

Princeton Township

11.0 Introduction

This Municipal Stormwater Management Plan for the Township of Princeton describes the policies and measures that the Township will implement to address stormwater-related impacts of land development and redevelopment projects. This Plan has been developed in response to the post-construction stormwater management requirements for new development and redevelopment contained in the Township's Tier A Municipal Stormwater General Permit (Permit No. NJ0141852) issued by the New Jersey Department of Environmental Protection (NJDEP) and described in N.J.A.C. 7:14A - Municipal Stormwater Regulations.

The Princeton Township Municipal Stormwater Management Plan has been prepared in accordance with the NJDEP *Tier A Stormwater Guidance Document* dated April 2004 and contains all of the required elements of a Municipal Stormwater Management Plan contained in N.J.A.C. 7:8 Stormwater Management Rules. The Plan addresses the groundwater recharge, stormwater quality, and stormwater quantity impacts of land development and redevelopment projects by identifying stormwater management design and performance standards for new major land developments, defined as projects that disturb one or more acre of land. These standards are intended to minimize the adverse impacts of stormwater runoff from such projects on water quality and quantity and prevent a loss of groundwater recharge. The Plan also describes operation and maintenance requirements for the stormwater management facilities that are created to achieve these standards in order to insure their long-term performance.

It is important to note that this Plan contains those Municipal Stormwater Management Plan components that must be completed within twelve months of the April 1, 2005 effective date of the Township's Tier A Municipal Stormwater General Permit. As such, this Plan will require modification in the future to incorporate the adopted municipal Stormwater Control Ordinance and those additional Plan components that must be completed within twelve months of the Plan's original adoption date.

11.1 Stormwater Impacts of Land Development and Redevelopment

According to the United States Environmental Protection Agency (USEPA), stormwater runoff is a major component of nonpoint source (NPS) pollution, the largest remaining source of pollutants in our nation's waters. The USEPA has also documented how the quality of our surface and ground waters is directly related to the overall health of our environment. Similarly, the NJDEP estimates that up to 60 percent of existing water pollution

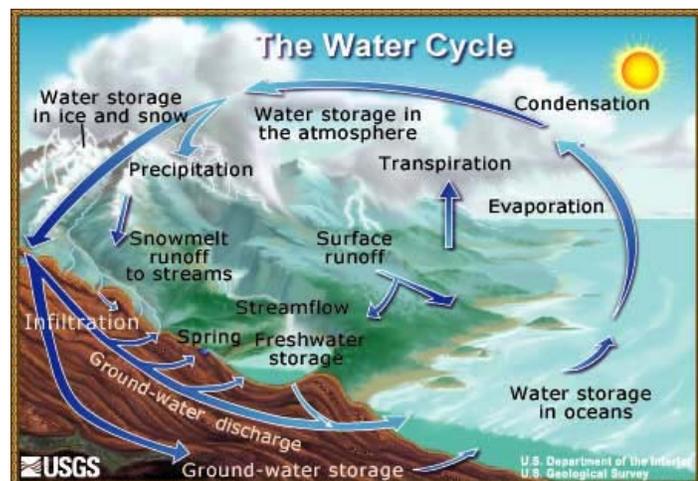


Illustration by John M. Evans, Colorado District, USGS

problems are attributable to NPS pollution and, in particular, the pollutants in stormwater runoff. However, since these pollutants originate from numerous, diffuse sources and are conveyed by runoff from an entire drainage area or watershed, they can be difficult to identify, regulate, and treat.

In natural environments that are undisturbed by land development, precipitation that reaches the ground surface can follow a number of routes. If the surface is covered with vegetation, the majority of the precipitation is either intercepted by the surface vegetation or infiltrates into the soil. Intercepted precipitation can evaporate back into the atmosphere along with the precipitation that collects in depressions on the ground surface. Infiltrated precipitation can either be drawn up by the root systems of the surface vegetation and transpired back into the atmosphere or can move downward to the groundwater, thereby recharging this important resource. A smaller portion of the precipitation typically runs off the ground surface to downstream creeks, streams, and rivers. This process, known as the hydrologic or water cycle and illustrated in the above figure, generally functions in equilibrium, but is susceptible to changes in the cycle's various processes, most notably changes in the ground surface upon which the precipitation falls.

Since land development by its very nature alters the ground surface, it can dramatically impact the natural hydrologic cycle and cause severe stormwater impacts if it is not carefully planned, designed, constructed, and maintained. Land development typically replaces natural vegetation with lawns and impervious surfaces, thereby reducing the site's natural evaporation, transpiration and infiltration rates. Construction activities can compact the soil, further reducing its ability to infiltrate. These reductions increase the amount of stormwater runoff that flows across the ground surface and decrease the amount that recharges into the groundwater. Land development also typically connects the runoff from impervious surface directly to a constructed drainage system of gutters, channels, and storm sewers. These systems transport runoff more quickly than natural surfaces and conveyance systems. This, in turn, shortens the area's rainfall-runoff response time, causing flow in downstream waterways to peak faster and at greater rates than natural conditions. This combination of increased runoff volumes and greater runoff rates can create new and aggravate existing downstream flooding and erosion problems and increase the quantity of sediment both transported by and deposited in the waterway's channel. Filtration of runoff and removal of pollutants by natural surface and channel vegetation is also eliminated through the use of constructed drainage systems.

