasins, only 75 acres, and does not experience as sharp of an increase in percent imperviousness as others. Percent change in impervious areas and future percent impervious areas of the Troy Brook Watershed are displayed in Figure 12.

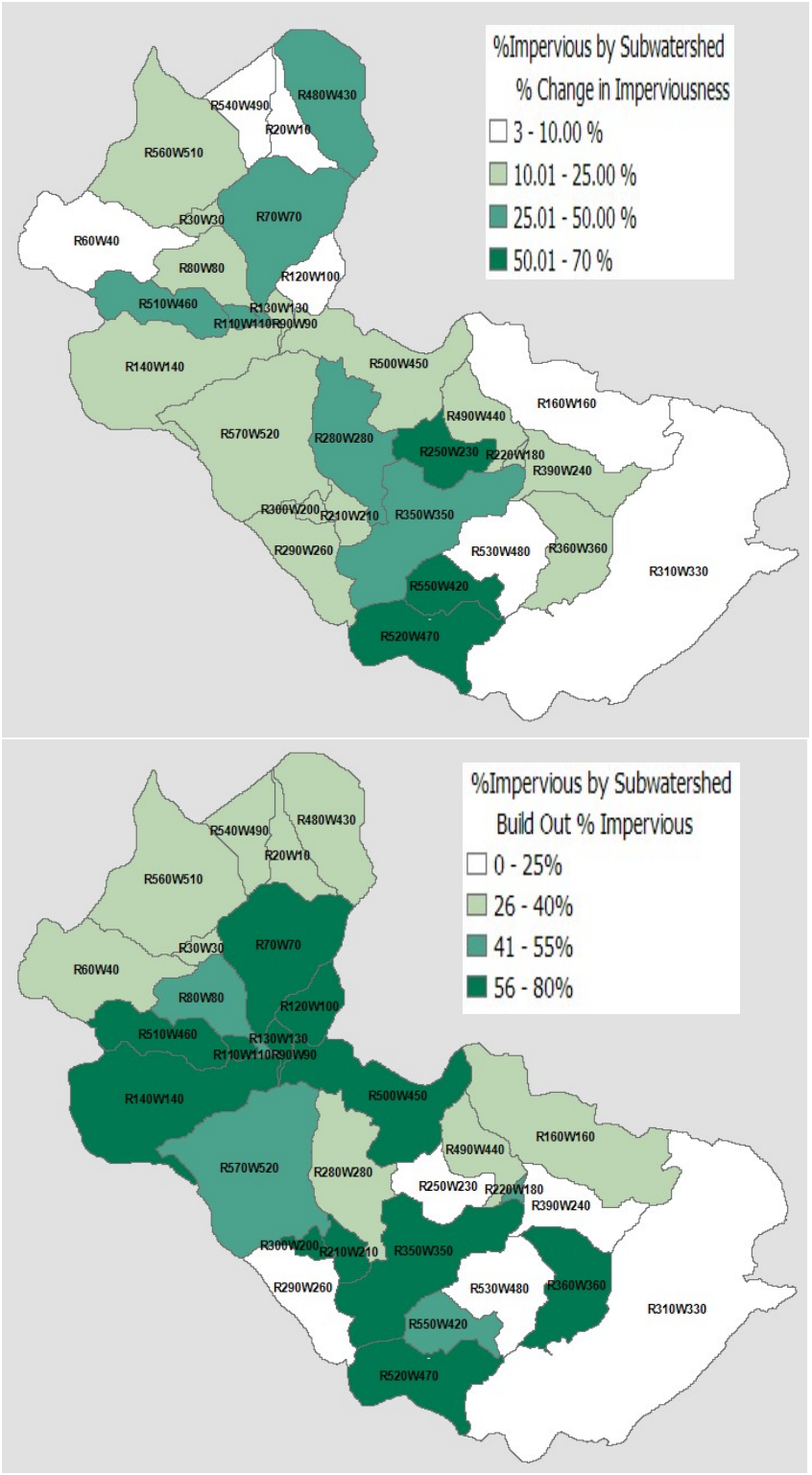

Figure 12: Percent Change in Imperviousness and Build Out Percent Impervious by Subwatershed

The areas of greatest impervious surface at build out are along the Route 46 and Route 287 corridor in Parsippany Troy Hills.

Figure 13 displays the change in percent imperviousness from 1995 to build out across all subwatersheds to the Troy Brook. This increasing impervious cover within the watershed can be properly managed through the use of stormwater BMPs and by the disconnection of impervious surfaces. Disconnecting impervious surfaces is the act of rerouting stormwater from a continuous impervious area to a lawn or rain garden, so that stormwater runoff has the opportunity to infiltrate to groundwater. Additional benefits of disconnection include increased groundwater recharge, less stormwater volume, and filtered stormwater runoff, given the opportunity for treatment through a buffer or vegetated swale.

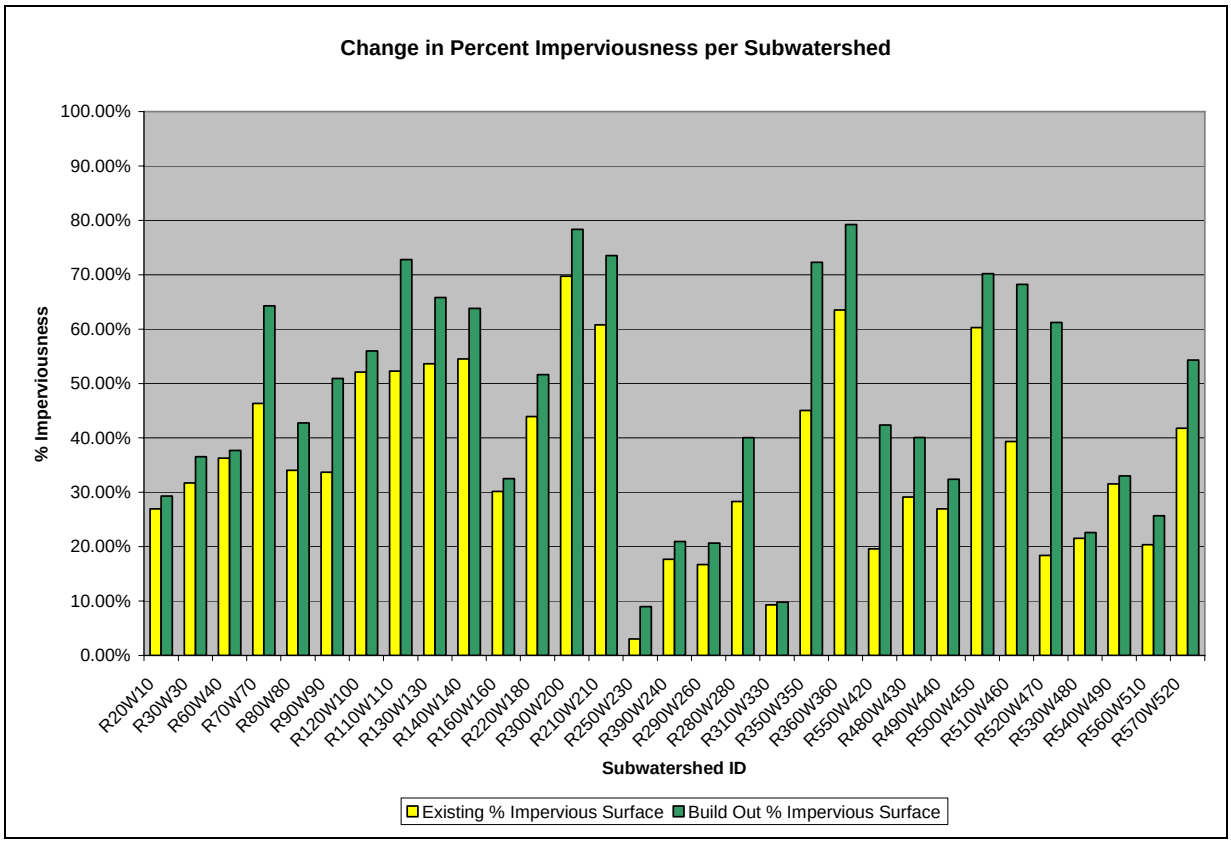

Figure 13: Comparison of Percent Imperviousness by Subwatershed under Existing Conditions and Build Out

VI. Regulations and Programs

Each of the three municipalities in the Troy Brook Watershed is required to comply with the requirements of the Statewide General Tier A New Jersey Pollutant Discharge Elimination System (NJPDES) permit for their municipal separate storm sewer system (MS4). The General

MS4 NJPDES permit requires each municipality to develop a municipal storm water management plan (MSWMP) and a stormwater control ordinance. Furthermore, each municipality must assure that all development complies with the Residential Site Improvement Standards. See Appendix E for a summary of the Statewide Basic Minimum Requirements for the General (Tier A) MS4 NJPDES permit.

The requirements for the MSWMP include completing a build out analysis, calculating pollutant loads that would result from build out, and incorporate nonstructural stormwater management strategies into municipal development codes. Since all three of these municipalities have less than one square mile of vacant or agricultural lands, they are except from these requirements. A pollutant loading analysis for existing build out condition of the watershed has been performed as part of this report.

Additionally, the General MS4 NJPDES permit requires each municipality to adopt and implement several key ordinances that will promote the use of stormwater as a resource. These ordinances include the following:

-Stormwater Control Ordinance:
A sample ordinance can be found at:
http://www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/bmpfeb2004pdfs/feb2004appdxd.pdf

-Yard waste:
A sample ordinance can be found at:
http://www.njstormwater.org/tier_A/pdf/containerized%20yard%20waste%20ordinance.pdf

-Illicit Connection
A sample ordinance can be found at:
http://www.njstormwater.org/tier_A/pdf/illicit%20connection%20ordinance.pdf

-Wildlife Feeding
A sample ordinance can be found at:
http://www.njstormwater.org/tier_A/pdf/wildlife%20feeding%20ordinance.pdf

-Improper Disposal of Waste
A sample ordinance can be found at:
http://www.njstormwater.org/tier_A/pdf/improper%20disposal%20of%20waste%20ordinance.pdf

-Litter Control
A sample ordinance can be found at:
http://www.njstormwater.org/tier_A/pdf/litter%20ordinance.pdf

-Pet Waste
A sample ordinance can be found at:
http://www.njstormwater.org/tier_A/pdf/pet%20waste%20ordinance.pdf

Additional considerations for ordinances that would benefit water quality and regulate water quantity could include a steep slope ordinance, a stream corridor/no fill ordinance, and an ordinance that will address the increase impervious area that comes with "knock-down/rebuilds". These ordinances should include low-impact development type language that allows for better use of stormwater as a resource.

Total Maximum Daily Load's (TMDL's)

As discussed previously, a TMDL represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint pollution, natural conditions, and surface water withdrawals. A TMDL is a mechanism for identifying and quantifying all contributors to surface water quality in a drainage basin and setting goals for reductions needed to meet surface water quality standards (NJDEP, 2004).

In 1999, the USEPA approved the Whippany River Watershed TMDL for fecal coliform, and this document became the first TMDL to be adopted by New Jersey (NJDEP, 2004). Recently, an addendum to the Whippany River TMDL for fecal coliform was published; this document is the *New Jersey Department of Environmental Protection Report on the Establishment of a Total Maximum Daily Load for Fecal Coliform and an Interim Total Phosphorus Reduction Plan for the Whippany River*. This interim plan for phosphorus reduction is a proactive step towards phosphorus controls. Presently, the Whippany River is not impaired for phosphorus and does not require a TMDL for phosphorus; however, since the Passaic River is impaired for phosphorus, the Whippany River's contribution of nutrients is under consideration in the TMDL process. In an effort to look ahead and reduce phosphorus contributions from the Whippany River to the Passaic River, the Whippany River Watershed Technical Advisory Committee is working with the NJDEP to develop low cost methods to reduce phosphorus loads from point source dischargers before the development of the Passaic River Watershed phosphorus TMDL.

In evaluating fecal coliform, the Whippany River Watershed TMDL process has located high levels of fecal coliform in specific locations within the Watershed. Based on monitoring in 1996, the Whippany River TMDL has derived the following land use associations in Table 24: Fecal Land Use Associations

Table 24: Whippany River Fecal Land Use Associations

Land Use	**Range of Fecal Coliform (counts/100mL)**
Forest	55 - 2,800
Mixed Land Use	7,600 – 21,000
Industrial	11,000 – 61,000
Low Density Residential	5,000 – 92,000
Wetlands Runoff	210 - 390

The Whippany River Watershed Technical Advisory Committee and subcommittee have identified the following as primary source of fecal contamination:

- Human sources: malfunctioning or older improperly sized septic systems in the upper reaches of the Watershed;
- Non-human sources: Canada geese, waterfowl, wildlife, pet waste, and stormwater basins which may be accumulation areas for fecal coliform from the mentioned sources (NJDEP, 2004).

For each of the mentioned sources above, the TMDL process has designated short-term and long-term strategies for reduction in fecal coliform pollution. The majority of these strategies pertains to stormwater and may be already underway due to the New Jersey Stormwater Management Regulations. Stormwater management is thus a priority for the watershed and similar strategies and implementations will be identifed specific to the Troy Brook Watershed.

The Regional Stormwater Management Plan for the Troy Brook Watershed aims to find solutions that may also aid in the reductions identified in the TMDL process for fecal coliform and will work to find solutions that may also reduce the amount of phosphorus loads entering surface waters.

In January of 2000, the Whippany River Watershed Nonpoint Source (NPS) Workgroup released *A Cleaner Whippany River Watershed,* a nonpoint source pollution control guidance manual which is a general guide to appropriate best management practices (BMPs) for the region. The Regional Stormwater Management Plan for the Troy Brook Watershed will include this previous work.

VII. Information not available

The needs of the watershed and the information available about the watershed will determine the analysis and structure of the final regional stormwater management plan. Information that can be obtained without consuming undue resources of the committee must be used to provide the plan within the boundaries that have been originally set. However, for the purposes of accurately representing the watershed for the intended purposes, several pieces of information would have been helpful.

A digital representation of the stormwater conveyance system would have provided information on sewersheds that may not follow the subbasins as defined by the topography. It is expected that these drainage patterns for the stormwater infrastructure would closely follow the topography of the land, making the cost of acquisition difficult to justify.

A digital representation of the flood hazard areas based on delineations made by the NJDEP under the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50. The flood hazard areas are delineated given a storm depth equal to 125% of the 100-year design storm for the county. These maps are currently being developed in hard copy by the NJDEP, and it is anticipated that they will eventually be available digitally.

VIII. Geographical Information System

As per 7:8-3.4 (b): *The Department encourages the use of existing information to the extent that it is available to minimize the cost of data acquisition, such as information available on the Department's Geographical Information System website or as developed through a watershed planning process.*

The process of map production for the Troy Brook Regional Stormwater Management Plan was achieved by the use of GIS data layers found on the NJDEP's website, http://www.state.nj.us/dep/gis/newmapping.htm.

This project has also benefited from GIS data sharing between the RCRE Water Resources Program and Morris County and the data made available through the Rutgers Center for Remote Sensing and Spatial Analysis (CRSSA).

IX. Determination of Inclusion in Watershed Boundary

As per 7:8-3.4 (c): *The characterization and assessment shall include information on locations and activities outside the regional stormwater management planning area that drain into the planning area.*

With the topographic and stormwater conveyance that has been obtained by the committee, and field verification by the Water Resources Program, it appears that the watershed boundary represents the watershed accurately and that there are no areas outside the boundary that contribute stormwater to the watershed.

X. Rank of Water Quality Impacts

According to 7:8-3.4 (d): *Using the modeling or other information obtained under(a) through (c) above, the stormwater-related water quality impacts of existing land uses and projected land uses assuming full development under existing zoning shall be identified and ranked*

A. Inventory Pollutant Sources to the Troy Brook Watershed

Stormwater-related pollutant sources

The highly urbanized nature of the watershed has resulted in significant pollutant loads to the Troy Brook. As discussed earlier in this report, the Troy Brook Watershed was subdivided into six subbasins and an aerial loading analysis was performed for each of these sub-watersheds. Based upon these calculations, the high density residential, commercial and industrial land uses provide the most significant loads to the Troy Brook. The residential areas and corporate complexes are believed to contribute significant nutrient loads and pesticide loads due to lawn

maintenance activities. Additionally, the roadways and highways located within the watershed provide ideal surfaces for accumulation and build up of pollutants from atmospheric deposition and the high level of auto emissions. These pollutants can severely impact the water quality of Troy Brook. Sediment, the number one pollutant throughout the country, has a high potential to impair the Troy Brook. Sources of sediment include road grit, sanding of icy impervious surfaces in the winter, stream bank erosion due to the flashy hydrologic nature of the Troy Brook and its tributaries, land disturbance from new development and redeveloping areas, and the inability of invasive species to provide the root structure needed to prevent soil erosion. Fecal coliform is also a pollutant that is suspected to impair the water quality of the waterways in the Troy Brook Watershed. Sources of fecal coliform include Canada geese population, pet waste, wildlife (deer, raccoons, etc.) and illicit discharges of human waste. Furthermore, debris is a pollutant found in this watershed. The high level of imperviousness in the watershed provides an avenue for debris to collect and be easily washed into the Troy Brook and its tributaries. Listed below are specific water quality issues that have been identified in the watershed.

Stormwater-related pollutant

All of the above pollutants can be transported to the waterways in the Troy Brook Watershed by stormwater runoff. Pollutants of concern include nutrients (phosphorus and nitrogen), sediment (total suspended solids), pathogens, toxics, and debris. These pollutants either individually or in combination may contribute to the impairment of the aquatic community in the Troy Brook Watershed.

B. Affected Uses

As demonstrated earlier in Table 5, many of the large waterbodies in the Troy Brook Watershed are used for active recreation including swimming. Fecal coliform is a major consideration in evaluating the use of these waterbodies. As for the streams, more information and benthic evaluations will be needed to decipher if the use of the streams is being affected by stormwater. Clearly, there are impacts of stormwater in the drainage basin, but with a lack of chemical water quality data in the Troy Brook Watershed, it is not possible to make a numeric comparison with water quality standards.

Although many of the traditional pollutants such as TSS and phosphorus discussed above primarily affect the surface waters, the infiltration of contaminated stormwater or the leaching of contaminants already in the system by precipitation could eventually affect the quality of the groundwater.

C. Identification and Rank of Pollutants and Sources

Manor Lake: Sedimentation and nutrient loading to Manor Lake is leading to eutrophic conditions. Roadway runoff from surrounding residential development discharges directly to the lake.

Forge Pond: A resident Canada goose population is partially responsible for pollutant loads to the lake. The additional residential develop around the lake is contributing to eutrophic conditions. The lake is filling with sediment.

Rainbow Lakes: Rainbow Lakes are private lakes that are surrounded by a high density residential development. Some of the lakes are swimmable. Fecal coliform concentrations have periodically been high. Phosphorus levels are also high. Some of the lakes are suffering from excessive algae growth, which most likely has an adverse effect on in-lake dissolved oxygen concentrations.

Lake Parsippany: Stormwater runoff from Route 80, Parsippany Road and Parsippany Boulevard are most likely impacting the water quality of Lake Parsippany. The areas surrounding the lakes are residential. Many of the existing homes around the lake are being torn down with large homes being built in their place. This increases the impervious cover around the lake, which provides more surfaces for pollutants to accumulate and wash off. The increase in impervious surface also results in large stormwater runoff volumes, thereby increasing flooding potential.

Ponds on Cherry Hill Road: There is one existing pond at the headwaters of the tributary that goes under Cherry Hill Road. This pond receives runoff from a corporate center. A second pond

was located immediately downstream of this existing pond but this second pond has been drained over the years. The existing pond has a significant population of resident geese that contributes nutrient and fecal loads to the waterway. Additionally, the lawn maintenance practices of the corporate center are also contributing nutrient and pesticide loads to the existing pond. An additional pond is located on the main stem Troy Brook and is associated with the Office Building at 50 Cherry Hill Road. This pond is mowed to the water's edge and has a significant resident goose problem.

Tivoli Gardens: The Troy Brook travels through the Tivoli Gardens Apartment Complex. At this location, the stream is suffering from stream bank erosion. The large impervious surfaces at this site (roof tops and parking lots) are directly connected to the stream. The riparian zone contains mowed lawn to the water's edge and all the stormwater is piped through this grassed area directly to the stream.

Troy Brook behind Intervale Garden Apartments and the Cherry Hill Road Corporate Center: There are highly impervious areas that discharge directly to the stream. Additionally, uncontrolled salt piles were observed in the parking lots at the Corporate Center. The stream is also actively downcutting and therefore losing access to its floodplain.

Grecian and Ulysses: A concrete channel receives runoff from Route 80. This concrete channel provides no habitat and promotes high stream velocities that carry sediment into the main channel of the Troy Brook. Sediment within the channel that has accumulated poses a source of TSS during high flow events.

Parsippany Public Works Yard: All runoff from the yard is uncontrolled and discharges directly to the Troy Brook. Since this is also the former site of the Township's leaf compost operation, residual nutrients may be contained in the soil at the site.

Table 25 provides a list of concerns regarding water quality that the Troy Brook Regional Stormwater Management Plan will address.

Table 25: Water Quality Impacts

	Concern	Notes
#1	Sublist 5 Waterbodies, including Mountain Lake, Lake Intervale, Lake Parsippany, and Rainbow Lakes	Address sources of Fecal Coliform impairing these waterbodies
#2	Parsippany Public Works runoff	
#3	Forge Pond eutrophication	Rapid development in area
#4	Manor Lake eutrophication	Requires dredging
#5	Morris Corporate Park eutrophication	Address Sources
#6	Pond on Cherry Hill Road eutrophication	Water fowl control
#7	Route 80 and 280 runoff	Enters Troy Meadows
#8	Tivoli Gardens erosion and runoff	
#9	Concrete Channel in area of Grecian and Ulysses	Address movement of TSS
#10	Underground stream networks	Loss of biodiversity and infiltration

XI. Rank of Water Quantity Impacts

As per 7:8-3.4 (e): *Using the model or other information obtained under (a) through (c) above for stormwater-related water quantity impacts and stormwater-related groundwater recharge impacts of existing and projected land uses*

A combination of the hydraulic modeling effort and the field reconnaissance surveys provided valuable information on areas within the Troy Brook that experience flooding. Some of these areas of concern have been ranked below in Table 26. Land use that increases impervious cover is a concern with regard to increasing the water quantity and velocity.

Table 26 ranks the water quantity concerns, flooding and otherwise, with consideration of threat to public health, safety, and welfare; risk of loss of or damage to water supplies; and risk of damage to the biological integrity of water bodies (as per N.J.A.C. 7:8 3.4 (e)).

Table 26: Water Quantity Impacts

	Concern	Notes
#1	Route 202 (Parsippany Blvd.) between Tivoli Gardens and Senior Center	Flooding
#2	Troy Meadows	Needs land use stability, provides stormwater receiving area
#3	Paris Street, bank opposite of the rear of the Parsippany Public Works	Flooding and mosquito habitat
#4	Homer, downstream of Morris Corporate Park	Flooding
#5	Forge Pond in Parsippany	Risk of land use change, provides storage
#6	Crescent and Center Street in Mountain Lakes	Mosquito habitat
#7	Lake Parsippany	Increasing impervious cover will increase stream volume and velocity downstream
#8	Recharge to Buried Valley Aquifer, increase in connected impervious areas	Water table appears to be decreasing (Charles, et al., 1993)
#9	Culvert under Rt. 80	Blocks and floods
#10	Erosion	Increase in volume and velocity with increasing impervious will contribute to stream bank erosion and to lower water quality.
#11	Smith Road Bridge	Flooding
#12	Ramp to Littleton Road near Route 287	Flooding
#13	Access road to municipal park from Route 46 near Route 80	Flooding

XII. Resources

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Appendix A: N.J.A.C. 7:8-3, Stormwater Management Rules

ENVIRONMENTAL PROTECTION

(a)

LAND USE MANAGEMENT
WATERSHED MANAGEMENT

✱ Stormwater Management

Adopted Repeal and New Rules: N.J.A.C. 7:7E-8.7, 7:8 and 7:13-2.8
Adopted Amendments: N.J.A.C. 7:7A-4.3 and 5.11, 7:15-3.4 and 3.5 and 7:20-1.3

Proposed: January 6, 2003 at 35 N.J.R. 119(a) (see also 35 N.J.R. 1328(a) and 4220(a)).

Adopted: January 5, 2004 by Bradley M. Campbell, Commissioner, Department of Environmental Protection.

Filed: January 6, 2004 as R.2004 d.48, **with substantive and technical changes** not requiring additional public notice and comment (see N.J.A.C. 1:30-6.3).

Authority: N.J.S.A. 12:5-3, 13:1D-1 et seq., 13:9A-1 et seq., 13:19-1 et seq., 40:55D-93 to 99, 58:4-1 et seq., 58:10A-1 et seq., 58:11A-1 et seq. and 58:16A-50 et seq.

DEP Docket Number: 34-02-12/109.

Effective Date: February 2, 2004.

Expiration Dates: August 3, 2006, N.J.A.C. 7:7A;
January 7, 2008, N.J.A.C. 7:7E;
February 2, 2009, N.J.A.C. 7:8;
June 30, 2005, N.J.A.C. 7:13;
April 30, 2004, N.J.A.C. 7:15;
April 28, 2005, N.J.A.C. 7:20.

The Department of Environmental Protection (Department) is adopting new Stormwater Management rules proposed on January 6, 2003 at 35 N.J.R. 119(a). The Department is also amending the stormwater management provisions of the following rules in order to coordinate with and cross-reference the new Stormwater Management rules: the Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A; the Coastal Zone Management Rules at N.J.A.C. 7:7E; the Flood Hazard Area Control Act rules at N.J.A.C. 7:13; the Water Quality Management Planning rules at N.J.A.C. 7:15; and the Dam Safety Standards at N.J.A.C. 7:20. Based on comments received on the January 6, 2003 proposal, the Department determined that the originally proposed definition of "major development" could have been misinterpreted to mean that projects possessing preliminary local approval before the new rules took effect would be considered exempt from all stormwater review, rather than exempt from the additional requirements imposed by the new rule. Implementation of the new rules under this exemption would not have provided the protection of waterbodies in the State from the impacts of stormwater runoff and nonpoint source pollution. Therefore, it was necessary to repropose the definition of "major development" and add a new applicability provision to ensure Department review of stormwater management has occurred in order for a project to be grandfathered. (See 35 N.J.R. 4220(a); September 15, 2003.) The Department is concurrently adopting the September 15, 2003 proposal of a new definition of "major development" and new applicability provision elsewhere in this issue of the New Jersey Register.

The Stormwater Management rules govern the development standards for State, municipal, and regional stormwater management requirements, plans and ordinances. In accordance with the Stormwater Management Act, N.J.S.A. 40:55D-93 to 99 and the Municipal Stormwater Regulation Program rules adopted elsewhere in this issue of the New Jersey Register, every municipality in the State is required to prepare a stormwater management plan and a stormwater management ordinance(s) to implement that plan.

The adopted Stormwater Management rules provide a framework and incentives for managing runoff and resolving nonpoint source impairment on a drainage area basis for new and existing development; establish a hierarchy for implementation of stormwater management measures with initial reliance on low impact site design techniques to maintain natural vegetation and drainage before incorporating structural best management practices; establish new runoff control performance standards for groundwater recharge, water quality and water quantity; establish special area protection measures for pristine and exceptional value waters; provide regulatory consistency among regulatory agencies at the local and State level; and provide safety standards for stormwater management basins.

As part of its comprehensive Stormwater Management Program, the Department is also adopting amendments to New Jersey Pollutant Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A. Those amendments include establishment and implementation of the Municipal Stormwater Regulation Program. Under that Program, potentially all of New Jersey's 566 municipalities, all 21 counties, the New Jersey Department of Transportation, State highway authorities, and many other State, interstate, and Federal agencies will be required to obtain a NJPDES permit for their stormwater discharges. See separate notice of adoption for N.J.A.C. 7:14A elsewhere in this issue of the New Jersey Register.

Summary of Hearing Officer's Recommendations and Agency Responses:

Public hearings on this proposal were held on the following dates and locations: February 13, 2003, Morris County Frelinghuysen Arboretum, Morristown; February 20, 2003, Collingswood Senior Community Center, Collingswood; and February 25, 2003, Department headquarters building, Trenton. Ms. Elizabeth Semple, Senior Policy Advisor, Division of Watershed Management, served as the hearing officer.

Ms. Semple recommended that the Department adopt the stormwater management rules proposed on January 6, 2003 and the stormwater management rule revisions proposed on September 15, 2003 with modifications described below in the Summary of Public Comments and Agency Responses.

The hearing records are available for inspection in accordance with applicable law by contacting:

New Jersey Department of Environmental Protection
Office of Legal Affairs
Attn. DEP Docket Number 34-02-12/109
PO Box 402
Trenton, New Jersey 08625-0402

Summary of Public Comments and Agency Responses:

The following people submitted written and/or oral comments on the proposed repeal and new Stormwater Management Rules, N.J.A.C. 7:8. The number in parentheses after each comment corresponds to the number identifying the respective commenters below.

1. A Illegible, Rob
2. Aasum, Mark
3. Accetta, Jacqueline
4. Addison, Doreen
5. Adler, John H., New Jersey Senate
6. Affrunti, Pat
7. Aheam, Matt
8. Ahles, Ray, New Jersey General Assembly
9. Ailey, Asher
10. Alama, Pauline
11. Alaya, Cristina
12. Aldom, Terence
13. Allen, Judith A., Delaware Township
14. Allen, Terri
15. Allessio, Renee
16. Altman, Tracye
17. Alvarado, Yeseni
18. Amendolic, Debra
19. Ammiano, Michael
20. Ammiano, Lisa
21. Amon, James C., D&R Canal Commission
22. Andersen, Thomas S., Du Pont
23. Anderson, Alma
24. Anderson, Dennis
25. Anderson, Jamie
26. Andrews, Robert
27. Andrews, Margaret
28. Anfuso, Timothy, Colts Neck Planning Board
29. Angarone, Nicholas
30. Arerhe , Jay
31. Argentina, Debra
32. Armstrong, Virginia M.
33. Arnold, Mary
33A. Arochas, Nora
34. Ashton, N.L.
35. Assante, Jamie M.
36. Astarta, M.
37. Auentyuon, Anne
38. Auentyuon, J.
39. Autran, Roland
40. B Illegible, Dave
41. B Illegible, R.
42. B Illegible, Sandra
43. Baier, Michael, Dept of Community Affairs
44. Bain, Elizabeth
45. Baker, Alfred (Mrs.)
46. Baker, David G., Borough of Lincoln Park
46A. Baker, David N., Village of Ridgewood
47. Baker, Marie
48. Bakun, George, Conocophillips Company Bayway Refinery
49. Baldwin, Donnamarie
50. Baldwin, Edward J.

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Responses by DEP to Public Comment

minimum rather than four to six feet width. To provide a choice will invariably result in the narrower width. (833)

RESPONSE TO COMMENTS 912 THROUGH 917: The safety criteria of N.J.A.C. 7:8-6.2(c)2 are based upon the report entitled "Recommendations for Public Safety Regulations," dated August 1994 from the Stormwater Detention Facility Advisory Council, and are consistent with the safety provisions in the RSIS at N.J.A.C. 5:21-7.5(f)6. The Department believes that it should discuss any substantial changes to these criteria with the Site Improvement Advisory Board before proposing such changes for public comment.

918. COMMENT: N.J.A.C. 7:8-6.1(c)2 is too restrictive. If the intent is to provide wet ponds with a wetlands function, a long gradually sloping shelf for the establishment of emergents is required. This shelf needs to be established from just above the water level at anywhere from a 1:10 to 1:20 slope to a depth of two to 2.5 feet. Establishment of a wetland shelf of emergents around the ponds edge also provides habitat for predators of mosquito larva and hinders the use of the pond by geese, a problem in New Jersey. The county would prefer the establishment of a performance standard dependent on the particular function of the pond. (1099)

RESPONSE: The intent of N.J.A.C. 7:8-6.1(c) is not to provide a wetlands function in a wet pond, but to address safety concerns.

919. COMMENT: The slope requirement in basins at N.J.A.C. 7:8-6.1(c)3 should be clarified. Does this section prohibit the use of properly designed and protected retaining walls in detention/retention basins? Walls should be allowed since they can provide attractive accents to basins as well as reducing the area of disturbance necessary for the construction of stormwater facilities. (596, 731, 1070, 1118)

RESPONSE: The slope requirement at N.J.A.C. 7:8-6.2(c)3 is for earthen dams, embankments, or berms, and does not prohibit the use of a non-earthen retaining wall as part of the stormwater basin.

920. COMMENT: The regulations should prohibit the construction of concrete low flow channels that tend to flush out the initial heavily polluted stormwater. Instead, the regulations should encourage the use of pervious low flow channels, such as paver blocks or gabion mattress low flow channels, which will allow for the planting of natural faltering vegetation instead of smooth concrete low flow channels. (21)

RESPONSE: The use of concrete low flow channels is not prohibited under the rules. The use of a concrete low flow channel is typically used in an extended dry detention basin, which must be utilized in a treatment train with other devices in order to meet the 80 percent TSS removal criteria. An extended detention basin typically removes pollutants due to settling by detaining flow over a period of time, which is controlled by the outlet structure. Other BMPs, such as a wet pond or a constructed wetlands, do not have concrete low flow channels. The use of vegetation or other types of low flow devices at the bottom of a stormwater BMP depends on the type of BMP proposed.

921. COMMENT: The commenter allows underground perforated pipe systems in a stone trench, wrapped with filter fabric. These systems have worked for many years in sandy soil areas. Are these systems permissible in your regulations? (875)

RESPONSE: Underground perforated pipes can be utilized to address the performance standards. Additionally, there is specific guidance in the BMP Manual for pretreatment of underground infiltration basins, including perforated pipes.

922. COMMENT: The Department should require the county to use perforated pipe, loose joints, and in general less concrete in new construction of roadside ditches. Water that gets into unperforated pipe with tight joints has no chance of recharging into the ground. The rules should consider further measures to assist with recharge. (3, 481)

RESPONSE: The use of perforated pipes is not specifically required through these regulations, but may be one of the ways in which the design and performance standards for stormwater runoff quantity, stormwater runoff quality, and groundwater recharge can be addressed, depending on site-specific conditions. N.J.A.C. 7:8-5.4(a)2i provides groundwater recharge performance standards for new major development, which requires groundwater recharge on a site to be maintained. The rules provide the flexibility to utilize many different measures to address groundwater recharge, such as nonstructural stormwater management strategies required at N.J.A.C. 7:8-5.2(a) and 5.3(a), surface infiltration basins, and subsurface infiltration facilities.

923. COMMENT: Can you improve upon an existing detention basin which, because of improper maintenance, may now be classified as wetlands? Is this a goal that will be permitted by the proposed stormwater management regulations, and how does this correlate to land use and regulations? (808, 842)

RESPONSE: The requirements regarding existing detention basins that have become wetlands are outside the scope of these rules. New stormwater management structures, such as basins or constructed wetlands, are required to be maintained regularly, including the keeping of maintenance logs.

924. COMMENT: The Department should prevent pollution from foreign chemicals such as fluoride, which increases osteoporosis and fractures in the elderly (as well as hypothyroidism in all ages) (605)

RESPONSE: The discharge of chemicals such a fluoride is regulated by another program and is outside of the scope of this rule.

925. COMMENT: Fertilizers, herbicides, pesticides should be banned for sale in New Jersey. (928)

RESPONSE: The banning of the sale of fertilizers, herbicides, and pesticides are outside the scope of this rule.

