STORMWATER MANAGEMENT PLAN
FOR
DELAWARE TOWNSHIP,
HUNTERDON COUNTY, NEW JERSEY

PREPARED BY:

The Delaware Township
Stormwater Management Committee:

Ken Johnson
Steve Pasternack
Leslie Sauer
Jay Trstensky

With assistance from:

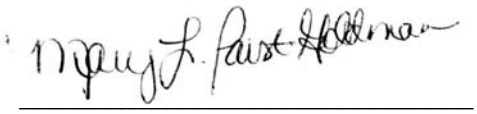
Princeton Hydro, LLC
1108 Old York Road, Suite 1
P.O. Box 720
Ringoes, New Jersey 08551
(P) 908.237.5660 • (F) 908.237.5666
email • info@princetonhydro.com

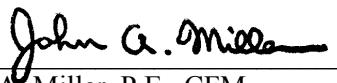
Adopted March 29, 2005
Princeton Hydro, LLC Project No. 546.001

DELAWARE TOWNSHIP
STORMWATER MANAGEMENT PLAN
CERTIFICATION

We certify that we have personally prepared and examined, and we are familiar with the information submitted herein including all attached documents, and that based on inquiry of those individuals immediately responsible for obtaining the information, to the best of our knowledge, we believe that the submitted information is true, accurate, and complete.

In addition, we certify that we are familiar with the Phase II Stormwater permitting requirements and that this plan was prepared in accordance with those regulations.

Prepared By:  Date: January 19, 2005
Mary L. Paist-Goldman, EIT

Project Manager:  Date: January 20, 2005
John A. Miller, P.E., CFM

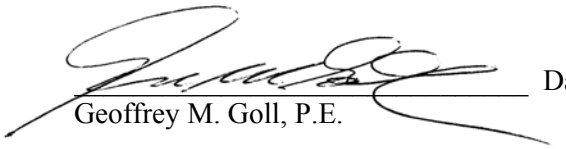
Project Principal:  Date: January 20, 2005
Geoffrey M. Goll, P.E.

Table of Contents

Appendices

1.0 Introduction

This document has been prepared in accordance with the New Jersey Department of Environmental Protection (herein referred to as NJDEP) *Tier B Stormwater Guidance Document* dated April 2004 in order to document Delaware Township's strategy to address stormwater-runoff impacts. It is important to note that this plan will require modification to incorporate the adopted municipal stormwater control ordinances in early 2006 as well as the pollutant loading analysis and build out analysis required.

1.1 How Does Stormwater Runoff Affect Us?

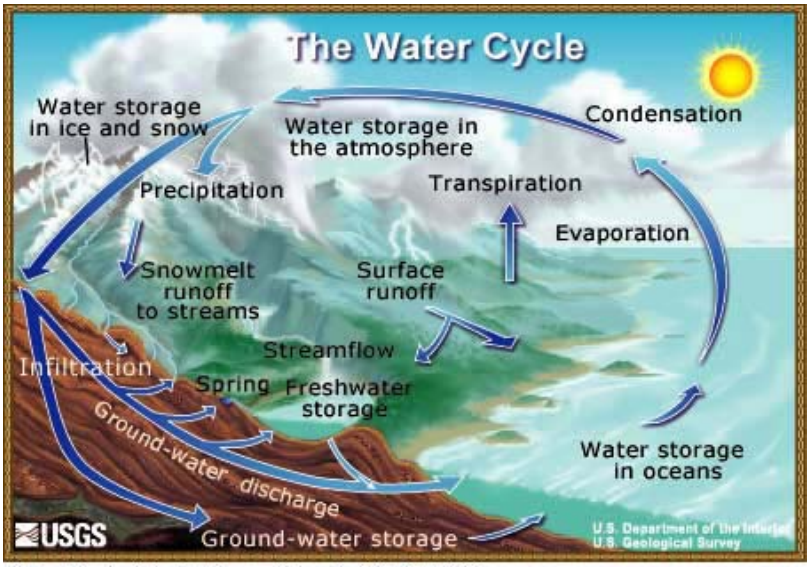


Illustration by John M. Evans, Colorado District, USGS

According to the United States Environmental Protection Agency (herein referred to as USEPA), stormwater runoff is part of the largest remaining major source of pollutants in our nation's waters and the quality of surface and ground waters is directly related to the health of the environment. NJDEP estimates that up to 60 percent of existing water pollution problems are attributable to nonpoint source (herein referred to as NPS) pollution. NPS pollution, and particularly, stormwater runoff is difficult to identify, control, and treat. In natural environments, those undisturbed by development, native vegetation either directly intercepts precipitation or draws from runoff that has infiltrated into the ground and returns it to the atmosphere through the process of evapotranspiration. A portion of precipitation runs off the land's surface to recharge the surface waters. Further, a portion of the rainfall that lands on the ground's surface infiltrates through the soil to the groundwater table and provides natural recharge of groundwater. This process, known as the hydrologic cycle, functions in equilibrium, but is extremely susceptible to impacts resulting from changes to the cycle's processes.

It has been shown that land development can dramatically impact the hydrology of a watershed if stormwater-runoff related impacts are not considered carefully. Development typically alters natural vegetation through the placement of lawns and impervious cover, thereby reducing the watershed's evaporation, transpiration and infiltration rates. Construction activities can compact soil and diminish its infiltration ability, resulting in increased volumes and rates of stormwater runoff from a property. In the past, development typically involved the construction of impervious areas connected to each other through gutters, channels, and storm sewers. These structures transport runoff more quickly than natural areas and cause significant erosion problems, water quality problems, and flooding in areas downstream.

Additionally, due to Delaware Township's rural nature there is concern regarding stormwater runoff from agriculture. Farms located adjacent to streams in the Township do not always have forested or vegetated

riparian buffers to protect the streams from agricultural runoff carrying nutrients and sediment to the streams. Further, livestock and horses that are not kept out of streams by vegetation or fencing can contribute additional nutrient and sediment runoff to streams as well.

Many times people do not know or understand that there are alternatives to the traditional way of managing their property. For example, homeowners can have a green lawn without massive doses of fertilizers and pesticides; horse owners can utilize fencing and vegetated riparian areas to keep horses away from environmentally sensitive areas and protect streams from potential erosion and water quality problems. Typically, people are unaware that untreated stormwater runoff enters waterbodies used for drinking water supplies and recreation.

1.2 Municipal Separate Stormwater Systems (MS4) Program

In response to the USEPA National Pollutant Discharge Elimination System (NPDES) Phase II regulations adopted in December 1999, the State of New Jersey developed the Municipal Stormwater Regulation Program. This program addresses pollutants entering our waters from stormwater management systems operated by local, county, state, interstate, and federal government agencies. These systems are referred to as "municipal separate storm sewer systems" or MS4s and are regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) Rules (N.J.A.C. 7:14A) and the NJDEP released four (4) NJPDES Stormwater General Permits for the various municipal separate storm sewer systems (MS4s). These include the Tier A Municipal Stormwater General Permit, Tier B Municipal Stormwater General Permit, Public Complex Stormwater General Permit, and the Highway Agency Stormwater General Permit. For each General Permit, NJDEP has mandated Statewide Basic Requirements (herein referred to as SBRs), which include minimum standards, measurable goals, and implementation schedules. Each minimum standard includes one or more actions that must be taken to comply with the requirements of the permit. The measurable goals are the mechanism for reporting to NJDEP the progress that the Township has made and are accomplished primarily through the submittal of the Annual Report and Certification. The implementation schedule sets the deadlines for permit compliance. All municipalities within the State of New Jersey have been classified as either Tier A or Tier B communities depending on population density as determined in the 2000 United States Census.

Statewide Basic Requirements (SBRs) for Delaware Township:

- February 2, 2004 – Ensure major development projects comply with RSIS
- February 2, 2004 – Ensure adequate O&M of BMPs on municipal property
- April 1, 2005 – Adopt Township Stormwater Management Plan
- April 1, 2005 – New storm drain inlets must meet design standards if municipally installed.
- April 1, 2005 – Establish Local Public Education Program
- July 1, 2005 – Submit Annual Report and Certification to NJDEP
- February 2, 2006 – Ensure adequate operation & maintenance of Best Management Practices on private property
- April 1, 2006 – Adopt stormwater control ordinances
- April 1, 2006 – New storm drain inlets must meet design standards for all projects.
- April 1, 2009 – Label all municipal storm drain inlets.

Delaware Township's rural setting resulted in its designation as a Tier B community. As such, the Township is regulated under the NJPDES Stormwater Tier B General Permit, NJPDES No. NJ0141861. As part of the permit, several SBRs were mandated and an associated implementation schedule was established (refer to Appendix A of this plan for a copy). The following minimum standards apply to all Tier B municipalities, including Delaware Township:

1. Adoption of a municipal stormwater management plan in accordance with the requirements of N.J.A.C. 7:8-4.
2. Adoption and implementation of municipal stormwater control ordinances in accordance with N.J.A.C. 7:8-4. The ordinances shall address the control of stormwater from non-residential development and redevelopment projects as well as control aspects of residential development and redevelopment projects that are not pre-empted by the Residential Site Improvement Standards (herein referred to as RSIS).
3. Assurance that any residential development and redevelopment projects that are subject to the RSIS for stormwater management comply with those standards. The RSIS for stormwater management address general stormwater management system strategy; runoff estimation techniques; runoff collection system design; inlets, catch basins, manholes, and outlets; detention basins and other stormwater facilities; and water quality.
4. Assurance of adequate and long-term operation and maintenance (O&M) of best management practices (BMPs).
5. Enforcement of compliance with the standards set forth in Attachment A of the NJPDES General Permit to control passage of solids and floatable materials through storm drain inlets.

The Township will be responsible for completing an Annual Report and Certification due annually beginning July 1, 2005 each year (refer to Appendix A for a copy of the report and certification form) to report on progress on completing SBRs and to certify compliance with completed SBRs. Any incidents of noncompliance with the permit conditions must be identified in the Annual Report and Certification. A copy of each Annual Report and Certification will be kept at the Delaware Township Hall and shall be made available to the NJDEP for inspection. If there are incidents of noncompliance, the Township shall identify the steps being taken to remedy the noncompliance and to prevent such incidents from reoccurring. The Annual Report and Certification shall be signed and dated by Delaware Township and shall be maintained for a period of at least five (5) years.

1.3 Stormwater Management Regulations

On February 2, 2004 the State of New Jersey adopted the new Stormwater Management Rules (N.J.A.C. 7:8). The revisions to the State's Stormwater Management Rules serve as the first major update to the rules since their inception in 1983 and detail fundamental changes in the management of stormwater runoff in New Jersey. These rules updated several other regulations including the RSIS, (N.J.A.C. 5:21); the Freshwater Wetland Protection Act (N.J.A.C. 7:7A); the Flood Hazard Area Control Act (N.J.A.C. 7:13); the Watershed Management Rules (N.JA.C. 7:15); and the New Jersey Dam Safety Standards (N.J.A.C. 7:20).

The new Stormwater Management Rules provide a framework and incentives for managing runoff and resolving NPS impairment on a drainage area basis for new development and redevelopment and existing developed areas. Additionally, they 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 stormwater BMPs. These new rules also establish runoff control performance standards for soil erosion and sediment control, groundwater recharge, water quality, and water quantity, establish special area protection measures for pristine and exceptional value waters; provide regulatory consistency among local and State regulatory agencies; and provide safety standards for stormwater management basins.

As of February 2, 2004, the design requirements identified in the Stormwater Management Rules including groundwater recharge, water quality, and water quantity must be met for all projects regulated under RSIS. The Stormwater Rules (N.J.A.C. 7:8-4) require that all municipalities within the State of New Jersey adopt a municipal stormwater management plan. The Tier B General Permit mandates that this be completed no later than 12 months from the effective date of permit authorization, which is April 1, 2004 for Delaware Township. Additionally, N.J.A.C. 7:8-4 mandates that stormwater control ordinances be adopted and implemented for all municipalities in the State no later than 12 months from the date of adoption of the Stormwater Management Plan.

2.0 Stormwater Management Plan Goals

Nine (9) minimum required goals for municipal stormwater management plans were identified in the NJDEP Guidance document for Tier B communities and are as follows:

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 NPS 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.

In addition to the minimum goals identified above, the Delaware Township Master Plan, last amended in 2002, includes the following goals relevant to stormwater management in the Township:

- Preserve sensitive and aesthetic areas in their natural state and protect natural resources;
- Minimize depletion of well water;
- Prevent contamination of well water;
- Improve the quality of streams;

- Identify critical environmental or scenic areas for special preservation efforts;
- Encourage the retention and expansion of significant woodlands in the Township;
- Provide for development location and density that respects environmental limitations;
- Seek appropriate locations for the establishment of greenways linking areas of environmental and recreational importance;
- Preserve historic sites and encourage compatibility of new development with the character of the Township;
- Site new housing to preserve open space;
- Site new housing to minimize the visual impact of new prospective development; and
- Maintain the rural character of Township roads.

Further, the Delaware Township Stormwater Management Committee has identified the following additional goals for this plan:

- Control the volume of runoff directed to roadside swales from new development;
- Protect headwaters for sensitive streams in the Township; and
- Encourage water quality treatment for existing stormwater runoff directed to streams.

To achieve the above goals, this plan outlines specific stormwater design and performance standards for new development. Additionally, the plan proposes stormwater management controls to address impacts from existing development. Preventative and corrective maintenance strategies are included in the plan to ensure long-term effectiveness of stormwater management facilities. The plan also outlines safety standards for stormwater infrastructure to protect public safety.

3.0 Municipal Background

Delaware Township is approximately 37 square miles in size and borders Stockton Borough, East and West Amwell Townships, Raritan Township, Franklin Township, Kingwood Township, and the City of Lambertville. The Township boundary is identified on the USGS Map - Figure B1 in Appendix B of this report. Delaware Township's population was 4,478 in the 2000 United States Census, down from 4,512 in 1990, which represents a population loss rate of 0.8%. Five (5) County roadways are located within the Township and include County Route 579, County Route 523, County Route 604, County Route 519, and County Route 605. Additionally, three (3) New Jersey Department of Transportation (NJDOT) maintained roadways are located in the Township. These include State Route 12, State Route 29, and United States Highway 202. The aforementioned roadways and their associated stormwater conveyance systems are covered under NJPDES Highway Agency Permits issued to both Hunterdon County and NJDOT and as such are not covered under this Plan and are not the responsibility of Delaware Township to operate and maintain. All roadways in the Township are identified on Figure B2 in Appendix B of this plan for reference.

As part of the Cross Acceptance process the Township has been proposed as Planning Area 4b (PA4b), but this designation is subject to final approval by the New Jersey State Planning Commission. Further, Delaware Township has supported the efforts of surrounding municipalities to designate the Delaware

River viewshed as a Special Resource Area. PA4b is considered a Rural/Environmentally Sensitive Planning Area.

PA4b designations comprise much of the countryside of New Jersey, where large masses of cultivated or open land surround rural Designated Centers, and distinguish other sparse residential, commercial and industrial sites from typical suburban development. Some lands have one or more environmentally sensitive features (qualifying for PA4b or PA5). Rural Planning Areas are supportive of agriculture and other related economic development efforts. Adequate water resources and large, contiguous tracts of land with minimal land-use conflicts are essential to sustaining successful farming operations and farmland productivity. More intensive farming operations and the growing encroachment of housing are creeping into previously agriculturally dominated areas. Prudent land development practices are required to protect these resources and retain large contiguous areas of agricultural land. Tools and techniques need to be tailored to address the distinctive situation. In particular, new development may require additional attention in areas with environmentally sensitive features.

Currently a large majority of the Township is zoned for agricultural and residential uses. The remaining portions of the Township are zoned as villages (Sergeantsville and Rosemont), highway commercial (Croton), and industrial and quarry uses. The highway commercial district is located at the intersection of County Route 579 and Old Croton Road. Current industrial uses are limited to a quarry operated by Trap Rock Industries.

3.1 Environmental, Water, and Historic Resources

3.1.1 Environmental Resources

Open Space. Based on data obtained from the Township in November 2004, approximately 6,165 acres (almost 22% of the Township) were protected open space. Additional preservation areas pending as of November 2004 include an additional 1,322 acres (or approximately 5.6% of the Township). These properties will be considered for potential mitigation sites. A copy of the open space areas within the Township is included as Figure B3 in Appendix B.

