MUNICIPAL STORMWATER MANAGEMENT PLAN

MASTER PLAN ELEMENT

TOWNSHIP OF NEPTUNE

MONMOUTH COUNTY, NEW JERSEY

PREPARED FOR:

NEPTUNE TOWNSHIP PLANNING BOARD

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1.0 INTRODUCTION

The Municipal Stormwater Management Plan (MSWMP) provides the Township of Neptune a strategy and approach for addressing stormwater related impacts resulting from development of lands or land use changes. Development of land may involve redevelopment of existing sections of the Township or development of vacant property. In accordance with the Municipal Stormwater Regulations (N.J.A.C. 7:14A-25), the intent of the MSWMP is to provide the Township an approach to stormwater management planning. The MSWMP will identify flooding and runoff problems throughout the various sections of the Township in order for future remedy.

The plan contains the required elements described in the Stormwater Management Rules (N.J.A.C. 7:8). The plan addresses groundwater recharge, stormwater **quantity**, and stormwater quality impacts by incorporating strict stormwater design and performance standards for new major development or redevelopment. These standards are based on the criteria described in the *New Jersey Best Management Practices (BMPs) Manual*. Major development pertains to projects that disturb one (1) or more acre of land or increase impervious surface by one-quarter (1/4) acre or more. These standards will minimize adverse impacts of stormwater runoff on water quality, quantity, and the loss of groundwater recharge providing base flow to receiving bodies of water. In addition, the MSWMP will describe the long-term operation and maintenance measures for existing and future stormwater facilities.

2.0 GOALS AND OBJECTIVES

The goals and objectives of this MSWMP are to:

- Reduce flood damage, including damage to life, property, and the environment;
- Minimize, to the extent practical, an increase in stormwater runoff from any new development or redevelopment;
- Reduce soil erosion from any development, construction project, or disturbance of land;
- Assure the adequacy of existing and proposed culverts and bridges/overpasses, and other in-stream structures;
- Maintain groundwater recharge;
- Prevent, to the greatest extent feasible, an increase in non-point pollution;
- Maintain the integrity of stream channels for their biological function, as well as for drainage;
- Minimize pollutants in stormwater runoff from new and existing development to restore, enhance, and maintain 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
- Protect public safety through the proper design and operation of stormwater basins.

In addition to the State required and recommended goals, the Township encourages the following, as outlined in the Neptune Township Master Plan:

- To preserve open space and natural resources, including waterfront access and views.
- To preserve natural systems and environmentally sensitive areas, particularly wetland, woodland, coastal, flood hazard, and aquifer recharge areas.
- Guide the redevelopment and development of the remaining large parcels and scattered vacant sites within neighborhoods to ensure proposed uses support existing uses without adverse impacts in terms of land use compatibility, traffic, economic, and aesthetic impacts.

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

3.0 MUNICIPAL BACKGROUND

3.1 Background

The Township of Neptune gets its name from The Roman God of the Sea and was formed in 1879. It has a land area of approximately eight (8) square miles and is situated in the central easternmost part of Monmouth County, New Jersey. Neptune is a community with several diverse neighborhoods including Ocean Grove, Shark River Hills, Mid-Town, Bradley Park, the Gables, Seaview Island, and West Neptune. Due to these various neighborhoods, Neptune Township includes rural, suburban, urban, waterfront, and tourist sections**. In 2000, the township revised the zoning map (as depicted on Figure A-7 in Appendix A) and the Land Development Ordinance. Major changes involved the commercial districts, highway corridors, and historic mixed-use sections. For example, the zoning along State Highway 35 (C-7) encourages business uses appropriate to the Route 35 highway corridor of Neptune Township situated south of the West Lake Avenue Town Commercial Zone. West Lake Avenue is zoned B-1 "Town Commercial", which intends to serve the needs of specific surrounding residential neighborhoods by providing for retail sale and service uses. The need to complement and preserve the character of the surrounding residential neighborhoods is paramount. The land use pattern as indicated on Figure A-7 begins in Ocean Grove with high density small lot residential to a small light industrial area west of the NJ Transit rail line. Heading west, the State Highway Route 33 commercial district is surrounded by residential communities known as mid-town and Bradley Park. The center of town is the civic zone, which includes the municipal complex (police, town hall, and library), senior center, high school, middle school, post office, and Jersey Shore University Medical Center. Other sections of town zoned single primarily single family residential include Shark River Hills, the Gables, Sunshine Village, and West Neptune. Route 33 continues to the west to the Tinton Falls border comprising of commercial and residential. The western section of town is rural, but developed. Route 66 has experienced much commercial development in the last few years including several big box retail centers.**