Coupled with increased surface flows, reduced base flows due to decreases in groundwater recharge can produce greater fluctuations between normal and storm flow rates in streams and rivers, which can further increase channel erosion. Reduced base flows can also negatively impact the hydrology of adjacent wetlands and the health of biological communities that depend on this source of water. Finally, erosion and sedimentation can destroy habitat from which some species cannot adapt.

In addition to surface runoff increases and the loss of groundwater, land development often results in the accumulation of pollutants on the land surface that can be mobilized by runoff and transport to streams. New impervious surfaces and cleared areas created by development can

accumulate a variety of pollutants from numerous sources, including the atmosphere, fertilizers, animal wastes, and leakage and wear from vehicles. These pollutants can include metals, suspended solids, hydrocarbons, pathogens, and nutrients which can adversely impact water quality and a wide range of important stream biota.

Land development can also adversely affect water quality and stream biota in more subtle ways. For example, stormwater falling on impervious surfaces or stored in detention or retention basins can become heated and raise the temperature of the downstream waterway, adversely affecting cold water fish species such as trout. Development can remove trees along stream banks that normally provide shading, stabilization, and leaf litter that falls into streams and becomes food for the aquatic community.

Finally, the pollution of surface waters and the depletion of groundwater caused by land development can impact both the quantity and quality of the drinking water supplies that are necessary to sustain existing populations and industries as well the recreational use of streams, rivers, and lakes.

11.2 NJDEP Municipal Stormwater Regulation Program

In response to the adverse impacts of nonpoint source pollution, including those caused by uncontrolled land development, the United States Congress amended the 1972 Clean Water Act in 1987 to require management and control of these pollutant sources. As a result of this amendment, the USEPA expanded the National Pollutant Discharge Elimination System (NPDES) to include regulations for stormwater discharges. This included the issuance of a series of regulations culminating in the Phase II Storm Water Regulations in December 1999. Among other requirements, these regulations directed municipalities with separate storm sewer systems to develop programs to control the post-construction runoff from land development and redevelopment projects.

In response to these Phase II Regulations, the State of New Jersey, which administers the federal NPDES program through the State's own New Jersey Pollutant Discharge Elimination System (NJPDES), initiated the New Jersey Municipal Stormwater Regulation Program (NJAC 7:14A) in March 2004. This program, which is administered by the NJDEP, addresses pollutants entering the State's waters from stormwater systems operated by local, county, state, interstate, and federal government agencies. These systems are collectively referred to as Municipal Separate Storm Sewer Systems (MS4s). Under the Municipal Stormwater Regulation Program, stormwater discharges from MS4s are regulated through one of four general NJPDES Permits. These are the Tier A and Tier B Municipal Stormwater General Permits, the Public Complex Stormwater General Permit, and the Highway Agency Stormwater General Permit. Each General Permit includes a number of Statewide Basic Requirements (SBRs) that must be met by those authorized through the Permit to discharge stormwater from their MS4. Each SBR includes minimum performance standards, measurable goals, and implementation schedules. All New Jersey municipalities have been classified as either Tier A or Tier B municipalities depending upon such factors as total population and population density as determined in the 2000 United States Census.

Princeton Township has been designated by the NJDEP as a Tier A municipality. As such, the discharge of stormwater from the Township's storm sewer systems has been authorized under NJPDES Stormwater Tier A General Permit No. NJ0141852. A key component of the Post-Construction Stormwater Management SBR is the requirement that Princeton Township develop and adopt both a Municipal Stormwater Management Plan and implementing Stormwater Control Ordinance that addresses the impacts of major land developments on the quality and quantity of those storm sewer system discharges. This Plan represents Princeton Township's compliance with this General Permit SBR.

11.3 NJDEP Stormwater Management Rules

Concurrently with the initiation of the Municipal Stormwater Regulation Program, the State of New Jersey also enacted major revisions to the New Jersey Stormwater Management Rules (NJAC 7:8). These revisions were the first major update to the State's Stormwater Management Rules since their original promulgation in 1983 and represented a fundamental change in the management of stormwater runoff in New Jersey. In addition, associated revisions were also enacted to portions of several related State regulations that involve stormwater management, including the Residential Site Improvement Standards (NJAC 5:21), the Freshwater Wetland Protection Act Rules (NJAC 7:7A), the Flood Hazard Area Control Act Rules (NJAC 7:13), the Watershed Management Rules (NJAC 7:15), and the New Jersey Dam Safety Standards (NJAC 7:20).

The new Stormwater Management Rules provide both a framework and incentives for managing runoff and resolving NPS impairment caused by land development. The Rules also establish a hierarchy for implementation of stormwater management measures at major land development projects, with initial reliance on nonstructural stormwater management measures (also known as low impact development techniques) to manage stormwater runoff before using more traditional structural measures. The 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 between local and State regulatory agencies; and provide maintenance and safety standards for stormwater management measures.