Threatened and Endangered Species Habitat. In preparation of this document the Landscape Project, the Natural Heritage Priority Sites, and the 2004 Delaware Township Natural Resource Inventory were reviewed. Habitat exists within the Township for numerous threatened and endangered species. The Landscape Project Version 2.0 identifies grassland, emergent wetland, forested wetland, forest, and wood turtle habitats within the Township. The specific species identified within the Township by the Landscape Project are included in Appendix B for reference. The Landscape Project maps include Figures B7 and B8 in Appendix B of this plan. The threatened and endangered species identified in the Landscape Project are discussed in the 2004 Delaware Township Natural Resource Inventory as well.

Additionally, we have identified the Natural Heritage Program's Priority Sites on Figure B9 and Grids on Figure B10 in Appendix B of this plan. There are seven (7) sites identified by the Natural Heritage Program as Priority Sites and include the following:

- BULLS ISLAND – wooded floodplain with extent of rare plant and animal habitats and buffer – several State listed endangered plants (both historic and extant) and two State listed threatened animals.
- BROOKVILLE HOLLOW – wooded ravine with a small brook and adjacent rocky steep wooded slope. Substrate is diabase and consequently has a good diversity of plant species – site is adjacent to an active quarry. Contains populations of two State listed endangered plant species and three special concern plant species.
- ABRAITYS PINE STAND SITE – second growth woods on low ridge. Sole occurrence of a State listed endangered plant.
- EAST AMWELL GRASSLANDS MACROSITE – contains five State endangered or threatened grassland bird species.
- SAND BROOK – roadside thicket adjacent to driveway and contains a single known NJ occurrence for a State listed plant species.
- RAVEN ROCK – dry to moist field rapidly succeeding in shrubs that contains two State listed endangered plants and one State rare plant plus additional special concern plants.
- HOLCOMBE – wooded floodplain along the Delaware River that contains three State listed endangered plant species.

The Natural Heritage Grids identify the following 22 vascular plant species: Few-fruit Sedge, Carolina Whitlow-grass, Low Sand Cherry, Pear Hawthorn, Few-flower Panic Grass, Basil Beebalm, Willow Leaf Aster, Smooth Hedge-nettle, Great St. John's Wort, Slender Toothwart, Pale Indian Plantain, Frank's Love Grass, Wafer Ash, Aunt Lucy, Buttonbush Dodder, Holmes' Hawthorn, Star Chickweed, Orange Coneflower, Hitchcock's Sedge, Smooth Beardtongue, Virginia Snakeroot, and Willdenow's Sedge. Additionally, there are three (3) other species that are not specifically identified.

Contaminated Sites. Currently, there are seven (7) contaminated sites within the Township as identified in the *Known Contaminated Sites in New Jersey* report last updated in 2001. These sites are identified on Figure B11 in Appendix B of this plan. The *Known Contaminated Sites in New Jersey* report is a municipal listing of sites where contamination of soil and/or ground water is confirmed at levels greater than the applicable cleanup criteria or standards. Remedial activities are underway or required at the sites with an on-site source(s) of contamination and at locations where the source(s) of contamination is unknown. Sites with completed remedial work that require engineering and/or institutional controls have reporting measures in place to ensure the effectiveness of past actions, and some include maintenance and/or monitoring. It is important to take note of these sites, as they will impact the selection of BMPs for stormwater runoff in the immediate vicinity.

Wellhead Protection Areas. There are four (4) existing Public Community Water Supply (PCWS) wells located within the Township and two (2) PCWS wells located within Stockton Borough that impact the Township. Of the four PCWS wells within Delaware Township, the Delaware Township Municipal Utilities Authority owns two and the Rosemont Water Company owns the other two. The New Jersey Geological Survey (herein referred to as NJGS) delineated Wellhead Protection Areas (herein referred to as WHPAs) for each of these supply wells. A WHPA in New Jersey is a mapped area calculated around a Public Community Water Supply (PCWS) well in New Jersey and is defined as the portion of an aquifer that contributes water to a well over a specified time interval.

WHPAs are divided into three sequential tiers based on Time of Travel (herein referred to as TOT) to a production well. TOT is the time it takes for a given particle of groundwater to flow to a pumping well and is directly related to the distance the water has to travel to arrive at the well once it starts pumping. For any given TOT, the distance will vary from well to well depending on the rate of pumping and aquifer characteristics. Tier 1, the 2-year TOT, is based on findings that bacteria have polluted wells and viruses have survived in groundwater up to 270 days. Tier 2, the 5-year TOT, is based on the lag time of a pollution plume caused by adsorption/desorption, the variable rate of pollutant travel, and the acceleration of groundwater once it comes close to a pumping well. Tier 3, the 12-year TOT, is defined to provide sufficient time so that monitoring and cleanup response to potential pollution sources/releases can be completed before contamination reaches a pumping well. The three (3) tiers, over two-, five-, and twelve-years, are defined using line boundaries and polygon areas generated with the ARC/INFO Geographic Information System (GIS). Refer to Figure B11 in Appendix B of this plan for the delineated WHPAs and the Known Contaminated Sites.

Groundwater Recharge. As can be seen in Figure B12 in Appendix B of this plan, the Township's soils indicate recharge rates ranging from not applicable (for the hydric soils, wetlands, and open waters) to 16 inches per year. These rates were obtained from the New Jersey Geological Survey (NJGS) and are based on New Jersey Geological Survey Report GSR-32 – A method for Evaluating Ground-Water-Recharge Areas in New Jersey. These rates are established purely as overall guidance in selecting areas for potential infiltration measures and are not to be utilized for design purposes. It is important to note that these rates are highly variable. The "Evaluation of Groundwater Resources – Delaware Township," prepared by M2 Associates, Inc., dated February 15, 2004, suggests potential problems associated with the NJGS methodology for identifying recharge rates for each soil type in the Township. Based on traditional hydrogeologic definitions GSR-32 really calculates "soil recharge." The M2 report states, "the term groundwater is usually reserved for the subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated." The report goes on to state, "approximately 69 percent of the soils in Delaware Township have severe limitations for septic systems primarily because of shallow bedrock, seasonal high water, and/or steep slopes, all of which limit the infiltration capacity of the soils. The NJGS method indicates that these soils are recharged at high rates suggesting that these systems should not be limited."

Geology. The Township consists of ten (10) different bedrock geologies as discussed in the NRI prepared by the Delaware Township Environmental Commission with input from Banisch Associates, Inc, dated July 2004. The map identifying these formations is included as Figure 5 in Appendix C of this plan. Details of the limitations for each formation are identified in the "Evaluation of Groundwater Resources of Delaware Township," dated February 2004. Additional consideration for stormwater management should be taken for soils with high depths of groundwater as well as highly erodible lands as these can be limiting depending on the structural stormwater Best Management Practice utilized. Figures from the NRI delineating these features are included as Figure 9 and Figure 10 in Appendix C of this plan for reference.

Significant Slopes. Additionally, based on a review of the Natural Resources Inventory prepared by Banisch Associates, Inc. significant slopes exist in multiple locations throughout the Township. Significant slopes for the Township are broken into several categories. Slopes in excess of 25% present serious limitations for development; often requiring extensive and costly engineering and construction. Development on slopes in excess of 15% can degrade the environment if not properly managed. The map

of these areas as prepared for the NRI is included in Appendix C as Figure 15. Typically, the steep slopes are located around the streams and waterbodies and must be carefully considered in selecting appropriate Stormwater BMPs for future development projects.

3.1.2 Water Resources

Wetlands. Based on a review of the NJDEP Geographic Information Systems (GIS) database for wetlands and the Natural Resources Inventory (NRI) prepared by Banisch Associates, Inc., approximately 2,279 acres of wetlands exist within the Township. The wetlands are primarily located in the eastern portion of the Township. Refer to Figure 11 in Appendix C of this plan for detailed locations of the existing wetland and water resources of the Township as prepared for the NRI.

Watersheds. There are eight (8) major watershed systems located within the Township boundaries. Four (4) of the watercourses associated with these watersheds are considered Category One (C1) waters by the New Jersey Surface Water Quality Standards. As such, these watercourses will have associated Special Water Resource Protection Areas. The Special Water Resource Protection Areas are defined under N.J.A.C. 7:8 as a 300-foot buffer area measured perpendicular to the stream from the tops of bank. Encroachment within this region is only allowed where previous development or disturbance has occurred or where the current Standard for Offsite Stability cannot be achieved. Even under these conditions, the buffer width cannot be reduced to less than 150 feet. The Hydrologic Unit Code 14 (HUC14) watersheds are shown on Figure B4 in Appendix B of this plan. Figure B5 details the C1 regulated watershed areas under the Special Water Resource Protection Areas. The HUC14 watersheds include the following:

Lockatong Creek, December 2004.

- **Lockatong Creek below Milltown** – This watercourse is currently designated Freshwater – Trout Maintenance (C1).
- **Wickecheoke Creek above Locktown** – This watercourse is currently designated Freshwater – Non Trout (C1).
- **Wickecheoke Creek below Locktown** – This watercourse is currently designated Freshwater – Trout Maintenance (C1).
- **Plum Creek** – This watercourse is currently designated Freshwater – Trout Maintenance (C1).
- **Second Neshanic River** – This watercourse is currently designated Freshwater – Non Trout.
- **Third Neshanic River** – This watercourse is currently designated Freshwater – Non Trout.
- **Headquarters Tributary of the Third Neshanic River** – This watercourse is currently designated Freshwater – Non Trout.
- **Alexauken Creek** – This watercourse is currently designated Freshwater – Trout Maintenance (C1).

Additionally, the Delaware River bounds the Township to the west. The Delaware River Basin Commission (DRBC) proposed revisions to the Water Quality Regulations including classification of the Delaware River as Special Protection Waters. This designation may result in additional protections for the Delaware River that impact stormwater management in the Township. Further, the Delaware and Raritan Canal runs through the Township and the Delaware and Raritan Canal Commission (DRCC) must review all stormwater measures proposed for projects within 1,000 feet of the Canal as well as for projects along watercourses directly discharging to the Canal. Figure B6 in Appendix B of this plan identifies the Regulatory Review Zones for both the DRBC and DRCC.

Current Stream Health. Despite relatively low levels of development, the Township's streams show significant signs of water quality change as evidenced by the data collected at the various Ambient Biomonitoring Network (AMNET) stations in and around the Township. This data is reported in the New Jersey Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)), dated June 2004, (herein referred to as the Integrated List). Site clearing and grading associated with large lot development and the associated road networks can create conditions where the creeks in the Township show streambank instability. The naturally flashy streams, like the Wickecheoke and the Lockatong, are particularly susceptible to both flooding and erosion. In part because the Township is so near to the Delaware River, there are many small streams, often first order streams that characterize this Township. Because of their small size they have been given less protection than is necessary for good overall watershed management.

Ongoing land use changes are contributing to existing problems. In many areas the terrain permitted extensive clearing of the land for agriculture. Today, these same areas are being converted to lawn with typically far greater pesticide and fertilizer use and more compaction than cropping. Elsewhere, some areas that formerly were pastured or cropped previously now serve as lawn and paddocks. In these amended areas cover is minimal, waste is concentrated or uncontrolled and compaction is often severe. Many of these lawns and paddocks are in former riparian forests that should be restored as buffers to help mitigate the impacts of agricultural and residential land uses on the water quality of the Townships streams. Less extensive clearing of forest in some of the diabase areas of the Township has already helped to protect some stream reaches.

NJDEP has established AMNET to document the health of the state's waterways. There are over 800 AMNET sites throughout the state of New Jersey. These sites are sampled for benthic macroinvertebrates by NJDEP on a five-year cycle. Streams are classified as non-impaired, moderately impaired, or severely impaired based on the AMNET data. The data is used to generate a New Jersey Impairment Score (NJIS), which is based on a number of biometrics related to benthic macroinvertebrate community dynamics. Portions of the Plum Brook, Wickecheoke Creek, Second Neshanic River, and Third Neshanic River were classified as moderately impaired in the Upper Delaware River Drainage Basin 1997-98 Benthic Macroinvertebrate Data. All other watercourses in the Township were not assigned any impairment under the 1997-98 Benthic Macroinvertebrate Data. There are currently five (5) AMNET biological monitoring sites in the Township and four (4) AMNET biological monitoring sites directly adjacent to the Township. Further, there are three (3) AMNET stream water quality sites in the Township and one (1) directly adjacent to the Township. Refer to Figure B5 in Appendix B for the exact locations.

The Integrated List must be prepared biennially by NJDEP as required under the federal Clean Water Act. This combined report presents the extent to which New Jersey waters are attaining water quality

standards, and identifies waters that are impaired. NJDEP must prepare TMDLs for all waters on Sublist 5 of the Integrated List, which constitutes the list of waters impaired or threatened by pollutants in the State of New Jersey. The Integrated List identifies the following impairments for streams in and around Delaware Township:

- **Lockatong Creek at Raven Rock-Rosemont Road Bridge – Phosphorus and temperature.** The water quality standards for temperature and phosphorus are not attained based on data collected by the DRBC. As such, the Lockatong will require TMDLs for these pollutants.

- **Wickecheoke Creek**
  - **at Croton – Fecal Coliform.** The water quality standards for fecal coliform are not attained based on data collected by the NJDEP and USGS. As such, a TMDL will be required for this pollutant. The Wickecheoke had insufficient data to determine whether attainment of the phosphorus and dissolved oxygen standards were achieved.
  - **at Locktown-Sergeantsville Road – Benthic Macroinvertebrates.** The water quality standards for benthic macroinvertebrates are not attained based on data collected by NJDEP AMNET. As such, a TMDL will be required for this pollutant.
  - **near Sergeantsville – Fecal Coliform.** The water quality standards for fecal coliform are not attained based on data collected by the NJDEP and USGS. As such, a TMDL will be required for this pollutant. The Wickecheoke had insufficient data to determine whether attainment of the phosphorus standard was achieved.
  - **at Stockton – Phosphorus, fecal coliform, and temperature.** The water quality standards for phosphorus, fecal coliform, and temperature are not attained based on data collected by the NJDEP, DRBC, and USGS. As such, the Wickecheoke will require a TMDL for these pollutants.

- **Plum Brook**
  - **At Pine Hill Road – Benthic Macroinvertebrates.** The water quality standards for benthic macroinvertebrates are not attained based on data collected by NJDEP AMNET. As such, a TMDL will be required for this pollutant.
  - **near Locktown – Fecal Coliform.** The water quality standards for fecal coliform are not attained based on data collected by the NJDEP and USGS. The Plum Brook had insufficient data to determine whether attainment of the phosphorus standards was achieved. In April 2003, a TMDL to address fecal coliform in 28 stream segments in the Northwest Water Region was proposed. The TMDL includes this segment of the Plum Brook (north of Ferry Road in Delaware Township) and recommended that sites with the watershed be prioritized for funding of agricultural BMPs as well as investigation into goose management programs. The TMDL has been established, but has not been formally approved by the USEPA. The Plum Brook had insufficient data to determine whether attainment of the phosphorus standard was achieved.

- **Second Neshanic River at Route 31 in Raritan – Benthic Macroinvertebrates**. The water quality standards for benthic macroinvertebrates are not attained based on data collected by NJDEP AMNET. As such, a TMDL will be required for this pollutant.

- **Third Neshanic River at Route 31 in Raritan – Benthic Macroinvertebrates**. The water quality standards for benthic macroinvertebrates are not attained based on data collected by NJDEP AMNET. As such, a TMDL will be required for this pollutant.

- **Third Neshanic River at Copper Hill** – Insufficient data was available to determine whether attainment of the dissolved oxygen standards was achieved.

- **Alexauken Creek** – No impairment was identified for this watershed in or adjacent to the Township.

It is important to note that both the Wickecheoke Creek at Croton and at Stockton were identified in the 2002 Integrated Water Quality Monitoring and Assessment Report for fecal coliform TMDLs, however, the April 2003 TMDL prepared for the Northwest Water Region identified that insufficient data existed for these streams and further data collection was warranted before establishing TMDLs for either watercourse.