926. COMMENT: The county's practice of acquiring wider rights-of-way (ROWs) as a condition for allowing land sales or transfers, and requiring landowners to grade their ROW to the county's specifications, exacerbates a condition that the Department does little to correct: runoff and erosion from road ROWs, including severely eroded roadsides and accumulations of sediment in the roads. This problem would not be corrected under the new regulations, which allow the county to disturb up to one acre of soil without a permit. The Department should reduce the allowable soil disturbance without permit in county road department building projects to 5,000 square feet, which is the soil conservation district's threshold. (481)

RESPONSE: The one-acre threshold is consistent with the NJPDES stormwater permit requirements adopted elsewhere in this issue of the New Jersey Register. The Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., already provides a basis for comprehensive and coordinated Statewide control of sediment in stormwater during construction, including projects that are not subject to this chapter.

927. COMMENT: When will the Category One designation take effect on the Papakating River? Other commenters indicated that the Millstone River, Stony Brook, and Lake Carnegie are not currently designated nor proposed as Category One; however, the Millstone River and Stony Brook are publicly nominated for Category One designation. Please clarify that these areas continue to be designated as FW2. (414, 808, 842)

RESPONSE: The designation of specific waters within the State as Category One occurs through the adoption of Surface Water Quality Standards (N.J.A.C. 7:9B) and its associated processes, and are not designated through the stormwater rules.

928. COMMENT: Putting buffers around waterways and using MS4s around the State will not completely address the need to protect waterways and recharge aquifers. Clean-up of hazardous wastes is a must and "beneficial sludge" that is non-compliant must stop being land applied. Handing over the responsibility to municipalities or developers for protecting water quality is not the answer. (1200)

RESPONSE: The Department agrees with the commenter that the remediation of contaminated sites and proper handling of sludge are also critical components to protecting and restoring water quality. However, the beneficial use of sludge and site remediation practices are governed by other rules and are not included in this proposal. The Department is not handing the responsibility to maintain water quality to developers and municipalities as suggested by the commenter, but is prescribing new design and performance standards at the State and the local level to enhance water resource protection. The requirement to develop a municipal stormwater management plan and adopt a stormwater control ordinance under the NJPDES Phase II Municipal Stormwater Permitting Program is intended to promote consistency in stormwater management requirements across all levels of government.

Summary of Agency-Initiated Changes:

The Department has made the following agency-initiated modifications to the rules upon adoption:

1. At N.J.A.C. 7:8-1.2, the definition of the term "stormwater" was amended to add the words ", or conveyed by snow removal equipment" to be consistent with a change made in the definition of the same term in the NJPDES Stormwater Regulation Program rules adopted elsewhere in this issue of the New Jersey Register.

2. At N.J.A.C. 7:8-1.3, the words "Nonpoint Source Program" were replaced with the words "Division of" in the address to update the contact information for the rules.

3. At N.J.A.C. 7:8-5.5(c), Table 2, the words "Forested Buffer" and its TSS Percent Removal Rate of "70" is being removed. The percent TSS removal rate for the vegetated filter strip of "50 " is revised to "60-80," to

combine the forested buffer and the vegetated filter strip. The forested buffer is a vegetated filter comprised of forested area, and the combination into one best management practice clarifies this BMP.

4. In the last sentence of N.J.A.C. 7:8-5.6(a)2, the phrase "good condition" was changed to "good hydrologic condition" to provide consistency in terminology.

5. At N.J.A.C. 7:8-5.9(a)1iv, "Forested buffers" is being removed for consistency with the removal of the Forested Buffer BMP in Table 2 at N.J.A.C. 7:8-5.5(c). Subparagraphs (a)1v through xi are recodified as (a)1iv through x.

Federal Standards Statement

Executive Order No. 27(1994) and N.J.S.A. 52:14B-1 et seq. (as amended by P.L. 1995, c.65) require State agencies which adopt, readopt, or amend State regulations that exceed any Federal standards or requirements to include in the rulemaking document a Federal standards analysis. There are no current, analogous Federal requirements for stormwater management planning; however, there are several Federal programs concerning stormwater runoff and nonpoint source pollution control. These are discussed below.

Clean Water Act

The Federal Clean Water Act (33 U.S.C. §§1251 et seq.) requires permits under Section 402 of that Act (33 U.S.C. §1342) for certain stormwater discharges. The Department's requirements to obtain such permits are set forth in the New Jersey Pollutant Discharge Elimination System Rules, N.J.A.C. 7:14A, rather than in these Stormwater Management rules being adopted.

Section 319 of the Clean Water Act (33 U.S.C. §1329) authorizes a Federal grant-in-aid program to encourage states to control nonpoint sources. The Department developed a management program for nonpoint source control under which the Department issues grants to local, regional, State, and interstate agencies as well as to nonprofit organizations to, for example, develop or monitor best management practices to control stormwater.

Coastal Zone Management Act

Under Section 6217(g) of the Coastal Zone Management Act Reauthorization and Amendments of 1990 (CZARA), P.L. 101-508, the U.S. Environmental Protection Agency (EPA) has published "Guidance Specifying Management Measures For Sources of Nonpoint Pollution In Coastal Waters" (CZARA 6217(g) Guidance). States may opt to participate or not participate in overall coastal zone management program, with no penalty for non-participation other than the loss of Federal grants for this program. No mandatory Federal standards or requirements for nonpoint sources pollution control are imposed. The CZARA 6217(g) Guidance includes management measures for stormwater runoff and nonpoint source pollution control from land development as well as many other source types. The Department has developed a coastal zone management program, including a component addressing coastal nonpoint pollution control. The Stormwater Management rules at N.J.A.C. 7:8 are one means by which the Department implements its nonpoint pollution control program.

The Department has determined that the adopted rules do not contain any standards or requirements that exceed the standards or requirements imposed by Federal law. Accordingly, Executive Order No. 27(1994) and N.J.S.A. 52:14B-1 et seq. (P.L. 1995, c.65) do not require any further analysis.

Full text of the adopted new rules and amendments follows (additions to proposal indicated in boldface with asterisks ***thus***; deletions from proposal indicated in brackets with asterisks *[thus]*):

CHAPTER 7A
FRESHWATER WETLANDS PROTECTION ACT RULES

7:7A-4.3 Conditions that apply to all general permit authorizations

(a) (No change.)

(b) The following conditions apply to all activities conducted under the authority of a general permit:

1.-9. (No change.)

10. If activities under the general permit meet the definition of "major development" at N.J.A.C. 7:8-1.2, the Stormwater Management Rules at N.J.A.C. 7:8 apply.

11.-16. (No change.)

(c)-(f) (No change.)

7:7A-5.11 General permit 11—Outfalls and intake structures

(a)-(e) (No change.)

(f) Stormwater discharged from an outfall authorized under general permit 11 shall be managed in accordance with the Stormwater Management Rules at N.J.A.C. 7:8.

(g)-(j) (No change.)

CHAPTER 7E
COASTAL ZONE MANAGEMENT

SUBCHAPTER 8. RESOURCE RULES

7:7E-8.7 Stormwater management

If a project or activity meets the definition of "major development" at N.J.A.C. 7:8-1.2, then the project or activity shall comply with the Stormwater Management rules at N.J.A.C. 7:8.

CHAPTER 8
STORMWATER MANAGEMENT

SUBCHAPTER 1. GENERAL PROVISIONS

7:8-1.1 Scope and purpose

(a) This chapter establishes general requirements for stormwater management plans and stormwater control ordinances, as well as content requirements and procedures for the adoption and implementation of regional stormwater management plans and municipal stormwater management plans under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq.; the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq.; the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.; and the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.; and implementing rules.

(b) This chapter establishes design and performance standards for stormwater management measures required by rules pursuant to the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.; the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.; the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq.; the Waterfront Development Law, N.J.S.A. 12:5-3; the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.; and the Dam Safety Act, N.J.S.A. 58:4-1 et seq.

(c) This chapter establishes safety standards for stormwater management basins pursuant to N.J.S.A. 40:55D-95.1.

(**Agency Note:** N.J.A.C. 7:8-1.2 below includes the definition of "major development" as reproposed at 35 N.J.R. 4220(a) and adopted elsewhere in this issue of the New Jersey Register.)

7:8-1.2 Definitions

The following words and terms, when used in this chapter, shall have the following meanings unless the context clearly indicates otherwise.

[“Agricultural development” means land uses normally associated with the production of food, fiber and livestock for sale. Such uses do not include the development of land for the processing or sale of food and the manufacture of agriculturally related products.]

“CAFRA Planning Map” means the geographic depiction of the boundaries for Coastal Planning Areas, CAFRA Centers, CAFRA Cores and CAFRA Nodes pursuant to N.J.A.C. 7:7E-5B.3.

“CAFRA Centers, Cores or Nodes” means those areas within boundaries accepted by the Department pursuant to N.J.A.C. 7:8E-5B.

“Compaction” means the increase in soil bulk density.

“Core” means a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

“County review agency” means an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The county review agency may either be:

1. A county planning agency; or

2. A county water resources association created under N.J.S.A. 58:16A-55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances.

“Department” means the Department of Environmental Protection.

"Designated Center" means a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.

"Design engineer" means a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

"Development" means the division of a parcel of land into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or structure, any mining excavation or landfill, and any use or change in the use of any building or other structure, or land or extension of use of land, for which permission is required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq.

In the case of development on agricultural land, development means: any activity that requires a State permit; any activity reviewed by the County Agricultural Boards (CAB) and the State Agricultural Development Committee (SADC), and municipal review of any activity not exempted by the Right to Farm Act, N.J.S.A. 4:1C-1 et seq.

"Drainage area" means a geographic area within which *[water]* *stormwater runoff*, sediments, *[and]* *or* dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

"Environmentally constrained area" means the following areas where the physical alteration of the land is in some way restricted, either through regulation, easement, deed restriction or ownership such as: wetlands, floodplains, threatened and endangered species sites or designated habitats, and parks and preserves. ***Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.***

"Environmentally critical area" means an area or feature which is of significant environmental value, including, but not limited to: stream corridors; natural heritage priority sites; habitats of endangered or threatened species; large areas of contiguous open space or upland forest; steep slopes; and well head protection and groundwater recharge areas. ***Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.***

"Empowerment Neighborhoods" means neighborhoods designated by the Urban Coordinating Council "in consultation and conjunction with" the New Jersey Redevelopment Authority pursuant to N.J.S.A. 55:19-69.

"Erosion" means the detachment and movement of soil or rock fragments by water, wind, ice or gravity.

"Impervious surface" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

"Infiltration" is the process by which water *[that]* seeps into the soil from precipitation.

"Lead planning agency" means one or more public entities having stormwater management planning authority designated by the regional stormwater management planning committee pursuant to N.J.A.C. 7:8-3.2*, **that serves*** as the primary representative of the committee.

"Major development" means any "development" that provides for ultimately disturbing one or more acres of land or increasing impervious surface by one-quarter acre or more. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation. Projects undertaken by any government agency which otherwise meet the definition of "major development" but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., are also considered "major development."

"Municipality" means any city, borough, town, township, or village.

"Node" means an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.

"Nutrient" means a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

"Person" means any individual, corporation, company, partnership, firm, association, political subdivision of this State and any state, interstate or Federal agency.

"Pollutant" means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. §§2011 et seq.)), thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and construction waste or runoff or other residue discharged directly or indirectly to the land, groundwaters or surface waters of the State, or to a domestic treatment works. "Pollutant" includes both hazardous and nonhazardous pollutants.

"Recharge" means the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

"Sediment" means solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

"Site" means the lot or lots upon which a major development is to occur or has occurred.

"Soil" means all unconsolidated mineral and organic material of any origin.

"State Development and Redevelopment Plan Metropolitan Planning Area (PA1)" means an area delineated on the State Plan Policy Map and adopted by the State Planning Commission that is intended to be the focus for much of the State's future redevelopment and revitalization efforts.

"State Plan Policy Map" is defined as the geographic application of the State Development and Redevelopment Plan's goals and Statewide policies, and the official map of these goals and policies.

"Stormwater" means water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities***, or conveyed by snow removal equipment***.

"Stormwater runoff" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.

"Stormwater management basin" means an excavation or embankment and related areas designed to retain stormwater runoff. A stormwater management basin may either be normally dry (that is, a detention basin or infiltration basin), retain water in a permanent pool (a retention basin), or be planted mainly with wetland vegetation (most constructed stormwater wetlands).

"Stormwater management measure" means any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal nonstormwater discharges into stormwater conveyances.

"Stormwater management planning agency" means a public body authorized by legislation to prepare stormwater management plans.

"Stormwater management planning area" means the geographic area for which a stormwater management planning agency is authorized to prepare stormwater management plans, or a specific portion of that area identified in a stormwater management plan prepared by that agency.

"Tidal Flood Hazard Area" means a flood hazard area, which may be influenced by stormwater runoff from inland areas, but which is primarily caused by the Atlantic Ocean.

"Urban Coordinating Council Empowerment Neighborhood" means a neighborhood given priority access to State resources through the New Jersey Redevelopment Authority.

"Urban Enterprise Zones" means a zone designated by the New Jersey Urban Enterprise Zone Authority pursuant to the New Jersey Urban Enterprise Zones Act, N.J.S.A. 52:27H-60 et seq.

"Urban Redevelopment Area" is defined as previously developed portions of areas:

1. Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;
2. Designated as CAFRA Centers, Cores or Nodes;
3. Designated as Urban Enterprise Zones; and

4. Designated as Urban Coordinating Council Empowerment Neighborhoods.

"Waters of the State" means the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or groundwater, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

"Wetlands" or "wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

7:8-1.3 Program information

Questions or submissions regarding this chapter should be directed to the *[Nonpoint Source Program,]* ***Division of*** Watershed Management, New Jersey Department of Environmental Protection, PO Box 418, Trenton, New Jersey 08625.

7:8-1.4 Severability

If the provisions of any section, subsection, paragraph, or clause of this chapter shall be judged invalid by a court of competent jurisdiction, such order or judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, or clause of this chapter.

7:8-1.5 Relationship to other regulatory programs

(a) Nothing in this chapter shall be construed as preventing the Department or other agencies or entities from imposing additional or more stringent stormwater management requirements necessary to implement the purposes of any enabling legislation including those measures necessary to achieve the Surface Water Quality Standards at N.J.A.C. 7:9B.

(b) If a stormwater management measure is used as a soil erosion or sediment control measure, the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., shall also apply.

(c) These stormwater requirements are the Department's standards referenced by the stormwater management provisions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.

(**Agency Note:** The following section, N.J.A.C. 7:8-1.6, Applicability to major development, reflects the adoption of this section, proposed at 35 N.J.R. 4220(a), published elsewhere in this issue of the New Jersey Register.)

7:8-1.6 Applicability to major development

(a) Except as provided in (b) below, all major development shall comply with the requirements of this chapter.

(b) The following major development shall be subject to the stormwater management requirements in effect on February 1, 2004, copies of which are available from the Department at the address specified in N.J.A.C. 7:8-1.3:

1. Major development which does not require any of the Department permits listed in (c) below and which has received one of the following approvals pursuant to the Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.) prior to February 2, 2004:

i. Preliminary or final site plan approval;

ii. Final municipal building or construction permit;

iii. Minor subdivision approval where no subsequent site plan approval is required;

iv. Final subdivision approval where no subsequent site plan approval is required; or

v. Preliminary subdivision approval where no subsequent site plan approval is required;

2. Major development which has received one of the approvals pursuant to the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., in (b)1 above prior to February 2, 2004 and has secured at least one of the applicable permits listed in (c) below from the Department by February 2, 2004, and provided that the permit included a stormwater management review component; and

3. Major development undertaken by any government agency, which does not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., provided that the project has secured at least one of the applicable Department permits listed in (c) below prior to February 2, 2004, and provided that the permit included a stormwater management review component.

(c) For the purposes of this section, the term "permit" shall include transition area waivers under the Freshwater Wetlands Protection Act. In order to qualify under (b)2 or 3 above, the major development must have obtained at least one Department permit granted under the following statutes and, provided that the permit included a stormwater management review component, prior to February 2, 2004:

1. Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.;
2. Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.;
3. Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.; or
4. Waterfront and Harbor Facilities Act, N.J.S.A. 12:5-3;

(d) An exemption provided by (b) above shall expire with the expiration, termination or other loss of duration or effect of either of the qualifying local approval or Department permit, whichever comes first. The expiration of local approvals under (b)1 above shall be governed by local ordinance. In the event there are multiple qualifying Department permits under (c) above, the expiration date is governed by that permit which expires last provided that the permit is still in effect. Once the exemption expires, the major development shall be subject to all requirements of this chapter upon reapplication for that permit and all subsequent permits or local approval(s) under the Municipal Land Use Law.

(e) An exemption under (b) above is limited to the land area and the scope of the project addressed by the qualifying approval(s) and permit(s). Exemptions under this section shall be deemed void if revisions are made to the qualifying approval or permit in (b) above, including approvals under the Municipal Land Use Law, unless upon application, the Department determines that each revision would have a de minimis impact on water resources. In making this determination, the Department shall consider the extent of any impacts on water resources resulting from the revision, including, but not limited to:

1. Increases in stormwater generated;
2. Increases in impervious surface;
3. Increases in stormwater pollutant loading;
4. Changes in land use;
5. New encroachments in special water resource protection areas; and
6. Changes in vegetative cover.

(f) In case of conflict with the Coastal Permit Program rules at N.J.A.C. 7:7-4.4(a)4, the requirements of this chapter shall supersede.

SUBCHAPTER 2. GENERAL REQUIREMENTS FOR STORMWATER MANAGEMENT PLANNING

7:8-2.1 Scope

This subchapter provides general principles applicable to all stormwater management plans and stormwater control ordinances, including the goals of stormwater management planning, the process for identification of stormwater management planning agencies, and stormwater management plan requirements.

7:8-2.2 Goals of stormwater management planning

(a) All stormwater management plans and stormwater control ordinances shall be designed to:

1. Reduce flood damage, including damage to life and property;
2. Minimize, to the extent practical, any increase in stormwater runoff from any new development;
3. Reduce soil erosion from any development or construction project;
4. Assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures;
5. Maintain groundwater recharge;
6. Prevent, to the greatest extent feasible, an increase in nonpoint pollution;
7. Maintain the integrity of stream channels for their biological functions, as well as for drainage;
8. Minimize pollutants in stormwater runoff from new and existing development in order to restore, enhance and maintain the chemical, physical, and biological integrity of the waters of the State, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial and other uses of water; and

9. Protect public safety through the proper design and operation of stormwater management basins.

7:8-2.3 Stormwater management planning agencies

(a) The following entities may be stormwater management planning agencies provided they are authorized under their enabling legislation to prepare stormwater management plans:

1. A municipality;
2. A county;
3. A county water resources agency or association;
4. A designated planning agency under N.J.A.C. 7:15;
5. A Soil Conservation District*, **in coordination with the State Soil Conservation Committee***;
6. The Delaware River Basin Commission;
7. The Pinelands Commission;
8. The Delaware and Raritan Canal Commission;
9. The New Jersey Meadowlands Commission;
10. The Department; or
11. Other regional, State or interstate agencies.

7:8-2.4 Stormwater management plan requirements

(a) A stormwater management plan shall include structural and nonstructural stormwater management strategies necessary to meet the stormwater management goals of this chapter.

(b) A regional stormwater management plan shall comply with the requirements of this subchapter and N.J.A.C. 7:8-3.

(c) A municipal stormwater management plan shall comply with the requirements of this subchapter and N.J.A.C. 7:8-4.

(d) A stormwater management plan shall incorporate the safety standards for stormwater management basins at N.J.A.C. 7:8-6.

(e) In developing a stormwater management plan and identifying appropriate stormwater management measures thereunder, each stormwater management planning agency shall consider the physical characteristics and ecological resources of the stormwater management planning area.

(f) A stormwater management plan and any stormwater management ordinance shall be coordinated with any other stormwater management plans related to the same river basin or drainage area.

7:8-2.5 Exemptions

A municipality or other entity conducting stormwater management planning under this chapter may petition the Department at the address provided at N.J.A.C. 7:8-1.3 for an exemption to the requirements of this chapter by submitting documentation to demonstrate that, if granted, the exemption will not result in an increase in flood damage, water pollution*, **including threats to the biological integrity,*** or constitute a threat to the public safety.

SUBCHAPTER 3. REGIONAL STORMWATER MANAGEMENT PLANNING

7:8-3.1 Scope

(a) This subchapter describes stormwater management planning and implementation at the regional level, including plan elements; planning process; characterization; development of drainage area-specific objectives and standards; selection of stormwater management measures; strategy for implementing the measures and evaluating the effectiveness of the regional stormwater management plan; plan review, adoption, amendment or revision; and implementation and periodic evaluation of the plan.

(b) A regional stormwater management plan shall address stormwater-related water quality, groundwater recharge and/or water quantity impacts of new and existing land uses in a regional stormwater management planning area. A regional stormwater management planning area shall consist of one or more ***continuous*** drainage areas. For example, a drainage area could be *[a]* ***an area defined by*** a hydrologic unit code 14 (HUC14) as defined by the United States Geological Survey.

7:8-3.2 Regional stormwater management planning committee and lead planning agency

(a) A regional stormwater management planning committee (the committee) shall be established for the purposes of creating a regional stormwater management plan.

(b) A person or entity seeking to establish a regional stormwater management committee shall solicit participation from municipalities, interstate agencies, regional agencies, counties, designated planning agencies under N.J.A.C. 7:15, Soil Conservation Districts, regional environmental commissions, ***Pinelands Commission, mosquito control and extermination commissions,*** public water supply and wastewater treatment utilities and agencies, lake associations, watershed associations, the watershed management planning area public advisory committee, environmental organizations, businesses, the Department and other appropriate State and Federal agencies and, members of the general public in the drainage area(s) to be addressed by the proposed plan. *The **solicitation for members of the general public to be part of the regional stormwater management planning committee can be performed through notices in local paper.***

(c) The regional stormwater management planning committee shall designate a lead planning agency, which shall be recognized as the primary contact for the committee. The regional stormwater management planning committee, through the lead planning agency, shall:

1. Prepare the regional stormwater management plan;
2. Coordinate the regional stormwater management planning process with any applicable watershed management area planning process;
3. Provide opportunities for public participation throughout the regional stormwater management planning process; and
4. Perform other activities appropriate to facilitate the regional stormwater management planning process, including mediation, public information, *[and]* providing technical assistance*,* and ***seeking and providing*** grants or other financial assistance*, **as available,*** to municipalities and/or local or regional agencies pursuant to N.J.S.A. 40:55D-99 or other applicable authority.

(d) A request for recognition as a regional stormwater management planning committee shall be submitted to the Department at the address listed in N.J.A.C. 7:8-1.3 by the lead planning agency, and include the following information:

1. A draft work plan and schedule for completing a regional stormwater management plan;
2. A copy of the mailing list used to solicit participation, including the entities identified in (b) above;
3. A copy of the letter of invitation to participate in the committee;
4. A copy of each response to the letter of invitation; and
5. In cases where no response from a public entity to the letter of invitation is received within 60 days, the group shall send a follow-up request by certified mail, return receipt requested, and submit proof of such follow-up.

(e) The Department shall respond in writing within 45 days of the receipt of a complete request for recognition as a regional stormwater management planning committee. The Department shall either approve the application, request additional information or deny the request for recognition. Denials will include a justification for the decision.

The Department shall base approval or denial on the information submitted in the draft work plan and schedule for plan completion, completion of the requirements to involve and notify impacted parties, and whether there are other competing or overlapping requests for recognition for the same regional stormwater management planning area.

7:8-3.3 Regional stormwater management plan and elements

(a) A regional stormwater management plan shall incorporate, at a minimum, the following elements:

1. Identification of the lead planning agency and a description of the structure and members of the committee;
2. A statement of authority to develop and implement a stormwater management plan from *[each]* public *[entity that is]* ***entities, as appropriate,*** represented on the regional stormwater management planning committee;
3. A characterization and assessment of the regional stormwater management planning area prepared in accordance with N.J.A.C. 7:8-3.4;

4. A statement of drainage area-specific water quality, groundwater recharge, and water quantity objectives established under N.J.A.C. 7:8-3.5;

5. The drainage area-specific stormwater-related water quality, groundwater recharge and water quantity design and performance standards established under N.J.A.C. 7:8-3.6;

6. The stormwater management measures selected in accordance with N.J.A.C. 7:8-3.7 and a summary of the rationale for the selection of each measure;

7. A description of the strategy for implementing the selected stormwater management measures for the regional stormwater management planning area and for evaluating the effectiveness of the regional stormwater management plan in accordance with N.J.A.C. 7:8-3.8, including a long-term monitoring program; and

8. To the extent elements of the plan do not represent the consensus of the committee, the plan shall identify and provide a discussion of the majority and minority positions.

(b) The regional stormwater management plan may also include:

1. Innovative stormwater measures and strategies such as nonpoint source pollutant trading, mitigation strategies, or special protection measures; and

2. A stream corridor protection plan to address protection of areas adjacent to waterbodies. For waterbodies subject to N.J.A.C. 7:8-5.5(h), the plan shall provide, at a minimum, protections equivalent to those provided at N.J.A.C. 7:8-5.5(h) and demonstrate that the functional value and overall condition of the special water resource protection area will be maintained or enhanced.

7:8-3.4 Characterization and assessment of the regional stormwater management planning area

(a) The regional stormwater management plan shall include a characterization and assessment that addresses the following components, unless the committee determines that a component is not appropriate for the regional stormwater management planning area and provides a rationale for not including the component:

1. Maps showing the following information. Maps developed on a Geographical Information System shall meet the Digital Data standards in N.J.A.C. 7:1D unless a rationale for a different format is provided.

i. The regional stormwater management planning area boundary;

ii. Existing land uses;

iii. Projected land uses assuming full development under existing zoning;

iv. Soil mapping units based on the detailed soil maps in County Soil Surveys published by the U.S. Department of Agriculture or, in areas for which County Soil Surveys are not available, on information obtained from Soil Conservation Districts;

v. Topography based on the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series, or other sources of information depicting topography in similar or greater detail;

vi. Water bodies based on detailed map sheets in County Soil Surveys published by the U.S. Department of Agriculture; the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series; or other sources of information depicting water bodies in similar or greater detail;

vii. Coastal wetlands based on maps prepared by the Department under the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq., and freshwater wetlands based on maps prepared by the Department under the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.;

viii. Flood hazard areas based on delineations made by the Department under the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq. For a water body for which the Department has not delineated the flood hazard area, a map of the flood hazard area prepared in accordance with N.J.A.C. 7:13 is acceptable;

ix. Groundwater recharge areas and well head protection areas based on maps prepared by the Department *[under N.J.S.A. 58:11A-13]* or ordinances of an affected municipality;

x. Environmentally constrained areas and environmentally critical areas;

xi. River areas designated under the New Jersey Wild and Scenic Rivers Act, N.J.S.A. 13:8-45 et seq., or the Federal Wild and Scenic Rivers Act, 16 U.S.C. §§1278 et seq.;

xii. For each waterbody in the regional stormwater management planning area, identification of the waterbody or waterbody segment, the drainage area, and the classification of the waterbody pursuant to N.J.A.C. 7:9B-1.15;

xiii. Each waterbody designated as a water quality limited surface water pursuant to N.J.A.C. 7:15-6;

xiv. Man-made stormwater conveyance, storage and discharge systems, including municipal separate storm sewer outfall pipes and the drainage areas as appropriate for these outfall structures; and

xv. *[Potable]* ***Source water areas of potable public*** surface water ***supply*** intakes and public water supply reservoirs ***available on the Department's webpage at www.nj.gov/dep/swap***;

2. A map showing jurisdictional boundaries within the regional stormwater management planning area of municipal, county, and other agencies with responsibility for implementing stormwater management;

3. Identification of the physical characteristics of the regional stormwater management planning area pertinent to stormwater management, such as slopes, swales and impoundment areas as necessary for completing the analysis in N.J.A.C. 7:8-3.4(a)4;

4. A water quality, groundwater recharge and water quantity hydrologic and hydraulic model or analysis of the regional stormwater management planning area which addresses existing land uses and projected land uses assuming full development under existing zoning and taking into account permanently preserved lands;

5. An identification and evaluation of existing municipal, county, State, Federal, and other stormwater-related groundwater recharge, water quality and water quantity regulations and programs shall be conducted, including, where applicable, programs to develop total maximum daily loads (TMDLs) in accordance with N.J.A.C. 7:15-7; and

6. A summary of information that has been identified as useful for purposes of stormwater management planning but that is not available for technical, financial, or other reasons.

(b) The Department encourages the use of existing information to the extent that it is available to minimize the cost of data acquisition, such as information available on the Department's Geographical Information System website (www.state.nj.us/dep/gis) or as developed through a watershed planning process.

(c) The characterization and assessment shall include information on locations and activities outside the regional stormwater management planning area that drain into the planning area (for example, stormwater originating in an adjacent drainage area that is transferred to the stormwater management planning area).

(d) Using the modeling or other information obtained under (a) through (c) above, the stormwater-related water quality impacts of existing land uses and projected land uses assuming full development under existing zoning shall be identified and ranked in accordance with the following process:

1. Inventory existing and potential stormwater-related pollutant sources and stormwater-related pollutants in the regional stormwater management planning area.

i. Stormwater-related pollutant sources include, for example, urban and suburban development, roads, storm sewers, agriculture, mining, and waterfront development.

ii. Stormwater-related pollutants include, for example, nutrients, pathogens, hydrocarbons, metals, pesticides, sediments, and suspended solids;

2. For surface water bodies and/or segments thereof and aquifers and/or portions thereof in the regional stormwater management planning area, identify and describe the existing or designated uses that are or may be adversely affected by stormwater-related pollutants, and to the extent feasible, identify the source(s) of the pollutant. The use of the report and list prepared by the Department to comply with Federal Clean Water Act, Section 303(d) and 305(b) (33 U.S.C. §§1313(d) and 1315(b)) and underlying data, including biological assessments, is encouraged; and

3. Identify and rank the most significant existing and potential stormwater-related pollutants and, for each pollutant, identify and rank the sources.

(e) Using the modeling or other information obtained under (a) through (c) above for stormwater-related water quantity impacts and stormwater-related groundwater recharge impacts of existing and

projected land uses assuming full development under existing zoning, the most significant existing and potential stormwater-related water quantity problems, including flooding, erosion, mosquitoes, base-flow reduction, groundwater depletion, and associated ecosystem impacts, shall be identified and described. The problems shall be ranked based on consideration of threat to public health, safety, and welfare as evidenced by history of or potential for flood damage; risk of loss of or damage to water supplies; and risk of damage to the biological integrity of water bodies.

7:8-3.5 Drainage area-specific water quality, groundwater recharge and water quantity objectives

(a) The regional stormwater management plan shall identify drainage area-specific water quality, groundwater recharge and water quantity objectives that are consistent with the goals of stormwater management planning at N.J.A.C. 7:8-2.3, and address each of the stormwater-related pollutant sources and pollutants ranked under N.J.A.C. 7:8-3.4(d) and the water quantity and groundwater recharge problems ranked under N.J.A.C. 7:8-3.4(e). The objectives shall address the elimination, reduction, or minimization of stormwater-related impacts associated with new and existing land uses. The objectives developed for the regional stormwater management plan may take into consideration environmental, social, and economic factors.

(b) Notwithstanding (a) above, the drainage area-specific objectives for major development shall provide, at a minimum, the protection that would be achieved through the application of N.J.A.C. 7:8-5, Design and Performance Standards for Stormwater Management Measures.

(c) If a TMDL has been established pursuant to N.J.A.C. 7:15 for a waterbody or waterbody segment in the regional stormwater management planning area, drainage area-specific objectives shall incorporate the loading reductions established in the TMDL for stormwater sources of pollution. In addition, if a waterbody or waterbody segment in the regional stormwater management planning area is on the Department's list prepared to comply with Federal Clean Water Act, Section 303(d) (33 U.S.C. §1313(d)) for one or more designated uses by stormwater runoff, then drainage area objectives shall be included that address the pollutants or pollution for which the waterbody is threatened or impaired.

7:8-3.6 Drainage area-specific design and performance standards

(a) The regional stormwater management plan shall identify drainage area-specific design and performance standards in order to meet the drainage area-specific water quality, groundwater recharge and water quantity objectives identified under N.J.A.C. 7:8-3.5.

(b) Drainage area-specific design and performance standards may include performance standards for control of stormwater quantity, erosion, groundwater recharge and stormwater quality, as well as design standards for particular structural and nonstructural stormwater management strategies.

(c) The design and performance standards for stormwater management measures for major development described in N.J.A.C. 7:8-5 shall be incorporated into the regional stormwater management plan. Alternative drainage area-specific design and performance standards may be developed provided the alternative standard is at least as protective as would be achieved under N.J.A.C. 7:8-5 when considered on a regional stormwater management planning area basis.

(d) For structural stormwater management measures, drainage area-specific design and performance standards shall conform to the general standards at N.J.A.C. 7:8-5.7.

(e) Drainage area-specific design and performance standards do not have to be uniform throughout a drainage area provided the drainage area, when considered in its entirety, satisfies N.J.A.C. 7:8-5.

7:8-3.7 Selection of stormwater management measures

(a) The regional stormwater management plan shall identify stormwater management measures necessary to achieve the drainage area-specific water quality, groundwater recharge and water quantity objectives developed in accordance with N.J.A.C. 7:8-3.5, and design and performance standards developed in accordance with N.J.A.C. 7:8-3.6.

(b) Stormwater management measures in the following categories shall be considered and selected, as appropriate:

1. Stormwater management measures for new land uses;

2. Stormwater management measures for existing land uses, including, for example, retrofit measures for the modification of existing structural stormwater management measures or other structures affecting stormwater runoff; elimination of illicit or illegal discharges; prevention or minimization of the exposure of pollutants to stormwater; and control of floatables;

3. Stormwater management measures that enhance, protect, and/or preserve land or water areas possessing characteristics or features that provide for flood control, maintenance or improvement of water quality, or conservation of natural resources (for example, land use controls, local and regional open space plans and taxes, buffer zones, redirecting, recharging or minimizing stormwater discharges, pretreatment and/or end-of-pipe treatment); and

4. Public education programs that address stormwater quantity and quality.

(c) A written rationale shall be provided for each selected stormwater management measure, including an analysis of feasibility, benefits and costs, estimated percent pollutant load reduction and anticipated performance longevity;

(d) Each selected stormwater management measure shall include, as appropriate, a program for preventative and corrective maintenance, including a long-term implementation schedule and identification of the entity responsible for implementation and maintenance.

7:8-3.8 Strategy for implementing and evaluating effectiveness of stormwater management measures

(a) The regional stormwater management plan shall include a strategy for implementing the stormwater management measures. The lead planning agency or another entity designated by the committee shall be responsible for coordination and tracking of the implementation of the regional stormwater management plan, including the long-term monitoring program.

(b) The implementation strategy shall:

1. Identify agencies and/or entities necessary to implement the measures and conduct the long-term monitoring program;

2. Identify the respective measures and/or monitoring each agency and/or entity will implement and the enabling mechanisms by which the measures will be implemented, including, for example, new or amended municipal ordinances or interagency agreements;

3. Establish a schedule for the implementation of the measures based on priority, including specific milestones for all mechanisms identified under (b)2 above;

4. Provide an estimate of short term and long term implementation costs to be incurred; and

5. Identify existing and potential private, local, State, and Federal funding sources to implement the regional stormwater management plan.

(c) The implementation strategy shall include a long-term monitoring program that will provide information about land use, water quality, water quantity, groundwater resources and riparian and aquatic habitat condition, as appropriate. Information for the monitoring program may include data obtained through watershed management, local, county, State, interstate, and/or Federal monitoring programs, including volunteer monitoring programs.

(d) The implementation strategy shall include a procedure for evaluating and then updating as necessary, at least every five years, the effectiveness of the implemented measures in achieving the objectives and design and performance standards established in the regional stormwater management plan.

7:8-3.9 Regional stormwater management plan review, adoption, and amendment and/or revision

(a) Upon completion of a regional stormwater management plan, the lead planning agency shall submit the plan to the Department and, if applicable, to the designated water quality management planning agency as an amendment to the areawide water quality management plan(s) in accordance with the Water Quality Management Planning Rules at N.J.A.C. 7:15.