In Subchapter 4, the new Stormwater Management Rules specify the required goals and contents of a Municipal Stormwater Management Plan as well as the schedule for its adoption as part of a municipality's Master Plan. According to the Stormwater Management Rules and the Township's Tier A Stormwater General Permit, a first version of this Plan must be adopted within twelve months of the Township's April 1, 2004 effective date of General Permit authorization. In addition, the Stormwater Management Rules also contain the minimum technical and performance standards to be included in the implementing Stormwater Control Ordinance that is also required by the Township's Tier A Stormwater General Permit. According to both the Rules and the Township's General Permit, both the Stormwater Control Ordinance and the final version of the Plan must be adopted within twelve months of the Plan's original adoption date.

The goals of the Township’s Municipal Stormwater Management Plan are presented below.

12.0 Princeton Township Municipal Stormwater Management Plan Goals

As required by the New Jersey Stormwater Management Rules at NJAC 7:8-4.2-c-1, the Princeton Township Municipal Stormwater Management Plan has been developed to achieve the following stormwater management planning goals:

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

In addition, the Township’s Land Use Code at Section 10B-227 – Surface Water Drainage requires the following:

- A proposed development shall, in accordance with this section and with applicable stream and flood plain encroachment laws and ordinances, be designed so as to provide for proper surface water management through a system of controlled drainage that, wherever practicable, preserves existing natural drainage patterns and wetlands and enhances groundwater recharge areas and that protects other properties and existing natural and artificial drainage features from the adverse effects of flooding, erosion and the depositing of silt, gravel or stone.

Further, the Township’s Flood Damage Prevention Ordinance has the following goals:

1. Protect human life and health.
2. Minimize expenditure of public money for costly flood control projects.
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public.
4. Minimize prolonged business interruptions.

5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, and streets and bridges located in areas of special flood hazard.
6. Help maintain a stable tax base by providing for the second use and development of areas of special flood hazard so as to minimize future flood blight areas.
7. Insure that potential buyers are notified that property is in an area of special flood hazard.
8. Ensure that those who occupy the areas of special flood hazard assume the responsibility for their actions.

Finally, the Princeton Regional Planning Board's stormwater control policy states:

1. Promote an integrated approach to regional stormwater management that addresses both water quality and quantity in the Township.
2. Design detention basins to fit into the natural terrain and preserve or reforest vegetation where appropriate in the Township.
3. Detention basins should be designed utilizing techniques that minimize disturbance and the size of the basin such as diversion of flow, compensation, and alternative quality measures.
4. Control both stormwater quality and quantity in the Borough where feasible.

To achieve all of the above goals, the Princeton Township Municipal Stormwater Management Plan outlines specific stormwater design and performance standards for major land development and redevelopment projects. 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.

13.0 Township Description

The Township of Princeton covers an area of 16.25 square miles in central New Jersey. It is located in northern Mercer County and surrounds the 1.85 square mile area of the Borough of Princeton. While the two municipalities are completely separate political entities, a close governmental relationship exists between them. In addition to the Princeton Regional Board, which oversees both municipalities, and a joint Environmental Commission, Princeton Township and Borough jointly provide community recreational facilities including a large pool complex, tennis and paddle tennis courts, athletic playing fields and various parks and playgrounds. According to the 2000 U.S. Census, the population of Princeton Township was 16,027. The Township boundary is identified on the USGS Map - Figure C9.

In general, Princeton Township is an open, semi-wooded residential community of substantial homes and is an example of sound suburban development. There is also one shopping center, several other shopping areas of smaller size, some office research and services areas, and a large amount of preserved open space. A substantial portion of Princeton University lies within the Township, along with the Institute for Advanced Study. Other well-known educational institutions within the Township include the American Boychoir School, the Hun School, the Princeton Day School, and the Stuart Country Day School of the Sacred Heart.

While there are no interstate highways within the Township, U.S. Highway Route 206 crosses the Township in a generally north-south direction and State Highway Route 27 extends from Princeton Borough across the eastern portion of the Township. In addition to Routes 206 and 27, which are maintained by the New Jersey Department of Transportation (NJDOT), portions of Mercer County Routes 533, 583, 604, 605, and 629 are located in the Township. These highways and County roadways and their associated stormwater conveyance systems are covered under NJPDES Highway Agency Stormwater General Permits issued to the NJDOT and Mercer County, respectively. As such, stormwater runoff from these systems is not covered under this Plan and the systems are not the responsibility of Princeton Township to operate and maintain. All roadways in Princeton Township are shown on Figure C10.

As part of the New Jersey State Planning Commission's Cross Acceptance process of the proposed State Development and Redevelopment Plan, Princeton Township would include Planning Areas 2, 3, and 5. In addition, a portion of the Township is proposed for inclusion with Princeton Borough as a Designated Regional Center. These proposals, however, are subject to final approval by the Commission.