3.1.3 Historic Resources

In 1984, the Township Environmental Commission identified 480 structures and 20 bridges for historic preservation. The sole remaining historic covered bridge (abutments constructed in 1750 - bridge built in 1872) in New Jersey can be found at the crossing of the Wickecheoke Creek between Sergeantsville and Rosemont. All of the historic bridges and structures are extremely important to the Township and careful consideration to the historic value of these properties must be given during all proposed major development projects when complying with the requirements of this Plan.

3.2 Existing Stormwater Infrastructure and Current Problems

Existing Stormwater Problems in Delaware Township:
- Overtaxed roadside swales
- Erosion along streambanks and roadsides
- High pollutant and sediment loadings
- Increased water volumes in streams
- Loss of riparian buffers

Currently, there are eight (8) known stormwater management basins located in the Township. These are identified on Figure E1 in Appendix E of this plan. The basins are all operated and maintained by private owners, with the exception of the detention basin at the Delaware Township School, which is operated and maintained by the Township. The Township plans to contact the owners on an annual basis to ensure that compliance with the new rules in the form of proper maintenance is being conducted and performed for the basins. The Township is responsible to report any non-compliance in the Annual Report and Certification submitted to NJDEP.

There are no existing stormwater inlet and storm sewer network maps for the Township. The Department of Public Works in conjunction with the Stormwater Management Committee will work to complete a map identifying these locations. The locations will be identified using a Global Positioning System (GPS) device and a map will be compiled at a future date. The Township will utilize this map for the SBR for stormwater inlet labeling as well as future maintenance.

Lot drainage directed to swale.

The following paragraphs present six (6) major elements of the existing roadway drainage infrastructure in Delaware Township. These elements are presented to identify existing problems and to address the potential for future problems if current trends continue. Many of these problems can be addressed through the recommended stormwater control ordinances.

Lot drainage. Many of the Township's roads are located along ridgelines and on slopes and drain well despite limited infrastructure, such as minimal roadside ditches. Many roadside swales present few problems. Because of shallow depths and sparse vegetation these roadside swales are extremely susceptible to failure when additional stormwater volumes are added. The conversion of farmlands to lawns can contribute significantly to overtaxing roadside swales if stormwater volumes are not carefully considered during site design. Compaction associated with lot regrading can lead to increased runoff volumes directed to roadside swales as well.

Steep slopes and steep gradient roadways. Road drainage problems are most severe where road widths are constrained due to steep slopes and where runoff is accelerated by steep road gradients. Pine Hill Road provides an illustration of the problem. Closely spaced runoff diversions have eroded the adjacent slope and ultimately carry sediment-laden runoff directly to the Wickecheoke Creek. Other culverts in the Township also located on high gradient roads and steep slopes show signs of erosion and serve as conveyance for sediment to the Township's streams.

"Road creep" and sedimentation

Maintenance practices. There are two (2) major problems resulting from roadway practices that impact drainage swales. The first practice resulting in negative impacts is "road creep." Road creep is a result of repaving operations that spread the pavement edge into roadside swales. Brookville Hollow Road, along with a few others in the Township, provides an example of road creep. The second problem with maintenance practices results from the collection of sediment and debris from the shoulder and performing swale clearing. Care should be taken to minimize disturbance of vegetation and re-excavation of the roadside swales.

Outfalls. Outfalls present the most difficult drainage condition to evaluate because of access limitations. Although outfall mapping in Tier B communities is not required, the major outfalls associated with the road system for the Township should be evaluated because of the severity of their impacts.

First Order and Headwater Streams. A large number of culverts in the Township convey the waters of unmapped first order and headwater streams. The Township should consider mapping and protecting these streams from further increases in runoff due either to impervious cover or to regrading and changes in vegetative cover. If the level of flow merits a culvert, the stream should be mapped and protections should be considered.

Loss of riparian vegetation for headwater streams and swales. Traditional erosion control plans for farmers involve regrading to make the terraces that sometimes include removing headwater woodlands and regrading headwater streams. "Blow outs" frequently occur in the form of severe erosion, channel

cutting, and scour associated with increased volumes of runoff being directed to swales and streams. Maintaining and replanting hedgerows and woodlands in headwater areas may work to reduce the occurrence of "blow outs." Further, delayed mow grasslands management for highly erodible land (HEL) soils may help correct these problems.

Low gradient roadways. Low gradient roadways are uncommon in the Township. One example is a portion of Locktown Sergeantsville Road above Mezzaros Road where the asphalt has buckled.

4.0 Design and Performance Standards

The design and performance standards for stormwater management measures for Delaware Township include those presented in N.J.A.C. 7:8-5 and will be required for all major development projects as defined in Section 10.0 – Applicable Definitions of this plan. As previously mentioned, it is the responsibility of the Township to ensure and certify that all major development and associated stormwater management features proposed in the Township comply with the design and performance standards identified below.

Please note that any application for a new agricultural development that meets the definition of major development shall be submitted to the Hunterdon County Soil Conservation District for review and approval in accordance with the requirements of this section and the *Standards for Soil Erosion and Sediment Control in New Jersey* (herein referred to as the NJ Soil Erosion Standards) for stormwater runoff quantity and erosion control.

4.1 Design Standards

Stormwater management measures for major development shall be designed to meet the following standards, as required under N.J.A.C. 7:8-5:

- **Erosion control** – all proposed land disturbance of 5,000 square feet or more must follow the NJ Soil Erosion Standards;
- **Groundwater recharge** – all major development projects that are considered new construction must maintain 100% of the pre-developed groundwater recharge under post-developed conditions or demonstrate that the increase of runoff from pre- to post- for the 2-year, 24-hour Natural Resources Conservation Service (NRCS) Type III storm (consistent with the most recent Technical Paper 40 release or its replacement) is infiltrated. It is important to note that Delaware Township must demonstrate compliance with this standard taking into account the WHPAs and known contaminated sites throughout the Township;
- **Stormwater runoff quantity** – all major development projects must demonstrate compliance with one of the following: peak runoff flow rate mitigation, runoff volume mitigation, or hydrograph mitigation; and
- **Stormwater runoff quality standards** – all major development projects must demonstrate an 80% Total Suspended Solids (TSS) removal rate.
- **Special Water Resource Protection Areas** – all major development projects must maintain a 300-foot buffer measured from top of bank of all USGS and Hunterdon County Soil Survey mapped Category One watercourses, with limited exceptions. Currently, there are four (4) C1

waters in Delaware Township including the Lockatong, Wickecheoke, Plum, and Alexauken Creeks.

- **Threatened and Endangered Species Searches** – all major development projects subject to review by NJDEP's Land Use Regulation Program must conduct a Threatened and Endangered Species search using the Natural Heritage Database.

It is important to note that the Stormwater Management Rules require that Low Impact Development (LID) Techniques and non-structural stormwater management measures must be employed to the maximum extent feasible. All projects must complete a Low Impact Development checklist specifically identifying what techniques were considered and utilized. A copy of the Low Impact Development Checklist is included in Appendix G for reference.

4.1.1 Erosion Control

Existing Erosion Control Problems. The Township regularly experiences erosion with some roadside swales as well as along the banks of the various watercourses within the Township. The vegetation (usually turf grass) adjacent to the banks of streams and within the channels of the swales in the Township typically cannot withstand the runoff velocities directed to them. Large volumes of runoff directed to roadside swales that do not have adequate capacity often exacerbate erosion.

State Required Minimum Standards. The Hunterdon County Soil Conservation District will be responsible for the review of all projects identified as major development for compliance with the NJ Soil Erosion Standards. Projects that involve the disturbance of 5,000 square feet or more of land will be required to obtain Soil Erosion and Sediment Control Certifications from the Hunterdon County Soil Conservation District. In accordance with the minimum goals identified in Section 2.0 of this plan, it is important that the Township also ensure that all soil erosion measures comply with the current standards and that proper measures are installed and maintained on projects under construction and after completion.

Soil Erosion and Sediment Control
Key Facts:

- Projects disturbing 5,000 sf or more of land require Soil Erosion Certification
- A NJPDES RFA Permit is required for stormwater discharge for all projects one (1) acre or more
- A Stormwater Pollution Prevention Plan is required for all NJPDES RFA projects

Recommendations. A copy of this plan will be provided to the Hunterdon County Soil Conservation District for their review and records. Maintenance personnel will document erosion within the Township and corrective measures will be discussed with the Soil Conservation District on a case-by-case basis. Supplemental meadow and/or woody vegetation may be required in roadside swales and along the banks of existing watercourses in the Township. Downstream stability analyses for swales and offsite properties will be required for all new development in the Township in accordance with the NJ Soil Erosion Standards.

4.1.2 Groundwater Recharge

Existing Groundwater Recharge Problems. Groundwater recharge has not been a traditional component of stormwater management design. In the past, projects have been constructed with little or no consideration to loss in groundwater recharge. As mentioned in Section 4.1.1 above, some roadside

swales are overloaded and erosion is a continual problem. This is primarily due to increased surface runoff volumes. Increased surface runoff volumes can sometimes be recharged back to the ground through the use of LID Techniques.

State Required Minimum Standards. The minimum design and performance standards for groundwater recharge, as previously identified above, require that the design engineer either 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 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. As discussed above, groundwater recharge is prohibited from sites with high pollutant loading or industrial stormwater exposed to "source material." As there are eight (8) known contaminated sites within the Township, groundwater recharge is prohibited for these properties and all future identified contaminated properties in accordance with N.J.A.C. 7:8-5.4(a) 2iii.

Required Information for all Groundwater Recharge Analyses:

- Evaluation of non-structural practices
- Soil testing including measured permeability rates and depth to groundwater
- Analyses demonstrating minimum requirements for recharge from pre-developed conditions
- Calculations showing recharge volume will infiltrate in 72 hours
- Consideration of maintenance requirements

All groundwater recharge analyses conducted must demonstrate one (1) of the following:

1. The site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site; or
2. The increase of stormwater runoff volume from pre-construction to post-construction for the two-year storm is infiltrated.

Option 1 above may be completed using the New Jersey Groundwater Recharge Spreadsheet available through the *New Jersey Stormwater Best Management Practices Manual* (herein referred to as the BMP Manual, found online at www.njstormwater.org). The design engineer (or qualified professional) shall assess the impacts on the groundwater table and design the site so as to avoid adverse hydrogeologic impacts. There are several potential adverse hydrogeologic impacts, including, but 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 down gradient of the groundwater recharge area.

Recommendations. Placing impervious areas on soils with poor recharge ability and minimizing the amount of grading on a project site will help to reduce the loss in groundwater recharge. Further, the surface runoff volumes can be mitigated through structural infiltration practices such as dry wells, infiltration basins, and bioretention systems. Rainfall from smaller events can be infiltrated and larger events can be bypassed for surface runoff quantity control. For all structural and nonstructural infiltration measures it is necessary to determine soil characteristics and depth to groundwater on a subject property prior to designing infiltration measures. In order to meet the requirements for groundwater recharge, the applicant is strongly encouraged to design nonstructural stormwater BMPs identified in Section 5.1 of this plan wherever feasible. Should nonstructural measures not satisfy the full groundwater recharge

requirements, alternatively or in combination with the nonstructural measures, the applicant can utilize the structural techniques described in Section 5.2 of this plan as well. Maintenance of infiltration structures is critical to ensure long-term performance.

4.1.3 Stormwater Runoff Quantity

Existing Runoff Quantity Problems. As discussed in Section 3.0 of this plan, stormwater runoff quantity is a significant existing problem in the Township. Of primary concern is the direct connection of lot drainage to roadside swales without downstream stability analyses. Further, traditional quantity controls have been limited to peak runoff rate mitigation and overall volume mitigation and hydrograph mitigation were likely not explored.

State Required Minimum Standards. For all three options identified below, the applicant must establish Point(s) of Analysis (POAs) based on natural watershed divisions on the subject site in accordance with Section 5 of the BMP Manual. These POAs must then be analyzed under pre- and post-construction conditions as discussed below. In order to control stormwater runoff quantity impacts, the design engineer shall complete one of the following:

Key Water Quantity Mitigation Components:
- Established watershed points of analysis
- Assessment of pre-developed and post-developed runoff conditions
- Pre-developed site conditions must be documented for at least five (5) years or assumed to be woods in good condition

1. Hydrograph Mitigation - 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;
2. Runoff Volume Mitigation - 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;
3. Peak Runoff Flow Rate Mitigation - design stormwater management measures so that the post-construction peak runoff rates for the 2, 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 under all phases of the project.

Stormwater runoff shall be calculated in accordance with the following:

1. The United States Department of Agriculture (USDA) NRCS methodology, including the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in Section 4 of the National Engineering Handbook (NEH-4), dated July 2002, last updated September 2004, and incorporated herein by reference as amended and supplemented (refer to Appendix F of this plan for a copy of the rainfall frequency data). 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; or

2. 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 NJ Soil Erosion Standards.

For the purpose of calculating runoff coefficients, there is a presumption that the pre-construction condition of a site is a wooded land use with good hydrologic condition. Alternatively, 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 (5) years without interruption prior to the time of 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.)

When 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. Additionally, when computing stormwater runoff from all design storms, 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 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 described in the BMP Manual may be employed. If the invert of the outlet structure of a stormwater management measure is below the Flood Hazard Design Flood elevation of a stream or its associated tributaries, the design engineer shall take into account the effects of tailwater in the design of structural stormwater management measures.

Recommendations. Runoff quantity can be controlled using both nonstructural (Section 5.1) and structural BMPs (Section 5.2) or combination thereof. Volume control is essential in protecting downstream channels and properties from erosion and flooding. Nonstructural measures can serve to increase times of concentration and slow the rate that stormwater runs off of a property. By disconnecting impervious surfaces, runoff rates will also be reduced. For detailed design guidance on the various BMPs to satisfy the requirements identified above, the applicant's professional(s) should refer to the BMP Manual.

4.1.4 Stormwater Runoff Quality

Existing Water Quality Problems. Excessive sediment loads in roadside swales occur frequently. Further, sediment and debris are common problems in the Township's watercourses as well. In the past, water quality treatment has been encouraged, but emphasis was not typically placed on water quality treatment during stormwater management design.

Key Water Quality Components:
- Volume for treatment should be based on 1.25-inch 2-hour water quality storm
- TSS removal rate required is 80% for each drainage area

State Required Minimum Standards. 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 major development project. Stormwater management measures shall be designed to reduce the post-construction load of 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. 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 in Appendix F of this plan. The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures. 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.

For purposes of TSS reduction calculations, Table 2 in Appendix F of this plan presents the presumed removal rates for certain BMPs designed in accordance with the *New Jersey Stormwater Best Management Practices Manual*. Alternative removal rates and calculation methods may be considered if the design engineer provides documentation demonstrating the capability of the alternative rates and methods to the Township Engineer. A copy of any Township approved alternative rate or method of calculating the removal rate shall be provided to NJDEP as required under N.J.A.C. 7:8-5.5.

If more than one BMP in series is necessary to achieve the required 80 percent TSS reduction requirement, 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

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 sub-areas converge onsite. Stormwater management measures shall also be designed to reduce, to the maximum extent feasible, the post-construction stormwater runoff nutrient load from the developed site generated during the water quality design storm. In achieving a 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 identified above.

Recommendations. Non-structural and structural BMPs may be required to achieve the required 80 percent TSS removal rate. Disconnecting impervious surfaces and the use of vegetative filter strips are critical in reducing the amount of sediment and other pollutants entering the Township's watercourses. Professionals are directed to the BMP Manual for detailed design guidance on several BMPs that can provide the required water quality treatment individually or in combination with other BMPs.

4.1.5 Special Water Resource Protection Areas

As discussed in Section 3.1.2 above, Special Water Resource Protection Areas are mandated for all Category One watercourses in the State identified on either USGS or Soil Survey maps and perennial or intermittent streams that drain into these watercourses. All USGS streams are identified on Figure B5 and the Hunterdon County Soil Survey streams identified in blue on the maps included in Appendix D. 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. Since there are four (4) major watercourses with this designation, the Township will be responsible for ensuring that the requirements of the special water resource protection areas are upheld. Due to the number of streams meeting the aforementioned criteria in the Township, a Stream Corridor Protection Plan and Ordinance will be adopted in order to enforce these requirements. The requirements for these areas are as follows:

1. All major development projects shall preserve and maintain a 300-foot special water resource protection area 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.