(b) In reviewing a regional stormwater management plan submitted under (a) above, the Department shall determine whether the plan conforms to the requirements of this chapter. The Department will

disapprove, return for additional information or proceed with a proposed amendment in accordance with N.J.A.C. 7:15-3.4(g).

(c) Modifications to an adopted regional stormwater management plan shall be processed as an amendment or revision in accordance with N.J.A.C. 7:15-3.4(b)5 or 3.5(b)5, as applicable.

7:8-3.10 Implementation of adopted regional stormwater management plan

(a) Once the regional stormwater management plan has been adopted pursuant to N.J.A.C. 7:8-3.9, implementation responsibilities are as follows:

1. The Department will use the adopted regional stormwater management plan as the basis for reviewing the stormwater management aspects of projects or activities regulated pursuant to Coastal Permit Program rules, N.J.A.C. 7:7; the Freshwater Wetland Protection Act rules, N.J.A.C. 7:7A; the Coastal Zone Management rules, N.J.A.C. 7:7E; the Flood Hazard Area Control Act rules, N.J.A.C. 7:13; the New Jersey Pollutant Discharge Elimination System rules, N.J.A.C. 7:14A; and the Dam Safety Standards, N.J.A.C. 7:20. The requirements of this chapter are considered to be the minimum stormwater standards. Additional requirements may be imposed as necessary under the respective programs.

2. Each municipality in the regional stormwater management planning area shall incorporate the applicable provisions of the regional stormwater management plan into a new or amended municipal stormwater management plan and ordinances.

3. In accordance with the Residential Site Improvement Standards at N.J.A.C. 5:21-7, if a stormwater management plan for the region has been approved by the Department, stormwater management systems must conform with that plan.

4. The Department shall not issue a permit for a project or activity that conflicts with an Areawide Water Quality Management Plan pursuant to N.J.A.C. 7:15-3.1.

SUBCHAPTER 4. MUNICIPAL STORMWATER MANAGEMENT PLANNING

7:8-4.1 Scope

This subchapter describes stormwater management planning and implementation at the municipal level, including plan elements, county review and technical assistance, the schedule for adoption of the plan and ordinances, and variance or exemption from design and performance standards for stormwater management measures.

7:8-4.2 Municipal stormwater management plan and elements

(a) A municipal stormwater management plan shall address stormwater-related water quality, groundwater recharge and water quantity impacts of major development, and may also address stormwater-related water quality, water quantity and groundwater recharge impacts of existing land uses. For purposes of this subchapter, major development is limited to projects that ultimately disturb one or more acres of land.

(b) A municipal stormwater management plan and stormwater control ordinance(s) shall conform with applicable regional stormwater management plan(s).

(c) A municipal stormwater management plan shall, at a minimum:

1. Describe how the municipal stormwater management plan will achieve the goals of stormwater management planning set forth at N.J.A.C. 7:8-2.3;

2. Include maps showing water bodies based on Soil Surveys published by the U.S. Department of Agriculture; the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series; or other sources of information depicting water bodies in similar or greater detail;

3. Map groundwater recharge areas and well head protection areas based on maps prepared by the Department under N.J.S.A. 58:11A-13 or a municipal ordinance;

4. Describe how the municipal stormwater management plan incorporates design and performance standards in N.J.A.C. 7:8-5 or alternative design and performance standards adopted as a part of a regional stormwater management plan or water quality management plan;

5. Describe how adequate long-term operation as well as preventative and corrective maintenance (including replacement) of the selected stormwater management measures will be ensured;

6. Describe how the plan will ensure compliance with Safety Standards for Stormwater Management Basins at N.J.A.C. 7:8-6;

7. Describe how the municipal stormwater management plan is coordinated with the appropriate Soil Conservation District and any other stormwater management plans, including any adopted regional stormwater management plan, prepared by any stormwater management planning agency related to the river basins or drainage areas to which the plans and/or ordinances apply;

8. Evaluate the extent to which the municipality's entire master plan (including the land use plan element), official map and development regulations (including the zoning ordinance) implement the *[principals]* ***principles*** expressed in N.J.A.C. 7:8-5.3(b). This evaluation shall also be included (with updating as appropriate) in the reexamination report adopted under N.J.S.A. 40:55D-89;

9. Include a map of the municipality showing:

i. Projected land uses assuming full development under existing zoning; and

ii. The hydrologic unit code 14 (HUC 14) drainage areas as defined by the United States Geological Survey; and an estimate, for each HUC 14 drainage area, of the total acreage in the municipality of impervious surface and associated future nonpoint source pollutant load assuming full build out of the projected land uses.

10. At the option of the municipality, document that it has a combined total of less than one square mile of vacant or agricultural lands rather than provide the information required in (c)8 and 9 above. Agricultural lands may be excluded if the development rights to these lands have been permanently purchased or restricted by covenant, easement or deed. Vacant or agricultural lands in environmentally constrained areas may be excluded if the documentation also includes an overlay map of these areas at the same scale as the map under (c)10i below.

i. Documentation shall include an existing land use map at an appropriate scale to display the land uses of each parcel within the municipality. Such a map shall display the following land uses: residential (which may be divided into single family, two-to-four family, and other multi-family), commercial, industrial, agricultural, parkland, other public uses, semipublic uses, and vacant land;

11. In order to grant a variance or exemption from the design and performance standards in N.J.A.C. 7:8-5, include a mitigation plan that identifies what measures are necessary to offset the deficit created by granting the variance or exemption. The mitigation plan shall ensure that mitigation is completed within the drainage area and for the performance standard for which the variance or exemption was granted; *[and]*

12. Include a copy of the recommended implementing stormwater control ordinance(s) requiring stormwater management measures*[.]**; **and***

13. The municipal stormwater management plan may also include a stream corridor protection plan to address protection of areas adjacent to waterbodies. For waterbodies subject to N.J.A.C. 7:8-5.5(h), the plan shall provide, at a minimum, protections equivalent to those provided at N.J.A.C. 7:8-5.5(h) and be approved by the Department.*

7:8-4.3 Schedule for adoption of municipal stormwater management plan and ordinances

(a) A municipality shall adopt a municipal stormwater management plan as an integral part of its master plan and official map in accordance with the schedule in (a)1 or 2 below, whichever is sooner. The requirements in N.J.A.C. 7:8-4.2(c)8 and 9 are not operative until *[(the date 24 months from the effective date of this subchapter)]* ***February 2, 2006****.

1. By the deadline established in a New Jersey Pollutant Discharge Elimination System permit obtained by the municipality for a municipal separate storm sewer system under N.J.A.C. 7:14A; or

2. By the next reexamination of the master plan under N.J.S.A. 40:55D-89, if a grant for 90 percent of the costs for the preparation of the municipal stormwater management plan has been made available to a municipality by the Department;

(b) Within one year after the municipality adopts the municipal stormwater management plan, the municipality shall adopt stormwater control ordinance(s) to implement the adopted plan and shall submit the adopted municipal stormwater management plan and ordinance(s) to the county review agency for approval. The adopted municipal stormwater management plan and ordinance(s) shall not take effect without approval by the county review agency.

(c) The municipality shall amend the municipal stormwater management plan and stormwater control ordinance(s) as necessary and submit the amended plan and amended ordinance(s) to the county review agency for approval.

(d) The municipality shall reexamine the municipal stormwater management plan at each reexamination of the municipality's master plan in accordance with N.J.S.A. 40:55D-89.

(e) Within one year of the adoption of a regional stormwater management plan as an amendment to the Areawide Water Quality Management Plan, or an amendment thereto, each municipality within the regional stormwater management planning area shall amend their respective municipal stormwater management plans and stormwater control ordinance(s) to implement the regional stormwater management plan.

7:8-4.4 County review process

(a) A municipality shall submit a copy of the adopted stormwater management plan and stormwater control ordinance(s) to the county review agency and the Department.

(b) In reviewing the adopted municipal stormwater management plan and ordinance(s), the county review agency shall consider whether the plan and ordinance(s) conform with the requirements of this chapter.

(c) In accordance with N.J.S.A. 40:55D-97, it is the county review agency's responsibility to review and approve, conditionally approve (specifying the necessary amendments to the plan and ordinance(s)) or disapprove the adopted municipal stormwater management plan and ordinance(s) within 60 calendar days of receipt of the plan and ordinance(s). If the county review agency does not approve, conditionally approve, or disapprove the plan or ordinance(s) within 60 calendar days, the plan and ordinance(s) shall be deemed approved. The county review agency shall issue a written decision to the municipality, with a copy to the Department.

(d) A municipal stormwater management plan and ordinance(s) approved under (c) above shall take effect immediately. A municipal stormwater management plan and ordinance(s) conditionally approved under (c) above shall take effect upon adoption by the municipality of the amendments specified by the county review agency.

(e) Within 30 days of the effective date of the municipal stormwater management plan and ordinance(s) under (d) above, the municipality shall place the plan and ordinance(s) on its website and notify the Department, the Soil Conservation District and State Soil Conservation Committee, or:

1. Submit a copy of the approved municipal stormwater management plan and ordinance(s) to the Department; and

2. Provide notice of such approval to the Soil Conservation District and the State Soil Conservation Committee and, upon request, submit a copy of the approved plan and ordinance(s).

7:8-4.5 Reservation of rights

The Department reserves the right to review stormwater management plans and ordinances for compliance with this subchapter and make recommendations to correct any deficiencies.

7:8-4.6 Variance or exemption from the design and performance standards for stormwater management measures

A municipality may grant a variance or exemption from the design and performance standards for stormwater management measures set forth in its approved municipal stormwater management plan and stormwater control ordinance(s), provided the municipal plan includes a mitigation plan in accordance with N.J.A.C. 7:8-4.2(c)11 and the municipality submits a written report to the county review agency and the Department describing the variance or exemption and the required mitigation.

SUBCHAPTER 5. DESIGN AND PERFORMANCE STANDARDS FOR STORMWATER MANAGEMENT MEASURES

7:8-5.1 Scope

(a) This subchapter establishes design and performance standards for stormwater management measures for(a) major development intended to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies.

(b) The standards specified in this subchapter do not apply to major development if alternative design and performance standards that are at least as protective as would be achieved through this subchapter when considered on a regional stormwater management area basis are applicable under a regional stormwater management plan *[or]* adopted in accordance with this chapter or a water quality management plan adopted in accordance with N.J.A.C. 7:15.

7:8-5.2 Stormwater management measures for major development

(a) Stormwater management measures for major development shall be developed to meet the erosion control, groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards at N.J.A.C. 7:8-5.4 and 5.5. To the maximum extent practicable, these standards shall be met by incorporating nonstructural stormwater management strategies at N.J.A.C. 7:8-5.3 into the design. If these measures alone are not sufficient to meet these standards, structural stormwater management measures at N.J.A.C. 7:8-5.7 necessary to meet these standards shall be incorporated into the design.

(b) The development shall incorporate a maintenance plan under N.J.A.C. 7:8-5.8 for the stormwater management measures.

(c) Stormwater management measures shall avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the ***Department's Landscape Project or*** Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly *Helonias bullata* (swamp pink) and/or *Clemmys muhlnebergi* (bog turtle).

(d) The following linear development projects are exempt from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements at N.J.A.C. 7:8-5.4 and 5.5:

1. The construction of an underground utility line provided that the disturbed areas are revegetated upon completion;

2. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable; and

3. The construction of a public pedestrian access, such as a sidewalk or trail with a maximum width of *[10]* *14* feet, provided that the access is made of permeable material.

(e) A waiver from strict compliance from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements at N.J.A.C. 7:8-5.4 and 5.5 may be obtained for the enlargement of an existing public roadway or railroad, or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

1. The applicant demonstrates that there is a public need for the project that cannot be accomplished by any other means;

2. The applicant demonstrates through an alternatives analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of N.J.A.C. 7:8-5.4 and 5.5 to the maximum extent practicable;

3. The applicant demonstrates that, in order to meet the requirements at N.J.A.C. 7:8-5.4 and 5.5 existing structures currently in use, such as homes and buildings would need to be condemned; and

4. The applicant demonstrates that it does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under (e)3 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate for requirements of N.J.A.C. 7:8-5.4 and 5.5 that were not achievable on-site.

7:8-5.3 Nonstructural stormwater management strategies

(a) ***To the maximum extent practicable, the standards in N.J.A.C. 7:8-5.4 and 5.5 shall be met by incorporating nonstructural stormwater management strategies at N.J.A.C. 7:8-5.3 into the design.*** The person submitting an application for review shall identify the nonstructural strategies incorporated into the design of the project. If the applicant contends that it is not feasible for engineering, environmental, or safety reasons to incorporate any nonstructural stormwater management strategies identified in (b) below into the design of a particular project, the applicant shall identify the *[measure]* ***strategy*** and provide a basis for the contention.

(b) Nonstructural stormwater management strategies incorporated into site design shall:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;

2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;

3. Maximize the protection of natural drainage features and vegetation;

4. Minimize the decrease in the *[pre-construction]* "time of concentration" ***from pre-construction to post-construction***. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed;

5. Minimize land disturbance including clearing and grading;

6. Minimize soil compaction;

7. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;

8. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas; and

9. Provide other *[preventative]* source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff. These source controls include, but are not limited to:

i. Site design features that help to prevent accumulation of trash and debris in drainage systems;

ii. Site design features that help to prevent discharge of trash and debris from drainage systems;

iii. Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

iv. When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules.

(c) Any land area used as a non-structural stormwater management measure to meet the performance standards in N.J.A.C. 7:8-5.4 and 5.5 shall be dedicated to a government agency, subjected to a conservation restriction filed with the appropriate County Clerk's office, or subject to Department approved or equivalent restriction that ensures *[the maintenance of]* that measure ***or an equivalent stormwater management measure approved by the reviewing agency is maintained*** in perpetuity.

(d) Guidance for nonstructural stormwater management strategies is available in the New Jersey Stormwater Best Management Practices Manual available from the Department through the address listed at N.J.A.C. 7:8-1.3.

7:8-5.4 Erosion control, groundwater recharge and runoff quantity standards

(a) This section contains minimum design and performance standards to control erosion, encourage and control infiltration and groundwater recharge, and control stormwater runoff quantity impacts of major development.

1. The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

2. The minimum design and performance standards for groundwater recharge are as follows:

i. The design engineer shall, using the assumptions and factors for stormwater runoff ***and groundwater recharge*** calculations at N.J.A.C. 7:8-5.6, either:

(1) Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site; or

(2) Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the two-year storm is infiltrated.

ii. This groundwater recharge requirement does not apply to projects *[that qualify as]* ***within the*** "urban redevelopment*[.]*****area,***" ***or to projects subject to (a)2iii below.***

iii. The following types of stormwater shall not be recharged:

(1) Stormwater from areas of high pollutant loading. High pollutant loading areas are areas in industrial and commercial developments where solvents and/or petroleum products are loaded/unloaded, stored, or applied, areas where pesticides are loaded/unloaded or stored; areas where hazardous materials are expected to be present in greater than 'reportable quantities' as defined by the United States Environmental Protection Agency (EPA) at 40 CFR 302.4; areas where recharge would be inconsistent with Department approved remedial action work plan or landfill closure plan; and areas with high risks for spills of toxic materials, such as gas stations and vehicle maintenance facilities; and

(2) Industrial stormwater exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to, raw materials; intermediate products; final products; waste materials; by-products; industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

iv. The design engineer shall assess the hydraulic impact on the groundwater table and design the site so as to avoid adverse hydraulic impacts. Potential adverse hydraulic impacts include, but are not limited to, exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, or interference with the proper operation of subsurface sewage disposal systems and other subsurface structures in the vicinity or downgradient of the groundwater recharge area.

3. In order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at N.J.A.C. 7:8-5.6, complete one of the following:

i. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the two, 10 and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;

ii. Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the two, 10 and 100-year storm events and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area; *[or]*

iii. Design stormwater management measures so that the post-construction peak runoff rates for the two, 10 and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed*[. The percentages shall not be applied to post-construction stormwater runoff into tidal flood hazard areas if the increased volume of stormwater runoff will not increase flood damages below the point of discharge]*; ***or***

iv. In tidal flood hazard areas, stormwater runoff quantity analysis in accordance with (a)3i, ii and iii above shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of discharge.

(b) Any application for a new agricultural development that meets the definition of major development at N.J.A.C. 7:8-1.2 shall be submitted to the Soil Conservation District for review and approval in accordance with the requirements of this section and any applicable Soil Conservation District guidelines for stormwater runoff quantity and erosion control. ***For purposes of this section, "agricultural development" means land uses normally associated with the production of food, fiber and livestock for sale. Such uses do not include the development of land for the processing or sale of food and the manufacture of agriculturally related products.***

7:8-5.5 Stormwater runoff quality standards

(a) Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from the developed site, expressed as an annual average. Stormwater management measures shall only be required for water quality control if an additional one-quarter acre of impervious surface is being proposed on a development site. ***The requirement to reduce TSS does not apply to any stormwater runoff in a discharge regulated under a numeric effluent limitation for TSS imposed under the New Jersey Pollutant Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A, or in a discharge specifically exempt under a NJPDES permit from this requirement.*** The water quality design storm is 1.25 inches of rainfall in two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm, as reflected in Table 1 below. The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures.

Table 1: Water Quality Design Storm Distribution

Time (Minutes)	Cumulative Rainfall (Inches)	Time (Minutes)	Cumulative Rainfall (Inches)
0	0.0000	65	0.8917
5	0.0083	70	0.9917
10	0.0166	75	1.0500
15	0.0250	80	1.0840
20	0.0500	85	1.1170
25	0.0750	90	1.1500
30	0.1000	95	1.1750
35	0.1330	100	1.2000
40	0.1660	105	1.2250
45	0.2000	110	1.2334
50	0.2583	115	1.2417
55	0.3583	120	1.2500
60	0.6250		

(b) For purposes of TSS reduction calculations, Table 2 below presents the presumed removal rates for certain BMPs designed in accordance with the New Jersey Stormwater Best Management Practices Manual*[, which]**. ***The BMP Manual** may be obtained from the address identified in N.J.A.C. 7:8-1.3 *or found on the Department's website at www.njstormwater.org. The BMP Manual and other sources of technical guidance are listed in N.J.A.C. 7:8-5.9(a)**. TSS reduction shall be calculated based on the removal rates for the BMPs in Table 2 below. Alternative removal rates and methods of calculating removal rates may be used if the design engineer provides documentation demonstrating the capability of these alternative rates and methods to the review agency. Where the Department is not the review agency, a copy of any approved alternative rate or method of calculating the removal rate shall be provided to the Department at the address at N.J.A.C. 7:8-1.3.

(c) If more than one BMP in series is necessary to achieve the required 80 percent TSS reduction for a site, the applicant shall utilize the following formula to calculate TSS reduction:

$R = A + B - (AXB)/100$

Where

R = total TSS *percent* load removal from application of both BMPs, and

A = the TSS *percent* removal rate applicable to the first BMP

B = the TSS *percent* removal rate applicable to the second BMP

Table 2: TSS Removal Rates for BMPs

Best Management Practice	TSS Percent Removal Rate
Bioretention Systems	90
Constructed Stormwater Wetland	90
*[Forested Buffers	70]*
Extended Detention Basin	40-60
Infiltration Structure	80
Manufactured Treatment Device	See N.J.A.C. 7:8-*[5.7(c)]**5.7(d)*
Sand Filter	80
Vegetative Filter Strip	*[50]**60-80*
Wet Pond	*[60]**50*-90

(d) If there is more than one onsite drainage area, the 80 percent TSS removal rate shall apply to each drainage area, unless the runoff from the subareas converge on site in which case the removal rate can be demonstrated through a calculation using a weighted average.

(e) Stormwater management measures shall also be designed to reduce, to the maximum extent feasible, the post-construction nutrient load of the anticipated load from the developed site in stormwater runoff generated from the water quality design storm. In achieving reduction of nutrients to the maximum extent feasible, the design of the site shall include nonstructural strategies and structural measures that optimize nutrient removal while still achieving the performance standards in N.J.A.C. 7:8-5.4 and 5.5.

(f) Additional information and examples are contained in the New Jersey Stormwater Best Management Practices Manual, which may be obtained from the address identified in N.J.A.C. 7:8-1.3.

(g) In accordance with the definition of FW1 at N.J.A.C. 7:9B-1.4, stormwater management measures shall be designed to prevent any increase in stormwater runoff to waters classified as FW1.

(h) Special water resource protection areas shall be established along all waters designated Category One at N.J.A.C. 7:9B and perennial or intermittent streams that drain into or upstream of the Category One waters as shown on the USGS Quadrangle Maps or in the County Soil Surveys, within the associated HUC 14 drainage. These areas shall be established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries significance of those established Category One waters. These areas shall be designated and protected as follows:

1. The applicant shall preserve and maintain a special water resource protection area in accordance with one of the following:

i. A 300-foot special water resource protection area ***shall be provided on each side of the waterway***, measured perpendicular to the waterway from the top of bank outwards or from the centerline of the waterway where the bank is not defined, consisting of existing vegetation or vegetation allowed to follow natural succession is provided.

ii. Encroachment within the designated special water resource protection area under (h)1i above shall only be allowed where previous development or disturbance has occurred (for example, active agricultural use, parking area or maintained lawn area). The encroachment shall only be allowed where applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable. In no case shall the remaining special water resource protection area be reduced to less than 150 feet as measured perpendicular to the ***top of bank of the*** waterway ***or centerline of the waterway where the bank is undefined***. All encroachments proposed under this subparagraph shall be subject to review and approval by the Department.

2. All stormwater shall be discharged outside of but may flow through the special water resource protection area and shall comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. (see N.J.A.C. 2:90-1.3).

3. If stormwater discharged outside of and flowing through the special water resource protection area cannot comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., (see N.J.A.C. 2:90-1.3), then the

stabilization measures in accordance with the requirements of the above standards may be placed within the special water resource protection area, provided that:

i. Stabilization measures shall not be placed within 150 feet of the waterway;

ii. Stormwater associated with discharges allowed by this paragraph shall achieve a 95 percent TSS post construction removal rate;

iii. Temperature shall be addressed to ensure no impact on receiving waterway;

iv. The encroachment shall only be allowed where the applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable;

v. A conceptual project design meeting shall be held with the appropriate Department staff and Soil Conservation District staff to identify necessary stabilization measures; and

vi. All encroachments proposed under this section shall be subject to review and approval by the Department.

4. A stream corridor protection plan may be developed by a regional stormwater management planning committee as an element of a regional stormwater management plan*, **or by a municipality through an adopted municipal stormwater management plan***. If a stream corridor protection plan for a waterway subject to this subsection has been approved by the Department, then the provisions of the plan shall be the applicable special water resource protection area requirements for that waterway. A stream corridor protection plan for a waterway subject to this subsection shall maintain or enhance the current functional value and overall condition of the special water resource protection area as defined above in (h)1i. In no case shall a stream corridor protection plan allow reduction of the Special Water Resource Protection Area to less than 150 feet as measured perpendicular to the waterway subject to this subsection.

5. This subsection does not apply to the construction of one individual single family dwelling that is not part of a larger development on a lot receiving preliminary or final subdivision approval on or before *[(effective date of the rule)]* ***February 2, 2004***, provided that the construction begins on or before *[(five years from effective date of the rule)]* ***February 2, 2009***.

7:8-5.6 Calculation of stormwater runoff ***and groundwater recharge***

(a) Stormwater runoff shall be calculated in accordance with the following:

1. The design engineer shall calculate runoff using one of the following methods:

i. The USDA Natural Resources Conservation Service (NRCS) methodology, including the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in Section 4, National Engineering Handbook (NEH-4), dated July 2002, incorporated herein by reference as amended and supplemented. This methodology is additionally described in Technical Release 55—Urban Hydrology for Small Watersheds (TR-55), dated June 1986, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the Natural Resources Conservation Service website at http://www.wcc.nrcs.usda.gov/water/quality/common/neh630/4content.html or at Natural Resources Conservation Service, 220 Davison Avenue, Somerset, New Jersey 08873; (732) 537-6040; or

ii. The Rational Method for peak flow and the Modified Rational Method for hydrograph computations. The rational and modified rational methods are described in "Appendix A-9 Modified Rational Method" in the Standards for Soil Erosion and Sediment Control in New Jersey, July 1999. This document is available from the State Soil Conservation Committee or any of the Soil Conservation Districts listed at N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number or each Soil Conservation District is available from the State Soil Conservation Committee, P.O. Box 330, Trenton, NJ 08625, 609-292-5540.

2. For the purpose of calculating runoff coefficients ***and groundwater recharge***, there is a presumption that the pre-construction condition of a site or portion thereof is a wooded land use with good hydrologic condition. ***The term "runoff coefficient" applies to both the NRCS methodology at N.J.A.C. 7:8-5.6(a)1i and the Rational and Modified Rational Methods at N.J.A.C. 7:8-5.6(a)1i.*** A runoff coefficient ***or a groundwater recharge land cover*** for an existing condition may be used on all or a portion of the site if the design engineer verifies that the hydrologic condition has existed on the site or portion of the site for at least five years without interruption prior to the time of *[calculation]* ***application. If more than one land cover has existed on the site during the five years immediately prior to the time of application, the land cover with the lowest runoff potential shall be used for the computations***. In addition, there is the presumption that the site is in good hydrologic condition (if the land use type is pasture, lawn, or park), with good cover (if the land use type is woods), or with good ***hydrologic*** condition and conservation treatment (if the land use type is cultivation).

3. In computing pre-construction stormwater runoff, the design engineer shall account for all significant land features and structures, such as ponds, wetlands, depressions, hedgerows, or culverts, that may reduce pre-construction stormwater runoff rates and volumes.

4. In computing stormwater runoff from *[a]* ***all*** design storm***s***, the design engineer shall consider the relative stormwater runoff rates and/or volumes of pervious and impervious surfaces separately to accurately compute the rates and volume of stormwater runoff from the site. To calculate *[the water quality storm]* ***runoff from unconnected impervious cover***, urban impervious area modifications as described in the NRCS Technical Release-55, Urban Hydrology for Small Watersheds ***or other methods*** may be employed.

5. If the invert of the outlet structure of a stormwater management measure is below the flood hazard design flood elevation as defined at N.J.A.C. 7:13, the design engineer shall take into account the effects of tailwater in the design of structural stormwater management measures.

(b) Groundwater recharge may be calculated in accordance with the following:

1. The New Jersey Geological Survey Report GSR-32 A Method for Evaluating Groundwater-Recharge Areas in New Jersey, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the New Jersey Stormwater Best Management Practices Manual; at the New Jersey Geological Survey website at http://www.state.nj.us/dep/njgs/; or at New Jersey Geological Survey, 29 Arctic Parkway, PO Box 427, Trenton, NJ 08625-0427; (609) 984-6587.

7:8-5.7 Standards for structural stormwater management measures

(a) Standards for structural stormwater management measures are as follows:

1. Structural stormwater management measures shall be designed to take into account the existing site conditions, including, for example, ***environmentally critical areas;*** wetlands; flood-prone areas; slopes; depth to seasonal high water table; soil type, permeability and texture; drainage area and drainage patterns; and the presence of solution-prone carbonate rocks (limestone).

2. Structural stormwater management measures shall be designed to minimize maintenance, facilitate maintenance and repairs, and ensure proper functioning. Trash racks shall be installed at the intake to the outlet structure as appropriate, and shall have parallel bars with one-inch spacing between the bars to the elevation of the water quality design storm. For elevations higher than the water quality design storm, the parallel bars at the outlet structure shall be spaced no greater than one-third the width of the diameter of the orifice or one-third the width of the weir*, **with a minimum spacing between bars of one inch and a maximum spacing between bars of six inches***. In addition, the design of trash racks must comply with the requirements of N.J.A.C. 7:8-6.2(a).

3. Structural stormwater management measures shall be designed, constructed, and installed to be strong, durable, and corrosion resistant. Measures that are consistent with the relevant portions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.3, 7.4 and 7.5 shall be deemed to meet this requirement.

4. At the intake to the outlet from the stormwater management basin, the orifice size shall be a minimum of two and one-half inches in diameter.

5. Stormwater management basins shall be designed to meet the minimum safety standards for stormwater management basins at N.J.A.C. 7:8-6.

*[(c)]**(b)* Stormwater management measure guidelines are available in the New Jersey Stormwater Best Management Practices Manual. Other stormwater management measures may be utilized provided the design engineer demonstrates that the proposed measure and its design will accomplish the required water quantity, groundwater recharge and water quality design and performance standards established by this subchapter.

*[(d)]**(c)* Manufactured treatment devices may be used to meet the requirements of this subchapter, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology and certified by the Department.

7:8-5.8 Maintenance requirements

(a) The design engineer shall prepare a maintenance plan for the stormwater management measures incorporated into the design of a major development.

(b) The maintenance plan shall contain specific preventative maintenance tasks and schedules; cost estimates, including estimated cost of sediment, debris, or trash removal; and the name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement). Maintenance guidelines for stormwater management measures are available in the New Jersey Stormwater Best Management Practices Manual. If the maintenance plan identifies a person other than the developer (for example, a public agency or homeowners' association) as having the responsibility for maintenance, the plan shall include documentation of such person's agreement to assume this responsibility, or of the developer's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

(c) Responsibility for maintenance shall not be assigned or transferred to the owner or tenant of an individual property in a residential development or project, unless such owner or tenant owns or leases the entire residential development or project.

(d) If the person responsible for maintenance identified under (b) above is not a public agency, the maintenance plan and any future revisions based on (h) below shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

(e) Preventative and corrective maintenance shall be performed *[as needed]* ***to maintain the function of the stormwater management measure***, including repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of nonvegetated linings.

(f) The person responsible for maintenance identified under (b) above shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

(g) The person responsible for maintenance identified under (b) above shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed.

(h) The person responsible for maintenance identified under (b) above shall retain and make available, upon request by *[a]* ***any*** public entity ***with administrative, health, environmental or safety authority over the site***, the maintenance plan and the documentation required by *[(g)]**(f)* and *[(h)]**(g)* above.

(i) Nothing in this section shall preclude the municipality in which the major development is located from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

7:8-5.9 Sources for technical guidance

(a) Technical guidance for stormwater management measures can be found in the documents listed at (a)1 and 2 below, which are available from Maps and Publications, Department of Environmental Protection, 428 East State Street, PO Box 420, Trenton, New Jersey, 08625; telephone (609) 777-1038.

1. Guidelines for stormwater management measures are contained in the New Jersey Stormwater Best Management Practices Manual, 2002 as amended. Information is provided on stormwater management measures such as:

i. Bioretention systems;
ii. Constructed stormwater wetlands;
iii. Dry wells;
[iv. Forested buffers;]
*[v.]**iv.* Extended detention basins;
*[vi.]**v.* Infiltration structures;
*[vii.]**vi.* Manufactured treatment devices;
*[viii.]**vii.* Pervious paving;
*[ix.]**viii.* Sand filters;
*[x.]**ix.* Vegetative filter *[strip]*; and
*[xi.]**x.* Wet pond.

2. The New Jersey Department of Environmental Protection Stormwater Management Facilities Maintenance Manual, as amended.

(b) Additional technical guidance for stormwater management measures can be obtained from the following:

1. The "Standards for Soil Erosion and Sediment Control in New Jersey" promulgated by the State Soil Conservation Committee and incorporated into N.J.A.C. 2:90. Copies of these standards may be obtained by contacting the State Soil Conservation Committee or any of the Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, PO Box 330, Trenton, New Jersey 08625, 609-292-5540;

2. The Rutgers Cooperative Extension Service, 732-932-9306; and

3. The Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, PO Box 330, Trenton, New Jersey 08625, 609-292-5540.

SUBCHAPTER 6. SAFETY STANDARDS FOR STORMWATER MANAGEMENT BASINS

7:8-6.1 Scope

(a) This subchapter sets forth requirements to protect public safety through the proper design and operation of stormwater management basins. This subchapter applies to any new stormwater management basin.

(b) The provisions of this subchapter are not intended to preempt ***more stringent*** municipal or county safety requirements for new or existing stormwater management basins. Municipal and county stormwater management plans and ordinances may, pursuant to their authority, require existing stormwater management basins to be retrofitted to meet one or more of the safety standards in N.J.A.C. 7:8-*[6.3(a)2]**6.2(a)2*, (b) and (c)1 for trash racks, overflow grates, and escape provisions at outlet structures.

7:8-6.2 Requirements for trash racks, overflow grates and escape provisions

(a) A trash rack is a device designed to catch trash and debris and prevent the clogging of outlet structures. Trash racks shall be installed at the intake to the outlet from the stormwater management basin to ensure proper functioning of the basin outlets in accordance with the following:

1. The trash rack shall have parallel bars, with no greater than six-inch spacing between the bars;

2. The trash rack shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure;

3. The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack; and

4. The trash rack shall be constructed of rigid, durable, and corrosion resistant material and designed to withstand a perpendicular live loading of 300 lbs./ft sq.

(b) An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, the grate shall comply with the following requirements:

1. The overflow grate shall be secured to the outlet structure but removable for emergencies and maintenance;

2. The overflow grate spacing shall be no greater than two inches across the smallest dimension; and

3. The overflow grate shall be constructed of rigid, durable, and corrosion resistant material and designed to withstand a perpendicular live loading of 300 lbs./ft sq.

(c) Stormwater management basins shall include escape provisions as follows:

1. If a stormwater management basin has an outlet structure, escape provisions shall be incorporated in or on the structure. Escape provisions include the installation of permanent ladders, steps, rungs, or other features that provide easily accessible means of egress from stormwater management basins. With the prior approval of the reviewing agency pursuant to N.J.A.C. 7:8-*[6.4(a)]* *6.3*, a free-standing outlet structure may be exempted from this requirement;

2. Safety ledges shall be constructed on the slopes of all new stormwater management basins having a permanent pool of water deeper than two and one-half feet. Safety ledges shall be comprised of two steps. Each step shall be four to six feet in width. One step shall be located approximately two and one-half feet below the permanent water surface, and the second step shall be located one to one and one-half feet above the permanent water surface. See N.J.A.C. 7:8-6 Appendix A for an illustration of safety ledges in a stormwater management basin; and

3. In new stormwater management basins, the maximum interior slope for an earthen dam, embankment, or berm shall not be steeper than three horizontal to one vertical.

7:8-*[6.4]* *6.3* Variance or exemption from safety standards

A variance or exemption from the safety standards for stormwater management basins may be granted only upon a written finding by the appropriate reviewing agency (municipality, county or Department) that the variance or exemption will not constitute a threat to public safety.

CHAPTER 13
FLOOD HAZARD AREA CONTROL

SUBCHAPTER 2. PROJECT STANDARDS

7:13-2.8 Stormwater management

If a project or activity meets the definition of "major development" at N.J.A.C. 7:8-1.2, then the project or activity shall comply with the Stormwater Management rules at N.J.A.C. 7:8.