Presently, the majority of Princeton Township is zoned for residential use. Minimum residential lot sizes range from 6,500 square feet in the R-9 Zone to 4 acres in the R-A Zone. The remaining portions of the Township include Business, Professional Office, Shopping Center, Educational, Office Research, Service, and Hospital Districts. Copies of the Township's official Zoning Map are available from the Princeton Regional Planning Board and the Princeton Township Engineer's Office.

It should be noted that Princeton Township presently regulates the quality and quantity of stormwater runoff from land developments through the Surface Water Drainage requirements in its Land Use Code.

13.1 Environmental and Water Resources

13.1.1 Environmental Resources

Open Space - Based on data obtained from the Princeton Regional Planning Board, approximately 2,782 acres or approximately 27% of Princeton Township are preserved as public or private open space. This includes golf courses, state, county, and Township-owned land, and private land that is restricted.

Contaminated Sites – According to the NJDEP, there are presently 21 sites with on-site sources of contamination in Princeton Township. These sites were identified from the NJDEP's *Known Contaminated Sites in New Jersey* report last updated in 2001. The *Known Contaminated Sites in New Jersey* report is a listing of sites by municipality where contamination of soil and/or ground water is confirmed at levels greater than the applicable cleanup criteria or standards. According to the NJDEP, remedial activities at these sites are either required, underway or have been completed. There are three sites where remedial activities have been completed in the Township. However, while no further NJDEP action is required, engineering and/or institutional

controls remain in place at these sites to address soil and ground water contamination. All three sites Classification Exception Areas (CEAs) as a result of groundwater contamination levels exceeding existing NJDEP Groundwater Quality Standards.

It is important that the precise location, contaminants, case status, and required remedial activities at these sites be determined before specific stormwater management measures are proposed for any land development projects in their vicinity since they may impact measure selection, design, and maintenance.

Wellhead Protection Areas - There are nine existing Public Community Water Supply (PCWS) wells located within Princeton Township. All of these PCWS wells are owned by the Elizabethtown Water Company. The New Jersey Geological Survey (NJGS) has delineated Wellhead Protection Areas (WHPAs) for each of these PCWS wells. As described below, a WHPA is a calculated area around a production well that defines the portion of an aquifer that contributes water to a well over a specified time interval. The locations of the delineated Wellhead Protection Areas for the nine PCWS are shown on Figure C11.

A WHPA is divided into three sequential tiers based on the Time of Travel (TOT) to a production well. TOT is the time it takes for a given particle of groundwater to flow to a pumping well. It is directly related to the distance the groundwater must travel to arrive at the well once well pumping starts. For a given TOT, the distance will vary from well to well depending on the rate of pumping and aquifer characteristics. WHPA Tier 1 is derived from a 2-Year TOT and is based on findings that bacteria have polluted wells and viruses have survived in groundwater for up to 270 days. WHPA Tier 2, derived from a 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. WHPA Tier 3 is derived from a 12-year TOT, and is established to provide sufficient time so that monitoring and cleanup of a potential pollution source or release can be completed before contamination reaches a pumping well. All three WHPA Tiers are defined using line boundaries and polygon areas generated with the ARC/INFO Geographic Information System.

Groundwater Recharge - A map of the various annual groundwater recharge rates in Princeton Township are depicted in Figure C12. As can be seen in the Figure, the annual recharge rates in Princeton Township range from essentially no recharge to an annual rate of approximately 23 inches per year. These annual recharge 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 presented as guidance for identifying both general groundwater recharge rates and areas for potential recharge measures and are not intended for design purposes.

Geology - According to the *Soil Survey of Mercer County* prepared by the USDA Natural Resources Conservation Service and the New Jersey Agricultural Experiment Station, there are four major soil associations within Princeton Township, all of which are found in the Northern Piedmont. Soils of the Neshaminy-Mount Lucas-Lehigh association predominate in the northern portion of the Township. These soils are mainly deep, well drained to somewhat poorly drained,

moderately sloping to steep, stony soils that a silty subsoil over diabase. Soils of the Quakertown-Chalfont-Doylestown association predominate in the central portion of the Township. These soils are moderately deep to deep, well drained to poorly drained, nearly level to moderately steep soils that have a silty subsoil over mainly sandstone and argillite but with areas of red shale and siltstone. Soils of the Bucks-Penn-Readington association are located in a relatively narrow area between the two associations described above. These soils are moderately deep and shallow, well drained and moderately well-drained, gently undulating or gently sloping soils that have a silty subsoil over red shale or siltstone. Finally, the southern portion of the Township has predominately soils of the Birdsboro-Rowland-Bowmansville association. These soils are mainly deep, well drained, nearly level to gently sloping soils that have a silty or loamy subsoil on high stream terraces or are moderately well drained to poorly drained soils on flood plains of the Stony Brook and Millstone River.

A map of these four major soil associations can be found in the *Soil Survey of Mercer County*.