2. Encroachment within a designated 300-foot special water resource protection area shall only be allowed where previous development or disturbance has occurred (for example, active agricultural use, parking area or maintained lawn area). The encroachment will only be allowed where sufficient documentation has been provided to ensure that the functional value and overall condition of the special water resource protection area will be maintained. 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. **NJDEP will review all encroachments proposed under this item.**

3. All stormwater must be discharged outside of the special water resource protection area and must comply with the Standard for Off-Site Stability in the NJ Soil Erosion Standards. It is important to note that stormwater can sheet flow through the special water resource protection area.

4. If stormwater discharged outside of the special water resource protection area cannot comply with the Standard For Off-Site Stability in the NJ Soil Erosion Standards, then stabilization measures may be placed within the special water resource protection area, provided that these stabilization measures are not be placed within 150 feet of the waterway. Additionally, the stormwater discharged must achieve a 95 percent TSS post construction removal rate and temperature must be addressed to ensure no impact on the receiving stream. A conceptual project design meeting shall be held with NJDEP and Hunterdon County Soil Conservation District staff to identify necessary stabilization measures.

It is important to note that Category One watercourses are being updated continuously by the NJDEP and the classification of surface waters within the Township boundaries are subject to change.

Specific recommendations for water quality compliance are included in Section 5.0 of this plan. For detailed design guidance for the BMPs mentioned, refer to the BMP Manual.

4.1.6 Threatened and Endangered Species Searches

For projects regulated by NJDEP under the Land Use Regulation Program, a Natural Heritage Database search must be conducted to confirm the presence or absence of threatened and endangered species (T&E). Completing a Natural Heritage Data Request Form and sending it to the Natural Heritage Program can accomplish this.

4.1.7 Exemption/Waiver Criteria from Design Standards

It is important to note that there are several types of major development projects that are exempt from some or all of the requirements identified above or for which a waiver from strict compliance with the above requirements can be obtained. These include the below identified project types.

Redevelopment projects are exempt from the groundwater recharge standards provided that the redevelopment involves disturbance only of previously disturbed areas. Additionally, a 50% TSS removal rate is required for proposed redevelopment projects involving only existing areas of impervious cover. Groundwater recharge requirements do not apply to projects within the "urban redevelopment area," or to projects subject to stormwater from areas of high pollutant loading, industrial stormwater exposed to "source material."

Additionally, the following linear development projects are exempt from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements:

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 14 feet, provided that the access is made of permeable material.

A waiver from strict compliance from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements 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 all of 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 above requirements to the maximum extent practicable;
3. The applicant demonstrates that, in order to meet the requirements above existing structures currently in use, such as homes and buildings would need to be condemned; and
4. The applicant demonstrates that he/she does not own or have rights to areas that would provide opportunities to mitigate for the requirements above that are not achievable on-site.

Additionally, it is important to note that applicants who cannot meet one or more of the design requirements identified above must complete a project identified under Section 6.0 – Mitigation Plan as identified in this plan with prior coordinated approval from the Township.

4.2 Performance Standards

Existing Maintenance and Performance Problems. Typically, the stormwater management structure maintenance is the responsibility of a private resident or homeowner's association. Often maintenance responsibilities are forgotten or misunderstood as properties are bought and sold. To remedy this, the State has mandated that municipalities take responsibility for stormwater management maintenance in their communities. Under the NJPDES permit, the Township is now responsible to report all non-compliant stormwater features located in the Township as well as address any maintenance and operational problems. As a result, penalties may be assessed should the responsible entity not properly operate and/or maintain the facility. The penalties may also serve to provide the necessary funds for the Township to maintain facilities in the Township.

State Required Minimum Standards. In order to ensure proper operation of all structural and nonstructural stormwater management measures, the Township requires that all projects considered major development incorporate maintenance plans for proposed stormwater management measures. These plans are essential to the long-term functionality of BMPs. All maintenance plans 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). Preventative and corrective maintenance shall be performed 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 non-vegetated linings. Specific maintenance guidelines for structural stormwater management measures are available in the BMP Manual.

Required Maintenance Plan Components:
- Required tasks and schedules
- Cost estimates for removal of debris, and sediment removal
- Responsible party for O&M
- Logs of all preventive and corrective maintenance

If a person other than the developer (for example, a public agency or homeowners' association) is responsible 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 that person or entity. In no instance shall the responsibility for maintenance be assigned or transferred to the owner of an individual property in a residential development or project, unless the owner owns the entire residential development or project. If the person responsible for maintenance identified above is not a public agency, the maintenance plan and any future revisions shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

The person or entity responsible for maintenance (herein referred to as the responsible party) 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. Additionally, the responsible party shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed. All maintenance records and the maintenance plan shall be retained by the responsible party and made available, upon request by any public entity with administrative, health, environmental or safety authority over the site. Nothing in this section shall preclude Delaware Township from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

During construction for all major development projects, Township inspectors will be onsite to observe the construction of the project to ensure that the stormwater management measures are constructed and function as designed. After construction, the Township will regularly follow up with the person responsible for maintenance of the stormwater management structures associated with all major development projects.

As previously indicated, each year the Township is responsible to submit an Annual Certification Form to NJDEP for their approval. This form requires that the Township certify that all stormwater management facilities are being properly operated and maintained. To ensure this, the Township will request all responsible parties to submit annual statements documenting the operation and maintenance of their facilities. This will assist the Township in completing the Annual Certification Form as well as provide documentation of all operations and maintenance not conducted by Township personnel on stormwater management facilities. Should the responsible parties not submit annual statements, the Township will assume responsibility for assessing the condition of the stormwater facilities and enforcement actions and/or penalties may be assigned for noncompliance.

5.0 Stormwater Runoff Best Management Practices (BMPs)

It should be noted that although attempts to mimic pre-existing natural conditions may be adequate to satisfy the State stormwater rules, alteration of land always modifies hydrology.

5.1 Nonstructural BMPs/ Low Impact Development (LID)

With the increasing emphasis on NPS pollution and concerns over the environmental impacts of land development, it has become necessary to develop effective alternatives to the centralized conveyance and treatment strategy that has been the basis for much of the historical stormwater management systems and programs in the state. New strategies must be developed to minimize and even prevent adverse stormwater runoff impacts from occurring and then to provide necessary treatment closer to the origin of those impacts. Such strategies, known collectively as LID, seek to reduce and/or prevent adverse runoff impacts through sound site planning and both nonstructural and structural techniques that preserve or closely mimic the site's natural or pre-developed hydrologic response to precipitation. Rather than responding to the rainfall-runoff process like centralized structural facilities, LID techniques interact with the process, controlling stormwater runoff and pollutants closer to the source and providing site design measures that can significantly reduce the overall impact of land development on stormwater runoff.

Any land area used as a non-structural stormwater management measure to meet the above identified design standards shall be dedicated to Delaware Township, Hunterdon County, or the State, subjected to a conservation restriction filed with the County Clerk's office, or subject to NJDEP approved or equivalent

restriction that ensures that measure or an equivalent stormwater management measure approved by the reviewing agency is maintained in perpetuity. Additionally, in general, all proposed stormwater management measures must avoid creating concentrated stormwater runoff flows on habitat for threatened and endangered species as documented in the NJDEP's Landscape Project or Natural Heritage Database (see Section 3.1.1 above).

To the maximum extent feasible, the design standards identified in Section 4.1 above shall be met by incorporating nonstructural stormwater management strategies into the design. The person(s) submitting an application for review shall identify the nonstructural strategies incorporated into the design of the project and shall complete a Low Impact Development Checklist as provided in the BMP Manual (included in Appendix G of this report) to be included in the application to the Township for review. In accordance with the Stormwater Management Rules, nonstructural stormwater management strategies incorporated into site design must:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss (i.e. headwater streams within the Township);
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 "time of concentration" from pre-construction to post-construction;
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 and pesticides;
8. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas; and
9. Provide other 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 and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and
    iii. When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the NJ Soil Erosion Standards.

While the nonstructural stormwater management strategies listed above represent a wide range of both objectives and practices, Strategies 1 through 8 can be directly addressed through the use of specific nonstructural LID-BMPs that can be grouped into four (4) general categories:

- Vegetation and Landscaping;
- Minimizing Site Disturbance;
- Impervious Area Management; and
- Time of Concentration Modifications.

Information on the specific nonstructural LID-BMPs recommended for each of these categories in Delaware Township is presented below. Prior to utilizing any of the specific nonstructural LID-BMPs described below, applicants are urged to review the land development regulations of the municipality and/or agency from which they are seeking development approval. Engineers and site designers should recognize the importance of accurately computing existing or pre-developed runoff at a land development site. While this is an important computation at all development sites, it is particular important at those sites where nonstructural LID-BMPs will be utilized. This is because, to a large degree, these nonstructural measures will utilize and/or mimic the pre-developed site's rainfall-runoff response. As such, accurate computation of pre-developed hydrologic conditions is vital to successful LID-BMP use. It is recommended that engineers and site designers consult with regulatory entities, such as the State, Township, or Hunterdon Soil Conservation District, regarding pre-developed hydrologic conditions. A pre-design meeting with the Township Engineer may help to refine concepts before final design.

5.1.1 Vegetation and Landscaping Techniques

There are three (3) key types of vegetation and landscaping nonstructural measures that should be considered in land development proposed within the Township.

- **Best Management Practice #1:** Preservation of existing natural vegetated areas

Description/Implementation: This should be considered throughout the design of a subdivision or land development. As indicated in Section 3.0 above, there are many areas with significant hydrologic functions including forested areas, riparian corridors, and threatened and endangered species habitat that have been identified within the Township limits. Close attention should be placed on the preservation of natural vegetation throughout the Township. When applying for development approval from Township or NJDEP, a plan showing natural vegetated areas on the pre-developed site, along with a narrative and photographs describing each area's vegetated and hydrologic characteristics should be included in the application package. The narrative should also discuss the alternatives evaluated to preserve the natural vegetated areas.

Maintenance Responsibilities: The maintenance responsibilities for this technique are minimal in that the area must be placed in an easement or deed restricted to ensure that the natural vegetation is not removed.

Recommended applications: Water quality, soil erosion and sediment control, and water quantity control.

- **Best Management Practice #2:** Native ground cover

Description/Implementation: As indicated in Section 1.0 above, areas covered with turf grass typically generate more runoff pollution than other types of vegetation. This is especially true when comparing grass areas with naturally wooded areas or forests. Therefore, the amount of

lawns and other grass areas at land development sites should be minimized. Instead, alternative vegetation, particularly native plants, should be used to revegetate disturbed site areas. Native ground cover can create infiltration characteristics similar to those of natural areas. Naturally wooded areas or forests should also be restored or reestablished at land development sites where opportunity exists.

Maintenance Responsibilities: The use of native plants decreases maintenance in the form of reduced mowing frequency and the elimination of fertilizers, when compared to turf grass.

Recommended applications: Water quality, soil erosion and sediment control, and water quantity control.

- **Best Management Practice #3:** Vegetative Filters/Buffers

Description/Implementation: Native ground cover can provide a vegetated buffer to help filter stormwater runoff and provide locations for runoff from impervious areas to infiltrate. Water flowing as sheet flow across a vegetated area is slowed and filtered prior to infiltrating into the soil. Dense vegetative cover, long flow path lengths, and low surface slopes provide the most effective vegetated filters. Vegetative filters and buffers can be created by preserving existing vegetated areas over which runoff will flow or by planting new vegetation. Vegetative filters located immediately downstream of impervious surfaces such as roadways and parking lots can achieve pollutant removal, groundwater recharge, and runoff volume reduction. Vegetated buffers adjacent to streams, creeks, and other waterways and water bodies can also help mitigate thermal runoff impacts, maintain stream base flow, provide wildlife habitat, and increase site aesthetics.

Maintenance Responsibilities: The use of vegetative filters decreases the quantity of and therefore the maintenance and inspection requirements for structures such as curbs, stormwater collection systems – pipes, inlets, outfalls, etc. Debris and trash should be removed from vegetative filter strips after rainfall events in excess of one (1) inch and at least once (1) per year.

Recommended applications: Water quality, groundwater recharge, and water quantity control.

5.1.2 Minimizing Site Disturbance

- **Best Management Practice #4:** Minimizing land disturbance and grading

Description/Implementation: Minimizing land disturbance and grading at a development site is a nonstructural LID-BMP that can be used during all phases of a land development project. Additionally, minimizing land disturbance and grading can help reduce post-development site runoff volumes and pollutant loads and maintain existing groundwater recharge rates and other hydrologic characteristics by preserving existing

Key Land Disturbance Considerations:
- Do not concentrate flow
- Minimize grading and impervious cover
- Build to the existing topography
- Do not alter natural drainage areas
- Increased structural loads contribute to slope failures
- Minimize changes to existing soil profiles including cut/fill for roads and driveways

site areas. Minimum disturbance begins during the project's planning and design phases by fitting the development into the terrain, as opposed to changing the terrain to fit the development. Roadway and building patterns that match the existing land forms and limit the amount of required clearing and grading should be chosen.

Maintenance Requirements: The applicant will ensure compliance by including these elements in soil erosion and sediment control plans, construction plans, and contract documents.

Recommended applications: Water quality, Groundwater recharge, soil erosion and sediment control, and water quantity control.

5.1.3 Impervious Area Management

Reductions in impervious area translate into more surface storage, infiltration and groundwater recharge, less stormwater runoff, and reduced storm sewer construction, maintenance, and repair costs. It is important to note that all reductions in the amount and dimensions of impervious surfaces at a land development site must also recognize safety and the level of use of the impervious surfaces. There are three (3) impervious area management techniques that may be considered for major development projects proposed within the Township.

- **Best Management Practice #5:** Minimizing street widths and sidewalks

  Description/Implementation: Street widths are typically based on traffic density, emergency vehicle movement, and the need for roadside parking. Street widths for residential developments should be the minimum pavement or cartway width consistent with the RSIS. Similarly, in all other development types, the widths of all streets should be evaluated to demonstrate that the proposed width is the narrowest possible consistent with safety and traffic requirements. The design of certain streets may also include features or areas that can be covered with pervious material, landscaped, or otherwise designed to receive runoff. These features reduce the amount of impervious cover and provide an opportunity to store and possibly infiltrate runoff from adjacent impervious street surfaces. When curbs are necessary to maintain traffic safety or to meet existing regulations, street runoff may be directed to these features through curb cuts or Belgian block curbing without the mortar.

  Sidewalk requirements within residential areas are specified in the RSIS; however, they can be made of pervious material or designed to provide runoff storage and infiltration in their stone base. Where impervious materials are used, sidewalks can be "disconnected" allowing the runoff to sheet flow and infiltrate in adjacent pervious areas.

  Maintenance Requirements: Should pervious paving materials be utilized as part of this BMP there is some maintenance required to ensure the long-term operation of the BMPs that serve this technique. Refer to Best Management Practice #17 for more details.

  Recommended applications: Water quality, water quantity control, and soil erosion and sediment control.

- **Best Management Practice #6:** Minimizing parking area and driveways

  Description/Implementation: Parking area and driveway requirements are mandated by the Township Land Development Ordinances and, in the case of residential areas, the RSIS. The RSIS provides flexibility in selecting parking and driveway size, provided that supporting local data is available. A mix of residential and nonresidential uses at a development site can share parking areas, thereby reducing the total parking area and impervious cover. The RSIS also allows a reduction in the standard 18-foot parking space length provided that room is provided for overhang by the vehicle. The overhang area can then be vegetated to further reduce (and possibly help disconnect) impervious surfaces. Non-residential uses can follow suit in the Township as well. At all development sites, consideration should be given to constructing some or all driveways and parking areas from pervious paving material. This is particularly true for overflow parking areas as well as driveways (and other access roadways) that are used relatively infrequently by maintenance and emergency vehicles. Parking can also be located underground or beneath buildings, which can help reduce the site's overall impervious coverage.

  Maintenance Requirements: Should pervious paving materials be utilized as part of this BMP there is some maintenance required to ensure the long-term operation of the BMPs that serve this technique. Refer to Best Management Practice #17 for more details.

  Recommended applications: Water quality, water quantity control, and soil erosion and sediment control.