The Township has been known as the "Crossroads of the Jersey Shore" due to the major corridors, which cross through and border the Township. Neptune Township is accessible from Garden State Parkway exits 100 and 102, with State Highways 18, 33, 35, 66 and 71 within its borders. Neptune Township is also accessible by New Jersey Transit trains (Bradley Beach/Neptune Station), and major bus routes and local taxi service. Neptune Township is home to Jersey Shore University Medical Center, the Regional Trauma Center for Central Jersey. The Township is bordered by the City of Asbury Park to the northeast, Bradley Beach to the southeast, Township of Ocean to the north, Wall Township to the southwest,

Neptune City to the south, Borough of Tinton Falls to the west, and Atlantic Ocean to the east. The greatest concentration of population resides east of Route 18, which bisects the Township.

3.2 Demographics

Based on the current census data, the population in year 2000 was 27,690. Table 1 indicates the population trends for the Township in comparison to Monmouth County and New Jersey. The Township experienced an increase in growth of nearly 60 percent from 1950 and 1960 and almost 30 percent from 1960 to 1970. Another major increase in population occurred in the 1920's. Although these figures are not indicated in Table 1, the Township's population grew from nearly 6,500 to almost 11,000. These figures relate to the age of the housing stock and infrastructure (roadways, drainage systems, sanitary collection system, and water lines) for the majority of the Township. Many of the older neighborhoods were developed in the 1920's and 1930's, where the "developments" were built in the 1950's and 1960's. Since 1980, the population of the Township stabilized and has experienced a slight decline, where Monmouth County has increased annually about 10 percent.

Table 1: Population Trends (1950 – 2000)

	Neptune Township		**Monmouth County**		**New Jersey**	
Year	*Population*	*% Change*	*Population*	*% Change*	*Population*	*% Change*
1950	13,613	---	225,327	---	4,835,529	---
1960	21,487	57.8	334,401	48.4	6,066,782	25.5
1970	27,863	29.7	461,849	38.1	7,171,112	18.2
1980	28,366	1.8	503,173	8.9	7,364,823	2.7
1990	28,148	-0.8	553,124	9.9	7,730,118	5.0
2000	27,690	-1.6	615,301	11.2	8,414,350	8.9

Source: U.S. Census Bureau

Neptune Township is a community with well-established patterns of development. In the past few years, several new housing units and developments were built in the western section of town. Although Monmouth County is recognized as one of the fastest growing counties in New Jersey, current estimates predict that Neptune's population may increase slightly in the next few years. This assumption is partially based on the Township approaching "build-out". Table 2 illustrates the Township housing units according to the 2000 US Census data.

Table 2: Profile of General Housing Characteristics

	2000	
	Number	**Percent**
Housing Occupancy		
Total housing units	12,217	100
Occupied housing units	10,907	89.2
Vacant housing units	1,310	10.7
For recreational, seasonal, or occasional use	681	5.6
Homeowner vacancy rate	---	1.7
Rental vacancy rate	---	5.6
Housing Tenure		
Owner-occupied housing units	7,146	65.5
Renter-occupied housing units	3,761	34.5
Average household size, owner occupied	2.66	---
Average household size, renter occupied	2.10	---

Source: U.S. Census Bureau

3.3 Waterbodies

Neptune Township lies primarily within the Shark River Watershed, which is located in Watershed Management Area 12. Figure A-2 in Appendix A delineates the major waterbodies in Neptune Township. The majority of the Township drains to Shark River through Jumping Brook, Musquash Brook, several small feeder streams, or directly to Shark River. The more significant small feeder streams in Neptune include Wells Brook and Hankins Brook. Shark River drains nearby to the Atlantic Ocean. Some land in Neptune flows to Hollow Brook, a tributary of Deal Lake, or directly to one of the three coastal lakes: Deal Lake, Fletcher Lake, and Wesley Lake.

NJDEP is designating a special level of protection for a number of waterways in New Jersey. Shark River and tributaries of Shark River have this protection, known as Category One, which targets waterbodies that provide drinking water, habitat for Endangered and Threatened species, and popular recreational and/or commercial species, such as trout or shellfish. Waterways can be designated Category One because of exceptional ecological significance, exceptional water supply

significance, exceptional recreational significance, exceptional shellfish resource, or exceptional fisheries resource. The Category One designation provides additional protections to waterbodies that help prevent water quality degradation and discourage development where it would impair or destroy natural resources and environmental quality. The new stormwater rules emphasizing groundwater recharge and special buffer-area protections for Category One waterbodies are also encouraged. The maintenance of water quality resources is important to all Neptune residents.