Steep Slopes – Based upon an analysis of topographic mapping of the Township, steep slopes exist at multiple locations throughout Princeton Township. Steep slopes are generally considered in two categories. Slopes in excess of 25% present serious limitations for development, often requiring extensive and costly engineering and construction efforts. Development on slopes in excess of 15% can degrade the environment if not properly managed. The locations of such slope areas are shown on Figure C13. Typically, the effects of steep slopes must be carefully considered in the selection of appropriate stormwater management measures for land developments.

13.1.2 Water Resources

Wetlands - Based on the National Wetland Inventory prepared by U.S. Fish and Wildlife Service and the NJDEP Wetlands Inventory for Mercer County, there are approximately 1,698 acres of freshwater wetlands within Princeton Township. The locations of these wetlands are shown on Figure C14.

Waterways – A plan of the waterways in Princeton Township as delineated by the U.S. Geological Survey (USGS) is shown on Figure C15 in Appendix C. In addition, streams are delineated by the USDA Natural Resources Conservation Service (NRCS) in the Soil Survey of Mercer County. Finally, the Township's *Flood Mitigation Plan* contains additional figures that depict the major waterways within Princeton Township. None of the waterways within the Township are classified as Category One (C1) waters by the New Jersey Surface Water Quality Standards.

Watersheds – According to the NJDEP and USGS, portions of five major watersheds are located within Princeton Township. The Hydrologic Unit Code 14 (HUC14) of each of these watersheds is shown on Figure 15. These HUC14 watersheds are listed in the Table below.

HUC14 Watersheds in Princeton Township

HUC14	Waterway	Description
02030105090060	Stony Brook	From Route 206 to Provinceline Road
02030105090070	Stony Brook	From Harrison Street to Route 206
02030105110020	Millstone River	From Heathcote Brook to Harrison Street
02030105110030	Millstone River	From Bedens Brook to Heathcote Brook
02030105110050	Bedens Brook	Below Provinceline Road

In addition, a portion of the Delaware and Raritan Canal runs through Princeton Township. As such, both Review Zones A and B of the Delaware and Raritan Canal Commission (DRCC) extend into Princeton Township. Therefore, the DRCC must review all stormwater measures proposed for land development projects located within the Township. Figure C16 identifies the DRCC Regulatory Review Zones within and adjacent to the Township.

Finally, the Township's *Flood Mitigation Plan* contains additional figures that depict the major watersheds within Princeton Township.

Current Waterway Health – The NJDEP has established the Ambient Biomonitoring Network (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.

According to the AMNET data, NJDEP has classified both the Stony Brook, which borders the Township to the west, and the Millstone River, which borders the Township to the south, as moderately impaired. The five tributaries that flow through the Township to these waterways are also classified by the NJDEP as moderately impaired. In addition to the AMNET data, the NJDEP and other regulatory agencies collect water chemistry data on the streams in the state. These data show that the instream concentrations of various pollutants in the Stony Brook and Carnegie Lake exceed the State's criteria. As a result, these waters are considered impaired and the NJDEP is required to develop Total Maximum Daily Loads (TMDLs) for these pollutants.

A TMDL is the amount of a particular pollutant that can be assimilated by a waterbody without causing its water quality standards to be exceeded or one or more of its designated uses to be interfered with. The TMDL is allocated, along with a margin of safety, to the various sources of the pollutant, including point sources such as wastewater discharges and nonpoint sources, which include runoff from agricultural, commercial, industrial, and residential areas. 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 stormwater control ordinances, reforestation of stream corridors, retrofitting of existing stormwater systems, and other structural and nonstructural stormwater management measures.

The New Jersey Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)) (Integrated List) is a valuable source of water quality information. 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 Princeton Township:

- **Carnegie Lake – Fish Mercury.** The water quality standard for mercury is not attained based on data collected by the NJDEP Clean Lakes and the NJDEP Fish Tissue Monitoring. As such, Carnegie Lake will require a TMDL for this pollutant. Insufficient data was available to determine whether attainment of the phosphorus standard was achieved in the lake.
- **Millstone River at Route 27 in Princeton.** Insufficient data was available to determine whether attainment of the benthic macroinvertebrates standard was achieved.
- **Stony Brook**
 - **At Princeton – Fecal coliform, Phosphorus, pH, Total Suspended Solids, and Arsenic.** The water quality standards for fecal coliform, phosphorus, pH, total suspended solids, and arsenic are not attained based on data collected by the NJDEP and USGS. As such, a TMDL will be required for these pollutants. The Stony Brook had insufficient data to determine whether attainment of the cadmium and mercury standards was achieved. In April 2003 TMDLs for fecal coliform impairment for forty-eight streams in the Raritan Water Region were proposed. The TMDLs included this segment of the Stony Brook and recommended that sites within the watershed be prioritized for funding of agricultural BMPs, investigation into goose management programs, and the Phase II stormwater program. The TMDL has been established, but has not been formally approved by the USEPA.
 - **At Province Line Road in Princeton – Benthic Macroinvertebrates.** Benthic macroinvertebrates are threatened or impaired based on data collected by NJDEP AMNET. As such, a TMDL will be required.
 - **At Route 206 in Princeton – Benthic Macroinvertebrates.** Benthic macroinvertebrates are threatened or impaired based on data collected by NJDEP AMNET. As such, a TMDL will be required.