- **Best Management Practice #7:** Unconnected impervious areas

  Description/Implementation: This technique includes impervious surfaces that are not directly connected to a site's drainage system. Instead, runoff from an unconnected impervious area is allowed to sheet flow from the impervious area across a downstream pervious surface, where it has the opportunity to re-infiltrate into the soil, thereby reducing the total runoff volume. In most circumstances, impervious areas can be considered unconnected under the following conditions:

  1. All runoff from the unconnected impervious area must be sheet flow.
  2. Upon entering the downstream pervious area, all runoff must remain as sheet flow.
  3. Flow from the impervious surface must enter the downstream pervious area as sheet flow or, in the case of roofs, from downspouts equipped with elongated splash pads, level spreaders, or dispersion trenches that reduce flow velocity and induce sheet flow in the downstream pervious area.
  4. All discharges onto the downstream pervious surfaces must be stable and non-erosive.
  5. The shape, slope, and vegetated cover in the downstream pervious area must be sufficient to maintain sheet flow throughout it length. Maximum slope of the downstream pervious area is 8 percent.
  6. The maximum roof area that can be drained by a single downspout is 600 square feet.

Maintenance Requirements: There is minimal maintenance required with this BMP, however, some repair may be necessary of eroded surfaces.

Recommended applications: Water quality and water quantity control.

5.1.4 Time of Concentration (Tc) Modifications

Changes in peak flow result from changes in Tc from drainage areas, with longer times yielding smaller peak runoff rates and shorter times causing greater ones. Site factors that affect a drainage area's time of concentration include precipitation, flow length, flow regime, surface roughness, channel shape, and slope. Typically, land development modifies most of these factors in ways that cause the time of concentration of a drainage area to be shorter (and, therefore the peak runoff rates to be greater) after development than prior to development. However, during site design, it may be possible to minimize this decrease in time of concentration by controlling the various site factors that affect it. Considerations for three (3) factors are presented below.

- **Best Management Practice #8:** Surface roughness changes

  Description/Implementation: Based upon hydraulic theory, surface roughness coefficients used in sheet flow computations are based on the land cover of a drainage area, with areas of dense vegetation having generally higher coefficients (and longer times of concentration) than smoother surfaces such as paved or grassed areas. Site designers should preserve existing native vegetation or use native plants with varied topography to restore disturbed areas as discussed above in order to increase surface roughness and time of concentration, and consequently reduce the peak flows from a drainage area.

  Maintenance Requirements: Not applicable.

  Recommended applications: Water quantity control and soil erosion and sediment control.

- **Best Management Practice #9:** Slope reduction

  Description/Implementation: Ground slope is an important factor in determining a drainage area's time of concentration and peak discharge. Reducing slopes in graded areas can help minimize Tc reductions and peak flow increases. In addition, terraces and reduced slope channels with grade breaks can be constructed on a sloping area to provide additional travel time. Terraces can also be used to redirect runoff to flow along rather than across the slope, decreasing the slope and increasing the flow length and, subsequently, the time of concentration. Care should also be taken to ensure that the grading of vegetated areas is sufficient to allow for positive drainage as required by local or state regulations, particularly adjacent to buildings and other structures.

  Maintenance Requirements: Not applicable.

  Recommended applications: Water quantity control and soil erosion and sediment control.

- **Best Management Practice #10:** Vegetated conveyance

Description/Implementation: The use of vegetated conveyance measures such as channels and swales can increase the surface roughness along the Tc flow path and increase the overall Tc. In addition, vegetated channels can provide opportunities for runoff treatment, runoff infiltration, and evapotranspiration. In designing vegetated conveyance measures, care should be taken to protect transitions to and from culverts from erosion caused by flow acceleration and turbulence. The vegetation must be tolerant of the hydrologic regime associated with the channel.

Maintenance Requirements: Maintenance of vegetated conveyance involves mowing at least once (1) per year to inhibit woody vegetation growth and removal of any debris at least once (1) per year and after any storm event larger than 1 inch of rainfall.

Recommended applications: Water quality, water quantity control, and soil erosion and sediment control.

At the time this plan was prepared, no actual quantitative values had been assigned to nonstructural BMPs by NJDEP. NJDEP is currently in the process of establishing a "point" based system for the use of these techniques and projects designed will then be required to have a minimum number of points before approval will be granted.

5.2 Structural BMPs

As mentioned previously, wherever possible, all major development projects proposed in the Township should utilize nonstructural stormwater management measures to meet the requirements of the Stormwater Management Rules. When structural measures are required, the following standards apply:

1. Structural stormwater management measures shall be designed to take into account the existing site conditions, including environmentally critical areas; wetlands; flood-prone areas; slopes; depth to seasonal high water table; soil type, permeability and texture; and drainage area and drainage patterns.
2. Structural stormwater management measures shall be designed to minimize maintenance, facilitate maintenance and repairs, and ensure proper functioning.
3. Structural stormwater management measures shall be designed, constructed, and installed to be strong, durable, and corrosion resistant.
4. Stormwater management basins shall be designed to meet the minimum safety standards for stormwater management basins at N.J.A.C. 7:8-6 and as identified below.
5. Stormwater management measure guidelines are available in the BMP Manual and as described below. 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, ground water recharge and water quality design and performance standards established by this subsection.
6. For all future proposed structural stormwater management measures the Township Engineer must evaluate the ability to clean out the selected structural BMP(s); the expense of replacement equipment, safety, and training for the BMP(s); and the ease of access to maintain the structure(s).

There are ten (10) types of structural BMPs identified in the BMP Manual, which are summarized below. This plan identifies the BMPs including maintenance requirements and site limitations. These include the following:

- **Best Management Practice #11:** Bioretention system

Description/Implementation: A bio-retention system consists of a soil bed planted with native vegetation located above an underdrained sand layer. It can be configured as either a bioretention basin or a bioretention swale. Stormwater runoff entering the bioretention system is filtered first through the vegetation and then the sand/soil mixture before being conveyed downstream by the underdrain system. Runoff storage depths above the planting bed surface are typically shallow. **The adopted TSS removal rate for bioretention systems is 90 percent.** Bioretention systems can be used to filter runoff from both residential and nonresidential developments. Bioretention systems are most effective if they receive runoff as close to its source as possible. They can vary in size and can receive and treat runoff from a variety of drainage areas within a land development site. They can be installed in lawns, median strips, parking lot islands, unused lot areas, and certain easements. The elevation of the Seasonal High Water Table (SHWT) is critical to ensure proper functioning of the bioretention basin, and must be evaluated to ensure that the SHWT is at least one (1) foot below the bottom of the bioretention basin's underdrain system during non-drought conditions. An estimated depth to seasonal high water table can be obtained by using Figure 9 of the 2004 Delaware Township Natural Resource Inventory. Additionally for areas located within Tier I and II of the WHPAs in the Township, an impermeable bottom layer should be considered.

Key Considerations for Bioretention systems:

- Evaluation of topographic, geologic, and ecologic characteristics of the site
- Should not be placed where mature trees existed pre-development
- Do not use for construction sediment
- Susceptible to clogging and failure if large quantities of sediment enter the system
- Pretreatment is recommended

Maintenance Requirements: Effective bio-retention system performance requires regular and effective maintenance. All bioretention system components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation after every storm exceeding one (1) inch of rainfall and at least four (4) times annually. Sediment removal should take place when the basin is thoroughly dry. Vegetation should be trimmed and grass should be mowed at least once a month during the growing season. Vegetated areas should be inspected for a decrease in vegetative cover as well as invasive species. Corrective action must be taken within one (1) month to ensure proper operation of the bioretention system. All structural components

must be thoroughly inspected for cracking, subsidence, spalling, erosion, and deterioration at least once per year and should be reviewed after every storm exceeding 1 inch of rainfall. The maintenance plan for a bioretention system must indicate the approximate time it would normally take to drain the maximum design storm runoff volume below the ground surface in the bioretention system. If significant increases or decreases in the normal drain time are observed or if the 72 hour maximum is exceeded, the system's planting soil bed, underdrain system, and both groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the system. Additionally, the planting soil bed at the bottom of the swale should be inspected after every storm exceeding one (1) inch of rainfall.

Recommended applications: Water quality, water quantity control, and groundwater recharge.

- **Best Management Practice #12:** Constructed stormwater wetland

Description/Implementation: Constructed stormwater wetlands are designed to maximize the removal of pollutants from stormwater runoff through settling and both uptake and filtering by vegetation. Constructed stormwater wetlands temporarily store runoff in relatively shallow pools that support conditions suitable for the growth of wetland plants. **The adopted TSS removal rate for constructed stormwater wetlands is 90 percent.** Constructed stormwater wetlands are used to remove a wide range of stormwater pollutants from land development sites as well as provide wildlife habitat and aesthetic features. The minimum drainage area to a constructed stormwater wetland ranges from 10 to 25 acres, depending on the type of wetland. Constructed stormwater wetlands should not be located within natural wetland areas, since they will typically not have the same range of ecological functions. It is important to note that a constructed stormwater wetland must be able to maintain its permanent pool level. Minimum setback requirements for all constructed wetlands are as follows: 50 feet from a septic leach field, 25 feet from a septic system tank, 10 feet from a property line, and 50 feet from a private well, however, a professional should analyze local site conditions during design.

Key Considerations for Constructed Wetland systems:

- Medium-fine texture soils are optimal
- An impermeable liner may be required where infiltration is too rapid
- Shallow depths to bedrock may make these systems not cost effective
- Pretreatment can reduce incoming velocities and capture coarse sediments

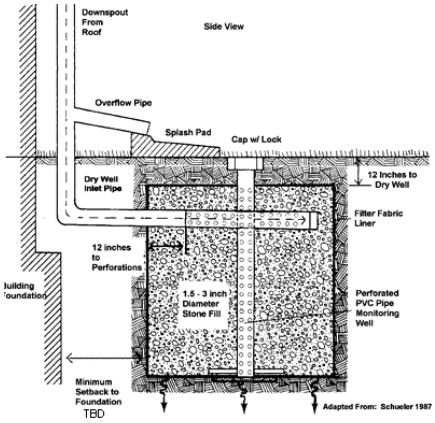
Maintenance Requirements: Effective constructed stormwater wetland performance requires regular and effective maintenance. All constructed stormwater wetland components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation after every storm

exceeding one (1) inch of rainfall and at least four (4) times annually. Vegetation trimming (and/or mowing) should be performed at least once a month during the growing season. Care must be taken to ensure that the vegetation is not damaged or destroyed as a result. The vegetative cover should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications after a professional assessment of the vegetation loss has been conducted. The assessment may include modifications to the original specifications to alleviate the vegetation loss as appropriate. All structural components must be thoroughly inspected for cracking, subsidence, spalling, erosion, and deterioration at least once per year and should be visually observed at all inspections of the constructed wetland system. The maintenance plan for the constructed wetland must indicate the approximate time it would normally take to drain the maximum design storm runoff and return the various wetland pools to their normal standing water levels. If significant increases or decreases in the normal drain time are observed, the wetland's outlet structure, forebay, and groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the wetland.

Recommended applications: Water quality, water quantity control, and soil erosion and sediment control.

- **Best Management Practice #13:** Dry well

Description/Implementation: A dry well is a subsurface storage facility that receives and temporarily stores stormwater runoff from roofs of structures. Discharge of this stored runoff from a dry well occurs through infiltration into the surrounding soils. A dry well may be either a structural chamber and/or an excavated pit filled with aggregate. **Due to the relatively low level of expected pollutants in roof runoff, a dry well cannot be used to directly comply with the suspended solids and nutrient removal requirements contained in the NJDEP Stormwater Management Rules at N.J.A.C. 7:8.** However, due to its storage capacity, a dry well may be used to reduce the total stormwater quality design storm runoff volume that a roof would ordinarily discharge to downstream stormwater management facilities. Dry wells can also be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules. The use of dry wells is applicable only where their subgrade soils have the required permeability rates (a measured rate of 1.0 inch/hour or better). Like other BMPs that rely on infiltration, dry wells are not appropriate for areas where high pollutant or sediment loading is anticipated due to the potential for groundwater contamination and clogging. As noted above, this structure cannot be utilized for sites with known contamination and caution should be utilized in selecting these units in Tier I and II of the delineated WHPAs. Additionally, dry wells should not be placed in areas of hydric soils as identified on the Groundwater Recharge Map in Appendix B. Dry wells are not assigned any TSS removal rate and pre-treatment is required for any stormwater runoff including rooftop runoff directed to these units.



Maintenance Requirements: Effective dry well performance requires regular and effective maintenance. A dry well and pretreatment device should be inspected after every storm exceeding 1 inch of rainfall and at least four (4) times annually. The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume from the dry well. If significant increases in the normal drain time are observed or if it exceeds the 72-hour maximum, appropriate measures must be taken to comply with the drain time requirements and maintain the proper functioning of the dry well.

Key Considerations for Dry Wells:
- The drainage area to the unit must not exceed 1 acre
- Tests for permeability and soil characteristics must be conducted at exact location prior to final design
- Roof gutter guards and sumps or traps should be included in the conduits of the dry well

Recommended applications: Water quantity control and groundwater recharge.

- **Best Management Practice #14:** Extended Detention Basin

Description/Implementation: An extended detention basin is a facility constructed through filling and/or excavation that provides temporary storage of stormwater runoff. It has an outlet structure that detains and attenuates runoff inflows and somewhat promotes the settlement of pollutants. An extended detention basin is normally designed as a multistage facility that provides runoff storage and attenuation for both stormwater quality and quantity management and the design must comply with the requirements of N.J.A.C. 7:20 - Dam Safety Standards. **The adopted TSS removal rate for extended detention basins is 40 to 60 percent, depending on the duration of detention time provided in the basin, which does not meet the requirements of the Stormwater Management Rules exclusively.** Extended detention basins can be used in part to address both the stormwater runoff quantity and quality impacts of land development. Extended detention basins are designed for complete evacuation of runoff and normally remain dry between storm events. Extended detention basins may be used at sites where significant increases in runoff are expected from site development. In addition, standard detention basins may be retrofitted or converted to extended detention by increasing the time over which the basin releases the stormwater quality design storm runoff volume, provided that erosion and flood control volumes and outflow rates are not adversely altered. It must be stressed that extended detention basins have a limited effectiveness in removing both particulate and soluble pollutants may limit their use for water quality treatment. The use of these structures should be limited in areas of environmental or historic significance as they are typically unsightly. A review of the Threatened

Key Considerations for Extended Detention Basins:
- Should collect as much site runoff as possible to be effective
- Shallow bedrock depths may make construction not cost effective
- Forebays are recommended for sediment capture.

and Endangered Species habitat maps should be conducted for all proposed dry detention basins.

Maintenance Requirements: Extended detention basin performance requires regular and effective maintenance. All extended detention basin components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation after every storm exceeding one (1) inch of rainfall and at least four (4) times annually. Sediment removal should take place when the basin is thoroughly dry. If grass is utilized in the basin it should be mowed at least once a month during the growing season. Should other vegetation be planted, the trimming of this vegetation should be increased during the growing season, but care should be taken not to damage or destroy any of the plantings. The vegetative cover should be maintained at 85 percent and corrective action must be taken should the vegetation become more than 50 percent damaged. All structural components must be thoroughly inspected for cracking, subsidence, spalling, erosion, and deterioration at least once (1) per year and should be visually observed at each inspection of the extended detention basin. The maintenance plan must indicate the approximate time it would normally take to completely drain the maximum design storm runoff volume from the basin. If significant increases or decreases in the normal drain time are observed, the basin's outlet structure, underdrain system, and both groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the basin.

Safety Requirements: All new stormwater management basins within the Township must, at a minimum, include trash racks, overflow grates, and escape provisions at 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. 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. 7:8-6.3(a), a freestanding 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.
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 (3:1).

Recommended applications: Water quantity control.