CHAPTER 15
WATER QUALITY MANAGEMENT PLANNING

SUBCHAPTER 3. PLAN ASSESSMENT, AMENDMENT AND ADOPTION

7:15-3.4 Water quality management plan amendment procedures

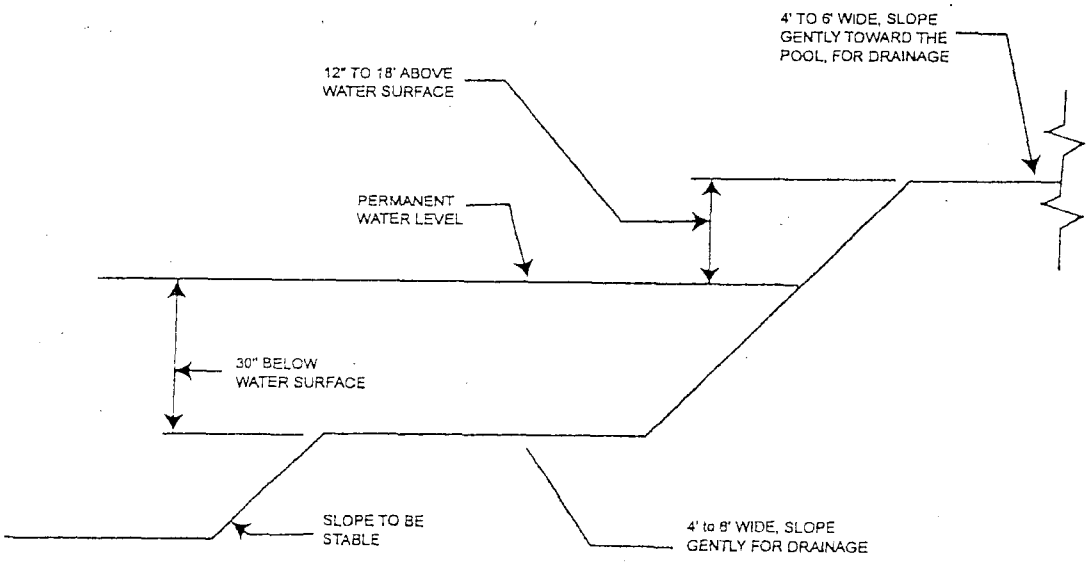
(a) (No change.)

(b) Procedures for amendment of the Statewide WQM Plan are as follows:

1. Water quality related provisions in present and future rules adopted by the Department shall be considered to be part of the Statewide WQM Plan. Such provisions may not be adopted, amended, or repealed through the WQM plan amendment process under (b)6 below.

2. Priority systems, intended use plans and project priority lists for wastewater facilities that are developed by the Department and accepted by the United States Environmental Protection Agency (USEPA) pursuant to USEPA regulations, or that otherwise are developed by the Department under N.J.A.C. 7:22, shall be considered to be part of the Statewide WQM Plan. Such priority systems and project priority lists shall be adopted or revised in accordance with USEPA regulations and N.J.A.C. 7:22, as appropriate, and shall not be adopted or revised through the WQM plan amendment process under (b)6 below.

Appendix A: Illustration of safety ledges in a new detention basin. Depicted is an elevational view.



NOTE: NOT DRAWN TO SCALE

NOTE: FOR BASINS WITH PERMANENT POOL OF WATER ONLY

3. Statewide Sludge Management Plans, District Sludge Management Plans and sludge management rules that are promulgated or approved by the Department pursuant to N.J.S.A. 13:1E-1 et seq. shall be considered to be part of the Statewide WQM Plan. Such plans and rules shall be promulgated, revised, updated or approved in accordance with N.J.S.A. 13:1E-1 et seq., and shall not be promulgated, revised, updated, or approved through the WQM plan amendment process under (b)6 below.

4. Lists of water quality limited segments, lists of segments where TMDLs will be developed, and project priority lists for TMDL development which are developed by the Department under N.J.A.C. 7:15-6 shall be adopted as amendments to the Statewide WQM Plan. TMDLs developed in accordance with N.J.A.C. 7:15-7 shall be adopted as amendments to the relevant Areawide WQM Plan(s). However, such lists, and TMDLs shall be adopted or revised in accordance with N.J.A.C. 7:15-6 or 7:15-7, as appropriate, and shall not be adopted or revised through the WQM plan amendment process under (b)6 below. The Department may also publish a draft amendment as an Interested Party Review document or as a pre-proposal prior to formal proposal of the amendment.

5. A regional stormwater management plan prepared in accordance with N.J.A.C. 7:8-3 shall be submitted only by a lead planning agency as a proposed amendment to the applicable areawide WQM plan. In addition, the following changes to an adopted regional stormwater management plan shall be processed as amendments to applicable areawide WQM Plans under this section:

i. The addition, deletion or modification to any of the drainage area-specific water quality, groundwater recharge or water quantity objectives identified under N.J.A.C. 7:8-3.5;

ii. The addition, deletion or modification to any drainage area-specific design or performance standard developed under N.J.A.C. 7:8-3.6;

iii. Any modification to a regional stormwater management plan that the Department or designated planning agency determines is likely to have a significant environmental, social, or economic impact; or

iv. Any modification that the applicant requests be processed as an amendment.

6. Components of the Statewide WQM Plan other than (b)1 through 5 above may be amended by using the procedure specified in (g) below, except that the Commissioner shall render the final decision identified in (g)9 below.

(c)-(f) (No change.)

(g) Except as provided in (h) below, the Department procedure for amendment of areawide WQM plans is as follows:

1.-2. (No change.)

3. The Department shall notify the applicant and the applicable designated planning agency, if any, in writing of its decision under (g)2 above. If the Department's decision is to proceed further with the amendment request under (g)2iii above, then this notification shall include the public notice that shall be given for the proposed amendment. If the proposed amendment is a regional stormwater management plan, the Department shall also notify the Department of Community Affairs and the Department of Agriculture. The applicant shall request written statements of consent under (g)4 below, and shall give public notice by publication in a newspaper of general circulation at the applicant's expense. The Department shall maintain a list identifying the newspaper that shall be used for this purpose in each planning area. The public notice shall also be published in the New Jersey Register. In cases where such Department decisions include a requirement for a non-adversarial public hearing, the public notice shall provide at least 30 days notice of the hearing.

4.-11. (No change.)

(h)-(l) (No change.)

7:15-3.5 Water quality management plan review, revision, and certification

(a) (No change.)

(b) The Department and the designated planning agencies shall prepare revisions to Statewide and areawide WQM Plans under this section whenever such revisions are necessary to:

1.-2. (No change.)

3. Revise schedules for submission of wastewater management plans under N.J.A.C. 7:15-5.23(g);

4. Provide for the following substantive changes in Statewide and areawide WQM plans where the Department determines no significant individual or cumulative impacts will occur to environmentally sensitive areas or other natural resources (such as water supplies) due to the proposed revision (individually or in combination with past revisions in the area), that the changes are consistent with N.J.A.C. 7:15-3.6 and 3.7, and that certain directly affected municipal and county agencies and other interests as identified by the Department have been provided an opportunity to review and comment on the proposed revision:

i.-iv. (No change.)

v. Expansion of a future sewer service area to contiguous lots, where the expansion involves less than 100 acres, contributes less than 8,000 gallons per day of additional wastewater flow, and does not create a significantly new pattern of sewered development such that a significant potential or incentive is created for additional revisions or amendments to open new areas to sewered development; or

5. Provide for any modification in an adopted regional stormwater management plan that does not require an amendment under N.J.A.C. 7:15-3.4(b)5.

(c)-(f) (No change.)

CHAPTER 20
DAM SAFETY STANDARDS

SUBCHAPTER 1. APPLICATION PROCEDURE; DESIGN CRITERIA FOR DAM CONSTRUCTION; DAM INSPECTION PROCEDURE

7:20-1.3 Permit-by-rule

(a) All dams must be designed, constructed, operated, maintained or removed in compliance with the rules in this subchapter except as set forth below:

1. Owners and operators of Class IV dams (see N.J.A.C. 7:20-1.8, Dam classification) are not required to file documents with nor obtain a permit from the Department, but must meet the following requirements, in addition to those set forth elsewhere in this subchapter:

i. (No change.)

ii. All necessary local approvals must be obtained;

iii. A New Jersey licensed professional engineer must design the Class IV Dam to meet all technical requirements of this subchapter; and

iv. If the Class IV dam is designed or constructed for stormwater management purposes, the dam shall comply with the Stormwater Management Rules at N.J.A.C. 7:8.

2. (No change.)

(b)-(c) (No change.)

(a)

LAND USE MANAGEMENT
WATERSHED MANAGEMENT
Stormwater Management
Definition of "Major Development"; Applicability to Major Development
Adopted New Rules: N.J.A.C. 7:8-1.2 and 1.6

Proposed: September 15, 2003 at 35 N.J.R. 4220(a).
Adopted: January 9, 2004 by Bradley M. Campbell, Commissioner, Department of Environmental Protection.
Filed: January 9, 2004 as R.2004 d.61, **with technical changes** not requiring additional public notice and comment (see N.J.A.C. 1:30-6.3).

Authority: N.J.S.A. 13:1D-1 et seq., 13:9A-1 et seq., 13:19-1 et seq., 40:55D-93 through 99, 58:4-1 et seq., 58:10A-1 et seq., 58:11A-1 et seq. and 58:16A-50 et seq.
DEP Docket Number: 20-03-08/417.
Effective Date: February 2, 2004.
Expiration Date: February 2, 2009.

The Department of Environmental Protection (Department) is adopting new Stormwater Management rules proposed on September 15, 2003 at 35 N.J.R. 4220(a). Particularly, the Department is adopting a new definition of "major development" and a new section at N.J.A.C. 7:8-1.6, Applicability to major development. On January 6, 2003, the Department proposed repeal and new Stormwater Management rules, N.J.A.C. 7:8. (See 35 N.J.R. 119(a).) The adoption of the new Stormwater Management rules appears elsewhere in this issue of the New Jersey Register. These new rules are incorporated within the new Stormwater Management Rules.

Based on comments received on the January 6, 2003 proposal of the Stormwater Management rules, the Department determined that the originally proposed definition of "major development" could have been misinterpreted to mean that projects possessing preliminary local approval, before the new rules took effect, would be considered exempt from all stormwater review, rather than exempt from the additional requirements imposed by the new rule. Implementation of the new rules under this exemption would not have provided adequate protection to waterbodies in the State from the impacts of stormwater runoff and nonpoint source pollution. Additionally, the Department determined that to qualify for grandfathering from the new rules, it was appropriate to require that, in addition to the enumerated local approvals, a project also have one enumerated Department permit that included stormwater management review component. Therefore, it was necessary to repropose the definition of "major development" and propose a new applicability provision to ensure adequate review of stormwater management has occurred in order for a project to qualify for continued treatment under the previous rules and that grandfathered approvals have a limited term. (See 35 N.J.R. 4220(a); September 15, 2003.)

The comment period on the reproposal closed on November 14, 2003. Comments were received from 327 interested persons.

Summary of Public Comments and Agency Responses:

The following people submitted written comments on the reproposed definition of "major development" and proposed new section at N.J.A.C. 7:8-1.6, Applicability to major development. The number in parentheses after each comment corresponds to the number identifying the respective commenters below.

List of Commenters

1. Akers, Fred
2. Alexandrini, Leanne
3. Allen, Francine
4. Allen, Kenneth
5. Allen, Peter
6. Allen, Julia
7. Anthony, Paul R.W.
8. Argentina, Debra
9. Armstrong, James
10. Armstrong, James C.
11. Aures, Bonita
12. Auth, Joan
13. Bailey, Robert
14. Baker, Marie
15. Balint, Christine
16. Barnett, Daniel
17. Bartholomew, Claude
18. Beckwith, Anita
19. Bellach, William
20. Best, Theodore V.
21. Boiyai, Melani
22. Boras, Jo & Leonard
23. Brenke, Richard
24. Brennenstuhl, James
25. Brine, Charles
26. Brinker, Erica
27. Brown, Jessica
28. Bryson, Jennifer
29. Bucquet, Caroline
30. Burani, Sergio
31. Buriani, Michael
32. Burns, Marilyn
33. Butrym, Michael
34. Cabri, Henry
35. Cannata-Nowel, Anita
36. Cantilli, John
37. Capozucca, John
38. Carley, Bryan
39. Carlough, Bob
40. Carluccio, Tracy; for the Delaware River Keeper
41. Carringer, Nancy
42. Case, Steve
43. Cheung, Danny
44. Chiang, Rodney
45. Chin, Alina
46. Christian, Mary Jo
47. Clougherty, Jill
48. Cohen, Martin
49. Colby, Richard
50. Colgan, Deborah
51. Colosi, Joseph
52. Colson, Linda for the Cape Accountability Civic Group
53. Connell, Joyce
54. Conner, Mike
55. Connolly, William M., Director, for the Department of Community Affairs Division of Codes and Standards
56. Cooper, Neil
57. Covington, Katharine
58. Croce, Michael
59. Crum, Daniel
60. Curtis, Marie A., for the New Jersey Environmental Lobby
61. D'Alessio-Cole, Cheryl
62. Dambra, John
63. Darrow, Michael
64. Deckelnick, Joe
65. Decker, George
66. DeFiglio, Judith
67. Denzer, Joan
68. Desjardins, Donna
69. DeWeese, Robin
70. Dey, Stephen P.; for the New Jersey State Board of Agriculture
71. DiLodovico, Anthony
72. Dockery, Dan
73. Donnici, Anthony
74. Dooley, Brian
75. Dreyling, Chris
76. Ducate, Janice
77. Duggan, Frances
78. Dumais, Susan
79. Dungan, Christian
80. Dunne, Loretta
81. Easton, Kathy
82. Eckstein
83. Edelmann, Carolyn Foot
84. Egenton, Michael for the New Jersey State Chamber of Commerce
85. Elbin, Susan
86. Ember, Steve
87. Eng, Sherman
88. Epstein, Susan
89. Erwin, Jane
90. Etter, Ron
91. Fair, Abigail for the Association of New Jersey Environmental Commissions
92. Farkas, Daniel Evans
93. Farri, Virginia
94. Federoff, Valadimir
95. Fenster, Steven
96. Finch, Kathy
97. Flanagan, Carol
98. Foester, Judith
99. Ford, Peter
100. Freireich, Jeffrey; for the Kushner Companies
101. Frey, Wilma
102. Fritsch, Wayne
103. Ftera, Constance
104. Fulmer, Noah
105. Garry, Lorrain Gagl
106. Gioielli, Lawrence
107. Giorgio, Heather
108. Goad, Brian
109. Goldberg, Rosalyn
110. Goldsholl, Bernard
111. Graham, Stephen J.; for the Gill St. Bernard's School
112. Grahn, Charlene
113. Grambor, Roberta
114. Grambor, Robert
115. Grant, Gordon P.
116. Graver, Robert
117. Grayzel, Jeffrey
118. Greene, Karen Patter
119. Griber, Penelope A.; for the D.W. Smith Associates, LLC
120. Halpin, Matthew S.; for the New Jersey Society of Municipal Engineers
121. Hamfeldt, Art
122. Handelman, Mary Ellen; Secretary to the Department of Community Affairs Division of Codes ad Standards Site Improvement Advisory Board
123. Hanna, Steve
124. Harrison, Charles
125. Hartley, Lorraine
126. Haselton, Kerry
127. Hawkins, George for the Stony Brook Millstone Watershed Association
128. Healy, James
129. Heiser, Christopher
130. Hellerman, George
131. Henderson, Amy
132. Henriquez, Pamela

Section 319 of the Clean Water Act authorizes a Federal grant-in-aid program to encourage states to control nonpoint sources. The Department developed a management program for nonpoint source control under which the Department issues grants to local, regional, State, and interstate agencies as well as to nonprofit organizations to, for example, develop or monitor best management practices to control stormwater.

Coastal Zone Management Act

Under Section 6217(g) of the Coastal Zone Management Act Reauthorization and Amendments of 1990 (CZARA), P.L. 101-508, the U.S. Environmental Protection Agency (EPA) has published "Guidance Specifying Management Measures For Sources of Nonpoint Pollution In Coastal Waters" (CZARA 6217(g) Guidance). States may opt to participate or not participate in overall coastal zone management program, with no penalty for non-participation other than the loss of Federal grants for this program. No mandatory Federal standards or requirements for nonpoint sources pollution control are imposed. The CZARA 6217(g) Guidance includes management measures for stormwater runoff and nonpoint source pollution control from land development as well as many other source types. The Department has developed a coastal zone management program, including a component addressing coastal nonpoint pollution control. The Stormwater Management Rules at N.J.A.C. 7:8 are one means by which the Department implements its nonpoint pollution control program.

The Department has determined that the adopted definition and rule do not contain any standards or requirements that exceed the standards or requirements imposed by Federal law. Accordingly, Executive Order No. 27(1994) and N.J.S.A. 52:14B-1 et seq. (P.L. 1995, c.65) do not require any further analysis.

Full text of the adoption follows (additions to proposal indicated in boldface with asterisks ***thus***; deletions from proposal indicated in brackets with asterisks *[thus]*):

CHAPTER 8
STORMWATER MANAGEMENT

SUBCHAPTER 1. GENERAL PROVISIONS

7:8-1.2 Definitions

The following words and terms, when used in this chapter, shall have the following meanings, unless the context clearly indicates otherwise.

. . .

"Major development" means any "development" that provides for ultimately disturbing one or more acres of land or increasing impervious surface by one-quarter acre or more. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation. Projects undertaken by any government agency which otherwise meet the definition of "major development" but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., are also considered "major development."

. . .

7:8-1.6 Applicability to major development

(a) Except as provided in (b) below, all major development shall comply with the requirements of this chapter.

(b) The following major development shall be subject to the stormwater management requirements in effect on *[(the date one day prior to the effective date of this rule)]* ***February 1, 2004***, copies of which are available from the Department at the address specified in N.J.A.C. 7:8-1.3:

1. Major development which does not require any of the Department permits listed in (c) below and which has received one of the following approvals pursuant to the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., prior to *[(the effective date of this rule)]* ***February 2, 2004***:

i. Preliminary or final site plan approval;

ii. Final municipal building or construction permit;

iii. Minor subdivision approval where no subsequent site plan approval is required;

iv. Final subdivision approval where no subsequent site plan approval is required; or

v. Preliminary subdivision approval where no subsequent site plan approval is required.

2. Major development which has received one of the approvals pursuant to the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., in (b)1 above prior to *[(the effective date of this rule)]* ***February 2, 2004*** and has secured at least one of the applicable permits listed in (c) below from the Department by *[(the effective date of this rule)]* ***February 2, 2004***, and provided that the permit included a stormwater management review component; and

3. Major development undertaken by any government agency, which does not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., provided the project has secured at least one of the applicable Department permits listed in (c) below prior to *[(the effective date of this rule)]* ***February 2, 2004***, and provided that the permit included a stormwater management review component.

(c) For the purposes of this section, the term "permit" shall include transition area waivers under the Freshwater Wetlands Protection Act. In order to qualify under (b)2 or 3 above, the major development must have obtained at least one Department permit granted under the following statutes and, provided that the permit included a stormwater management review component, prior to *[(the effective date of this rule)]* ***February 2, 2004***:

1. Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.;
2. Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.;
3. Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.; or
4. Waterfront and Harbor Facilities Act, N.J.S.A. 12:5-3.

(d) An exemption provided by (b) above shall expire with the expiration, termination or other loss of duration or effect of either of the qualifying local approval or Department permit, whichever comes first. The expiration of local approvals under (b)1 above shall be governed by local ordinance. In the event there are multiple qualifying Department permits under (c) above, the expiration date is governed by that permit which expires last provided that the permit is still in effect. Once the exemption expires, the major development shall be subject to all requirements of this chapter upon reapplication for that permit and all subsequent permits or local approval(s) under the Municipal Land Use Law.

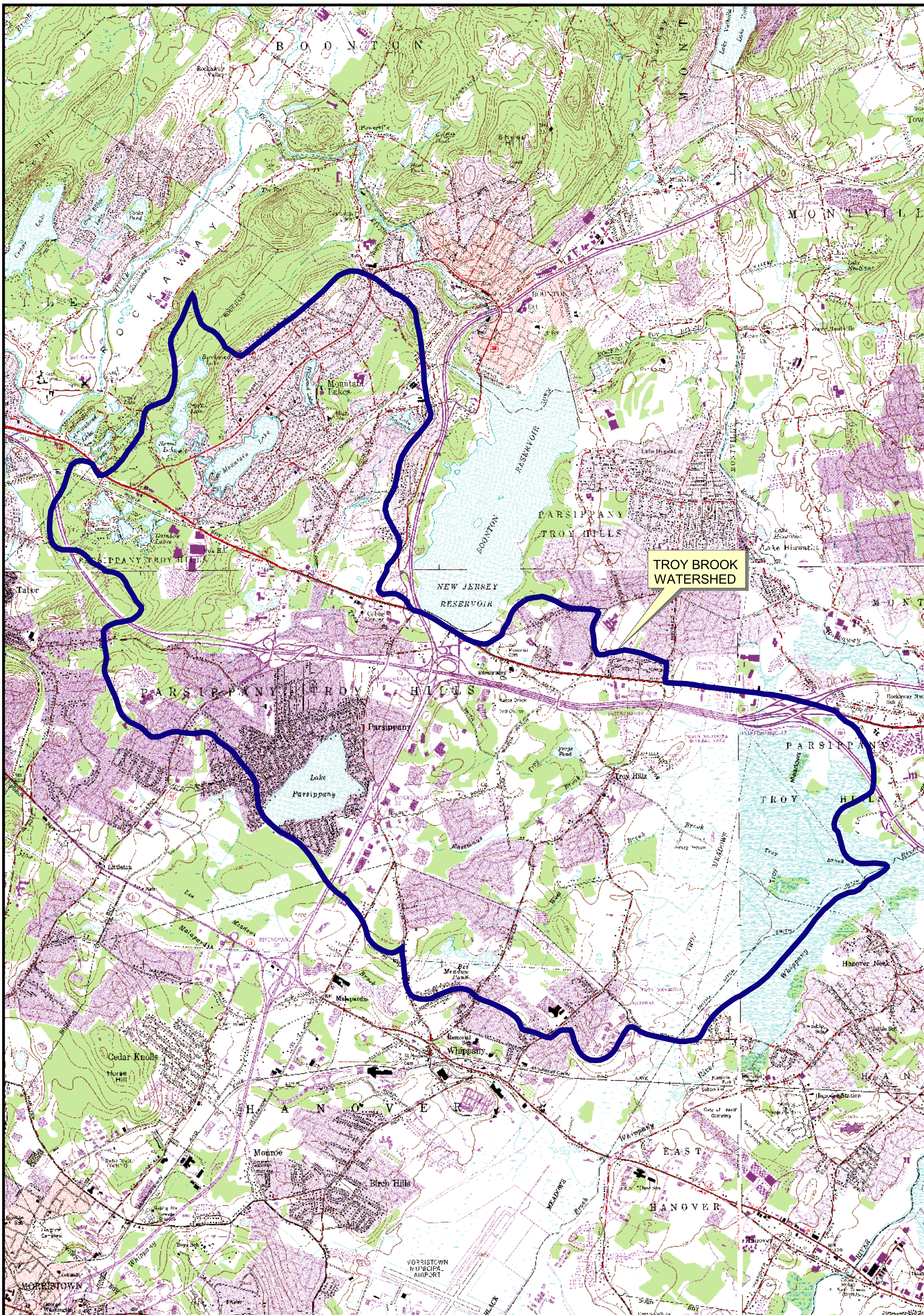
(e) An exemption under (b) above is limited to the land area and the scope of the project addressed by the qualifying approval(s) and permit(s). Exemptions under this section shall be deemed void if revisions are made to the qualifying approval or permit in (b) above, including approvals under the Municipal Land Use Law, unless upon application, the Department determines that each revision would have a de minimis impact on water resources. In making this determination, the Department shall consider the extent of any impacts on water resources resulting from the revision, including, but not limited to:

1. Increases in stormwater generated;
2. Increases in impervious surface;
3. Increases in stormwater pollutant loading;
4. Changes in land use;
5. New encroachments in special water resource protection areas; and
6. Changes in vegetative cover.

(f) In case of conflict with the Coastal Permit Program Rules at N.J.A.C. 7:7-4.4(a)4, the requirements of this chapter shall supersede.

Appendix B: Maps

MAP LIST



MAP 1 - USGS QUADRANGLE MAP

Troy Brook Regional Stormwater Management Plan

Data Source: USGS 7.5' Topographic Quadrangle, Boonton-NJ, Caldwell-NJ, Dover-NJ, Mendham-NJ, Morristown-NJ, Pompton Plains-NJ.

LEGEND

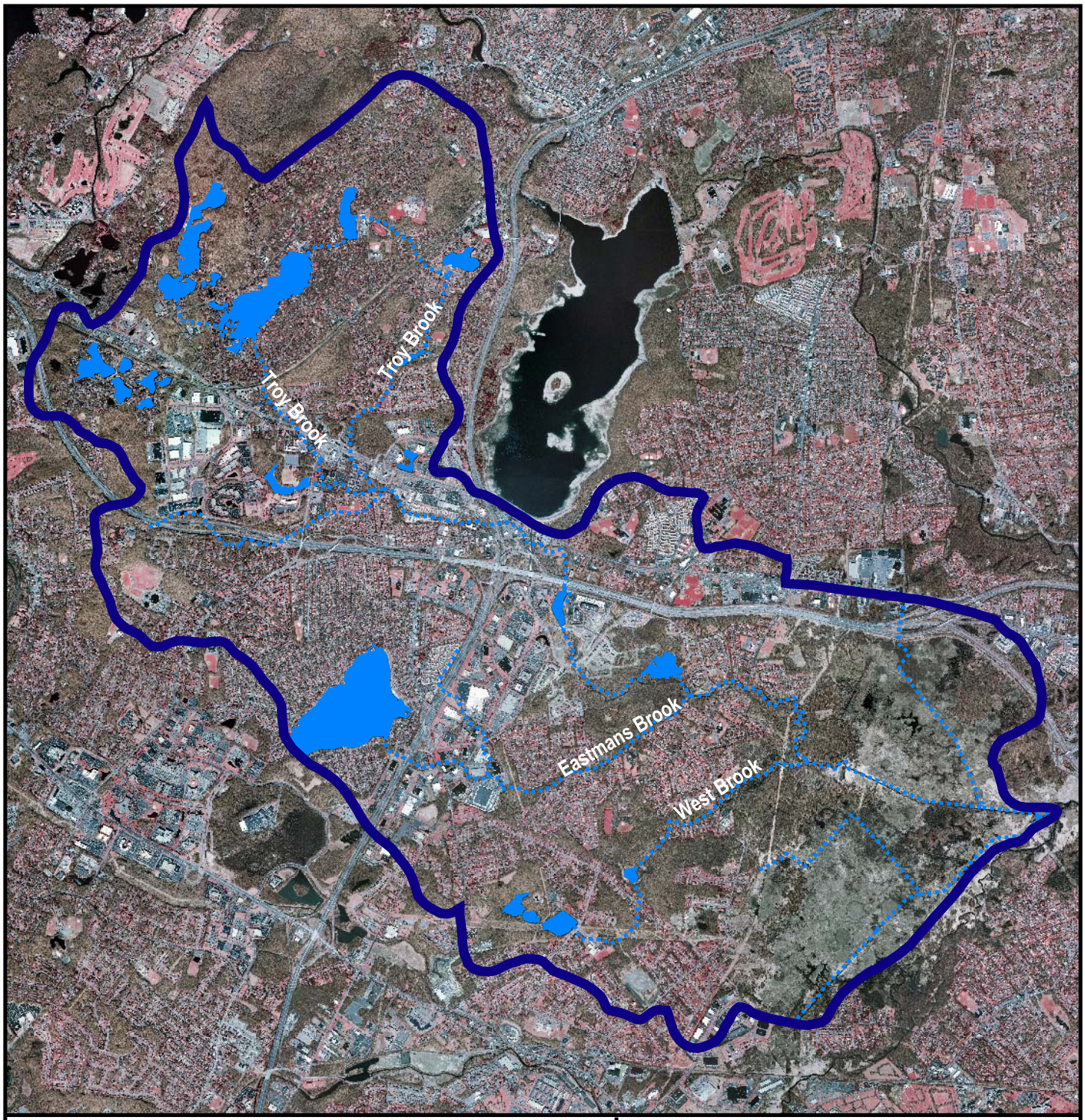
Watershed Boundary

Rutgers University
RCRE Water Resources Program
14 College Farm Road
New Brunswick, NJ 08901
T: 732-932-9011
F: 732-932-8644

N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 2 - AERIAL MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 2002 Digital Orthophotos; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams (Labeled)
- Lakes

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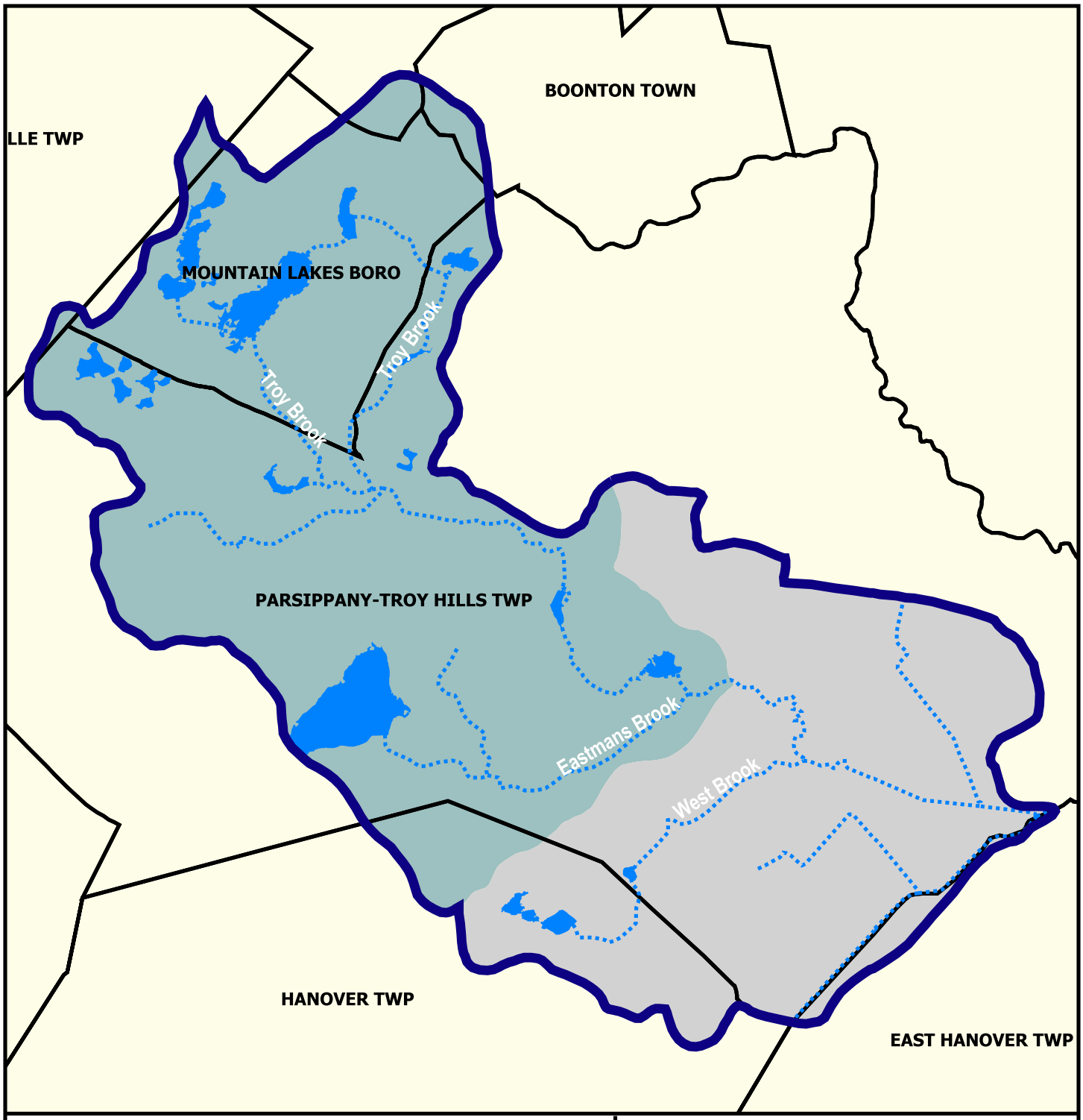
F: 732-932-8644

N
W E
S

1 inch = 4500 feet

0 4500 Feet



MAP 3- MUNICIPAL MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 2002 Digital Orthophotos; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams (Labeled)
- Lakes
- Municipalities

Subwatersheds

- North
- South

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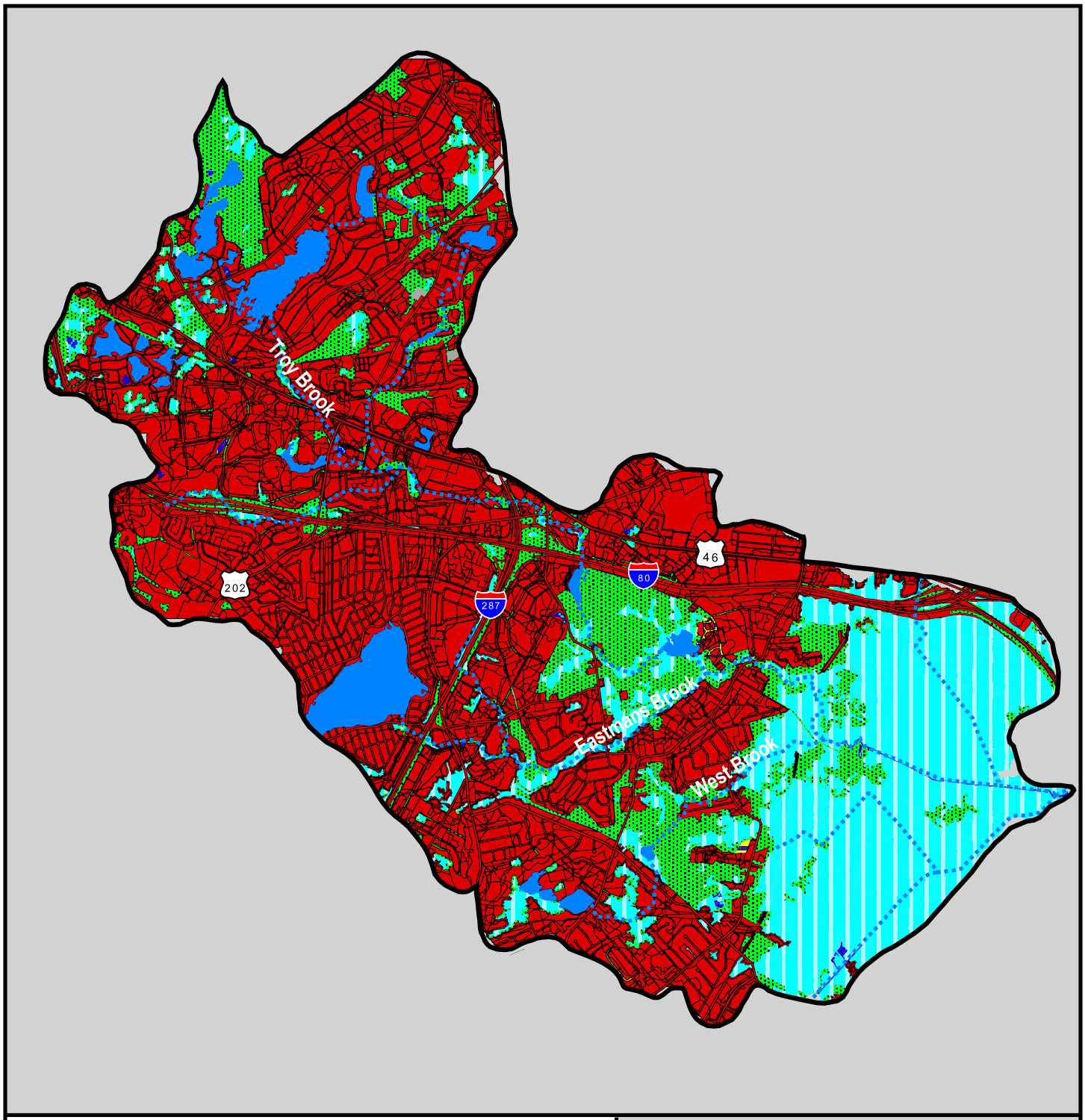
N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 3A - LAND USES ACCORDING TO BUILD OUT

Troy Brook Regional Stormwater Management Plan

Data Source: Land Use/Land Cover according to Build Out Analysis; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams (Labeled)
- Highways
- Lakes