13.2 Current Waterway Flooding and Erosion

Comprehensive descriptions and mapping of the current erosion and flooding problems throughout the Township are contained in the Township's *Flood Mitigation Plan*, which was developed by the Princeton Township Flood Control Committee with assistance by the Natural Resources Conservation Service. By reference, this important document is made part of the Princeton Township Municipal Stormwater Plan.

14.0 Design and Performance Standards

In accordance with the requirements of the New Jersey Stormwater Management Rules (NJAC 7:8), major land developments within Princeton Township will be required to meet specific stormwater design and performance standards. These standards will be applied to these developments through the forthcoming Stormwater Control Ordinance that will be developed and adopted by the Township following the adoption of this Municipal Stormwater Management Plan. Summaries of these design and performance standards are presented below.

It is important to note that any major residential land development proposed subject to review and approval by Princeton Township will also be reviewed in accordance with the stormwater management requirements of the New Jersey Residential Site Improvement Standards (NJAC 5:21). These standards may be supplemented where permitted by additional stormwater design and performance standards developed by the Township. In addition, any application for a new agricultural development that meets the definition of major development shall be submitted to the Mercer 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*.

14.1 General Design and Performance Standards

In accordance with the requirements of Subchapter 5 of the Stormwater Management Rules, stormwater management measures for major land developments in Princeton Township will be designed to meet the following design and performance standards. Complete details of each standard can be found in Subchapter 5 of the New Jersey Stormwater Management Rules.

- **Soil Erosion and Sediment Control** – All major developments shall meet the requirements of the *Soil Erosion and Sediment Control Standards for New Jersey*. Princeton Township presently has review authority for compliance with these standards in accordance with the delegated authority policies of the Mercer County Soil Conservation District.
- **Groundwater Recharge** – Unless otherwise exempted by the Stormwater Management Rules, all major developments must either maintain 100% of the development site's pre-developed annual groundwater recharge under post-developed site conditions or infiltrate the runoff increase between pre- to post-developed site conditions for a 2-Year, 24-hour III storm. Compliance with this standard must consider certain designated redevelopment areas and any WHPAs and known contaminated sites within the Township.
- **Stormwater Quality** – All major developments must reduce the total suspended solids (TSS) load in the development site's post-construction runoff by a minimum of 80%. In addition, the post-construction nutrient load from the site must be reduced by the maximum extent feasible. Additional stormwater quality requirements are described

below for land developments that drain to a Category One watercourse or its mapped tributaries.

- **Stormwater Quantity** – All major developments must demonstrate compliance with one of three alternative stormwater quantity requirements for the 2, 10, and 100-Year storm events. These alternatives are: 1) preservation of existing development site runoff volumes and rates, 2) preservation of existing downstream peak runoff rates under full watershed development, or 3) reduction in existing site peak runoff rates by 50%, 25%, and 20%, respectively.
- **Nonstructural Stormwater Management** - Compliance with the groundwater recharge and stormwater quality and quantity standards described above must be achieved through the use of nonstructural stormwater management measures to the maximum extent feasible. If the standards cannot be met through the exclusive use of nonstructural measures, then structural stormwater management measure shall be utilized to complete compliance.
- **Special Water Resource Protection Areas** – All major developments must maintain a 300-foot buffer measured from the top of bank of all Category One watercourses, as designated by the NJDEP, and their tributaries, as mapped by the USGS and the Soil Survey of Mercer County. At the present time, there are no NJDEP designated Category One watercourses within Princeton Township. As such, this requirement will apply to any waterway within the Township designated as a Category One watercourse by the NJDEP in the future.
- **Threatened and Endangered Species Searches** – All major developments subject to review by NJDEP’s Land Use Regulation Program must conduct a Threatened and Endangered Species search using the Natural Heritage Database.

14.2 Exemption and Waiver Criteria

In addition to the design and performance standards described above, the New Jersey Stormwater Management Rules contain both exemption and waiver criteria for each standard. These criteria are presented in Subchapter 5 of the Stormwater Management Rules. Princeton Township will utilize these criteria in the development of its Stormwater Control Ordinance. In addition, the Township will develop a Mitigation Plan in accordance with Subchapter 4 of the Stormwater Management Rules in order to grant necessary waivers from the design and performance standards on a case-by-case basis. Development of this Mitigation Plan will be done concurrently with the development of the Township’s Stormwater Control Ordinance.

Finally, in accordance with Section 2.5 of Subchapter 2 of the Stormwater Management Rules, Princeton Township has the ability to petition the NJDEP for an exemption from any of the design and performance standards presented in Subchapter 5 of the Rules provided that such exemption will not result in an increase in flood damage, water pollution, threats to biological

integrity, or constitute a threat to public safety. The Township may utilize this petition process if necessary during the development of its Stormwater Control Ordinance.