- **Best Management Practice #15:** Infiltration system

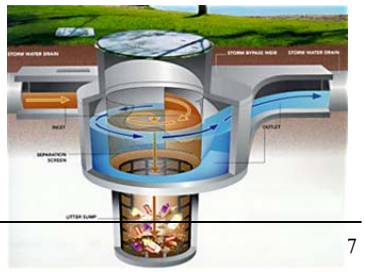
Description/Implementation: An infiltration system is either an aboveground or subsurface facility constructed within highly permeable soils that provides temporary storage of stormwater runoff. Discharge of this stored runoff occurs through infiltration into the surrounding soils. A dry well may be either a structural chamber and/or an excavated pit filled with aggregate. **The adopted TSS removal rate for surface infiltration systems is 80 percent. Pretreatment of at least 50% TSS removal is required for all subsurface infiltration systems.** Infiltration systems can also be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules. The use of surface infiltration systems is applicable only where their subgrade soils have the required permeability rates (a measured rate of 1.0 inch/hour or better for surface systems and 0.4 inch/hour for subsurface systems). Like other BMPs that rely on infiltration, these systems are not appropriate for areas where high pollutant or sediment loading is anticipated due to the potential for groundwater contamination and clogging. As noted above, this structure cannot be utilized for sites with known contamination and caution should be utilized in selecting these units in Tier I and II of the delineated WHPAs. Additionally, infiltration structures should not be placed in areas of hydric soils as identified on the Groundwater Recharge Map in Appendix B.

Key Considerations for Infiltration Systems:
- Tests for permeability and soil characteristics must be conducted at exact location prior to final design
- Preventing compaction of subgrade soils during construction is vital
- Pretreatment is highly recommended in the form of vegetative filters, forebays or manufactured treatment devices

Maintenance Requirements: Effective infiltration system performance requires regular and effective maintenance. An infiltration system should be inspected after every storm exceeding 1 inch of rainfall and at least four (4) times annually. The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume from the infiltration system. If significant increases in the normal drain time are observed or if it exceeds the 72-hour maximum, appropriate measures must be taken to comply with the drain time requirements and maintain the proper functioning of the system.

Recommended applications: Water quantity control and groundwater recharge.

- **Best Management Practice #16:** Manufactured Treatment Device



Description/Implementation: A manufactured treatment device is a pre-fabricated stormwater treatment structure utilizing settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to remove pollutants from stormwater runoff.

Manufactured treatment devices may be used to meet the requirements of the Stormwater Management Rules, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology (NJCAT) and certified by NJDEP. Other manufactured treatment devices not certified under the NJCAT program may be utilized if they are approved by NJDEP prior to their use. Other pollutants, such as nutrients, metals, hydrocarbons, and bacteria can be included in the verification/certification process if the data supports their removal efficiencies. Manufactured treatment devices are intended to capture sediments, metals, hydrocarbons, floatables, or other pollutants in stormwater runoff before being conveyed to a storm sewer system, additional stormwater quality treatment measure, or waterbody. A manufactured treatment device is adequate for small drainage areas that contain a predominance of impervious cover that is likely to contribute high hydrocarbon and sediment loadings, such as small parking lots and gas stations. For larger sites, multiple devices may be necessary. Devices are normally used for pretreatment of runoff before discharging to other, more effective stormwater quality treatment facilities. The Township Engineer should be consulted about each manufactured treatment device proposed and consideration should be given to maintenance, training, and future costs to the Township before approval.

Maintenance Requirements: The maintenance of manufactured treatment devices depends on the manufacturer's guidance. All manufacturer maintenance requirements must be followed to ensure proper operation of these BMPs. Prior to selecting these BMPs for design, applicants should meet with Delaware Township to discuss maintenance of these BMPs over the long-term.

Recommended applications: Water quality.

- **Best Management Practice #17:** Pervious paving

Description/Implementation: Pervious paving materials can be used at some site locations in the Township to replace standard impervious pavement in parking lots and driveways. For all sites where pervious paving is proposed, care should be taken in assessing soil conditions, high groundwater conditions, and potential sources of contamination. **The adopted TSS removal rate for pervious paving systems is 80% for all systems with a storage bed. No water quality credit is assigned for systems that do not include a storage bed.** Further, it is recommended that some form of pre-treatment (i.e. filter strips) be utilized to minimize the chance of clogging the pervious paving. All design criteria identified in the BMP Manual should be followed if this technique is selected. Also, the use of pervious paving materials shall be discussed with Township officials and the Hunterdon County Soil Conservation District prior to use on a project site. Subsurface soil conditions including seasonal high groundwater table, depth to bedrock, and soil type should be carefully reviewed for this BMP. These maps are located in Appendix B of this plan. Careful consideration must be given to freezing weather and to drainage and flooding if clogging occurs. Further, the applicant must evaluate where water will go if the pervious paving fails.

Maintenance Requirements: Effective pervious paving system performance requires regular and effective maintenance. The surface course of all pervious paving systems must be inspected for cracking, subsidence, spalling, deterioration, erosion, and the growth of unwanted vegetation at least once a year. Care must be taken when removing snow from the pervious paving surface courses. Pervious paving surface courses can be damaged by snowplows or loader buckets that are set too low to the ground. This is particularly true at permeable paver systems where differential settlement of pavers has occurred. Sand, grit, or cinders should not be used on pervious paving surface courses for snow or ice control. If mud or sediment is tracked onto the surface course of a pervious paving system, it must be removed as soon as possible. Removal should take place when the surface course is thoroughly dry. The surface course of a porous paving system must be vacuum swept at least four (4) times a year. A high pressure hosing should follow this. All dislodged sediment and other particulate matter must be removed and properly disposed. Maintenance of permeable pavers should be consistent with the manufacturer's recommendations. Grass should be mowed at least once a month during the growing season. Vegetated areas should be inspected at least annually. The vegetative cover should be maintained at 85 percent. The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume below the pervious paving system's surface course. If significant increases or decreases in the normal drain time are observed, the various system components and groundwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the system.

Key Considerations for pervious paving systems:
- Maximum surface slope is 5 percent
- Permeability rate must be 2 times the maximum design storm rainfall intensity
- 80% TSS removal pretreatment required for runoff directed to system that does not pass through surface course

Recommended applications: Water quantity and groundwater recharge.

- **Best Management Practice #18:** Sand filter

Description/Implementation: A sand filter consists of a forebay and underdrained sand bed. It can be configured as either a surface or subsurface facility. Runoff entering the sand filter is conveyed first through the forebay, which removes trash, debris, and coarse sediment, and then through the sand bed to an outlet pipe. Sand filters use solids settling, filtering, and adsorption processes to reduce pollutant concentrations in stormwater. **The adopted TSS removal rate for sand filters is 80 percent.** Sand filters are normally used in highly impervious areas with relatively high TSS, heavy metal, and hydrocarbon loadings such as roads, driveways, drive-up lanes, parking lots, and urban areas. However, due to their relatively high sediment removal capabilities, sand filters are not generally recommended in pervious drainage areas where high coarse sediment loads and organic material such as leaves can quickly clog the sand bed. The use of sand filters in areas that are predominantly wooded should be limited. Where such loadings cannot be avoided, effective pretreatment is absolutely required.

Key Considerations for Sand Filters:
- A drain and valve must be provided to facilitate sediment removal
- Underground sand filters must be completely watertight
- Pretreatment is required

Since sand filters can be located underground, they can also be used in areas with limited surface space.

Maintenance Requirements: Effective sand filter performance requires regular and effective maintenance. All sand filter components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation after every storm exceeding 1 inch of rainfall and at least four (4) times annually. Such components may include inlets and diversion structures, forebays, sand beds, and overflows. Sediment removal should take place when all runoff has drained from the sand bed and the sand is reasonably dry. In addition, runoff should be properly drained or pumped from forebays with permanent pools before removing sediment. In surface sand filters with turf grass bottom surfaces, mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must also be inspected at least annually. The filter bottom must be inspected for unwanted underbrush and tree growth at least once a year. Inspections of vegetation health, density, and diversity should be performed during both the growing and non-growing season. All structural components must be thoroughly inspected for cracking, subsidence, spalling, erosion, and deterioration at least once per year. A visual observation of all structural components should be part of every inspection of the sand filter. The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume below the top of the filter's sand bed. If significant increases or decreases in the normal drain time are observed, the filter's sand bed, underdrain system, and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the filter. The infiltration rate of the sand bed should be retested at least once per year.

Recommended applications: Water quality (for both surface and subsurface sand filters) and groundwater recharge (for surface sand filters).

- **Best Management Practice #19:** Vegetative filter

Description/Implementation: Similar to BMP #3 described above, a structural vegetative filter strip can be employed using native ground cover or other vegetation to provide pollutant removal from stormwater runoff. A vegetative filter is an area designed to remove suspended solids and other pollutants from stormwater runoff flowing through a length of vegetation called a vegetated filter strip. The vegetation in a filter strip can range from turf (not recommended) and native grasses to herbaceous and woody vegetation, all of which can either be planted or indigenous. It is important to note that all runoff to a vegetated filter strip must both enter and flow through the strip as sheet flow. Failure to do so can severely reduce and even eliminate the filter strip's pollutant removal capabilities. **The total suspended solid (TSS) removal rate for vegetative filters will depend upon the vegetated cover in the filter strip ranging from 60 to 80 percent.** Vegetated filter strips can be effective in reducing sediment and other solids and particulates, as well as associated pollutants such as hydrocarbons, heavy metals, and nutrients. The pollutant removal mechanisms include sedimentation, filtration, adsorption, infiltration, biological uptake, and microbacterial activity. Vegetated filter strips with planted or indigenous woods may also create shade along water bodies that lower aquatic temperatures, provide a source of detritus and

large woody debris for fish and other aquatic organisms, and provide habitat and corridors for wildlife. Depending upon their TSS removal rate, vegetated filter strips can be used separately or in conjunction with other stormwater quality practices to achieve an overall pollutant removal goal.

Key Considerations for Vegetative Filters:
- Adequate filter area and length of flow is essential to water quality treatment
- Slopes less than 5 percent are most effective

Maintenance Requirements: Effective vegetated filter strip performance requires regular and effective maintenance. All vegetated filter strip components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation after every storm exceeding 1 inch of rainfall and at least four (4) times annually. Such components may include vegetated areas and stone cutoffs and, in particular, the upstream edge of the filter strip where coarse sediment and/or debris accumulation could cause inflow to concentrate. Sediment removal should take place when the filter strip is thoroughly dry. If turf grass is utilized, it should be mowed at least once a month during the growing season. Vegetated areas must be thoroughly inspected at least once per year. Maintenance practices for filter strips are dependent on the types of plantings. Visual observations should be noted at the time of each inspection of the filter. The vegetative cover should be maintained at 85 percent. All areas of the filter strip should be inspected for excess ponding after significant storm events. The maintenance plan must indicate the approximate time it would normally take for the filter strip to drain the maximum design storm runoff volume and begin to dry. If significant increases or decreases in the normal drain time are observed or if the 72 hour maximum is exceeded, the filter strip's planting soil bed, vegetation, and groundwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the filter strip.

Recommended applications: Water quality, water quantity, and soil erosion and sediment control.

- **Best Management Practice #20:** Wet Ponds

Description/Implementation: A wet pond is a stormwater facility constructed through filling and/or excavation that provides both permanent and temporary storage of stormwater runoff. It has an outlet structure that creates a permanent pool and detains and attenuates runoff inflows and promotes the settlement of pollutants. A wet pond is normally designed as a multistage facility that provides runoff storage and attenuation for both stormwater quality and quantity management and the design must comply with N.J.A.C. 7:20 – Dam Safety Standards. **The adopted TSS removal rate for wet ponds ranges from 50 to 90 percent depending on pool volume and detention time.** A wet pond's permanent pool can retain runoff from the stormwater quality design storm, thereby promoting pollutant removal through sedimentation and biological processing. The permanent pool can also protect deposited sediments from resuspension. Higher stages in the basin can also be used to provide additional stormwater quality treatment through extended detention and/or attenuate the peak rates of runoff from larger storms through the use of multi-stage outlets for flood and erosion control. Wet ponds can also provide aesthetic and recreational benefits as well as water supply for fire protection and/or irrigation. Wet ponds

require sufficient drainage area and, in turn, dry weather or base flow to maintain the volume and environmental quality of the permanent pool. Therefore, the minimum drainage area to a wet pond must be 20 acres. Wet ponds should not be located within the limits of natural ponds or wetlands, since they will typically not have the full range of ecological functions as these natural facilities. While providing some habitat and aesthetic values, wet ponds are designed primarily for pollutant removal and erosion and flood control. It is important to note that a wet pond must be able to maintain its permanent pool level. If the soil at the site is not sufficiently impermeable to prevent excessive seepage, construction of an impermeable liner or other soil modifications will be necessary.

Key Considerations for Wet Ponds:
- An adequate inflow of surface and/or groundwater
- Sediment entering basin should be carefully considered
- Thermal effects should be considered especially for trout production waters
- Pretreatment is highly recommended

Maintenance Requirements: All wet pond components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four (4) times annually as well as after every storm exceeding one (1) inch of rainfall. The primary location for debris and particularly sediment accumulation will be within a wet pond's permanent pool. Additional components may include forebays, inflow points, trash racks, outlet structures, and riprap or gabion aprons. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state and federal waste regulations. Studies have shown that readily visible stormwater management facilities like wet ponds receive more frequent and thorough maintenance than those in less visible, more remote locations. Maintenance and mosquito control personnel can also inspect readily visible facilities faster and more easily. Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must also be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the remaining vegetation. All structural components must be inspected for cracking, subsidence, spalling, erosion and deterioration at least annually. All outlet valves are to be inspected and exercised at least four times annually. The maintenance plan must indicate the approximate time it would normally take to completely drain the maximum design storm runoff volume and return the pond to its permanent pool level. This normal drain time should then be used to evaluate the pond's actual performance. If significant increases or decreases in the normal drain time are observed, the pond's outlet structure and both groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements.

Recommended applications: Water quality, water quantity control, and soil erosion and sediment control.

6.0 Mitigation Plan

The Delaware Township Stormwater Mitigation Plan is set in the context of a larger vision of managing the watersheds of the Township. While the Township is still rural, almost all of the streams exhibit signs

of the impact of mismanaged or uncontrolled stormwater runoff, including streambeds incised to bedrock, streambank collapse and instability, and localized flooding. The primary goal of this mitigation plan is to provide several options to applicants who cannot meet one or more of the requirements of the Stormwater Management Plan including soil erosion, water quantity, water quality, or groundwater recharge. The projects identified below represent a sample of the types of projects may be implemented on public and quasi-public lands, starting on Township-owned properties and roadways. Before an applicant selects a project from this list for mitigation, the applicant must meet with the Township, Hunterdon County, Hunterdon Soil Conservation District, and others to determine whether the selected project will satisfy the mitigation requirements. This Plan will continue to evolve over time as data becomes available about the Township's watersheds during this compliance process.

The following is a preliminary list of mitigation options :

- Retrofit of the Delaware Township School Detention Basin
- Retrofit of Dilts Park Drainage
- Retrofit of the Township Maintenance Area
- Retrofit of the Sergeantsville Firehouse Site
- Riparian Forest Replanting Program
- Lower Creek Road Wetland Impoundment
- Pine Hill Road Culvert Retrofit
- Roadside Forest Buffer Protection Program

Option #1 – Retrofit of the Delaware Township School Stormwater Detention Basin and Installation of Rain Barrels and Water Gardens

Problem: The existing detention structure at the School does not provide water quality treatment or infiltration. Both of these elements are emphasized in the new stormwater management rules. Although the current basin is functioning properly, retrofits might be considered to serve as a demonstration project for the Township that meets the current stormwater guidelines. The detention structure at the school is located in the Headquarters Tributary of the Third Neshanic River HUC14.

Solution: The existing basin could be converted to a bioretention basin or wet pond to provide water quality improvements to meet the current regulations as well as additional infiltration. Rain barrels and water gardens could also be used to meet infiltration requirements immediately around the existing building.

Opportunities: This site is highly visible and will serve as an excellent demonstration of both water quality improvement and habitat management. The students can be involved in the design as well as the implementation for a very interactive learning program that helps meets the education requirements of the NJPDES permit.

Constraints: Minimal. The Township of Buckingham in Pennsylvania recently retrofitted a retention basin behind the municipal building off Route 413 in order to provide habitat as well as improve water quality. The conversion has been very successful and has sparked further efforts on adjacent Township land.

Option #2 – Retrofit of Dilts Park Stormwater Drainage with Rain Gardens and the Implementation of Native Landscape BMPs

Problem: Dilts Park is located at the vulnerable headwaters of several tributaries to Alexauken Creek. The site is presently managed conventionally with turf grass. The turf grass is being mowed to control the deer tick population for the public health of those who use the park. Conventional use of fertilizers, lime, and pesticides may lead to long-term water quality problems in the Alexauken Creek. Dilts Park is located in the Alexauken Creek HUC14.