Land Use According to Build Out

- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS

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F: 732-932-8644

N
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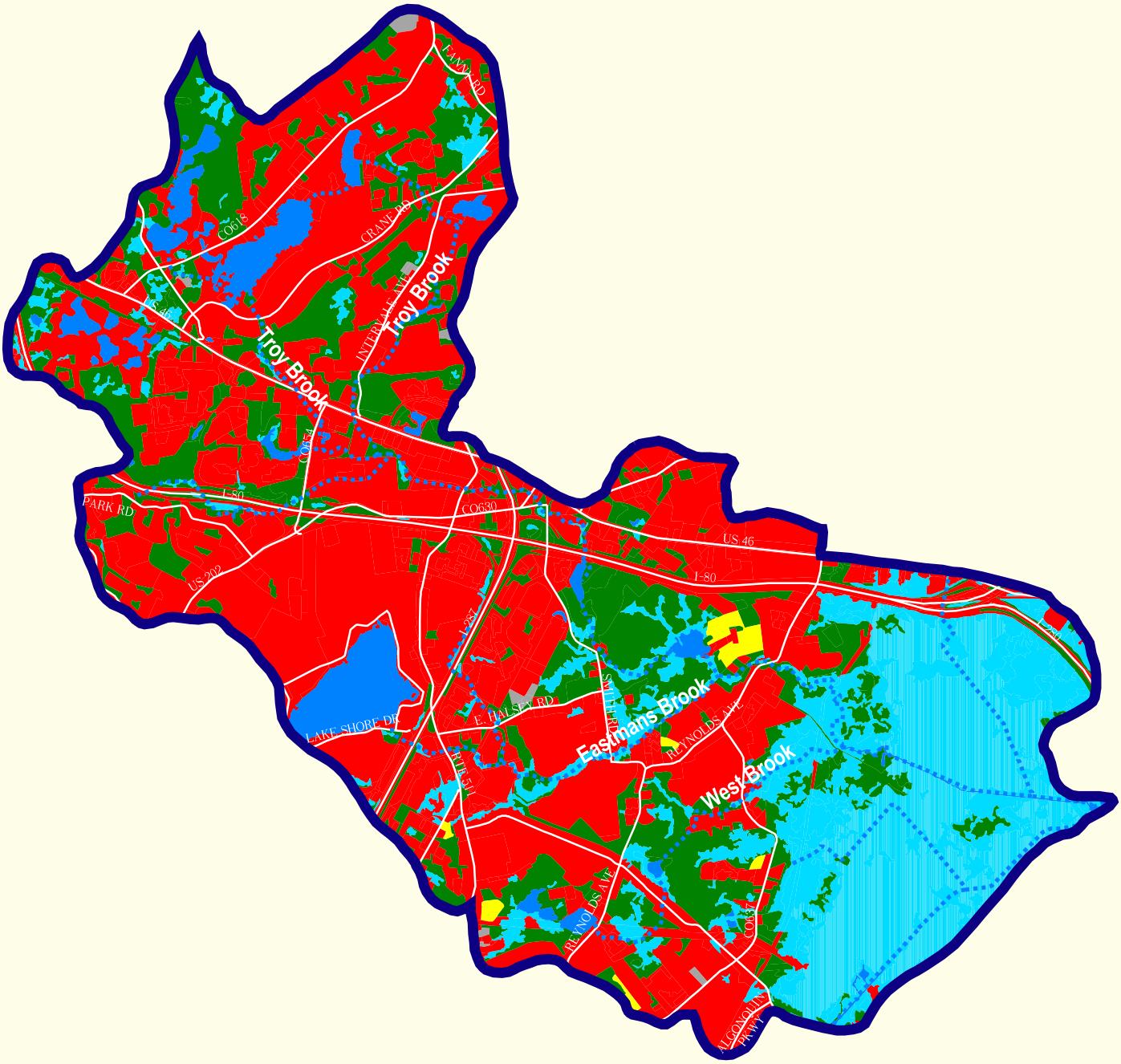
S

1 inch = 4500 feet

0 4500 Feet



MAP 4- LAND USE/LAND COVER MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1995/97 Land Use/Land Cover; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams (Labeled)
- County Roads
- Lakes

NJDEP 1995/97 Land Use

- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS

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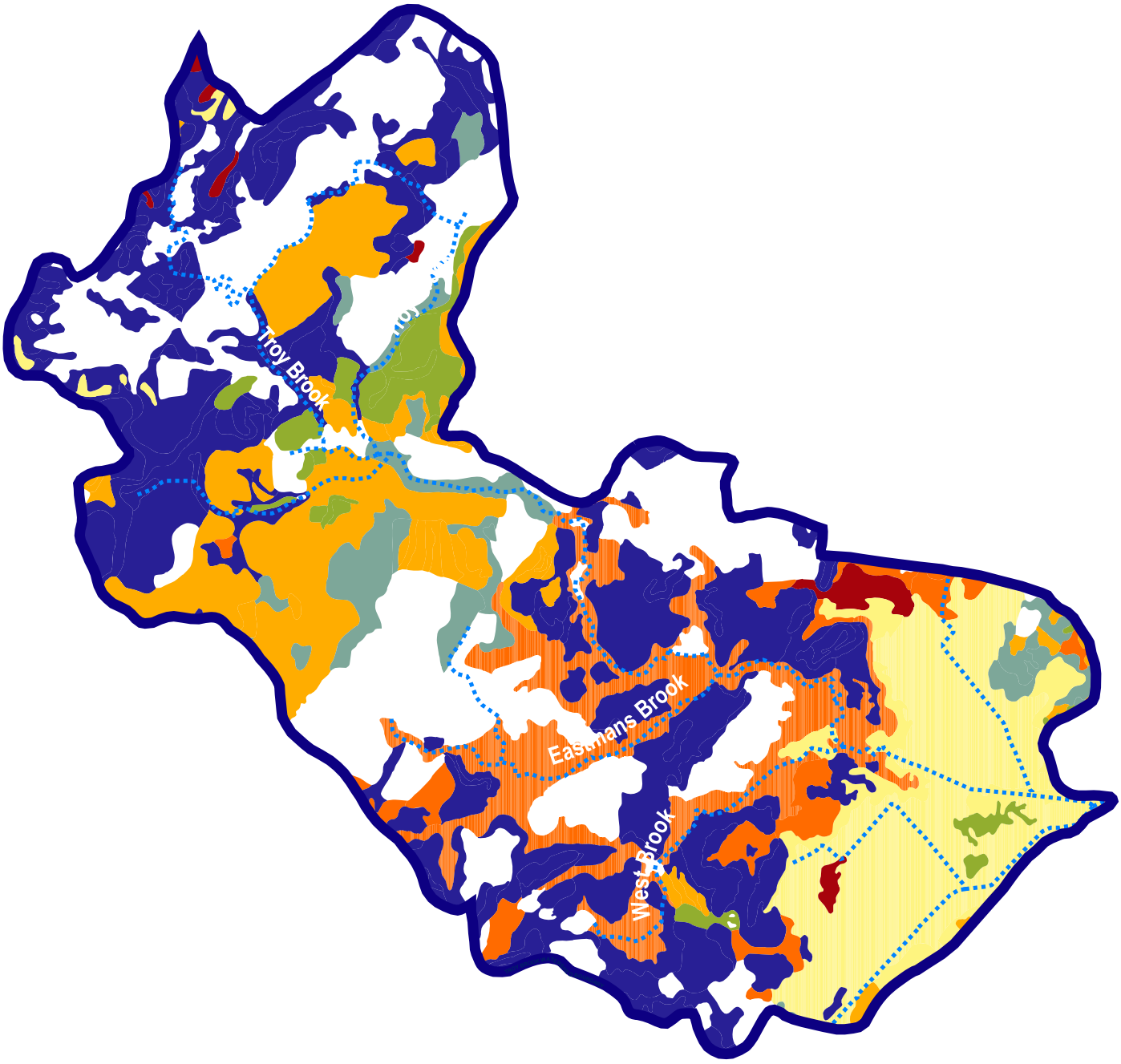
N
W E
S

1 inch = 4500 feet

0 4500 Feet



MAP 5 - HYDROLOGIC SOIL GROUP

Troy Brook Regional Stormwater Management Plan

Data Source: USDA/NRCS SSURGO Soil Data for Morris County (2005); NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams

Hydric Soil Classifications

- A: High infiltration rates
- A/D
- B:: Moderate infiltration rates
- B/D
- C: Slow infiltration rates.
- C/D
- D: Very slow infiltration rates.

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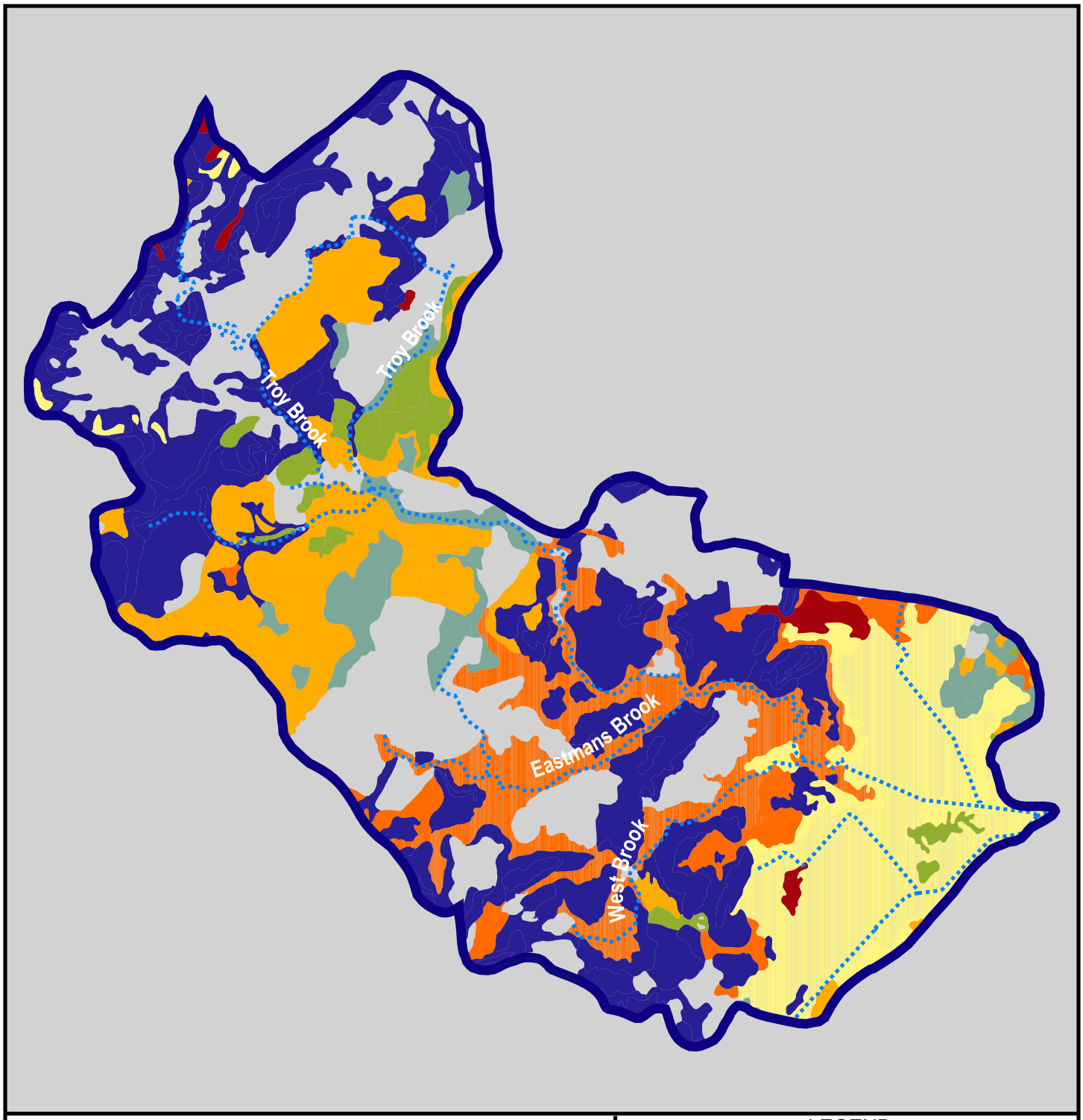
N
W E
S

1 inch = 4500 feet

0 4500 Feet



MAP 6 - SOIL ERODIBILITY MAP

Troy Brook Regional Stormwater Management Plan

Data Source: USDA/NRCS SSURGO Soil Data for Morris County (2005); NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams

Hydric Soil Classifications

- A: High infiltration rates
- A/D
- B:: Moderate infiltration rates
- B/D
- C: Slow infiltration rates.
- C/D
- D: Very slow infiltration rates.

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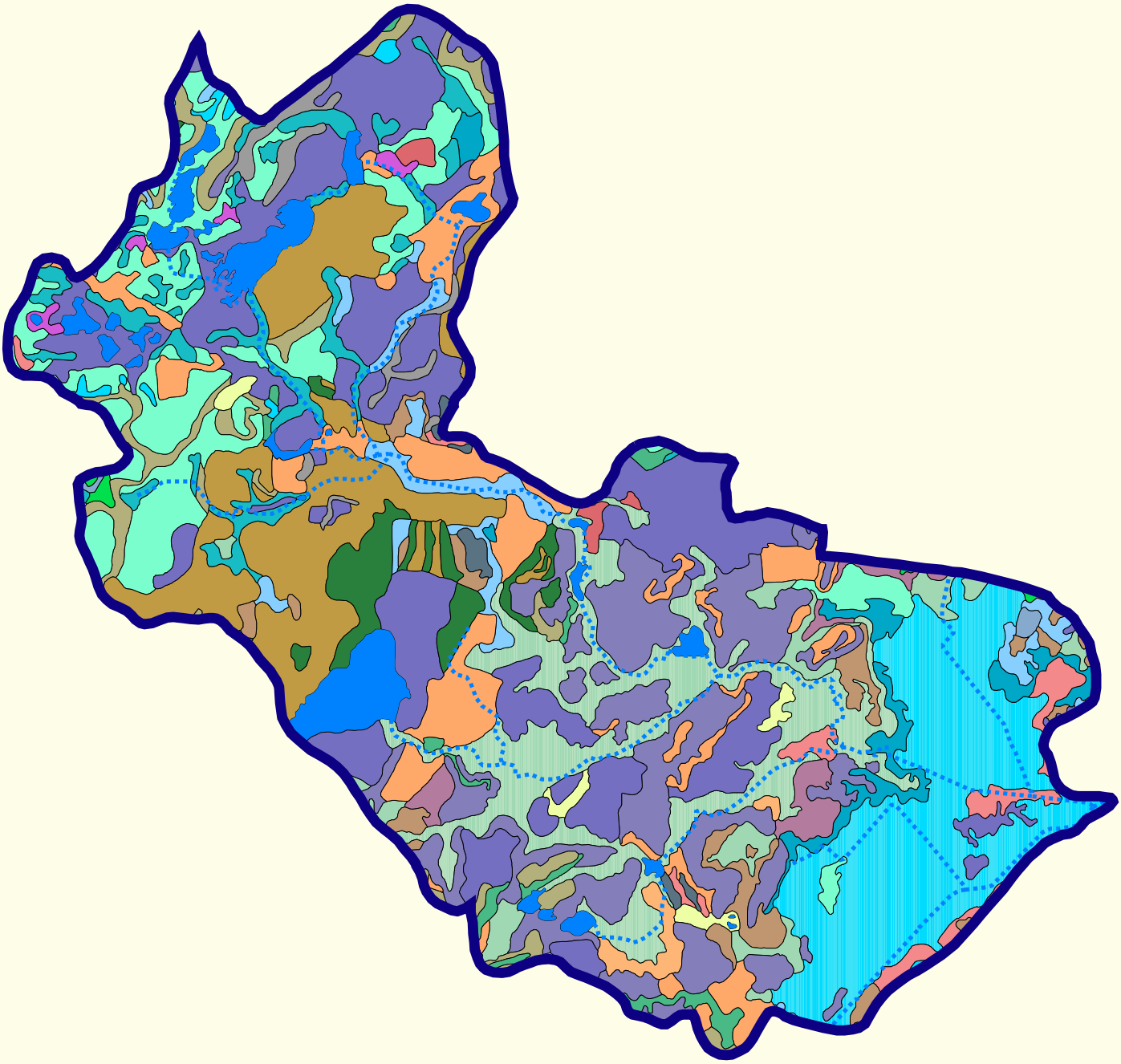
N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 7- SSURGO SOILS MAP

Troy Brook Regional Stormwater Management Plan

Data Source: USDA/NRCS SSURGO Soil Data for Morris County; NJDEP 1996 GIS Data CD-ROM

LEGEND

Watershed Boundary

Rivers & Streams

Soil Types

Adr, Bhd, BohB, BohC, Car, HanB, HanC, HhmCa, MknB, NerB, NerC, OtsC, OtsD, PHF, PauCc, PauDc, Pbp, Pbph, PohA, PohB, PrkA, PrsdA, RkgBb, RkgBc, RksB, RksC, RobCb, RobDc, RocB, RocC, RomE, UR, UREDC, URNEB, URPR, URRHB, URROC, URROD, URWH, USG, Udz, WATER, WhpB, WhphA, WhphB, Whvb, Wkk

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New Brunswick, NJ 08901
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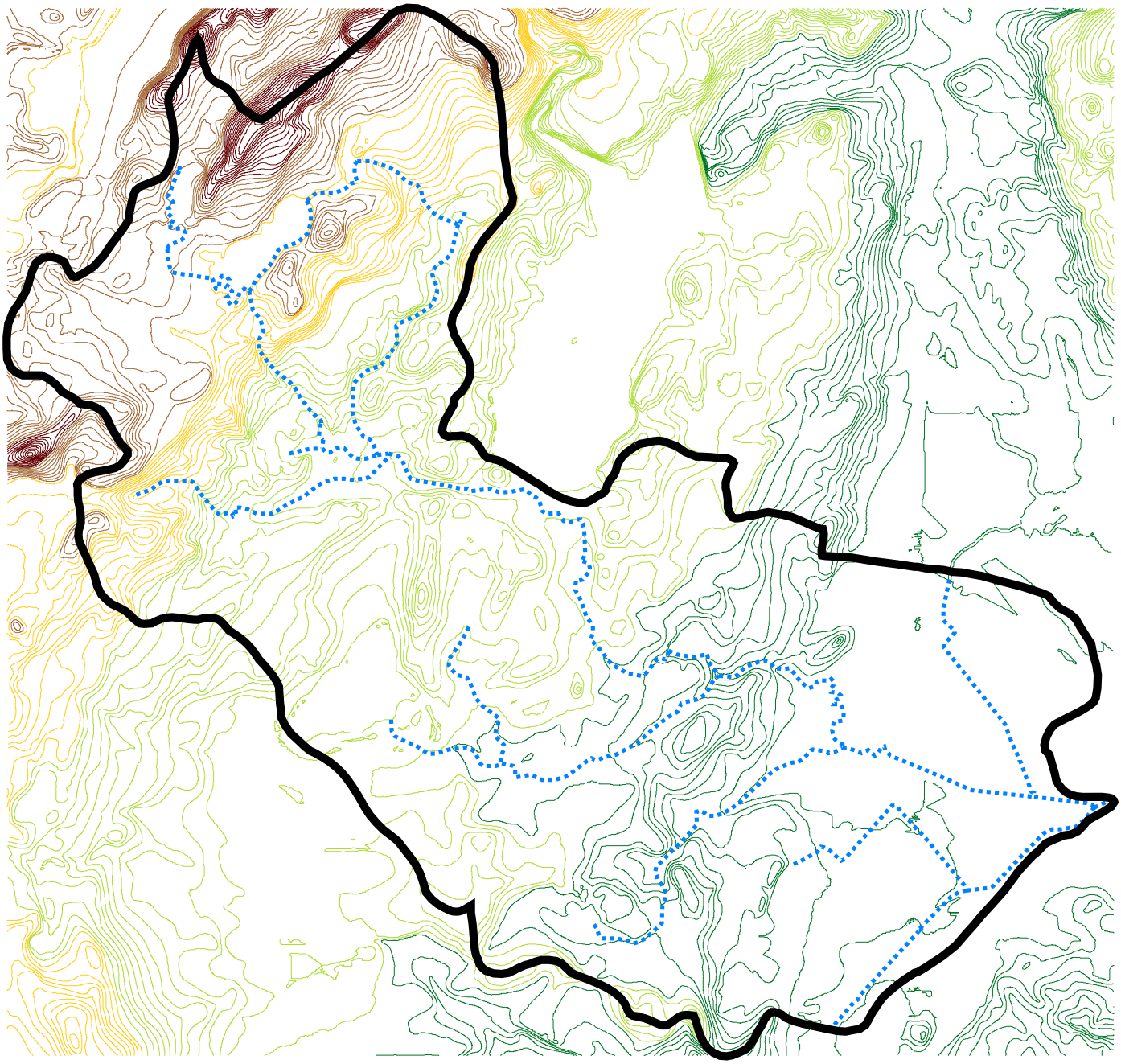
F: 732-932-8644

N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 7B - CONTOUR MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP WMA 6 DEM data; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams

Slope Data

- 5 - 8 %
- 8 - 12 %
- 12 - 15 %
- > 15 %
- No Data

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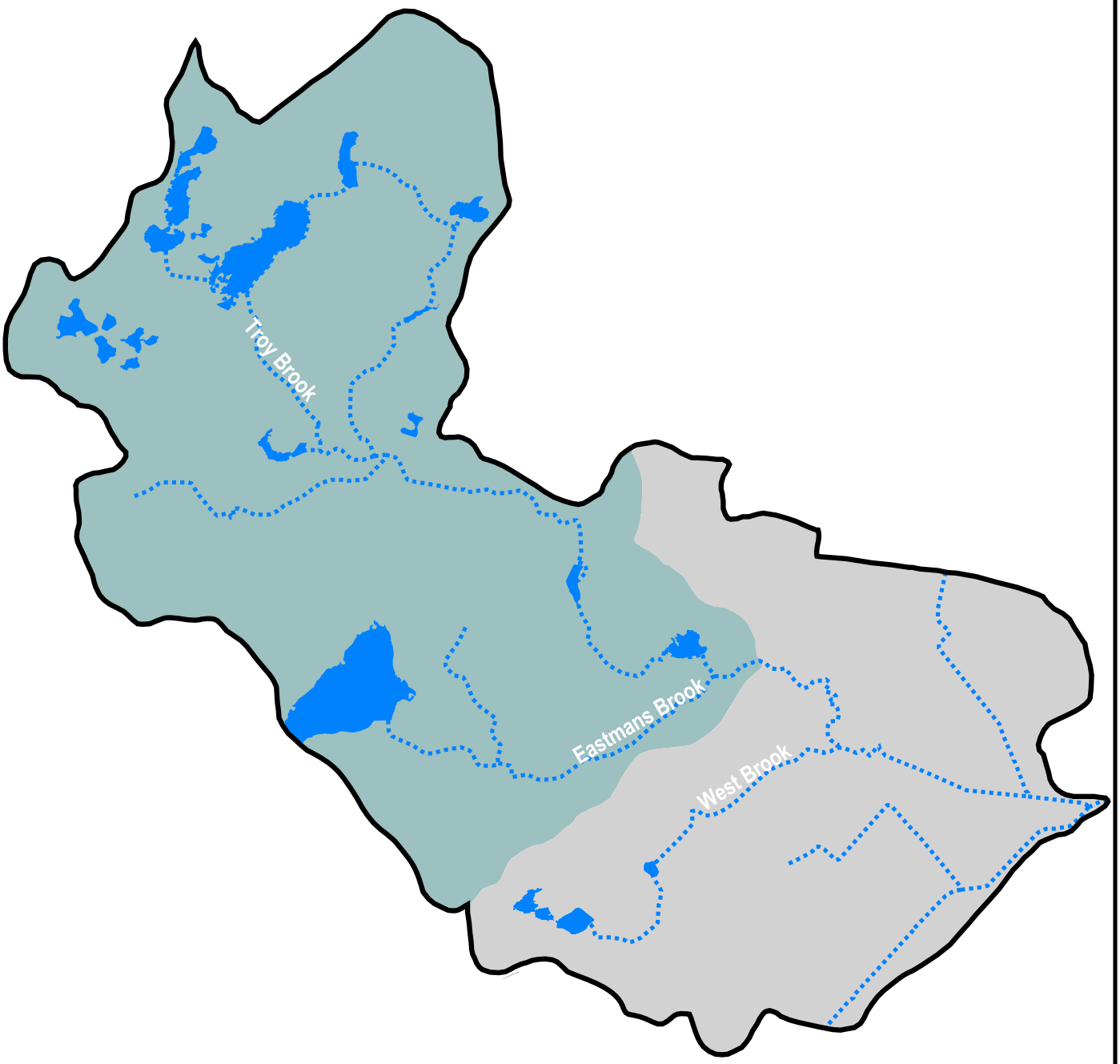
F: 732-932-8644

N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 8 - WATERBODIES MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 2002 Digital Orthophotos; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Lakes
- Rivers & Streams (Labeled)

Subwatersheds

- Upper Basin (HUC 02030103020080)
- Lower Basin (HUC 02030103020090)

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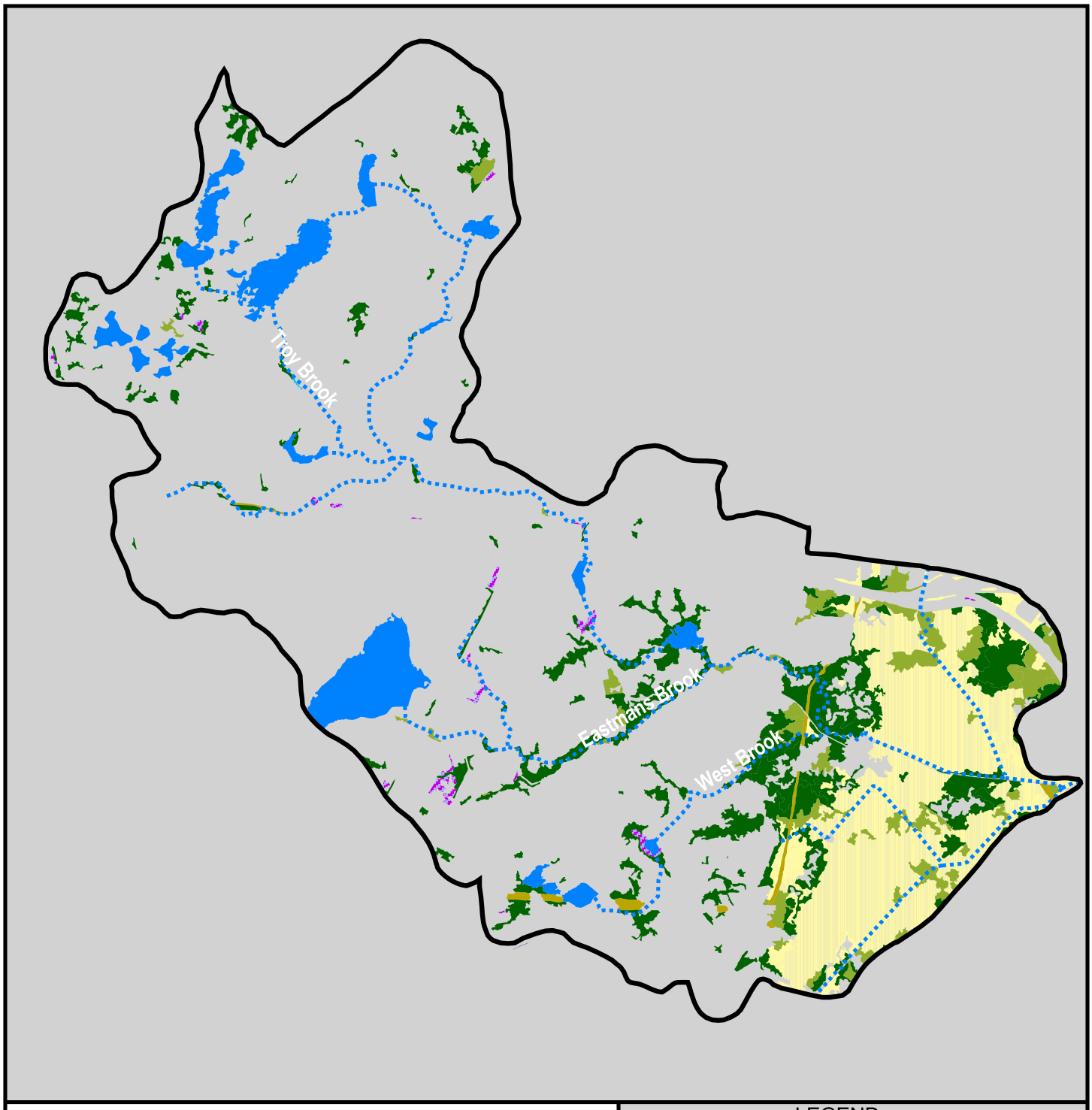
N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 9 - WETLANDS MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1995/97 Land Use/Land Cover; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams
- Highways
- County Roads
- Lakes

1995/97 Wetlands Data

- Deciduous Scrub/ Shrub Wetlands
- Deciduous Wooded Wetlands
- Disturbed Wetlands
- Herbaceous Wetlands
- Managed Wetlands in Maintained Lawn Greenspace
- Wetlands Rights -of-Way (modified)

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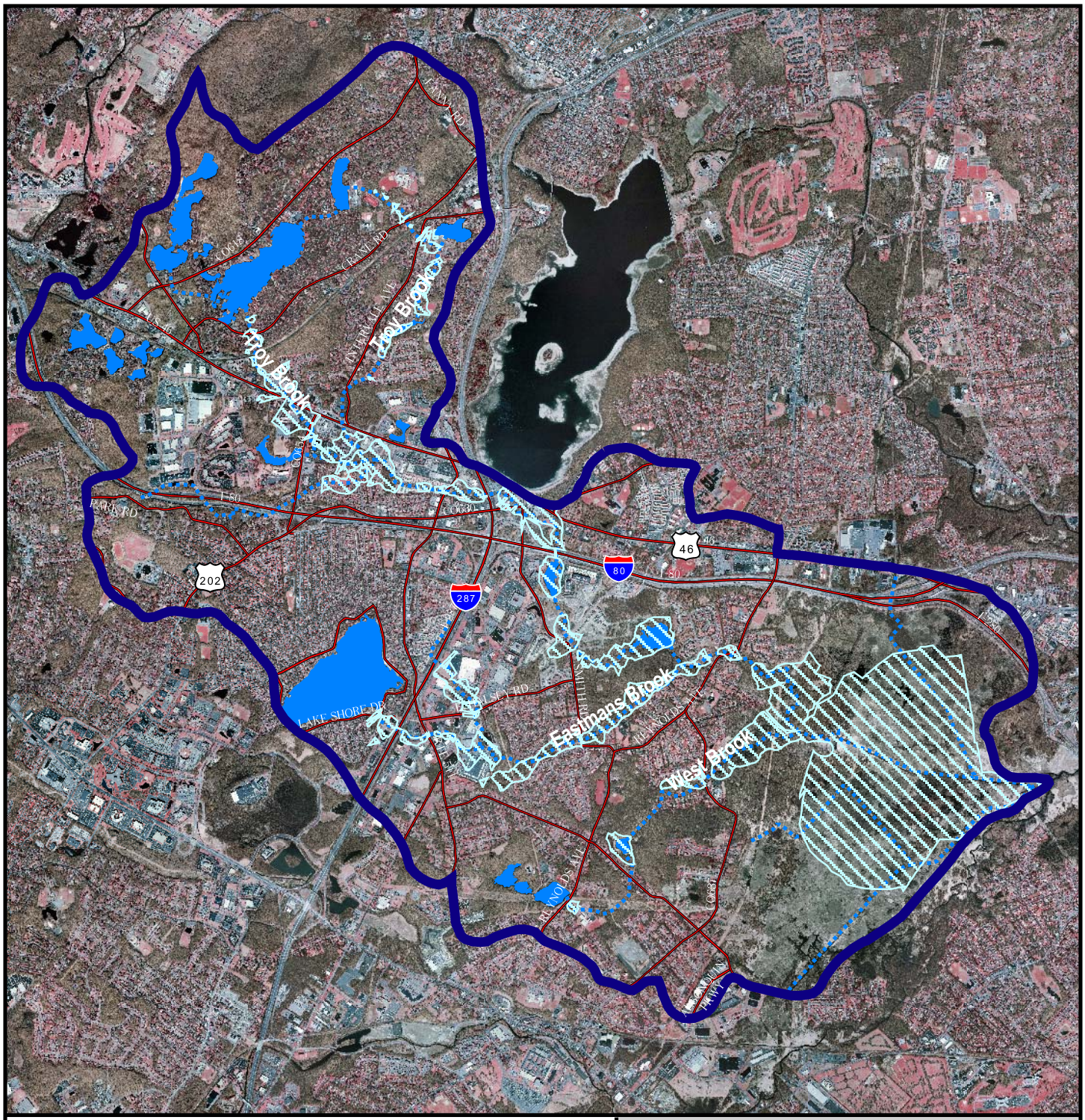
F: 732-932-8644

N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 10 - FLOOD HAZARD AREAS MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 2002 Digital Orthophotos; RCRE Water Resources HEC-RAS Flood Hazard Data, 2005; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Flood Hazard Area (100-Year + 25%)
- Lakes
- Rivers & Streams (Labeled)
- Highways
- County Roads

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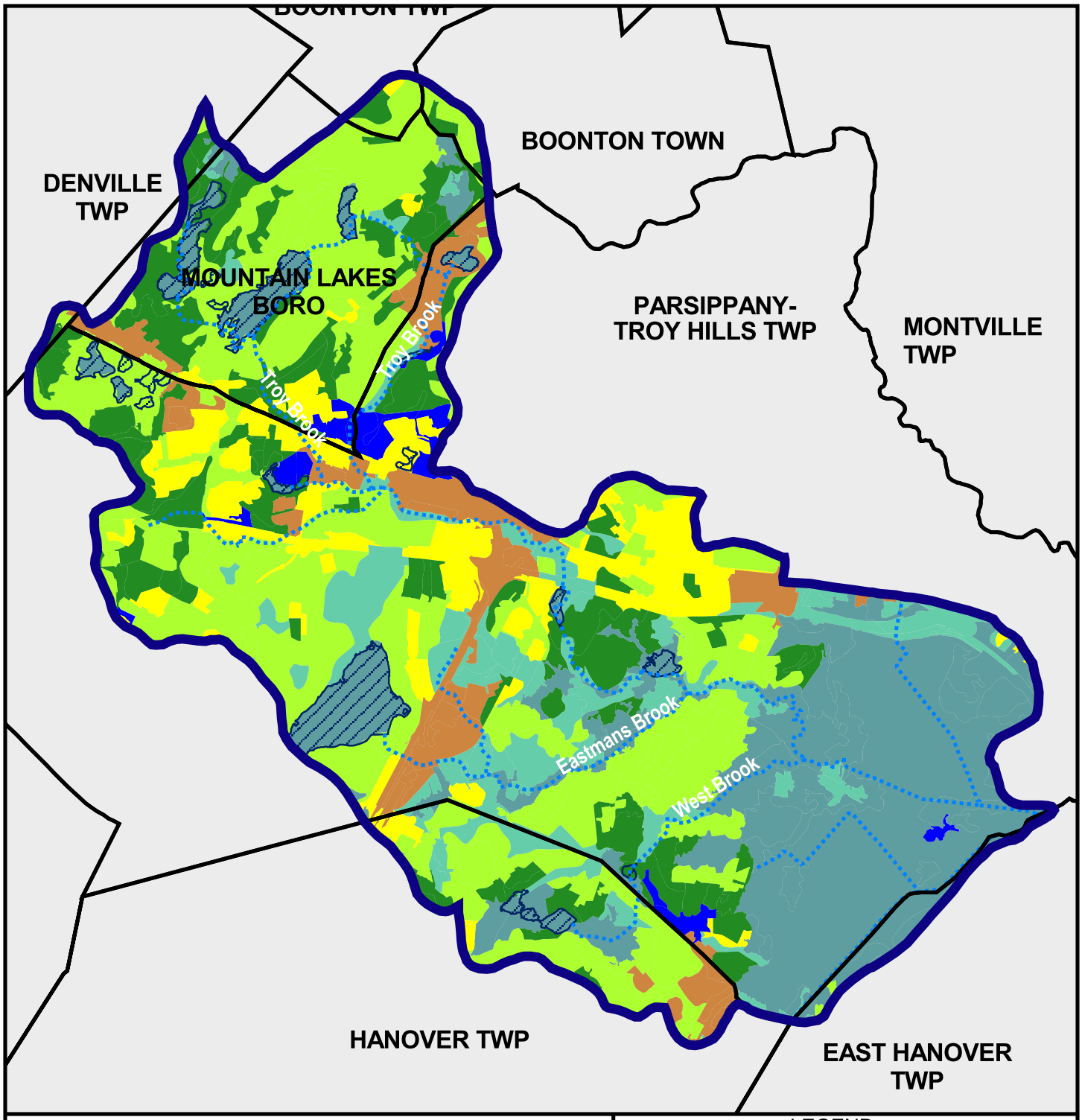
N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 11 - GROUNDWATER RECHARGE MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJGS 2000 Recharge Data; NJDEP 1996
GIS Data on CD-Rom