14.3 Maintenance Requirements

In order to ensure the proper functioning and operation of all structural and nonstructural stormwater management measures, Princeton Township will require that maintenance plans be developed for all such measures incorporated into the design of major land developments. All maintenance plans shall meet the requirements specified in Section 5.8 of Subchapter 5 of the Stormwater Management Rules. The Township will also utilize the maintenance plan recommendations and references contained in the NJDEP Stormwater Best Management Practices Manual. Final maintenance plan requirements will be included in the Township's Stormwater Control Ordinance and also be applied to any stormwater management measure included in a major development activity by the Township.

According to the maintenance plan requirements contained in the Stormwater Management Rules, all stormwater management measure maintenance plans must contain:

- Specific preventative and corrective maintenance tasks and schedules.
- Cost estimates including the estimated costs of sediment, debris, and trash removal.
- The name, address, and telephone number of those responsible for maintenance.

In addition, the maintenance plan must guarantee that preventative and corrective maintenance will be performed to maintain the function of the stormwater management measure, including (where appropriate) structural repairs and replacements; sediment, debris, and trash removal; restoration of eroded areas; snow and ice removal; fence repair and replacement; restoration of vegetation; and repair and replacement of non-vegetated linings.

14.4 Safety Standards

In order to protect the safety of maintenance and inspection personnel and the general public, Princeton Township will develop safety standards for the proper design and operation of new structural stormwater management measures utilized at major land developments. These standards will be included in the Township's Stormwater Control Ordinance and also be applied to any structural stormwater management measure included in a major development activity by the Township. At a minimum, these safety standards will be based upon the safety standards for stormwater management basins contained in Subchapter 6 of the Stormwater Management Rules. The Township may adopt additional and/or more stringent standards as necessary in order to provide an appropriate level of safety at such stormwater management measures.

15.0 Stormwater Management Measures

In order to meet the design and performance standards for major land developments described in Subchapter 5 of the Stormwater Management Rules, Princeton Township will allow the utilization of a range of nonstructural and structural stormwater management measures. In

general, the design, construction, and maintenance of these measures, which are also known as Best Management Practices or BMPs, will be based upon the guidance provided by the current version of the NJDEP *Stormwater Best Management Practices Manual*. In particular, the guidance provided Chapter Two of the Manual will be used for nonstructural stormwater management measures and the guidance provided in Chapter Nine of the Manual will be used for structural stormwater management measures.

As a result, the NJDEP *Stormwater Best Management Practices Manual* is incorporated by reference into the Princeton Township Municipal Stormwater Management Plan.

16.0 Mitigation Plan

As noted above in **14.2 – Exemption and Waiver Criteria**, Princeton Township will utilize the waiver criteria contained in Subchapter 5 of the Stormwater Management Rules to develop a Mitigation Plan in order to grant necessary waivers from the design and performance standards at major land developments on a case-by-case basis. Development of this Mitigation Plan will be done concurrently with the development of the Township’s Stormwater Control Ordinance and will be based upon the Mitigation Plan requirements contained in Subchapter 4 of the Stormwater Management Rules.

17.0 Build-Out and Pollutant Load Analysis

In accordance with the Municipal Stormwater Management Plan requirements in Subchapter 4 of the Stormwater Management Rules, Princeton Township will perform a Build-Out and Pollutant Load Analysis of the Township if it is determined that there is at least one square mile of developable land remaining in the Township. This analysis will be based upon current Township zoning and will use appropriate land use data and pollutant load models. This analysis will be completed by February 2, 2006 in accordance with the Municipal Stormwater Management Plan requirements of the Stormwater Management Rules. Upon completion of the Build-Out and Pollutant Load Analysis, appropriate revisions to the Princeton Township Municipal Stormwater Management Plan will be made to incorporate its results and recommendations.

18.0 Master Plan Evaluation

In accordance with the Municipal Stormwater Management Plan requirements in Subchapter 4 of the Stormwater Management Rules, Princeton Township will evaluate the extent to which its Master Plan, official map, land use ordinances, and construction standards implement the nonstructural stormwater management strategies described in Subchapter 5 of the Rules. Based upon this evaluation, appropriate revisions to these documents and standards will be made to eliminate conflicts to the maximum extent feasible. This evaluation will be performed if it is determined that there is at least one square mile of developable land remaining in the Township. This analysis will be completed by February 2, 2006 in accordance with the Municipal Stormwater Management Plan requirements of the Stormwater Management Rules. Upon completion of the Master Plan evaluation, appropriate revisions to the Princeton Township

Municipal Stormwater Management Plan will be made to incorporate its results and recommendations.

19.0 Recommended Stormwater Control Ordinance

A copy of a recommended Stormwater Control Ordinance follows this appendix. This recommended ordinance is based upon the model ordinance contained in the NJDEP Stormwater Best Management Practices Manual. This model ordinance will serve as the basis for the final Stormwater Control Ordinance to be developed and adopted by the Township. Such adoption will occur within twelve months of the original adoption of this Plan.