Solution: A study may be undertaken into the implementation of riparian forest corridors to manage the runoff generated by the play fields of the Park. Planting grasslands and forest where turf is not essential for playing and walking should be considered.

Opportunities: The site is a highly visible area for demonstration projects. It's position, at the headwaters of two tributaries to the Alexauken, although not mapped on the USGS Quadrangle maps is ideal for retrofits.

Constraints: The most significant constraint is the limited availability of local expertise and information on managing native landscapes in Delaware Township. Invasive exotic species as well as deer overgrazing require adequate management in order for this type of project to be successful. Further, public health must be carefully considered, as it is a concern to those who utilize the Park.

Option #3 – Retrofit the Township Maintenance Yard

Problem: Overall there are several existing measures in place to minimize the potential for spills and leaks at the Township maintenance yard. The fuel tanks have double walls to minimize the likelihood for leaks. Further, road salt is stored in a protected area. However, there are still additional measures that could be implemented to further reduce the likelihood of spills and contamination entering the tributary to the Wickecheoke Creek. This site is within the Wickecheoke Creek below Locktown HUC14.

Solution: Potential areas for retrofits should be investigated throughout the maintenance yard. A vegetated swale could be established along the entire downslope perimeter to reduce potential contamination of the creek from stormwater runoff. A bioretention area or a sand filter might intercept and treat the runoff that drains directly from the building. Further, an evaluation of the benefits of spill pads with filtration systems for bus and vehicle fueling may be an option.

Opportunities: The likelihood of some potential accidental contamination would be reduced. Sediment management could also be improved.

Constraints: The site is heavily used in all seasons making any retrofits difficult to install.

Option #4 – Retrofit of the Sergeantsville Fire House

Problem: The Sergeantsville Fire House has a very large and continuous parking area that generates a large volume of runoff. Runoff from the parking area is discharged directly to the storm drain with minimal water quality treatment. A large roof area also contributes to the runoff volume, as does the adjacent open field area. The Fire House is located in the Wickecheoke below Locktown HUC14.

Solution: The Fire House is an excellent place to demonstrate the use of rain barrels to collect runoff from the roof. The use of infiltration devices to minimize surface runoff to the road from the parking area should be considered. Field drainage might be better managed before reaching the inlets below the parking lot. The existing planting box could be reconfigured as a rain garden bio-retention area. Similarly, the planting beds on the upper tier of the parking lot can be reconfigured to accommodate runoff if the gravel area is reworked. Potentially underground basins might serve to provide additional water quantity control from the parking lot.

Opportunities: The area of parking and impervious cover is large so the reduction in runoff discharged could be significant. The site is highly visible and could include permanent educational exhibits.

Constraints: The functional uses of the Fire House require both expansive parking and relatively unconstrained movement of vehicles. The existing grading and paving are not conducive to a simple retrofit. The sites uses are unpredictable and vary from day to day making site work phasing difficult.

Option #5 – Establishment of Riparian Corridor Forests on Various Public and Quasi-Public Lands

Problem: Historic farming practices typically cropped as close to the banks of the streams as feasible eliminating many riparian forests. These farming patterns have been carried over to farms now converted to residential subdivision. As such, lawns sometimes exist right up to the stream banks, which can lead to problems with water quality, water quantity, soil erosion and groundwater recharge.

Solution: A study of the Township's streams to identify potential locations for replanting riparian forest buffers where they have been eliminated may be beneficial. It has been shown that riparian forests can serve to reduce nutrients and sediments as well as rates and volumes of stormwater runoff. Vegetated buffers can also support infiltration and provide beneficial groundwater recharge.

Opportunities: Sites can be prioritized for reforestation. Potentially the reforestation may require cooperation with private landowners. Land conservancies may be able to provide assistance.

Constraints: The biggest impediment to riparian planting is the general lack of local expertise in establishing and managing native vegetation; however, this is changing rapidly. Currently, there is one County contractor who specializes in this field, Paul Steinbeiser. Several area institutions such as Bowman's Hill Wildlife Preserve and Rutgers also offer training programs in planting native landscapes.

Option # 6 – Lower Creek Road Wetland Impoundment

Problem: The Wickecheoke Creek, like most others in the Township, is already receiving significant quantities of stormwater runoff. As a result, some Township infrastructure, such as Lower Creek Road, and habitat for threatened and endangered species has been damaged.

Solution: Beyond limiting future increases in runoff, however, some effort should go to reducing the quantity of stormwater runoff. One potential pilot project is a diversion and impoundment on Lower Creek Road. An investigation into creating a temporary impoundment on property owned by the NJCF upstream of the roadway bottleneck in order to reduce the volume of floodwater in the Wickecheoke would be conducted. During periods of high flow water would be diverted from just upstream to the field across Lower Creek Road. A portion of the former cropland could be converted to either grassland or riparian forest using a combination of berms and shallow excavations to create the temporary impoundment.

Opportunities: Due to the porosity of the soil and its location above and adjacent to the stream, this upper floodplain land may provide opportunities for both infiltration as well as flood storage. The area should be partially regraded to increase storage capacity and improve opportunities to create desirable wildlife habitat.

Constraints: The cooperation of the NJCF is required, however the habitat opportunities increase that likelihood. It is also in their interest to start to address the roadway problem further downstream as a complete collapse would impact that habitat as well as the road. This solution is only helpful if there are no further increases in runoff diverted to the Wickecheoke Creek, in fact, as well as by regulation. All of the elements of the Stormwater Management Plan must be in place for this solution to have more than temporary benefits to the stream.

Option #7 – Pine Hill Road Culvert Retrofit and Demonstration

Problem: Runoff discharged directly through road culverts onto steep slopes can destabilize the slopes and deliver sediment and contaminants directly to streams. Pine Hill Road lies within the Wickecheoke Creek below Locktown HUC14.

Solution: Some modification to the existing culverts at Pine Hill Road may be necessary to ensure slope stability at the outfall. Investigation into alternatives for the existing culverts could be undertaken in an effort to develop a cost effective and environmentally effective solution in steep rocky areas. All solutions, however, are dependent on effectively preventing further increases in stormwater runoff directed to the roadside swales.

Opportunities: Acquiring easements and pursuing reforestation may be an option, especially where a change in cover type might alleviate existing problems.

Constraints: There are no demonstrated successful solutions to this problem in the area. Some research is necessary beforehand. Good solutions may be difficult to implement within the right-of-way.

Option #8 – Roadside Buffer Protection Program

Problem: Road rights-of-way are not always large enough to accommodate alternatives to eventually discharging stormwater runoff via a storm sewer network. Even when the right-of-way is wide enough, historic structures such as stone walls and established vegetation may inhibit right-of-way or road widening for swales.

Solution: The Township may consider investigating the possibility of a roadside buffer protection program. In some instances drainage from large unforested agricultural fields could be reduced significantly before reaching the roadway by establishing a vegetated buffer strip. Where successful, this alternative may be substantially less costly than installing a storm sewer system. A forest buffer also would foster infiltration and pollutant and sediment reduction. Because of the long-term investment inherent in planting forest, this program should be considered only where the farmland has been preserved from future development. A temporary program for tall, delayed mow grasslands as buffers should also be considered and evaluated.

Opportunities: Considering this program provides an opportunity of looking to solutions beyond the limitation of Township-owned land. The cost might include establishment and monitoring as well as payments for land acquisition.

Constraints: Constraints for this program will be determined if the Township decides to implement this mitigation plan at a later date.

7.0 Stream Corridor Protection Plans

Stream Corridor Protection Plans will be developed for each of the four (4) Category One waters within the Township boundaries. A stream corridor is composed of several essential elements, the stream channel itself and the associated wetlands, flood plains and forests. These elements function as an integrated ecological and hydrologic system. Stream corridors are not static but dynamic in terms of function, structure and location.

The benefits of stream corridors for streams and the related ecological habitat are well researched and analyzed. Stream corridors, if maintained in their natural condition with minimum disturbance, are instrumental in performing the following functions:

1. The forests and wetlands within stream corridors provide a buffer against pollution impacts to the stream. The benefits of such buffers (a.k.a. filter strips or buffer strips) include: (a) Removal of sediment and pollutants in overland flow by providing opportunities for filtration, deposition, infiltration, absorption, adsorption, decomposition and volatilization (b) Reduction of sheet, bank and stream bed erosion by stabilization of the stream bank ground surface (c) Displacement of activities from the waters edge that represent potential sources of NPS pollutant generation, spill accidents and illegal dumping (d) Shade surface waters so that waters are not excessively warmed.

There are several studies that have observed the efficiency of filter strips in controlling farming related pollutants being carried through runoff to streams. Filter strips have found to be effective in reducing the amount of solids and liquid nutrients originating through farming activities.

2. Maintain the genetic diversity within native plant and animal populations by providing a contiguous migration corridor, especially in urban areas where streams and associated forests are often the only suitable habitat areas remaining after urbanization. Stream Corridors also provide a

source of food for the aquatic ecosystem. A large percentage of New Jersey's endangered species rely on stream corridors and wetlands for survival.

3. Wetland areas and floodplains help prevent flood related damage to surrounding communities by providing flood storage capacity; help recharge ground water aquifers; and help maintain the surface water level of the stream channel during low rainfall periods.

The destruction or the improper use of one or more elements in a stream corridor can lead to the deterioration of the entire system and can result in significant regional environmental degradation. Problems could include water quality degradation, stream bank erosion, excessive sedimentation in streams and lakes, flooding and loss of wild life and plant habitat. The sensitivity of stream corridors to human interference is heightened when features such as steep slopes and highly erodible soils are present within the corridor.

Adequate protection of stream corridors will eliminate some of these water quality problems by removing sediments, organic matter, and other pollutants from runoff and waste water before entering the stream, and displacing potential NPSs such as underground oil storage tanks from the stream corridor.

Establishment of proper maintenance standards for stream corridors is critical. The effectiveness of stream corridors in buffering the streams to maintain water quality and performing other functions depends on the defined width for the stream corridor (the area encompassing the critical environmental components and a buffer) as well as the permitted uses within the corridor. Although a buffer strip is defined as an undisturbed naturally vegetated zone, the term "undisturbed" should not be taken in its most stringent definition.

Most stream corridor protection related initiatives permit farming within stream corridors. Impacts on water quality caused through farming activities can be reduced to a large extent by utilizing BMPs such as maintaining a filter strip between streams and all farming activities. BMPs in farming should be promoted through the municipality or a related organization to farmers under the Right to Farm Act, receiving federal funding or receiving grain or other equipment subsidies (NRCS).

8.0 Land Use/Build Out Analysis

A Land Use/Build Out Analysis will be prepared using information provided by the Hunterdon County Planning Board in the year 2005. Once this analysis is completed, this section will be amended accordingly.

9.0 Plan Consistency and Recommended Stormwater Control Ordinances

As stated in Section 2.0 above, several goals for the Delaware Township Stormwater Management Plan were identified. The following summarizes how the Township has addressed these goals:

- **GOAL: Reduce flood damage, including damage to life and property** – By requiring that all major development projects address stormwater quantity in accordance with the new Stormwater

Management Rules and the requirements identified in Sections 4 and 5 above, the Township should be able to reduce increased flood damage to a great extent. Further, the Township will mandate mitigation measures for projects that cannot strictly comply with the Stormwater Rules or the Township's ordinances for stormwater. Retrofits to existing stormwater collection systems and stormwater quantity control devices can be employed to further reduce existing flood damage.

- **GOAL: Minimize, to the extent practical, any increase in stormwater runoff from any new development** – By mandating the use of various nonstructural stormwater management techniques as discussed in Section 5.1 above, the Township shall minimize the increase in stormwater runoff from new development. All projects meeting the definition of major development will be required to complete the Low Impact Development Checklist as well. Additionally, requiring projects to meet the stormwater runoff quantity control requirements of the new rules further decreases the potential for stormwater runoff concerns from new development projects in the Township.
- **GOAL: Reduce soil erosion from any development or construction project** – The Township's Stormwater Management Plan identifies that the NJ Soil Erosion Standards be followed for all major development projects. Further, the Township will mandate mitigation measures for projects that cannot strictly comply with the Stormwater Rules or the Township's ordinances for stormwater, retrofits to existing stormwater management features can be employed to reduce erosion from existing development and construction projects.
- **GOAL: Assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures** – All future proposed culverts and bridges will comply with the requirements of the Flood Hazard Area Control Act, N.J.A.C. 7:13, for all drainage areas greater than or equal to 50 acres in size. For all bridges and culverts draining less than 50 acres, the culvert will be sized in accordance with Hunterdon County Engineering Standards. The Township may undertake an evaluation of existing culvert and bridge capacities at a later date.
- **GOAL: Maintain groundwater recharge** – By mandating that all major development projects complete groundwater recharge analyses, it will be possible for the Township to identify the pre-developed and post-developed groundwater recharge conditions. Through the use of BMPs for infiltration the existing groundwater recharge conditions will be maintained post-development. The groundwater recharge requirements cannot be met for all projects within Tier I and Tier II WHPAs. As such, the Township has mandated mitigation measures to compensate for this shortfall.
- **GOAL: Prevent, to the greatest extent feasible, an increase in NPS pollution** – By strongly encouraging the use of LID and preservation, the Township is working to minimize NPS pollution. Additionally, since the Township is mandating that all major development projects meet an 80% TSS removal rate, NPS pollution is mitigated to an even greater extent. Further, the Township will mandate mitigation measures for projects that cannot strictly comply with the Stormwater Rules or the Township's ordinances for stormwater, retrofits to existing stormwater management features can be employed to reduce NPS pollution from existing development and construction projects.
- **GOAL: Maintain the integrity of stream channels for their biological functions, as well as for drainage** – The biological function of the Alexauken Creek will likely be assessed under a 319 Grant with West Amwell Township as the lead partner. The Stream Corridor Protection Plans will further enforce that this goal will be met.

- **GOAL: 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** - By mandating that all major development projects meet an 80% TSS removal rate, NPS pollution is mitigated to a greater extent. Further, the Township will mandate mitigation measures for projects that cannot strictly comply with the Stormwater Rules or the Township's ordinances for stormwater, retrofits to existing stormwater management features can be employed to reduce NPS pollution from existing development and construction projects.
- **GOAL: Protect public safety through the proper design and operation of stormwater management basins –** Public safety will be protected as the Township is mandating all new stormwater management basins be designed in accordance with the public safety requirements of the Stormwater Management Rules.

The following is a list of goals Delaware Township has identified in their Master Plan:

- **GOAL: Preserve sensitive and aesthetic areas in their natural state and to protect natural resources –** Every major development project will be reviewed for overall impact to the natural resources. Stormwater management for all projects will consider and utilize non-structural and LID techniques to the greatest extent feasible.
- **GOAL: Minimize depletion of well water –** Through the requirements for groundwater recharge in stormwater management design Delaware Township will ensure that impacts to groundwater resulting from development will be minimized.
- **GOAL: Prevent contamination of well water –** Recharge of stormwater from contaminated sites is strictly prohibited under this Stormwater Plan. Delaware Township has identified all NJDEP known contaminated sites on mapping included in Appendix B of this plan. Recharge from these sites and any future industrial or contaminated sites will be prohibited without treatment prior to infiltration.
- **GOAL: Improve the quality of streams –** Through the development of Stream Corridor Protection Plans for the various watercourses in the Township, implementation of this plan will ensure that riparian corridors are protected. Strict water quality standards for stormwater runoff from all major development will be enforced. Further, Delaware Township's Mitigation Plans include efforts to restore damaged or lost riparian vegetation.
- **GOAL: Identify critical environmental or scenic areas for special preservation efforts –** All wetlands and water resources that have been mapped in the Township are included in this plan. Further, all State identified Threatened and Endangered Species and habitat for species are delineated on mapping included in Appendix B of this plan.
- **GOAL: Encourage the retention and expansion of significant woodlands in the Township –** Through the Township's recommended Mitigation Plans for riparian restoration as well as through one of the recommended ordinances, Delaware Township will seek to restore and retain woodlands vital to the current health of the streams in the Township. The ordinance may include specific requirements that proposed stormwater management features be designed with allowance for retention or enhancement of existing woodlands.
- **GOAL: Provide for development location and density that respects environmental limitations –** Utilizing the LID techniques discussed and emphasized above, stormwater management and site design can be conducted without significant impact to environmental

features. Further, by enforcing deed restrictions and easements the Township can work to actively preserve and protect critical environmental features both natural and created.