LEGEND

- Watershed Boundary
- Municipalities
- Rivers & Streams
- Lakes

WMA 6 Recharge Data

- 18 to 22 in/yr
- 12 to 17 in/yr
- 9 to 11 in/yr
- 1 to 8 in/yr
- 0 in/yr
- Hydric Soils
- Wetlands and Open Water
- No Recharge Calculated

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RCRE Water Resources Program
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New Brunswick, NJ 08901
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F: 732-932-8644

N
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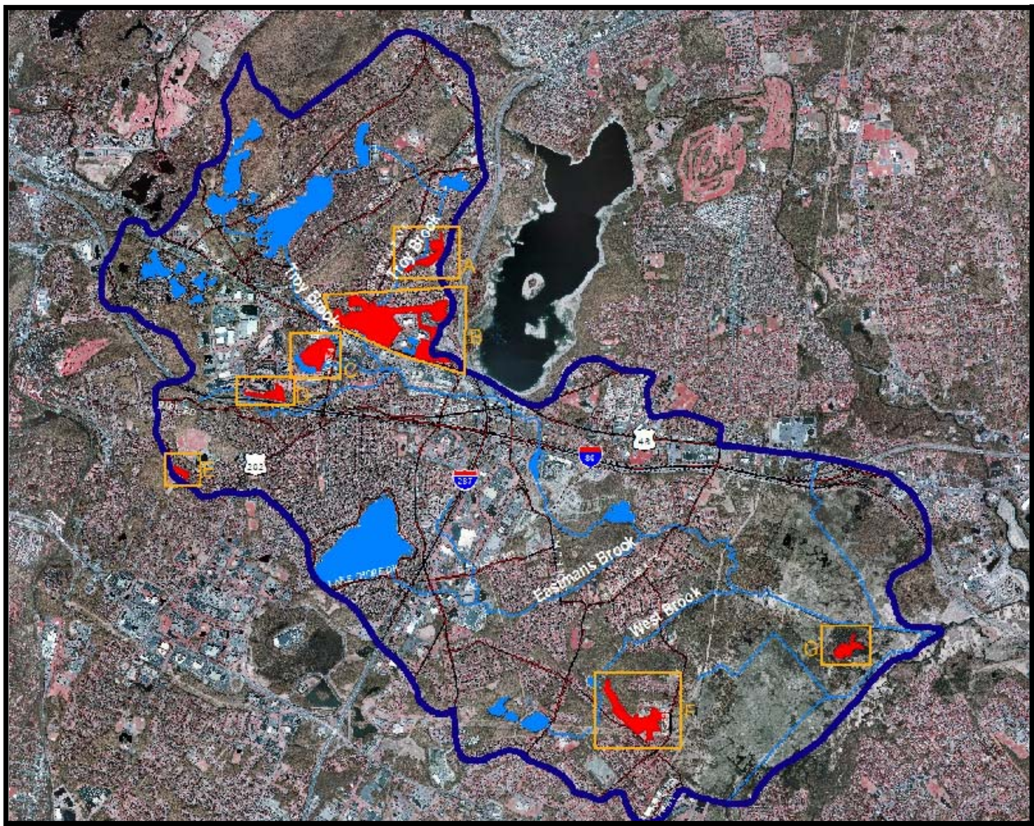
S

1 inch = 4500 feet

0 4500 Feet



N
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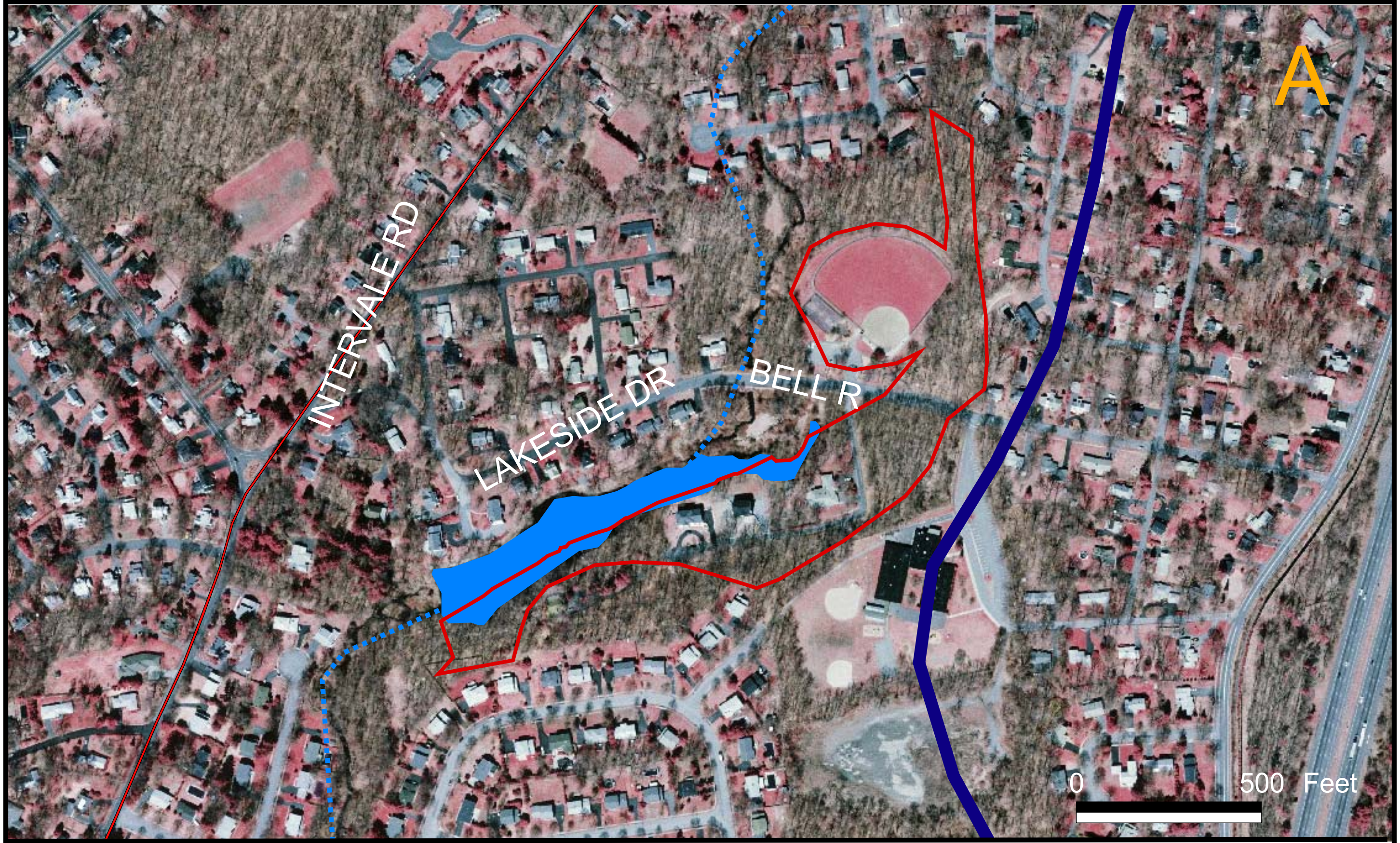
LEGEND

- Watershed Boundary
- Areas of High Groundwater Recharge
- NJDOT 2004 Roads Data
- Lakes
- Highways
- Rivers & Streams

Data Source: NJGS 2000 Recharge Data; NJDEP 1996 GIS Data on CD-Rom



MAP 11A - HIGH GROUNDWATER RECHARGE AREAS MAP

Troy Brook Regional Stormwater Management Plan

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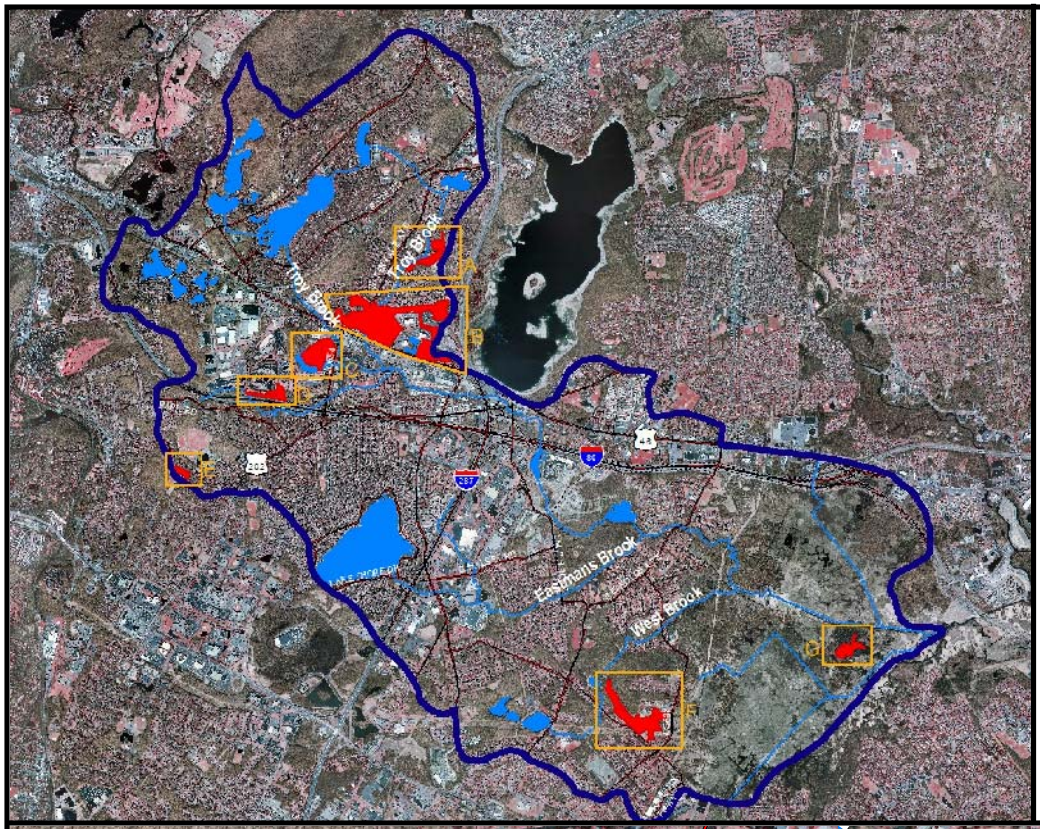
F: 732-932-8644



N
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LEGEND

- Watershed Boundary
- Areas of High Groundwater Recharge
- NJDOT 2004 Roads Data
- Lakes
- Highways
- Rivers & Streams

Data Source: NJGS 2000 Recharge Data; NJDEP 1996 GIS Data on CD-Rom

MAP 11B - HIGH GROUNDWATER RECHARGE AREAS MAP

Troy Brook Regional Stormwater Management Plan

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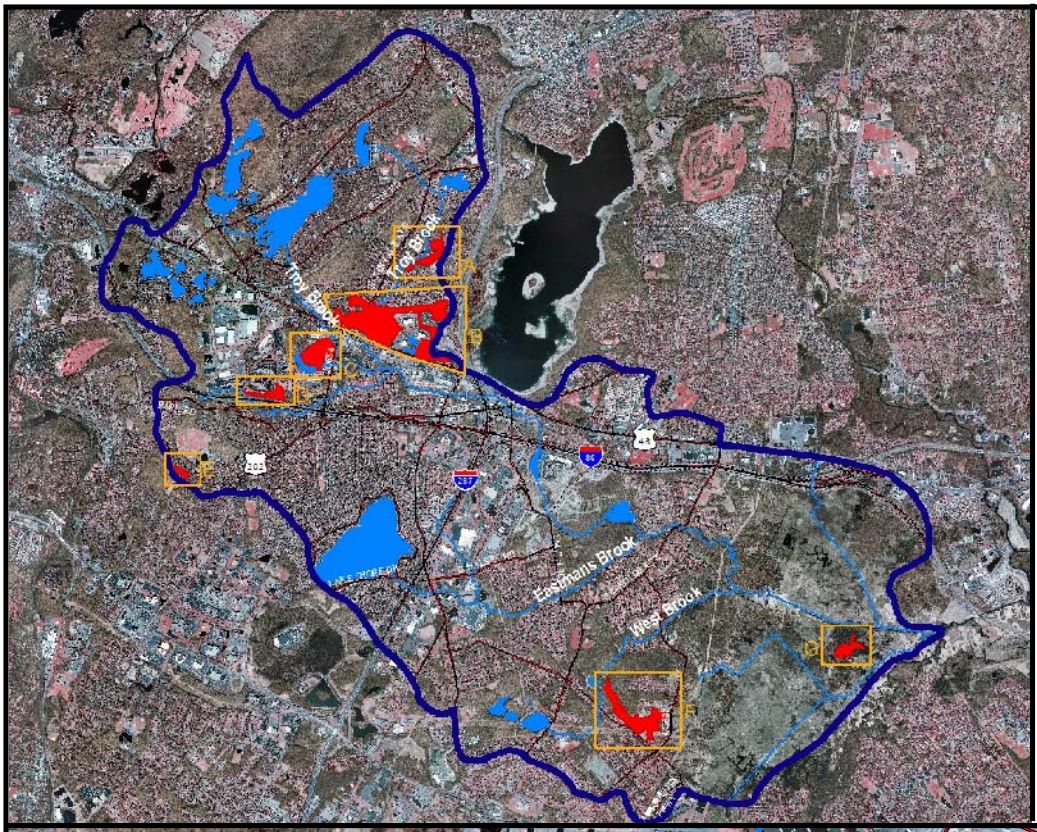

N
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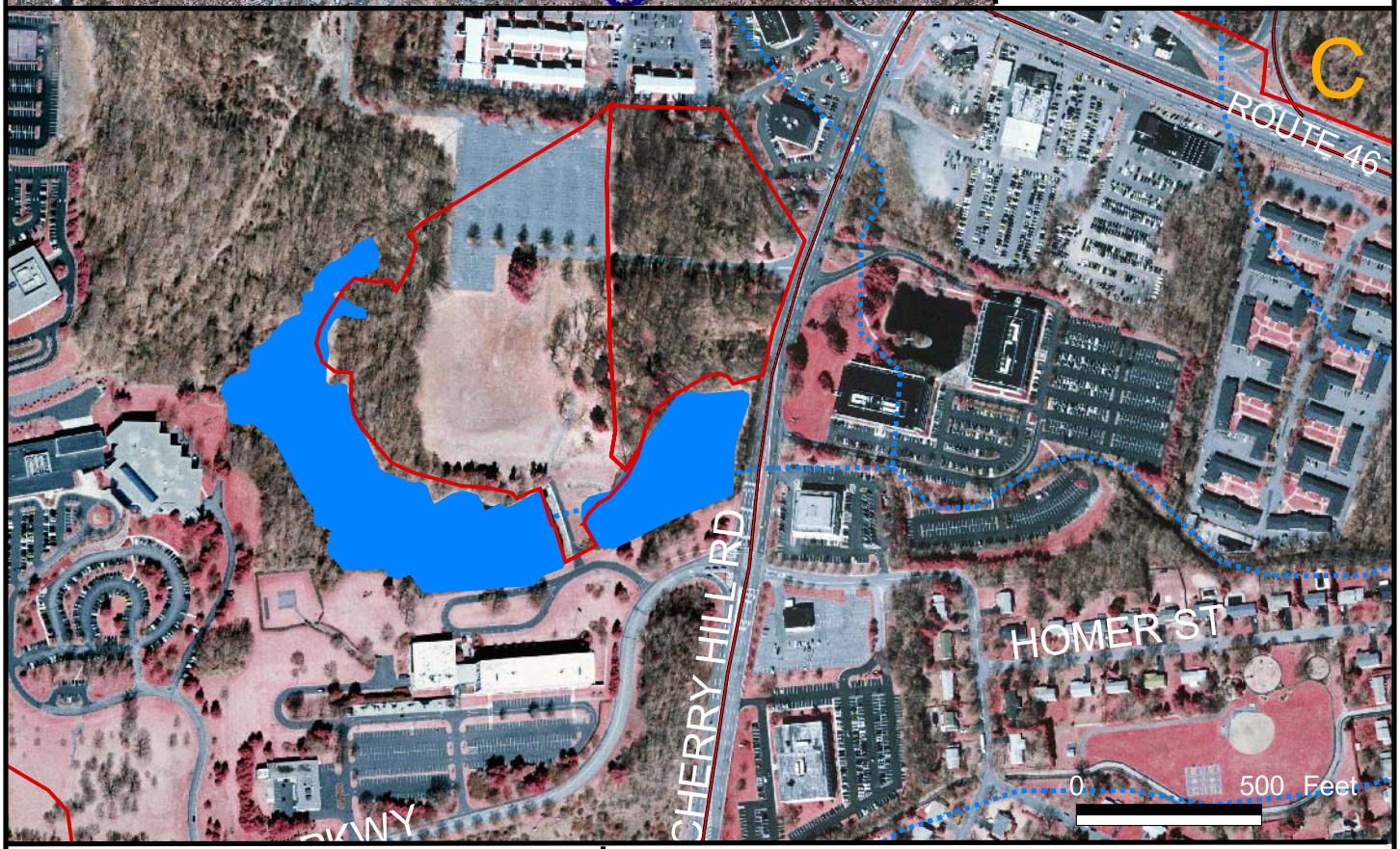
LEGEND

- Watershed Boundary
- Areas of High Groundwater Recharge
- NJDOT 2004 Roads Data
- Lakes
- Highways
- Rivers & Streams

Data Source: NJGS 2000 Recharge Data; NJDEP 1996 GIS Data on CD-Rom



MAP 11C - HIGH GROUNDWATER RECHARGE AREAS MAP

Troy Brook Regional Stormwater Management Plan

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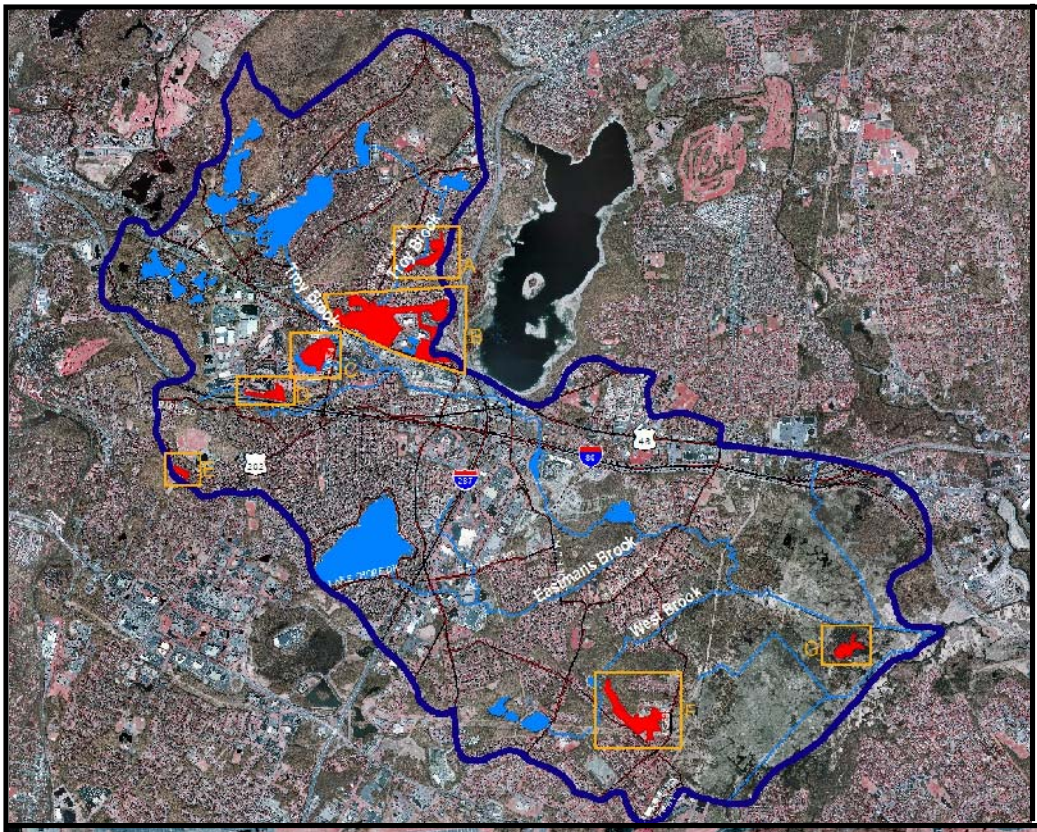

N

W E

S

LEGEND

- Watershed Boundary
- Areas of High Groundwater Recharge
- NJDOT 2004 Roads Data
- Lakes
- Highways
- Rivers & Streams

Data Source: NJGS 2000 Recharge Data; NJDEP 1996 GIS Data on CD-Rom

MAP 11D - HIGH GROUNDWATER RECHARGE AREAS MAP

Troy Brook Regional Stormwater Management Plan

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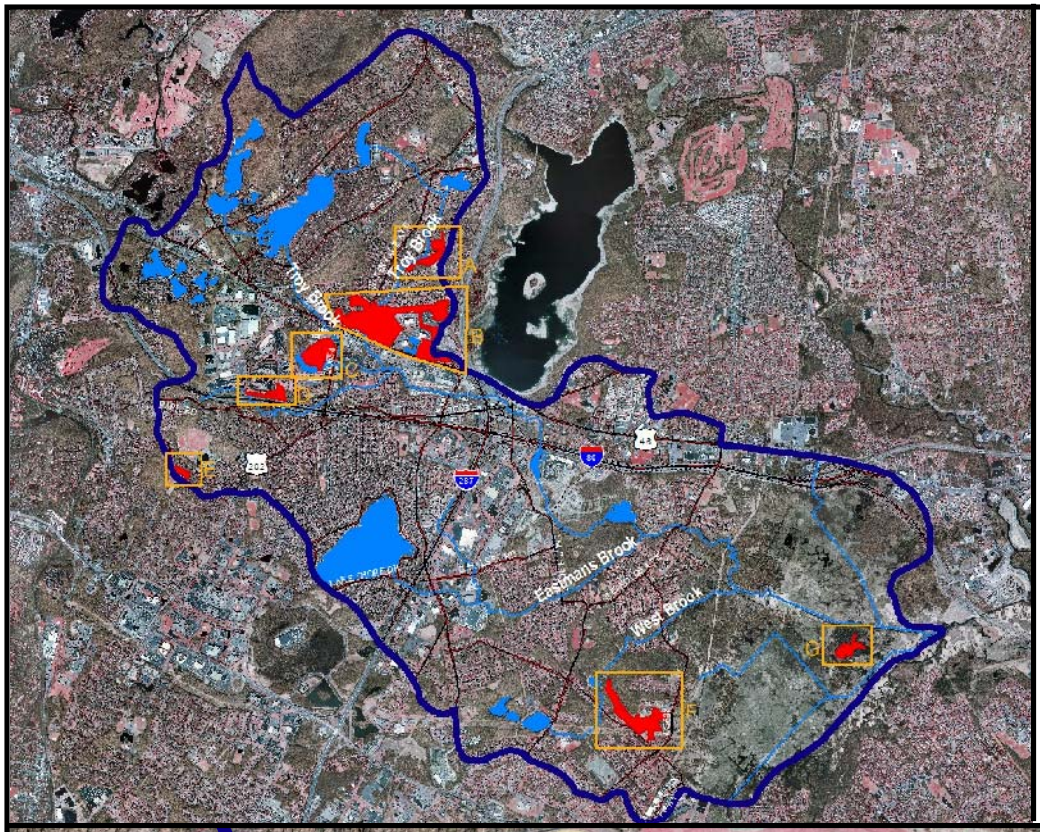
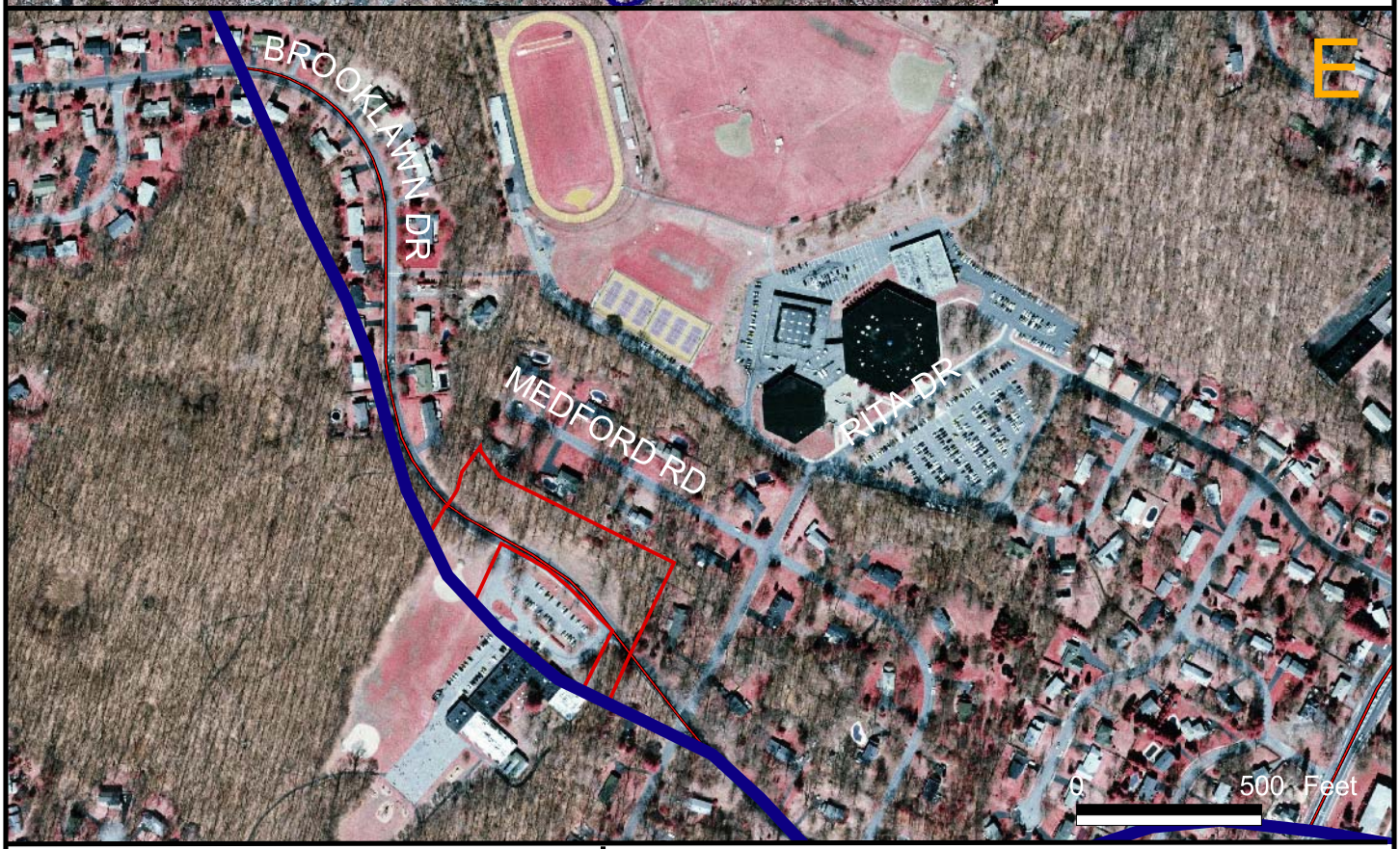


N
W E
S

LEGEND

- Watershed Boundary
- Areas of High Groundwater Recharge
- NJDOT 2004 Roads Data
- Lakes
- Highways
- Rivers & Streams

Data Source: NJGS 2000 Recharge Data; NJDEP 1996 GIS Data on CD-Rom



MAP 11E - HIGH GROUNDWATER RECHARGE AREAS MAP

Troy Brook Regional Stormwater Management Plan

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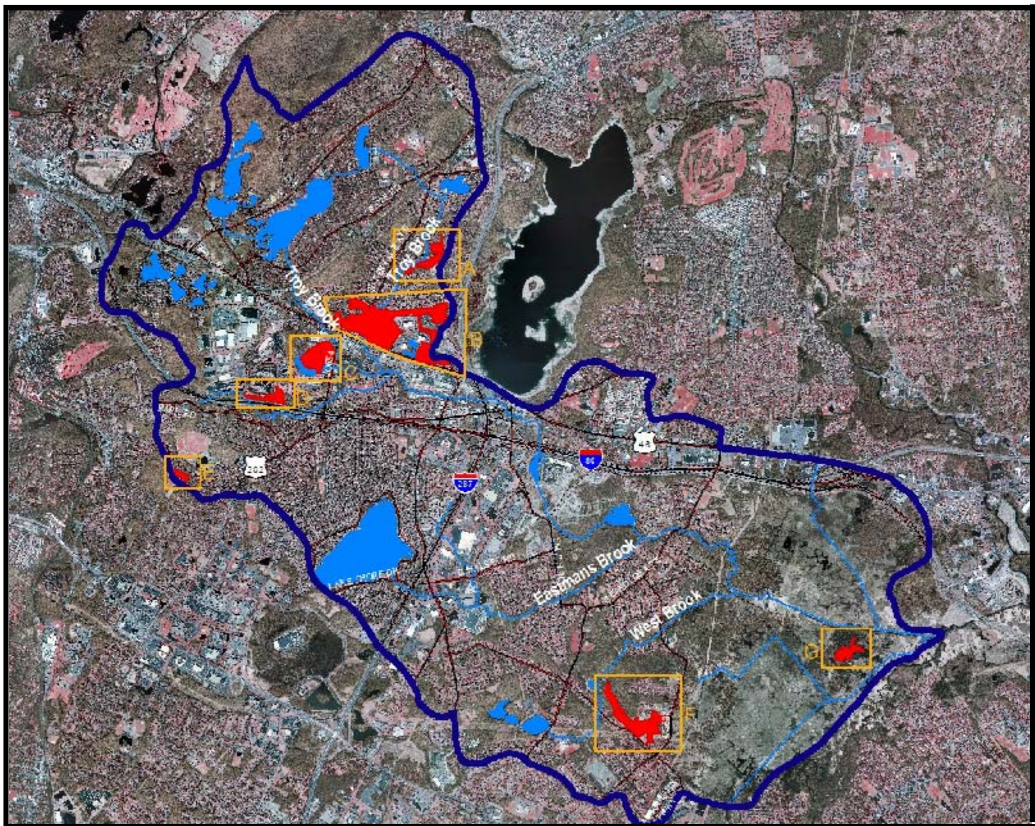

N
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LEGEND

- Watershed Boundary
- Areas of High Groundwater Recharge
- NJDOT 2004 Roads Data
- Lakes
- Highways
- Rivers & Streams

Data Source: NJGS 2000 Recharge Data; NJDEP 1996 GIS Data on CD-Rom

MAP 11F - HIGH GROUNDWATER RECHARGE AREAS MAP

Troy Brook Regional Stormwater Management Plan

NEW JERSEY AGRICULTURAL EXPERIMENT STATION RUTGERS COOPERATIVE RESEARCH & EXTENSION

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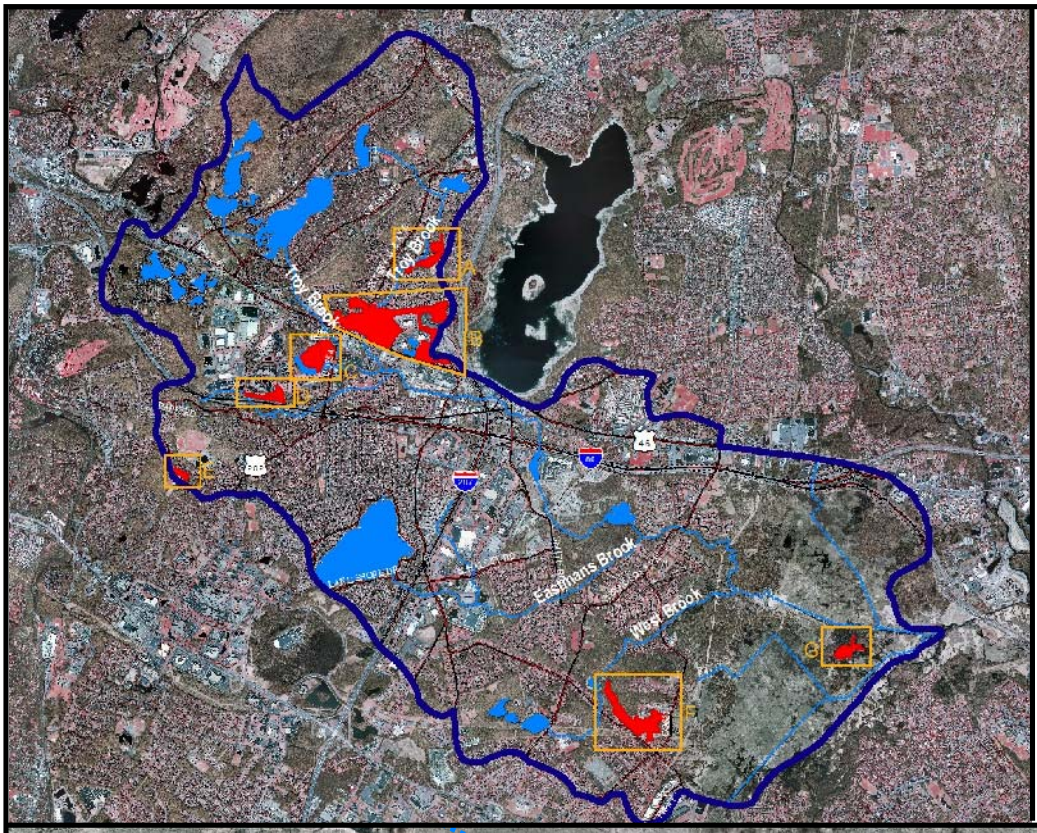
F: 732-932-8644