20.0 Achievement of NJDEP Stormwater Management Planning Goals

In accordance with the Municipal Stormwater Management Plan requirements in Subchapter 4 of the Stormwater Management Rules, the Princeton Township Municipal Stormwater Management Plan must demonstrate achievement of the general goals for stormwater management planning specified in Subchapter 2 of the Rules. These goals were previously discussed above in **12.0 - Princeton Township Municipal Stormwater Management Plan Goals**. The following summary has been prepared to demonstrate how the Plan achieves these goals.

- **GOAL: Reduce flood damage, including damage to life and property** – By requiring all major land developments to meet the stormwater quantity design and performance standards in Subchapter 5 of the Stormwater Management Rules, the Princeton Township Municipal Stormwater Management Plan will reduce flood damage. In addition, the Plan will require mitigation measures for major developments that cannot strictly comply with the stormwater quantity design and performance standards in the Township’s Stormwater Control Ordinance or the Residential Site Improvement Standards. Retrofits to existing stormwater collection systems and stormwater quantity management measures mandated by the Mitigation Plan will also reduce existing flood damage.
- **GOAL: Minimize, to the extent practical, any increase in stormwater runoff from any new development** – By requiring the use of nonstructural stormwater management measures, the Princeton Township Municipal Stormwater Management Plan will minimize the increase in stormwater runoff from new major land developments. Additionally, requiring compliance with the stormwater quantity standards described above will further decrease the potential for stormwater runoff increases from new land developments in the Township.
- **GOAL: Reduce soil erosion from any development or construction project** – The Princeton Township Municipal Stormwater Management Plan requires that the *Soil Erosion and Sediment Control Standards in New Jersey* be followed for all major development projects. In addition, the Township also presently requires compliance with these standards for all projects that disturb at least 5,000 square feet of land.

- **GOAL: Assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures** – By requiring all major land developments to meet the stormwater quantity design and performance standards in Subchapter 5 of the Stormwater Management Rules either directly or through appropriate mitigation measures, the Princeton Township Municipal Stormwater Management Plan will help assure the adequacy of existing and proposed culverts, bridges, and other in-stream structures.
- **GOAL: Maintain groundwater recharge** – By requiring all major land developments to meet the groundwater recharge design and performance standards in Subchapter 5 of the Stormwater Management Rules either directly or through appropriate mitigation measures analyses, the Princeton Township Municipal Stormwater Management Plan will help maintain groundwater recharge in the Township.
- **GOAL: Prevent, to the greatest extent feasible, an increase in NPS pollution** – By requiring all major land developments to meet the stormwater quality design and performance standards in Subchapter 5 of the Stormwater Management Rules either directly or through appropriate mitigation measures analyses, the Princeton Township Municipal Stormwater Management Plan will help prevent an increase in NPS pollution in the Township. These results will be enhanced through the maximum practical use of nonstructural stormwater management measures at such developments.
- **GOAL: Maintain the integrity of stream channels for their biological functions, as well as for drainage** – By requiring all major land developments to meet the groundwater recharge and stormwater quality and quantity design and performance standards in Subchapter 5 of the Stormwater Management Rules either directly or through appropriate mitigation measures analyses, the Princeton Township Municipal Stormwater Management Plan will help maintain the biological integrity of stream channels in the Township. These results will be enhanced through the maximum practical use of nonstructural stormwater management measures at such developments.
- **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 requiring all major land developments to meet the groundwater recharge and stormwater quality and quantity design and performance standards in Subchapter 5 of the Stormwater Management Rules either directly or through appropriate mitigation measures analyses, the Princeton Township Municipal Stormwater Management Plan will help achieve these multiple goals in waterways in the Township. These results will be enhanced through the maximum practical use of nonstructural stormwater management measures at such developments.
- **GOAL: Protect public safety through the proper design and operation of stormwater management basins** – By requiring the design of structural stormwater

management facilities at major land developments to comply with the safety standards in Subchapter 6 of the Stormwater Management Rules, the Princeton Township Municipal Stormwater Management Plan will protect the safety of inspection and maintenance personnel and members of the general public.

21.0 Definitions

The following definitions have been developed to supplement those contained in the New Jersey Stormwater Management Rules.

“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 from precipitation seeps into the soil.

“**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 moves below the root zone of surface vegetation.

“**Redevelopment**” refers to alterations that change the “footprint” of a site or building in such a way that result 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 that portion of water from precipitation that flows across the surface of the ground.

“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. TSS is differentiated from total dissolved solids (TDS) by a standardized filtration process with 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 (also known as BMPs). As described in the Stormwater Management Rules, the Water Quality Design Storm follows a nonlinear pattern and has a total rainfall depth of 1.25 inches and a total duration of two hours.

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

22.0 References

New Jersey Administrative Code (NJAC) 7:8 - Stormwater Management Rules. Adopted February 2, 2004.

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New Jersey Department of Environmental Protection. *New Jersey Stormwater Best Management Practices Manual*. April 2004.

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<http://www.nj.gov/dep/watershedmgt/stormwaterfaqs.htm>.

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