- **GOAL: Seek appropriate locations for the establishment of greenways linking areas of environmental and recreational importance –** The Township is actively working with the New Jersey Conservation Foundation and Green Acres program to preserve open space. A map has been prepared of the current and pending preserved parcels in the Township and is included in Appendix B of this plan.
- **GOAL: Preserve historic sites and encourage compatibility of new development with the character of the Township –** Locations of all historic sites must be considered when new development and redevelopment projects are planned. Further, stormwater management features recommended must consider the historic character of the surrounding area.
- **GOAL: Site new housing to preserve open space –** Major development projects should consider site design layouts that serve to preserve open space. This is currently delineated in the existing Land Development Ordinance "cluster option." Further, applicants must consider placing housing away from environmentally sensitive features and working within the existing landscape in site design.
- **GOAL: Site new housing to minimize the visual impact of new prospective development –** Housing as well as the associated stormwater management features can sometimes have a significant impact visually. Careful consideration should be made before selecting certain types of structural stormwater BMPs and wherever possible the use of nonstructural BMPs is recommended.
- **GOAL: Maintain the rural character of Township roads –** Through limiting the use of curbs and encouraging the use of roadside swales and vegetative filter strips, the rural character of the roads can be maintained.
- **GOAL: Maintain the Environs as large contiguous areas of farmland and other lands –** Through the use of vegetative filters and buffers and limiting the use of structural stormwater BMPs stream corridors and riparian areas will be preserved.

The following are goals that the Stormwater Management Committee has identified:

- **GOAL: Control the volume of runoff directed to roadside swales from new development –** This plan requires water quantity control for all major development. Further, requiring all applicants to prepare a downstream stability analysis will serve to eliminate excessive volumes of runoff entering overtaxed roadside swales in the Township. It is important to note that as part of preparing the ordinance for stormwater management would involve evaluating the stormwater quantity requirements for major development in the Township specific to addressing current problems with roadside swales.
- **GOAL: Protect headwaters for sensitive streams in the Township –** This plan will provide protection for headwaters through the mitigation plans as well as through the use of nonstructural and LID techniques.
- **GOAL: Encourage water quality treatment for existing stormwater runoff directed to streams –** Water quality treatment to a level of 80 percent TSS removal is required for all major development in the Township. The use of vegetative filter strips and buffers is strongly

encouraged to slow down the velocity of stormwater runoff entering the Township's streams. This will ultimately serve to reduce the amount of turbidity and nutrients entering the waterways.

In addition to the mitigation plans identified above, Delaware Township will evaluate several optional measures for stormwater management in the future. These measures may help to address problems created by historical forest clearing, past agricultural practices and current impacts from new development and other land use changes. If the Township is to have healthy, stable streams and a well-protected water supply, several overall strategies should be considered. These include the following:

1. **Consider the use of Township owned lands to demonstrate the BMPs that are most suitable in Delaware Township**. In order to confront the reality that is faced by private property owners, it is important that the Township attempt to meet the same standards that all major development projects must. The goal of this option is to bring all Township property into compliance with the current State standards. The goal is also to save taxpayers money over time so the solutions should be cost-effective.

2. **Consider the implementation of a reforestation program in riparian corridors.** All riparian corridors and existing riparian forest may be protected by proposed ordinance additions. Additional riparian buffers can be established during the development process. On properties where no land use change is anticipated, however, such as on many area farms, replacement of lost riparian forests would contribute greatly to water quality as well as reduce some impacts from excess runoff.

3. **Investigation into developing a series of wetland and lowland habitats that provide short-term storage of stormwater and improve water quality in addition to creating valuable habitat**. These impoundment areas can be almost any size and range from water gardens to bio-retention facilities. The object is to hold water in the uplands with an opportunity for infiltration as well as biological pollutant reduction and reconnect the channel and the floodplain overbanks.

4. **Assess opportunities to divert and impound creek water temporarily**. In some cases there is the opportunity to even take water out of overloaded creeks, especially at storm intervals that shape the streambanks (from the one-year to five-year design storms). The Township should evaluate the locations for potentially diverting water out of the main creeks during periods of high flow to adjacent low lying areas to increase retention capacity.

5. **Emphasize the importance of evaluating BMPs for agricultural land**. This recommendation may be difficult to implement because there are so many involved players, all of whose participation is voluntary. Nonetheless, the benefits are real, to both the landowner and the community and well-worth pursuing.

6. **Implement BMPs on all construction sites**. This recommendation can be met at no cost and with no regulatory changes. It is largely a matter of attitude and desire to enforce the current regulations. As identified previously in this plan, all projects involving the disturbance of more than one (1) acre of land will require a NJPDES Construction Discharge Permit. Some of the requirements of this permit application include detailed information on all BMPs temporarily placed during construction and other construction issues such as waste disposal.

7. **Evaluate existing road standards and recommend potential new road standards and management guidelines**. Road culverts are a major source of local sedimentation and contamination in the Township. Stormwater runoff typically is shunted directly to receiving streams with little to no management except where natural swales can accommodate the volume of runoff received. Road infrastructure is getting both larger and more difficult to maintain, with associated increases in runoff and contamination. Rights-of-way are often to narrow or constrained by rocks, trees or other landscape features. Conventional solutions do not address current needs. Alternative solutions need to be evaluated.

8. **Consider the development of a program to provide native landscape management services**. Many of the recommended practices in this Plan as well as embedded in our current ordinances, such as riparian buffers, depend upon some expertise in managing and installing native landscapes. Many homeowners do not have the inclination or the expertise to establish and maintain native ground cover. Similarly, stormwater management structures require appropriate and informed maintenance. Some communities are creating management entities that homeowners associations and individuals can contract with for services to install and manage native landscapes. A local non-profit may be interested in playing this role. Some area farmers and contractors may be interested in training for managing native landscapes. These services also could be provided as a service to the community as a mitigation project.

9.1 Plan Consistency

A preliminary review of the consistency of the Master Plan, Land Development Ordinance, and the Site Plan and Subdivision Application Checklists with the new Stormwater Management Rules was conducted as part of the preparation of this plan. The major inconsistencies identified include the following:

Township Master Plan, 1994 Revision:

- Section 2.1 Conservation Goals. The first goal is to preserve sensitive and aesthetic areas in their natural state and to protect natural resources. In particular, to minimize erosion, minimize depletion and prevent contamination of well water, maintain and improve the quality of streams and identify critical environmental or scenic areas for special preservation efforts. ***This Plan is consistent with the Conservation Goals identified in the Master Plan.***
- Section 2.3 discusses the major streams in the township and the preservation of these stream corridors. ***It will be necessary to modify this section to reference the Category One designated streams and the associated regulatory requirements for these streams.***
- Section 2.8 specifically discusses storm or surface water management. ***This section must be re-written to include the new Stormwater Management Rules, N.J.A.C. 7:8 as well as the additional requirements set forth in this Plan.***

Township Master Plan & Development Regulations Re-examination Report – 2000:

- Section B addresses the expansion of protection to protect the Township's environmental natural resources by the desirability of increasing infiltration of precipitation and protecting its ground water supply. ***This supports the new SWMP regulations.***

- Section C mentions the availability of new methods of managing infiltration of surface water, including providing adequate stream buffers. ***This section will be amended to include the need to maintain water recharge, maintain water quality, address water quantity, and soil erosion following the new regulations.***
- Section D describes specific changes recommended for the Master Plan or development regulations including creating additional strategies to protect critical groundwater resources and adopting new policies to ensure no adverse impact on groundwater supply to adjoining properties from new construction. ***This supports the new SWMP regulations.***

Township Land Use Ordinance:

- Article IX (Subdivision Review) 9:6.9H – Protection of Water. Proposed subdivisions will have adequate drinking water for its future occupants and further, will not decrease the quality of ground or surface waters. ***This supports the new SWMP regulations.***
- The Delaware Township Major Subdivision Preliminary Application – Checklist B requires applicant to provide a Soil & Sedimentation Plan and a Storm Water Management Plan and Calculations. ***This supports the new SWMP regulations.***
- Article X (Site Plan Review) 10:7.4 H.1 requires that major site plans consider among environmental considerations that there be minimal impairment of the regenerative capacity of aquifers or other ground water supplies and surface waters. ***This will be amended by an ordinance to specifically address the protection of C-1 streams in the Township.***
- Article XI (Design Standards & Improvements) 11:15 - This section includes a requirement for compliance of NJ RSIS. A SWMP is required prior to site plan or subdivision approval. ***There may be a need to change 11:15.1 A of this article. The existing section permits waiver of the requirements of the submission of a SWMP by the Municipal Authority if it determines upon the basis of data submitted by the developer that there will be no increase anticipated in the rate or velocity of run-off resulting from the proposed development. This should be amended to include the four basic requirements of the Stormwater Management Rules, namely water quality, water quantity, groundwater recharge, and soil erosion.***
- Article XII (Environmental & Natural Resource Requirements) 12:9 specifically describes the Storm water Management, its purpose and regulations. ***This supports the new SWMP regulations.***

9.2 Recommended Stormwater Ordinances

Preliminarily, it appears that the existing Township ordinances may be updated to include the following stormwater control ordinances:

Overall Stormwater Control Ordinance – a copy of the NJDEP Model Stormwater Control Ordinance is included in Appendix H of this plan. Currently Hunterdon County is in the process of preparing a more detailed overall stormwater control ordinance for its municipalities. Delaware Township will review this ordinance and develop an ordinance that is consistent with the recommendations of both NJDEP and Hunterdon County as required under the Township's NJPDES permit.

Stream Corridor Protection Ordinance – a copy of the NJDEP Division of Watershed Management Model Riparian Protection Ordinance is included in Appendix H of this plan. Delaware Township will

review this ordinance and consider the development of Stream Corridor Protection Plans for all watercourses in the Township with help from the Environmental Commission.

Native Vegetation Ordinance – A copy of an ordinance from Westchester, Pennsylvania is included in Appendix H of this plan for Native Vegetation. Delaware Township will review this ordinance and consider the development of an ordinance consistent with this sample.

Woodland Protection Ordinance – Delaware Township would like to consider developing a woodlands protection ordinance to ensure that vital woodlands within the Township are preserved and that restoration of woodlands is ensured.

10.0 Applicable Definitions

"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 manufacturer of agriculturally related products.

"Best Management Practices (BMPs)" are defined as any program, process, location criteria, operating method, measure or device that controls, prevents, removes, or reduces pollution.

"Category One (C1) Waters" means Waters of the State, including unnamed waterways that appear on Soil Survey and USGS Topographic Quadrangle within the same HUC 14 watershed, designated in NJAC 7:9B-1.15 (c) through (h) for purposes of implementing the anti-degradation policies set forth at NJAC 7:9B-1.5(d) for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resources(s).

"Development" includes 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. 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.

"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 USEPA at 40 CFR 302.4; areas where recharge would be inconsistent with NJDEP 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.

"Impervious surface" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water. Impervious surfaces include areas such as paved parking lots and concrete sidewalks.

"Infiltration" is the process by which water seeps into the soil from precipitation.

"Low Impact Development (LID)" attempts to replicate pre-development hydrology to reduce the impacts of development at a lot-level basis, treating rainwater where it falls by creating conditions that allow the water to infiltrate back into the ground. The primary goals of LID include, greater infiltration of stormwater instead of regarding the water as disposable.

"Major development" includes those projects that disturb one (1) or more acres of land for the purposes of the Township regulations. Projects that increase impervious surfaces by 0.25 acres or more that are regulated by NJDEP are also considered major development. Disturbance includes 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."

"Nonpoint source (NPS) pollution" refers to all sources that cannot be identified as a point discharge. These include stormwater surface runoff and agricultural runoff, among others.

"Pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.

"Pollution" refers to the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.

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

"Redevelopment" refers to alterations that change the "footprint" of a site or building in such a way that results in the disturbance of one acre or more of land. The term is not intended to include such activities as exterior remodeling, which would not be expected to cause adverse stormwater quality impacts and offer no new opportunity for stormwater controls. The NJDEP does not consider pavement resurfacing projects that do not disturb the underlying or surrounding soil, remove surrounding vegetation, or increase the area of impervious surface to be "redevelopment projects."

"Riparian" means an area of land or water within or adjacent to a surface water body.

"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.

"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.

"Threatened and Endangered Species" include the following: Endangered Species are those whose prospects for survival in New Jersey are in immediate danger because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance or contamination. Assistance is needed to prevent future extinction in New Jersey. Threatened Species are those who may become endangered if conditions surrounding them begin to or continue to deteriorate.

"Time of Concentration" (Tc) 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.

"Total Maximum Daily Load (TMDL)" is the amount of a pollutant that can be accepted by a waterbody without causing an exceedance of water quality standards or interfering with the ability to use a waterbody for one or more of its designated uses. The allowable load is allocated to the various sources of the pollutant, such as stormwater and wastewater discharges, which require a NJPDES permit to discharge, and NPS, which includes stormwater runoff from agricultural areas and residential areas, along with a margin of safety. Provisions may also be made for future sources in the form of reserve capacity. An implementation plan is developed to identify how the various sources will be reduced to the designated allocations. Implementation strategies may include improved stormwater treatment plants, adoption of ordinances, reforestation of stream corridors, retrofitting stormwater systems, and other BMPs.

"Total Suspended Solids" (TSS) refers to particles that are suspended in water. Suspended solids in water reduce light penetration in the water column, can clog the gills of fish and invertebrates, and are often associated with toxic contaminants because organics and metals tend to bind to particles. Differentiated from total dissolved solids (TDS) by a standardized filtration process, the dissolved portion passing through the filter.

"Water Quality Design Storm" refers to the rainfall event used to analyze and design structural and nonstructural stormwater quality measures (known as BMPs). As described in the Stormwater Management Rules, the NJDEP stormwater quality design storm has a total rainfall depth of 1.25 inches and a total duration of two (2) hours. During its duration, the rain falls in a nonlinear pattern as depicted in Table 2 in Appendix F. This rainfall pattern or distribution is based on Trenton, New Jersey rainfall data collected between 1913 and 1975 and contains intermediate rainfall intensities that have the same probability or recurrence interval as the storm's total rainfall and duration. As such, for times of concentration up to two hours, the stormwater quality design storm can be used to compute runoff volumes, peak rates, and hydrographs of equal probability. This ensures that all stormwater quality

BMPs, whether they are based on total runoff volume or peak runoff rate, will provide the same level of stormwater pollution control.

"Wellhead protection areas (WHPAs)" in New Jersey are mapped areas calculated around a Public Community Water Supply well in New Jersey and is defined as the portion of an aquifer that contributes water to a well over a specified time interval.

References:

Delaware Township, Hunterdon County, New Jersey - Master Plan Reexamination Report - 2000.

Delaware Township, Hunterdon County, New Jersey - Master Plan, 1994 Revision.

Delaware Township Environmental Commission and Banisch Associates, Inc. "2004 Delaware Township Natural Resource Inventory," 2004.

M^2 Associates, Inc. "Evaluation of Groundwater Resources of Delaware Township, Hunterdon County, New Jersey," dated July 2004.

New Jersey Administrative Code (N.J.A.C.) 7:8 – Stormwater Management Rules, adopted February 2, 2004.

New Jersey Department of Environmental Protection. "New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report *(includes 305 (b) Report & 303(d) List)*," dated June 2004.

New Jersey Department of Environmental Protection. "New Jersey Stormwater Best Management Practices Manual," dated April 2004.

New Jersey Department of Environmental Protection. *Stormwater Management Rule Frequently Asked Questions*. Retrieved October 3, 2004, from NJ Stormwater Web site: http://www.nj.gov/dep/watershedmgt/stormwaterfaqs.htm.

New Jersey Department of Environmental Protection. "Tier B Municipal Stormwater Guidance Document – NJPDES General Permit No. NJ0141861," dated April 2004.

New Jersey State Soil Conservation Committee. "Standards for Soil Erosion and Sediment Control in New Jersey," adopted July 1999.

United States Department of Agriculture. "Soil Survey of Hunterdon County, New Jersey," issued November 1974.

APPENDICES