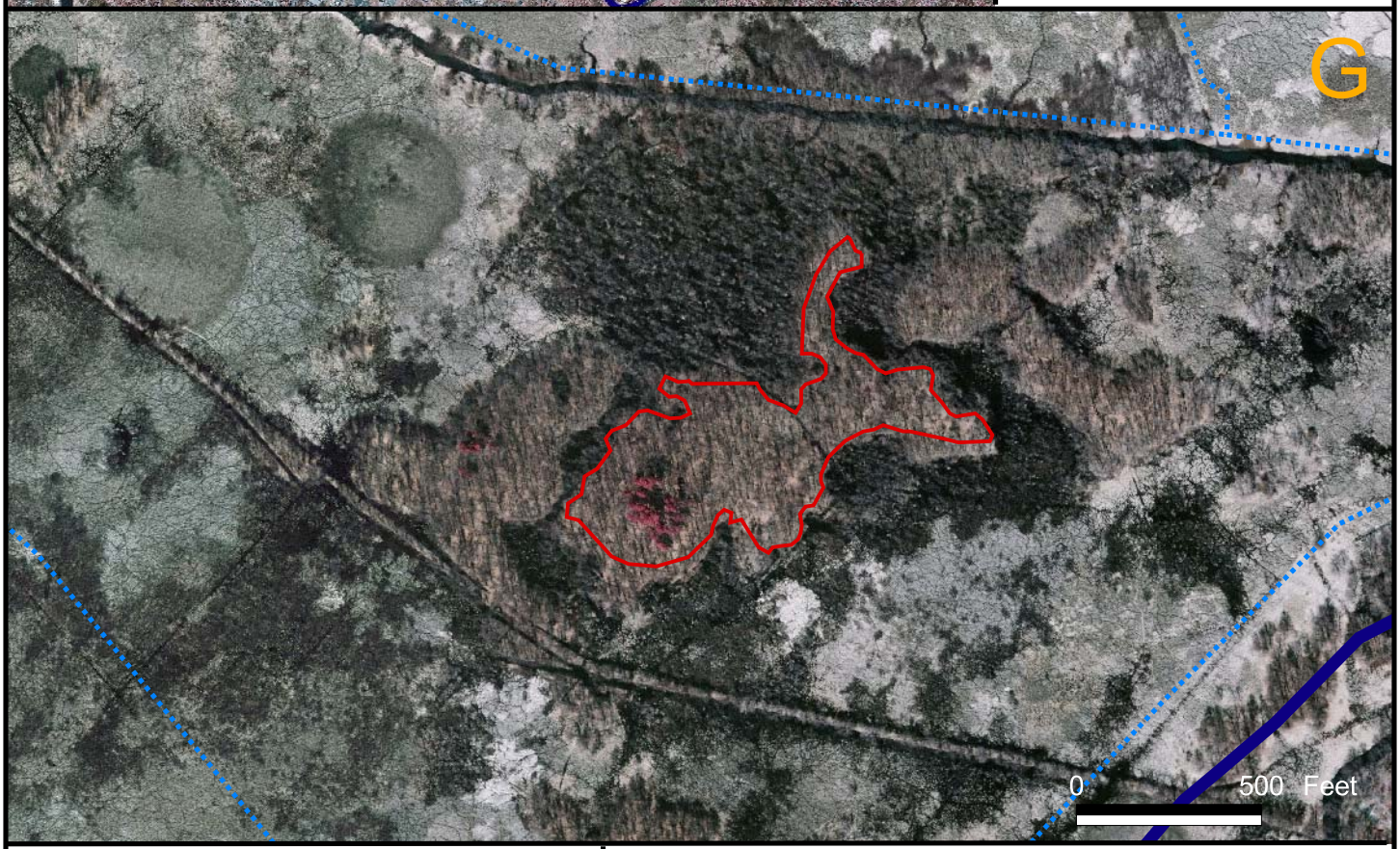


N
W E
S

LEGEND

- Watershed Boundary
- Areas of High Groundwater Recharge
- NJDOT 2004 Roads Data
- Lakes
- Highways
- Rivers & Streams

Data Source: NJGS 2000 Recharge Data; NJDEP 1996 GIS Data on CD-Rom



MAP 11G - HIGH GROUNDWATER RECHARGE AREAS MAP

Troy Brook Regional Stormwater Management Plan

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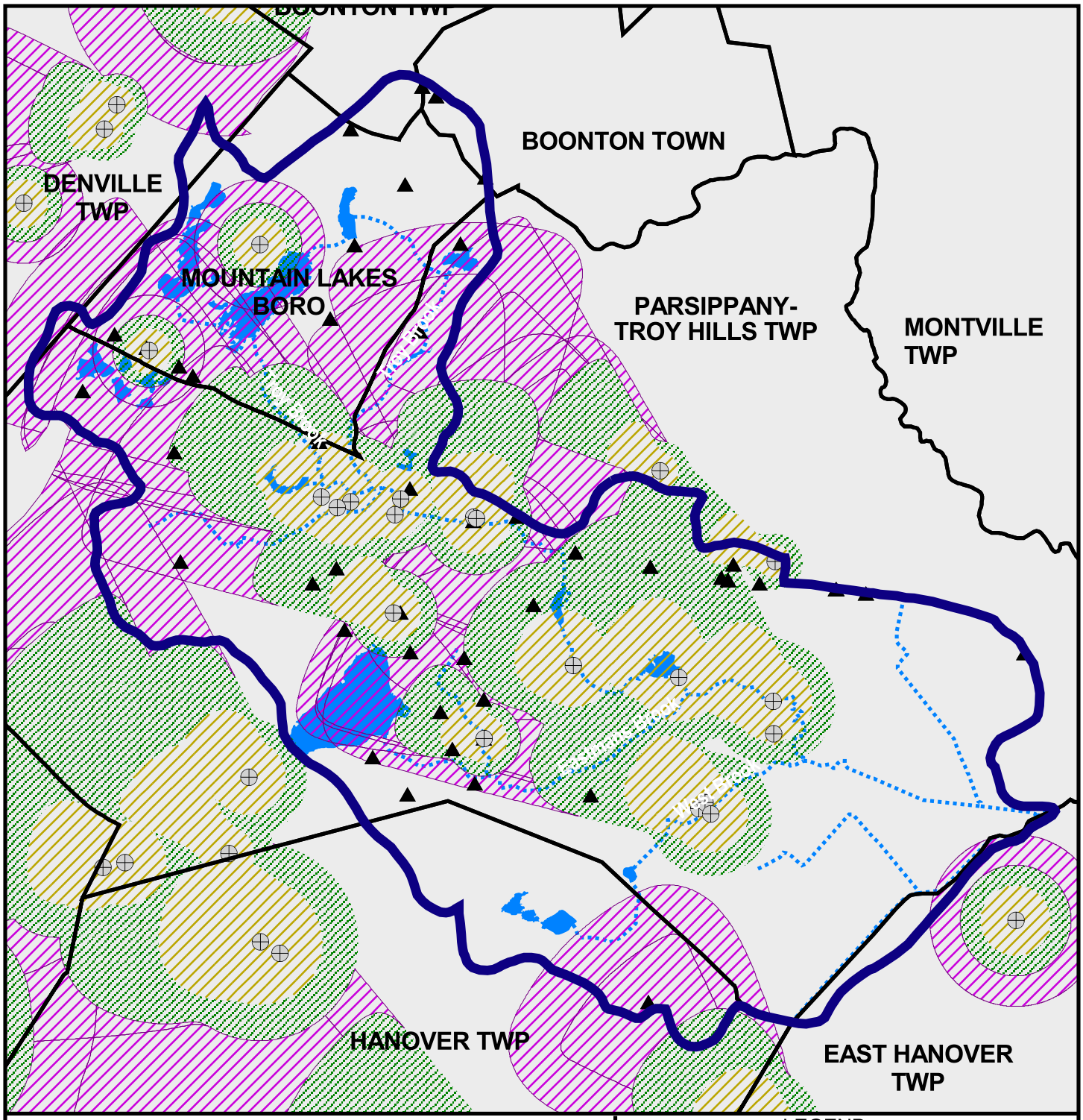

MAP 12 - WELLHEAD PROTECTION AREAS MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 2002 Digital Orthophotos; NJDEP 1996 GIS Data CD-ROM; NJDEP WHPA, 2002; PCWS Data , 1997; NJDEP KCS List, 2001

LEGEND

- Watershed Boundary
- Municipalities
- Public Community Water Supply Wells
- Known Contaminated Sites (2001)

NJGS Wellhead Protection Areas

- 2-Year Time of Travel to Well
- 5-Year Time of Travel to Well
- 12-Year Time of Travel to Well
- Rivers & Streams (Labeled)
- Lakes

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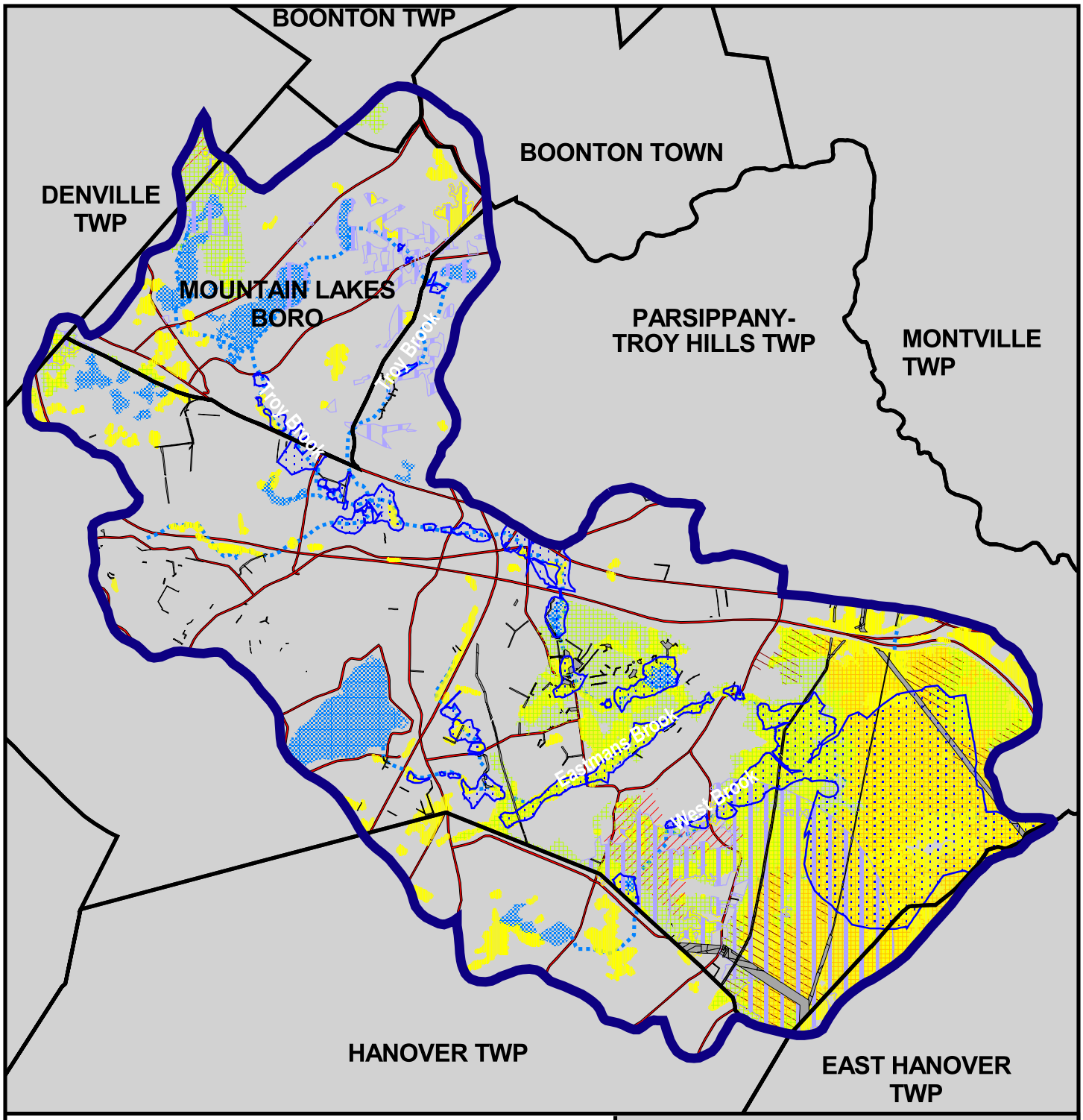
N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 13 - ENVIRONMENTALLY CONSTRAINED AREAS MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1996 GIS Data CD-ROM; Township of Parsippany-Troy Hills Easements; CRSSA Local Open Space Data; NJDEP Landscape Project, 2001

LEGEND

- Watershed Boundary
- Municipalities
- 100-Year Floodplain
- Parsippany-Troy Hills Easements
- Wood Turtle Habitat
- Forest Critical Habitat for T&E Species
- Emergent Wetland Habitat for T&E Species
- Lakes
- State Open Space
- Local Open Space
- Wetlands + 50' Buffer
- Rivers & Streams (Labeled)
- Highways

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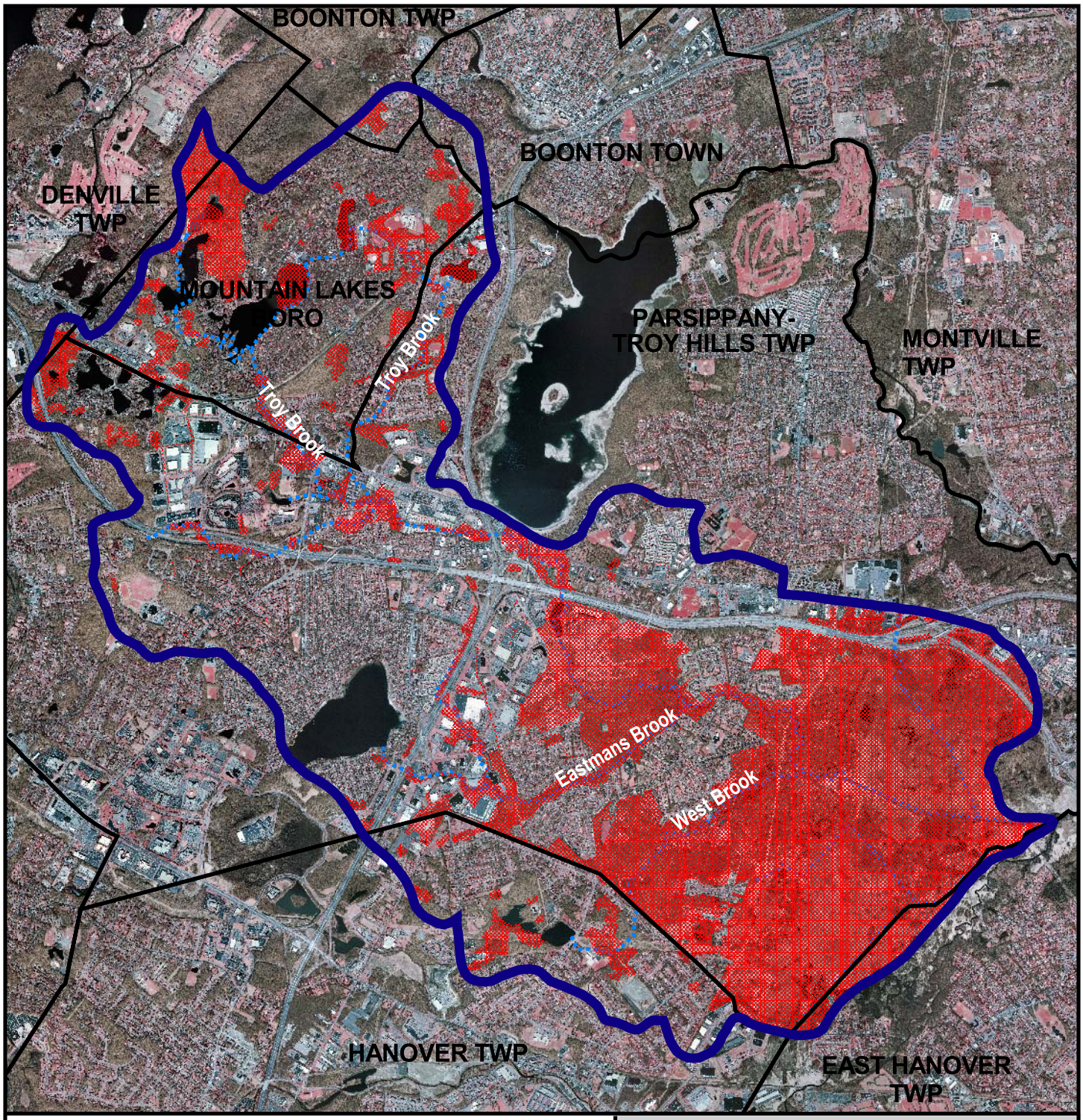
N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 13A - ENVIRONMENTALLY CONSTRAINED AREAS AERIAL MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1996 GIS Data CD-ROM; Township of Parsippany-Troy Hills Easements; CRSSA Local Open Space Data; NJDEP Landscape Project, 2001; NJDEP 2002 Digital Orthophotos

LEGEND

- Watershed Boundary
- Municipalities
- Environmentally Constrained Areas
- Rivers & Streams (Labeled)

NEW JERSEY AGRICULTURAL EXPERIMENT STATION
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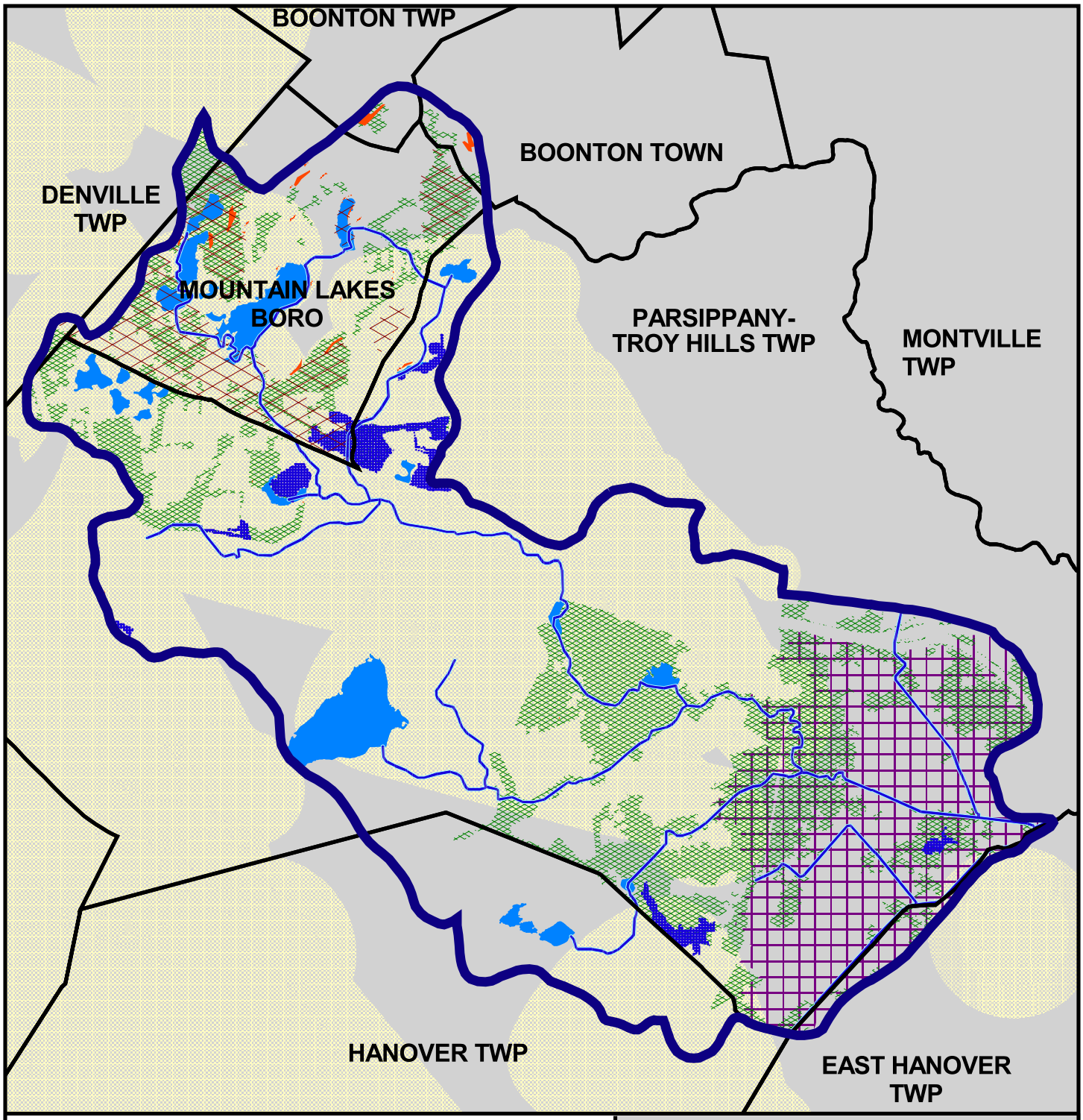
N
W E
S

1 inch = 4500 feet

0 4500 Feet



MAP 14 - ENVIRONMENTALLY CRITICAL AREAS MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1996 GIS Data CD-ROM; NJDEP Landscape Project, 2001; NJDEP 10-Meter Digital Elevation Grid, 2002; NJ State Development & Redevelopment Plan, 2001; NJ Natural Heritage Priority Sites, 2001

LEGEND

- Watershed Boundary
- Municipalities
- Stream Corridor
- NJDEP Critical, Environmental, & Historic Sites
- Areas of High Ground-water Recharge
- Steep Slopes
  - > 15%
- Contiguous Forested Areas
- Lakes
- Natural Heritage Priority Sites
  - B4 Macrosite (Moderate Significance)
  - B4 Standard Site (Moderate Significance)
- NJGS Wellhead Protection Areas

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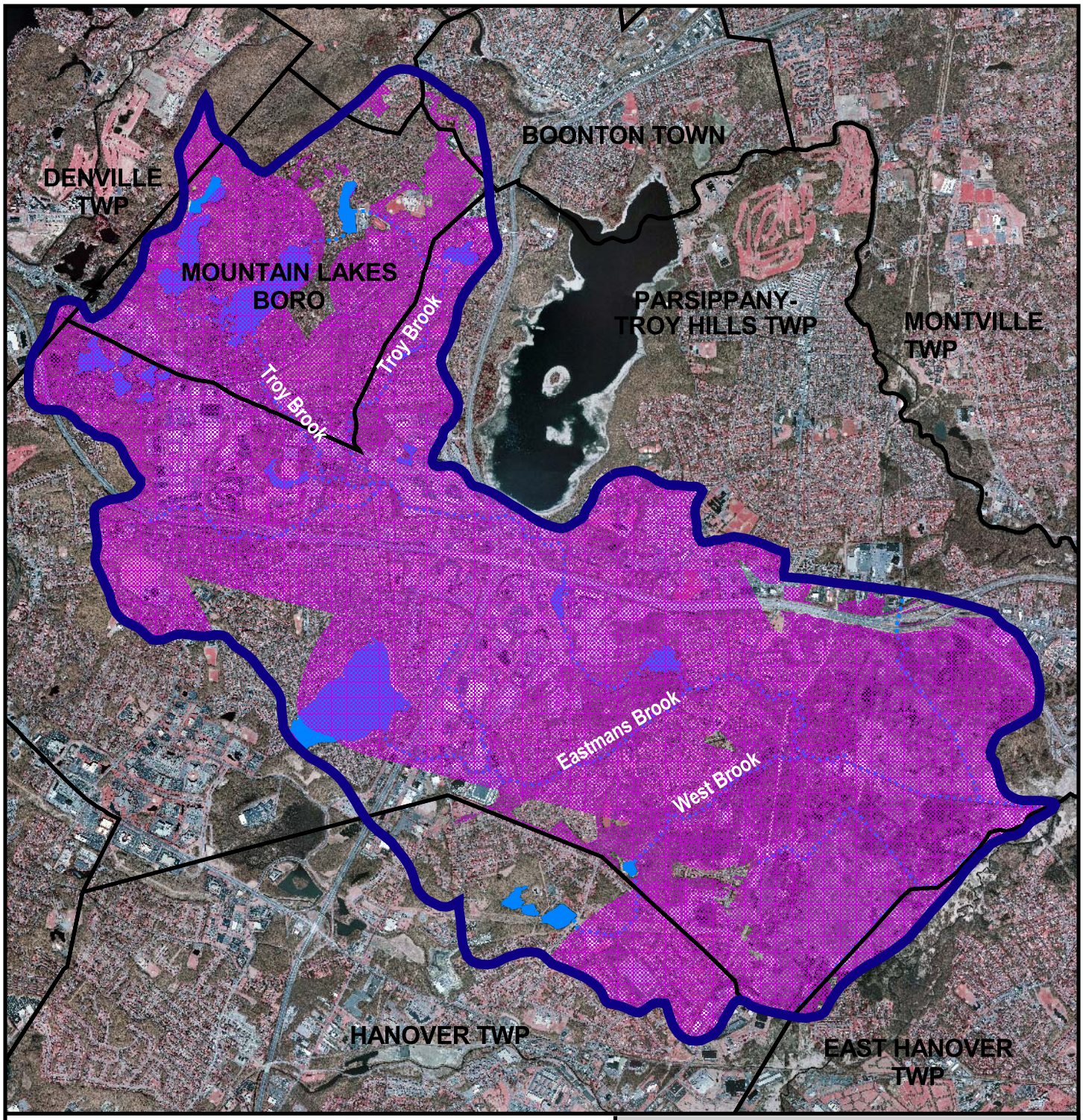
N
W E
S

1 inch = 4500 feet

0 4500 Feet



MAP 14A - ENVIRONMENTALLY CRITICAL AREAS AERIAL MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1996 GIS Data CD-ROM; Township of Parsippany-Troy Hills Easements; CRSSA Local Open Space Data; NJDEP Landscape Project, 2001; NJDEP 2002 Digital Orthophotos

LEGEND

- Watershed Boundary
- Municipalities
- Environmentally Constrained Areas
- Lakes
- Rivers & Streams (Labeled)

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N
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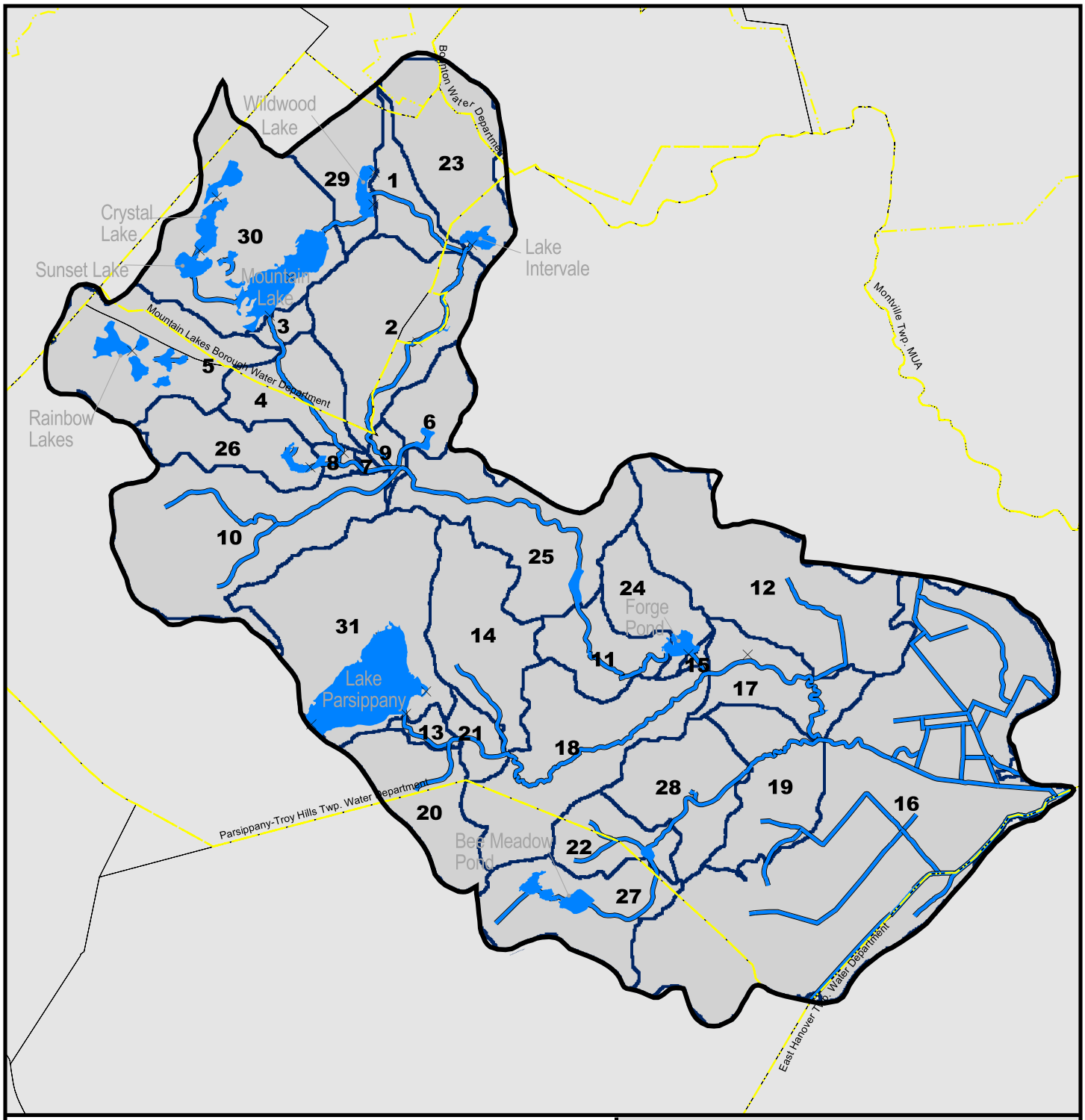
S

1 inch = 4500 feet

0 4500 Feet



MAP 15 - WATERBODY CLASSIFICATION MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1996 GIS Data CD-ROM; Subwatersheds delineated by HEC-RAS Model; NJDEP Surface Water Quality Standards, 2003

LEGEND

- Water Purveyor Boundary
- Watershed Boundary
- Municipalities
- Dams
- Lakes

NJDEP Surface Water Quality Standards

- FW2-NT
- Subbasins

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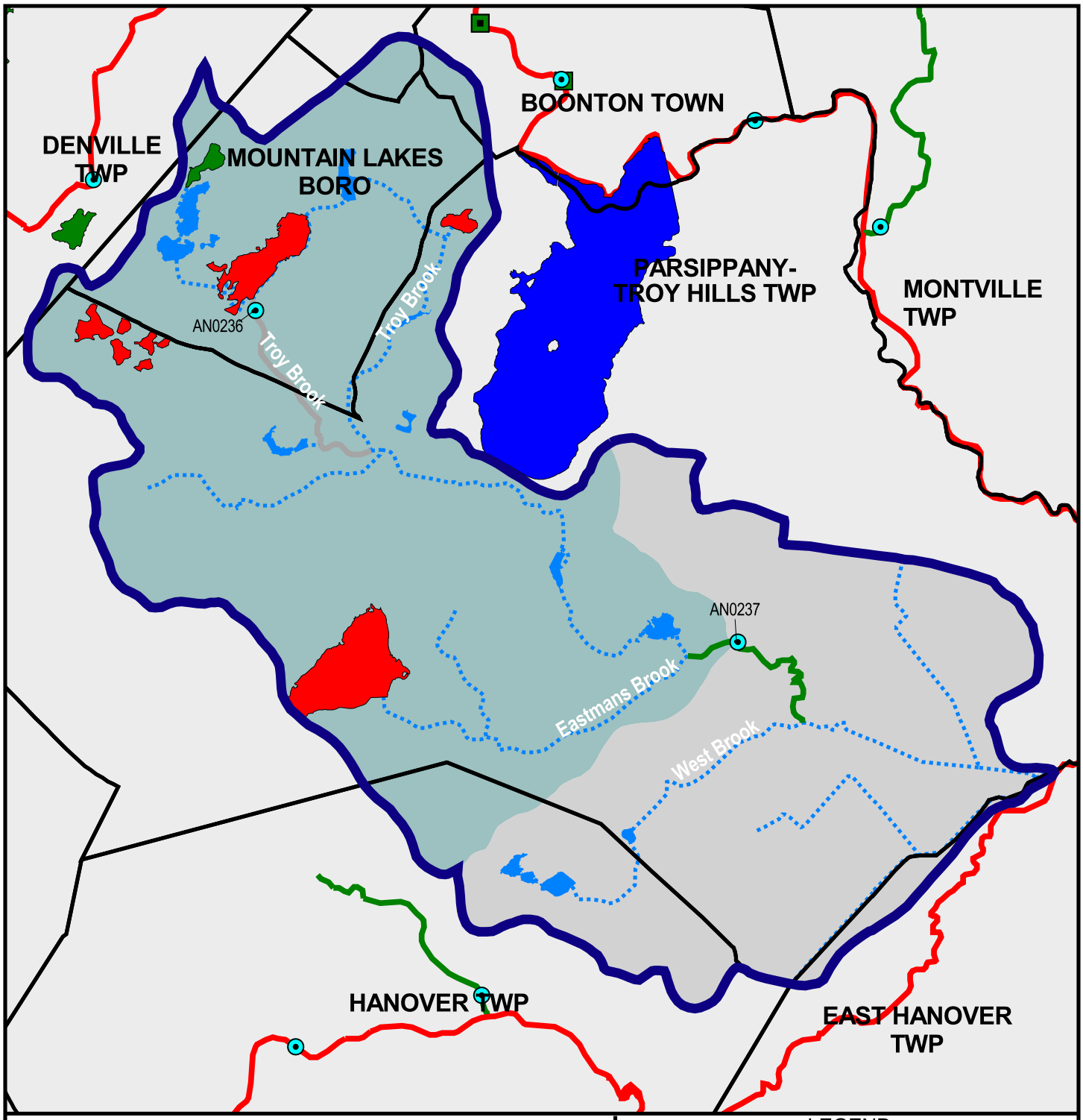
N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 16 - 2004 IMPAIRED WATERBODIES MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 2004 Integrated List of Impaired Waterbodies; NJDEP 1996 GIS Data on CD-Rom

LEGEND

- Municipal Boundaries
- Watershed Boundary
- AMNET Stations
- NJDEP Water Quality Monitoring Stations

2004 Impaired Rivers Status

- Fish Advisory Only
- Full Attainment
- Insufficient Data
- Sublist 4
- Non Attainment

2004 Impaired Lakes Status

- Fish Advisory Only
- Full Attainment
- Insufficient Data
- Sublist 4
- Non Attainment
- Rivers & Streams
- Lakes

Subwatersheds

- Upper Basin (HUC 02030103020080)
- Lower Basin (HUC 02030103020090)

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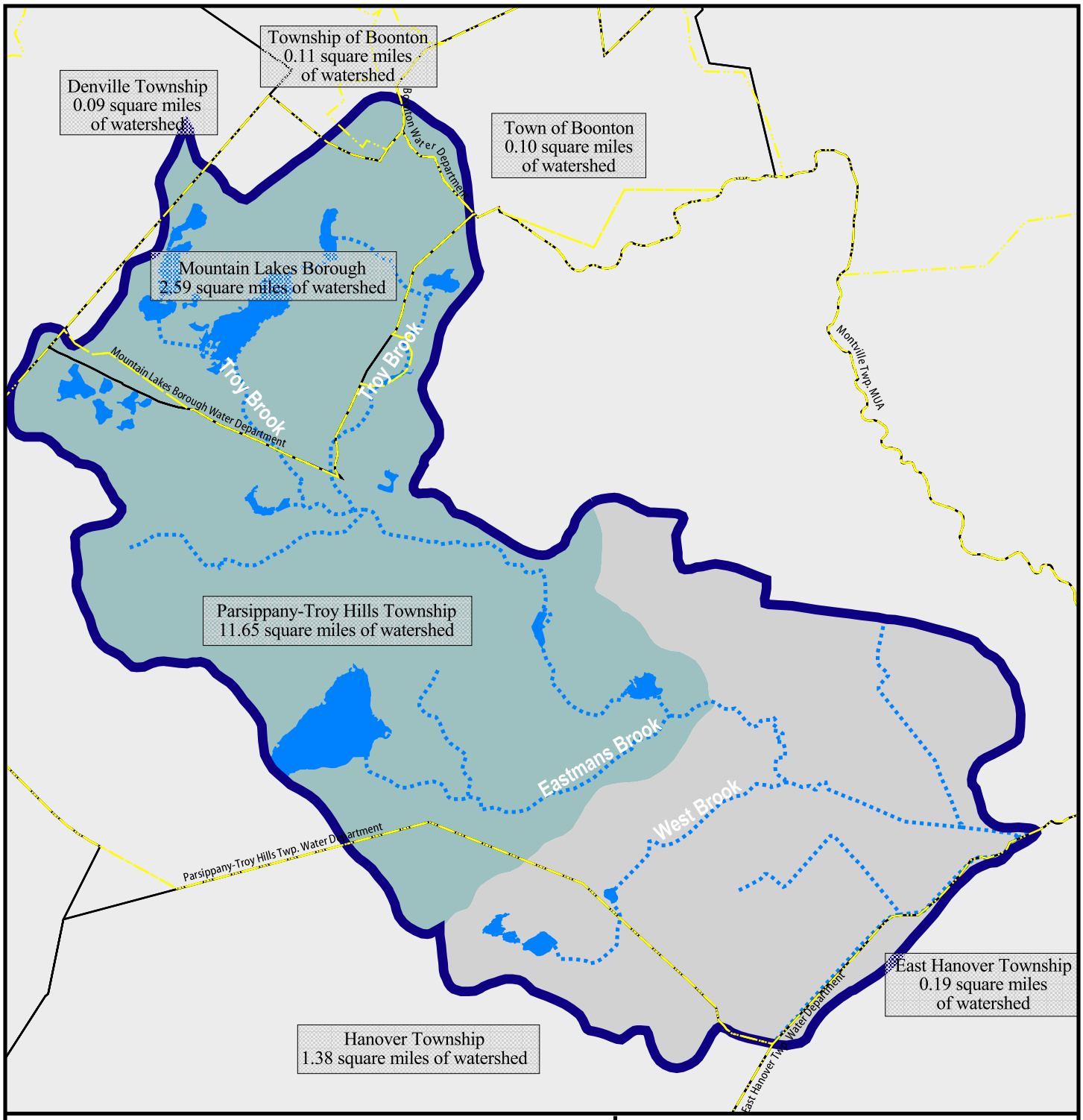
N W E S

1 inch = 4500 feet

0 4500 Feet



MAP 17 - JURISDICTIONAL BOUNDARIES OF THOSE AGENCIES RESPONSIBLE FOR STORMWATER MANAGEMENT

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1996 GIS Data CD-ROM

LEGEND

- Water Purveyor Boundary
- Watershed Boundary
- Municipalities
- Lakes
- Rivers & Streams (Labeled)

Subwatersheds

- Upper Basin (HUC 02030103020080)
- Lower Basin (HUC 02030103020090)

** The Troy Brook Watershed lies entirely within Morris County.*

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N
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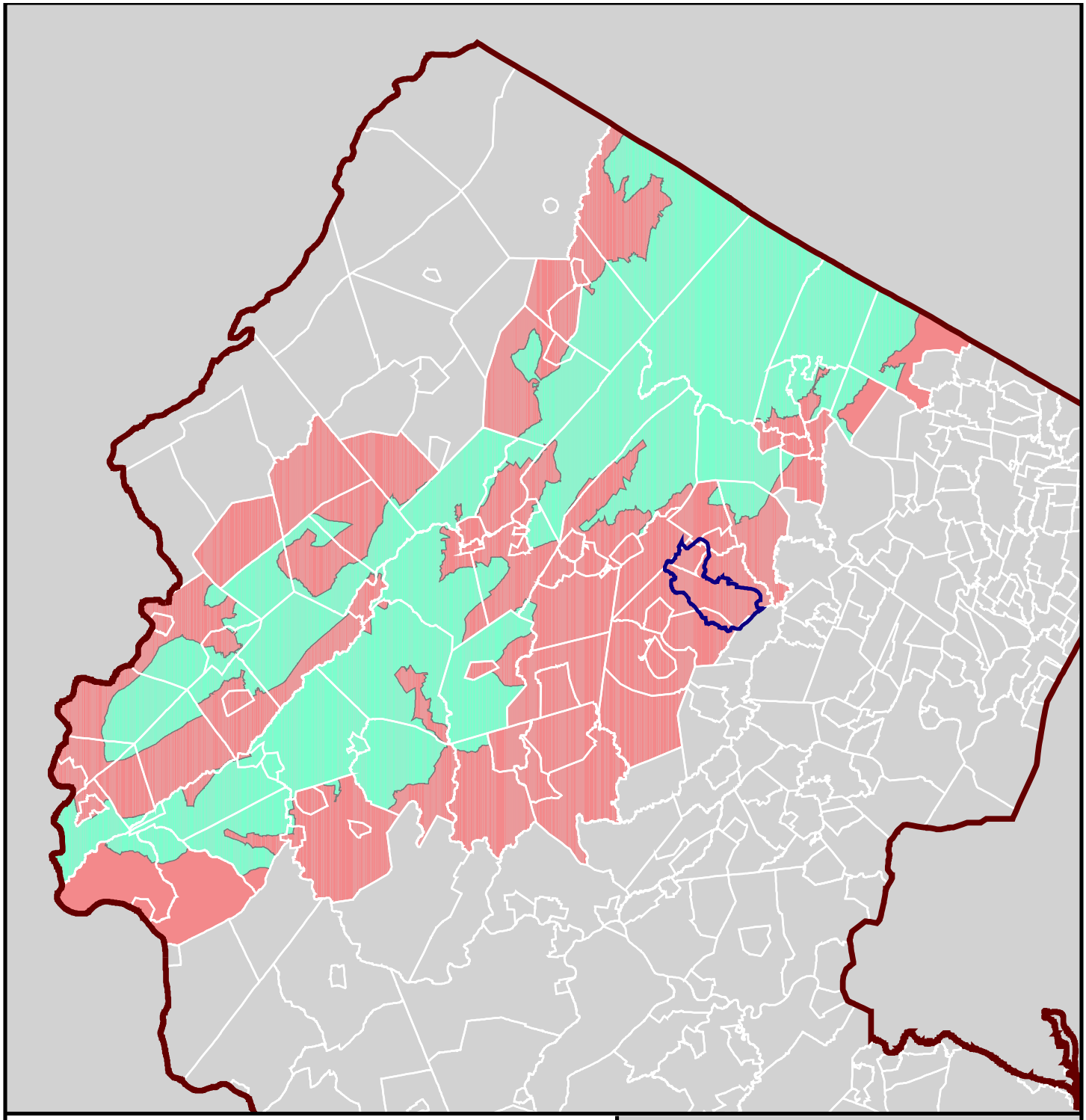
S

1 inch = 4500 feet

0 4500 Feet



MAP 17A - HIGHLANDS PRESERVATION AND PLANNING AREA

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1996 GIS Data CD-ROM;
NJDEP Highlands Preservation and Planning Area, 2004

LEGEND

- Watershed Boundary
- State Boundary
- Municipal Boundary

Highlands Preservation and Planning Area

- Highlands Planning Area
- Highlands Preservation Area

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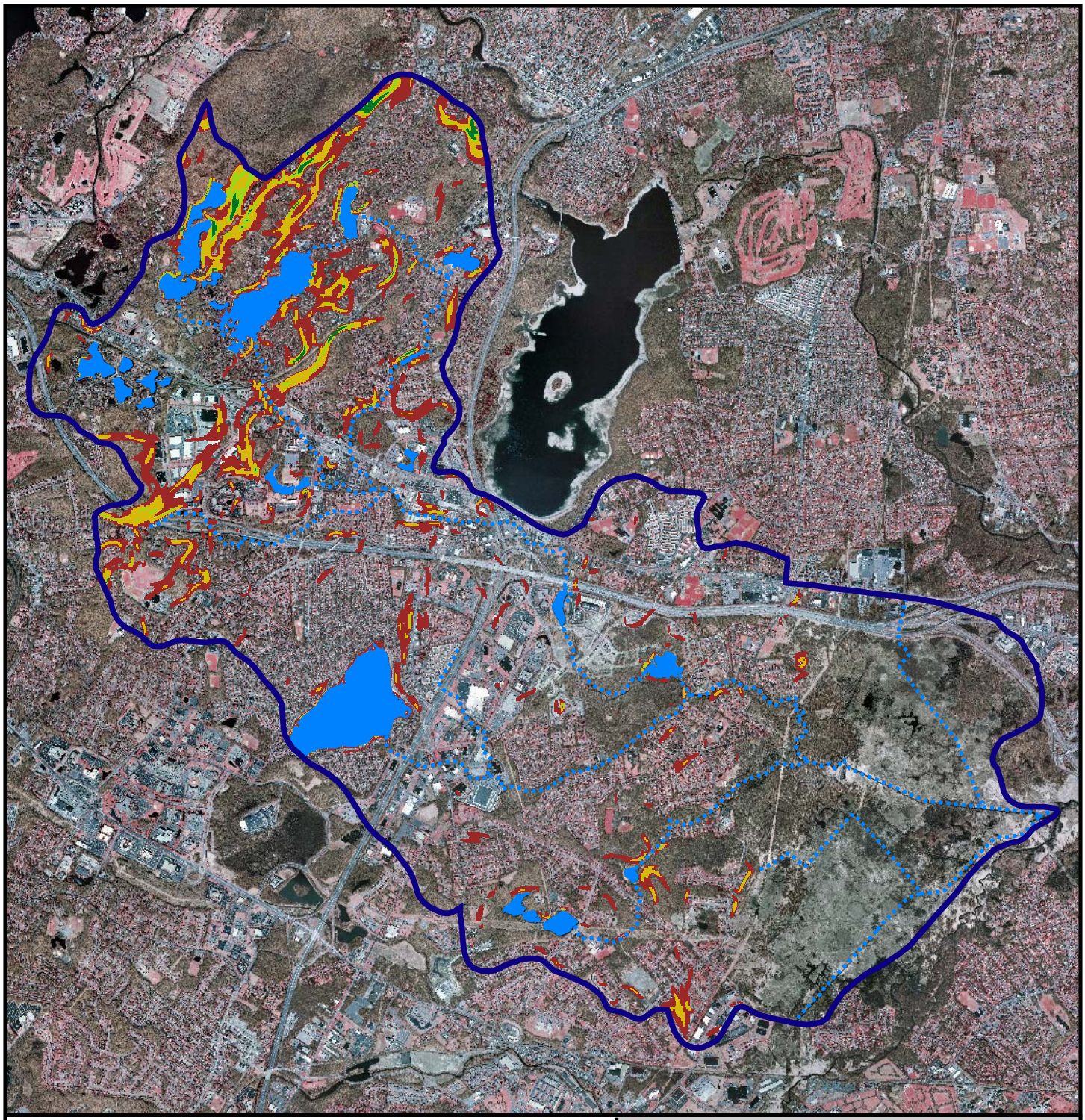
N
W E
S

1 inch = 9 miles

0 9 Miles



MAP 18 - SLOPES MAP

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP WMA 6 DEM data; NJDEP 1996 GIS Data CD-ROM

LEGEND

- Watershed Boundary
- Rivers & Streams
- Lakes

Slope Data

- 5 - 8 %
- 8 - 12 %
- 12 - 15 %
- > 15 %

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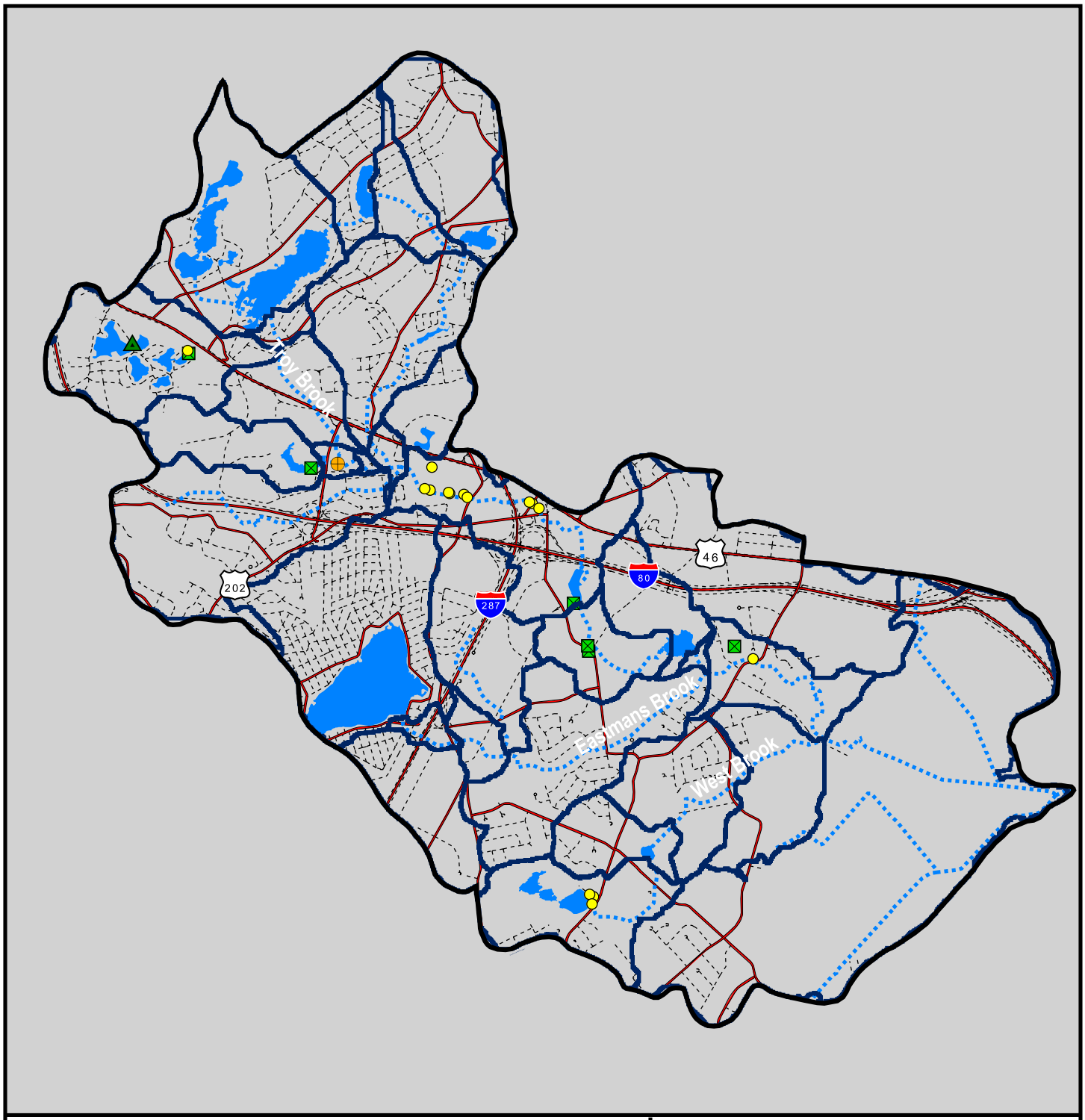
N
W E
S

1 inch = 4500 feet

0 4500 Feet



MAP 19 - MAN-MADE STORMWATER CONVEYANCE, STORAGE, AND DISCHARGE SYSTEMS

Troy Brook Regional Stormwater Management Plan

Data Source: NJDEP 1996 GIS Data CD-ROM; GPS Mapping Completed by RCRE Water Resources Program, 2005.

** RCRE Water Resources Program acknowledges that this stormwater conveyance system map is not complete.*

LEGEND

Man-Made Stormwater Conveyance, Storage, & Discharge Systems
- Swale
- Culvert
- Outfall Pipe
- Detention Basin

Watershed Boundary
Lakes
Rivers & Streams

Highways
Roads
Subbasins

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N W E S

1 inch = 4500 feet

0 4500 Feet

Appendix C:

NJDEP Known Contaminated Sites List within the Troy Brook Watershed

Status	Date of Status Reporting	Name	NJ Site ID	Address	Municipality	Lead Agency	Level of Remediation
ACTIVE	2001	PFIZER INCORPORATED	NJD002188811	100 JEFFERSON RD	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	C2
ACTIVE	2000	700 EDWARDS RD	NJL800612574	700 EDWARDS RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C2
ACTIVE	2000	532 POWERVILLE RD	NJL800612491	532 POWERVILLE RD	BOONTON TOWN	BFO-N	
ACTIVE	2000	142 HAWKINS AVE	NJL800590630	142 HAWKINS AVE	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
ACTIVE	2000	28 DEERFIELD ROAD	NJL800214314	28 DEERFIELD RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
ACTIVE	2000	23 ALPINE RD	NJL800525016	23 ALPINE RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C2
ACTIVE	2000	97 KENILWORTH AVE	NJL800588709	97 KENILWORTH AVE	MOUNTAIN LAKES BOROUGH	BFO-N	C1
ACTIVE	2000	56 FAIRFIELD ROAD	NJL800391542	56 FAIRFIELD RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
ACTIVE	2000	109 ELY ST	NJL800575201	109 ELY ST	BOONTON TOWN	BFO-N	C1
ACTIVE	2000	SPANJER BROTHERS INCORPORATED	NJD980775241	77 HALSEY RD E	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C2
ACTIVE	1999	20 DEAUVILLE DR	NJL800492209	20 DEAUVILLE DR	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
ACTIVE	1999	REYNOLDS AND REYNOLDS COMPANY	NJL800503237	280 WALSH DR	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1

ACTIVE	1999	16 HENNION DR	NJL800487985	16 HENNION DR	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
ACTIVE	1999	178 ALLENTOWN RD	NJL800477010	178 ALLENTOWN RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
ACTIVE	1999	745 ROUTE 46 EAST	NJL800438020	745 RTE 46 E	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	
ACTIVE	1999	MOUNTAIN LAKES MOTORS	NJL800474561	12 BALDWIN LN	MOUNTAIN LAKES BOROUGH	BFO-IN	B
ACTIVE	1998	41 LOWELL AVE	NJL800431330	41 LOWELL AVE	MOUNTAIN LAKES BOROUGH	BFO-N	C1
ACTIVE	1998	67 BRIARCLIFF RD	NJL800419228	67 BRIARCLIFF RD	MOUNTAIN LAKES BOROUGH	BFO-N	C2
ACTIVE	1998	228 CAMDEN RD	NJL800410037	228 CAMDEN RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
ACTIVE	1998	B & V TAILORING & CLEANING	NJD011463163	RTE 46	MOUNTAIN LAKES BOROUGH	BSM	C2
ACTIVE	1997	PARSIPPANY TROY HILLS WATER DEPARTMENT WELL 4 & 4A	NJL000073924	PARSIPPANY BLVD	PARSIPPANY-TROY HILLS TOWNSHIP	BSM	NA
ACTIVE	1997	HESS SERVICE STATION	NJL800076309	RTE 46 E	MOUNTAIN LAKES BOROUGH	BUST	C2
ACTIVE	1997	TROY HILLS SHOPPING CENTER	NJL000067553	RTE 46 & BEVERWYCK RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C2
ACTIVE	1995	AMOCO SERVICE STATION	NJD986610046	277 RTE 46 W	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	C2
ACTIVE	1993	FAITHFUL SOURCE BOOK STORE	NJL800025736	150 RTE 46	MOUNTAIN LAKES BOROUGH	BFO-IN	C1
ACTIVE	1993	UNITED PARCEL SERVICE	NJD980755706	799 JEFFERSON RD	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	C2
ACTIVE	1993	64 HIGHWOOD ROAD	NJL800003352	64 HIGHWOOD RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1

ACTIVE	1993	BOONTON ELECTRONICS CORPORATION	NJD980536114	499 POMEROY RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C2
ACTIVE	1992	L P THEBAULT COMPANY INCORPORATED	NJD982530891	249 POMEROY RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C2
ACTIVE	1992	MOBIL SERVICE STATION	NJL600193833	267 PARSIPPANY RD	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	C2
ACTIVE	1992	AMOCO SERVICE STATION	NJC876026055	859 RTE 46 E	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	B
ACTIVE	1991	EXXON SERVICE STATION	NJD986599835	RTE 46 & SANDRA DR	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	C2
ACTIVE	1991	ATLAS SOUND DIVISION	NJD001354513	10 POMEROY RD	PARSIPPANY-TROY HILLS TOWNSHIP	BEECRA	C2
ACTIVE	1991	GULF SERVICE STATION	NJD000599035	1409 RTE 46 & BALDWIN AVE	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	C2
ACTIVE	1991	ASCO ELECTRIC PRODUCTS COMPANY INC	NJD071173066	7 EASTMANS RD	PARSIPPANY-TROY HILLS TOWNSHIP	BEECRA	C2
ACTIVE	1990	STANDARD FUSEE CORPORATION	NJL500030408	MORRIS AVE & FANNY RD	MOUNTAIN LAKES BOROUGH	BEECRA	C3
ACTIVE	1989	SUNOCO SERVICE STATION	NJD000705228	1947 RTE 46	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	C2
ACTIVE	1988	KEUFFEL & ESSER COMPANY	NJD981134372	1259 RTE 46	PARSIPPANY-TROY HILLS TOWNSHIP	BUST	B
ACTIVE	1985	ROWE INTERNATIONAL INCORPORATED	NJD042902916	75 TROY HILLS RD	HANOVER TOWNSHIP	BEECRA	D
NO FURTHER ACTION	1999	GRIFFITH PRIDEAUX REALTY	NJL800465510	355 RTE 46 W	MOUNTAIN LAKES BOROUGH	BFO-N	C1
PENDING	1999	THE HUNDAL GROUP	NJD986569911	1259 RTE 46	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C2
PENDING	1999	TRANS CITY	NJL800228108	1272 RTE 46	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	NA

PENDING	1996	SYNTHATRON CORPORATION	NJD042061978	50 INTERVALE RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-CA	C3
PENDING	1996	WILLIAM SCERBO & SONS INCORPORATED	NJD011596319	3469 RTE 46	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
PENDING	1995	PARSIPPANY TROY HILLS DEPT PUBLIC WORKS	NJL820001642	1 PUMP HOUSE RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C1
PENDING	1993	15A ALLOWAY ROAD	NJL000069716	15A ALLOWAY RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-N	C2
PENDING	1992	7520 ROUTE 46 WEST	NJL600197784	7520 RTE 46 W	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-IN	
PENDING	1992	PARSIPPANY TROY HILLS WATER DEPT WELL 7	NJL000033944	HALSEY RD	PARSIPPANY-TROY HILLS TOWNSHIP	BFO-CA	C3

Lead Agencies:

BEECRA	*Bureau of Environmental Evaluation, Cleanup and Responsibility Assessment*
BFO-IN	*Bureau of Field Operations - Initial Notice Section*
BFO-N	*Bureau of Field Operations - Northern*
BFO-CA	*Bureau of Field Operations - Case Assignment Section*
BSM	*Bureau of Site Management*
BUST	*Bureau of Underground Storage Tanks*

Levels of Remediation:

B	*A single-phase remedial action in response to a single contaminatn category affecting only soils. Example remediations include drum removal, fencing, and temporary capping.*
C	*Ranges from 1 to 3 and may include an unknown and/or uncontrolled source or discharge. May involve groundwater contamination. There may not be a determinable timeframe for conclusion of remedial action. Examples of C1 cases include unregulated storage tank leaks.*
D	*A multi-phase remedial action in response to multiple, unknown and/or uncontrolled sources or releases affecting multiple medium which includes known contamaintion of groundwater. Contamination is unquantifiable, and therefore, no determinable timeframe for conclusion of remedial activities is known (NJDEP Known Contaminated Site List for NJ, 2001).*
NA	*Not available*

Appendix D: Pollutant Loading Coefficients

NJDEP 1995/97 Land Use Type	**Aerial Loading Source Analysis: Loading Rates**										
	TP (lbs/acre/yr)	*TN (lbs/acre/yr)*	*TSS (lbs/acre/yr)*	*NH3-N (lbs/acre/yr)*	*LEAD (lbs/acre/yr)*	*ZINC (lbs/acre/yr)*	*COPPER (lbs/acre/yr)*	*CADMIUM (lbs/acre/yr)*	*BOD (lbs/acre/yr)*	*COD (lbs/acre/yr)*	*NO2+NO3 (lbs/acre/yr)*
High/Med Residential	1.4	15	140	0.65	0.2965	0.335	0.453	N/A	25.6	152.6	1.7
Low/Rural Residential	0.6	5	100	0.02	0.217	0.172	0.19	N/A	N/A	N/A	0.1
Commercial	2.1	22	200	1.9	0.955	0.873	0.784	0.002	42.1	662.6	3.1
Industrial	1.5	16	200	0.2	1.409	1.598	0.93	0.003	31.4	N/A	1.3
Mixed Urban	1	10	120	1.75	3.215	1.743	1.529	0.0025	67.2	184.8	3.55
Agriculture	1.3	10	300	N/A	0.071	0.089	0.027	N/A	15.45	N/A	N/A
Forest, Water, Wetlands	0.1	3	40	N/A	0.009	0.018	0.027	N/A	9.2	2	0.3
Barren Land	0.5	5	60	N/A	N/A	0.002	N/A	N/A	3.1	N/A	N/A
N/A: Data not available from sources used.											
The loading coefficients used in this table have been provided by the NJDEP in the "New Jersey Stormwater Best Management Practices Manual," February 2004.											

Appendix E: Macroinvertebrate Sampling

Table 1: Habitat Assessment for High Gradient Streams

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regimes	All 4 velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (slow is < 0.3 m/s, deep is > 0.5 m)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity / depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (< 20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Bank Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone < 6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

HABITAT SCORES	VALUE
OPTIMAL	160 – 200
SUB-OPTIMAL	110 – 159
MARGINAL	60 – 109
POOR	< 60

TABLE 2. Results of the Benthic Macroinvertebrate Sampling

Location A – Troy Brook at Lake Drive

Taxa:	***Number:***
Tricladida (flatworms)	
Planariidae	
Dugesia sp.	7
Tubificida (worms)	
Naididae	1
Amphipoda (scuds/side swimmers)	
Gammaridae	
Gammarus sp.	85
Collembola (springtails)	
Isotomidae	
Isotomurus sp.	1
Trichoptera (caddisflies)	
Hydropsychidae	
Cheumatopsyche sp.	1
Hydropsyche sp.	6
Leptoceridae	
Ceraclea sp.	1
Coleoptera (beetles)	
Elmidae	
Stenelmis sp. (adult)	1
Hydrophilidae	
Hydrochus sp.	1
Diptera (true flies)	
Chironomidae	
Orthocladiinae	4
Simuliidae	
Simulium sp.	1
Total # taxa:	***11***
Total # individuals:	***109***

TABLE 2. Results of the Benthic Macroinvertebrate Sampling (continued)

Location B – Unnamed Tributary to Troy Brook at Sherwood Drive

Taxa:	***Number:***
Tricladida (flatworms)	
Planariidae	
Dugesia sp.	11
Arhynchobdellida (leeches)	
Erpobdellidae	
Erpobdella punctata	1
Limnophila (freshwater snails)	
Physidae	
Physa sp.	3
Amphipoda (scuds/side swimmers)	
Gammaridae	
Gammarus sp.	4
Ephemeroptera (mayflies)	
Baetidae	
Baetis sp.	4
Trichoptera (caddisflies)	
Hydropsychidae	
Cheumatopsyche sp.	3
Hydropsyche sp. (pupae)	3
Hydropsyche sp.	22
Leptoceridae	
Mystacides sp.	1
Philopotamidae	
Chimarra sp.	13
Uenoidae	
Neophylax sp.	2
Coleoptera (beetles)	
Elmidae	
Stenelmis sp. (adult)	17
Stenelmis sp.	5
Psephenidae	
Ectopria sp.	1
Psephenus sp.	1

TABLE 2. Results of the Benthic Macroinvertebrate Sampling (continued)

Diptera (true flies)	
Chironomidae	
Chironominae	5
Orthocladiinae	1
Simuliidae	
Simulium sp.	2
Tipulidae	
Tipula sp.	1
Total # taxa:	***17***
Total # individuals:	***100***

Location C – Troy Brook at Waterview Park

Taxa:	***Number:***
Tricladida (flatworms)	
Planariidae	
Dugesia sp.	1
Limnophila (freshwater snails)	
Physidae	
Physa sp.	1
Amphipoda (scuds/side swimmers)	
Gammaridae	
Gammarus sp.	41
Decapoda (crayfish)	
Cambaridae *(immature/female)*	1
Ephemeroptera (mayflies)	
Baetidae	
Baetis sp.	8
Trichoptera (caddisflies)	
Hydropsychidae	
Cheumatopsyche sp.	14
Hydropsyche sp. (pupae)	1
Hydropsyche sp.	1
Coleoptera (beetles)	
Elmidae	
Stenelmis sp. (adult)	12
Stenelmis sp.	8

TABLE 2. Results of the Benthic Macroinvertebrate Sampling (continued)

Diptera (true flies)	
Chironomidae	
Chironominae	1
Orthocladiinae	1
Total # taxa:	***10***
Total # individuals:	***105***

Location D – Troy Brook at Smith Road

Taxa:	***Number:***
Tubificida (worms)	
Naididae	1
Isopoda (pill bugs/sow bugs)	
Asellidae	
Caecidotea sp.	3
Amphipoda (scud/ side swimmer)	
Gammaridae	
Gammarus sp.	2
Decapoda (crayfish)	
Cambaridae *(immature/female)*	2
Hemiptera (true bugs)	
Gerridae	
Gerris sp.	1
Trichoptera (caddisflies)	
Hydropsychidae	
Cheumatopsyche sp.	7
Hydropsyche sp. (pupae)	1
Hydropsyche sp.	70
Coleoptera (beetles)	
Elmidae	
Stenelmis sp. (adult)	7
Stenelmis sp.	5

TABLE 2. Results of the Benthic Macroinvertebrate Sampling (continued)

Diptera (true flies)	
Simuliidae	
Simulium sp.	3
Total # taxa:	***9***
Total # individuals:	***102***

Location E – Eastmans Brook at Smith Road

Taxa:	***Number:***
Tricladida (flatworms)	
Planariidae	
Dugesia sp.	54
Tubificida (worms)	
Naididae	2
Amphipoda (scuds/side swimmers)	
Gammaridae	
Gammarus sp.	1
Coleoptera (beetles)	
Elmidae	
Stenelmis sp. (adult)	29
Stenelmis sp.	13
Diptera (true flies)	
Chironomidae	
Chironominae	2
Total # taxa:	***5***
Total # individuals:	***101***

Location F – Troy Brook at Beverwyk Road

Taxa:	***Number:***
Tricladida (flatworms)	
Planariidae	
Dugesia sp.	2
Arhynchobdellida (leeches)	
Erpobdellidae	
Erpobdella punctata	1

TABLE 2. Results of the Benthic Macroinvertebrate Sampling (continued)

Limnophila (freshwater snails)	
Ancylidae	
Laevapex fuscus	5
Isopoda (pill bugs/sow bugs)	
Asellidae	
Caecidotea sp.	1
Amphipoda (scuds/side swimmers)	
Gammaridae	
Gammarus sp.	4
Collembola (springtails)	
Isotomidae	
Isotomurus sp.	1
Ephemeroptera (mayflies)	
Baetidae	
Baetis sp.	1
Heptageniidae	
Stenacron sp.	10
Trichoptera (caddisflies)	
Hydropsychidae	
Cheumatopsyche sp.	12
Hydropsyche sp. (pupae)	2
Hydropsyche sp.	17
Philopotamidae	
Chimarra sp.	11
Coleoptera (beetles)	
Elmidae	
Stenelmis sp. (adult)	5
Stenelmis sp.	1
Psephenidae	
Psephenus sp.	1
Diptera (true flies)	
Simuliidae	
Simulium sp.	3
Total # taxa:	***14***
Total # individuals:	***77***

TABLE 3. Scoring Criteria for Rapid Bioassessments in New Jersey Streams

	Non-impaired	***Moderately Impaired***	***Severely Impaired***
Biological Condition Score:	***6***	***3***	***0***
Biometrics:			
1. Taxa Richness	>10	10-5	4-0
2. EPT Index - Northern, NJ	>5	5-3	2-0
- Southern, NJ	>4	4-2	1-0
3. %CDF	<40	40-60	>60
4. %EPT	>35	35-10	<10
5. Family Biotic Index	0-4	4-6	6-10
Biological Condition:	Total Score		
Non-impaired	24-30		
Moderately impaired	9-21		
Severely impaired	0-6		

TABLE 4A. Calculation of Biological Condition for Location A

Taxa	***Tolerance Value***	***Location A Number of Individuals***
Planariidae	4	7
Naididae	7	1
Gammaridae	4	85
Isotomidae	10	1
Hydropsychidae	4	7
Leptoceridae	4	1
Elmidae	4	1
Hydrophilidae	5	1
Chironomidae	6	4
Simuliidae	6	1
Taxa Richness		10
EPT Index		2
%CDF		78% Gammaridae
%EPT		7.3%
Family Biotic Index		4.2
NJIS Rating		6
Biological Condition		Severely Impaired

TABLE 4B. Calculation of Biological Condition for Location B

Taxa	***Tolerance Value***	***Location B Number of Individuals***
Planariidae	4	11
Erpobdellidae	8	1
Physidae	7	3
Gammaridae	4	4
Baetidae	4	4
Hydropsychidae	4	28
Leptoceridae	4	1
Philopotamidae	3	13
Uenoidae	4	2
Elmidae	4	22
Psephenidae	4	2
Chironomidae	6	6
Simuliidae	6	2
Tipulidae	3	1
Taxa Richness		14
EPT Index		5
%CDF		28% Hydropsychidae

%EPT	48%
Family Biotic Index	4.2
NJIS Rating	24
Biological Condition	Non-Impaired

TABLE 4C. Calculation of Biological Condition for Location C

Taxa	***Tolerance Value***	***Location C Number of Individuals***
Planariidae	4	1
Physidae	7	1
Gammaridae	4	41
Cambaridae	6	1
Baetidae	4	8
Hydropsychidae	4	31
Elmidae	4	20
Chironomidae	6	2
Taxa Richness		8
EPT Index		2
%CDF		39% Gammaridae
%EPT		37.1%
Family Biotic Index		4.1
NJIS Rating		18
Biological Condition		Moderately Impaired

TABLE 4D. Calculation of Biological Condition for Location D

Taxa	***Tolerance Value***	***Location D Number of Individuals***
Naididae	7	1
Asellidae	8	3
Gammaridae	4	2
Cambaridae	6	2
Gerridae	8	1
Hydropsychidae	4	78
Elmidae	4	12
Simuliidae	6	3
Taxa Richness		8
EPT Index		1
%CDF		76.5% Hydropsychidae
%EPT		76.5%
Family Biotic Index		4.3
NJIS Rating		12
Biological Condition		Moderately Impaired

TABLE 4E. Calculation of Biological Condition for Location E

Taxa	***Tolerance Value***	***Location E Number of Individuals***
Planariidae	4	54
Naididae	7	2
Gammaridae	4	1
Elmidae	4	42
Chironomidae	6	2
Taxa Richness		5
EPT Index		0
%CDF		53.5% Planariidae
%EPT		0
Family Biotic Index		4.1
NJIS Rating		9
Biological Condition		Moderately Impaired

TABLE 4F. Calculation of Biological Condition for Location F

Taxa	***Tolerance Value***	***Location F Number of Individuals***
Planariidae	4	2
Erpobdellidae	8	1
Ancylidae	7	5
Asellidae	8	1
Gammaridae	4	4
Isotomidae	10	1
Baetidae	4	1
Heptageniidae	4	10
Hydropsychidae	4	31
Philopotamidae	3	11
Elmidae	4	6
Psephenidae	4	1
Simuliidae	6	3
Taxa Richness		13
EPT Index		4
%CDF		40.3% Hydropsychidae
%EPT		68.8%
Family Biotic Index		4.3
NJIS Rating		21
Biological Condition		Moderately Impaired