3.4 Soils and Topography

Neptune Township lies within the outer Coastal Plain, one of five distinctively different physiographic provinces in New Jersey. Geologically, the Coastal Plain is part of the Continental Shelf, and emerged from the ocean through uplifting of the land. Erosion and later inundations by the sea have resulted in the deposition of sand, clay, and mud.

The topography of Neptune Township may be characterized as flat to gently sloping with steeper slopes located in the central portion of the Shark River Hills neighborhood, the northern section of the Township, and near Route 18/Asbury Avenue interchange. Ravines are found along Shark River and Jumping Brook corridors. The highest point of the Township is approximately 160 feet above sea level, located north of West Bangs Avenue and south of Asbury Avenue.

The United States Department of Agriculture Natural Resource Service has delineated the soil types throughout the State, and published a Soil Survey for each county. The Soil Survey indicates that Neptune Township has nineteen (19) different soil series broken down into twenty-three (23) soil types. These are designated as Atsion Sand (At), Downer Loamy Sand (DnA), Elkton Loam (En), Evesboro Sand (EvC), Fallsington **Loam** (Fb), Freehold Series (FrB, FrC, FrD, and FUB), Hammonton Sandy Loam (HbA), Hooksan Sand (HwB), Humaquepts (HV), Keyport Sandy Loam (KeA), Klej Loamy Sand (KIA), Lakehurst Sand (LaA), Lakewood Sand (LeB), Manahawkin Muck (Ma), Sassafras Sandy Loam (SaC), Sulfaquents and Sulfihemists (SS), Urban Land (UL), Udorthents (Ua and UD), and Woodstown Sandy Loam (WnB).

3.5 Flood Prone Areas:

Due to the coastal location of Neptune Township, frequent flooding occurs. Flooding occurs during major storm events and with tidal influence. Several capital improvement projects have been completed within the Township to alleviate flooding along the roadways. The New Jersey Department of Transportation (NJDOT) recently completed an extensive drainage improvement project along Route 35 at Hollow Brook. In addition, the NJDOT has assembled design plans for improvements to Route 33 (from Route 35 to Route 71), which include upgrading the stormwater infrastructure. Monmouth County maintains several of the culverts in Neptune Township. Within the past few years, the county has replaced several of these culverts.

Other areas in need of improvement include the following:

Mid-Town: Extend the existing drainage system to eliminate ponding along West Lake Avenue and intersecting streets.

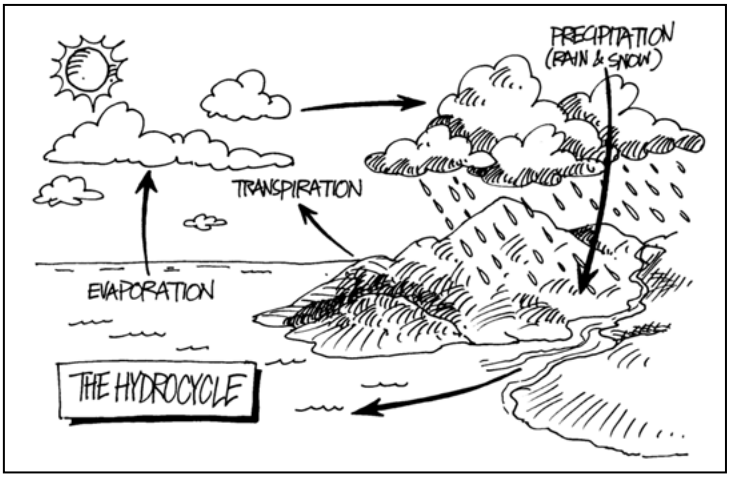
Ocean Grove: Install drainage pipe to eliminate flooding in the Main Avenue business district. Upgrade the existing system, which drains toward Fletcher Lake.

Shark River Hills: Cleaning and replacement of stormwater outfalls, installation of shoreline protection, and reconstruction of the intersections along the Shark River waterfront area (Riverside Drive).

4.0 STORMWATER DISCUSSION

4.1 Hydrologic Cycle

Figure 1 – Hydrologic Cycle



There are five (5) processes at work in the hydrologic cycle, also known as the water cycle. As indicated in figure 1 (Source: The Foundation for Water and Energy Education), these include condensation, precipitation, infiltration, runoff, and evapotranspiration. These all occur simultaneously, and except for precipitation, continuously. As defined by NASA, below are the keys terms for the hydrologic cycle:

- **Condensation:** the process of water changing from a vapor to a liquid. Water vapor in the air rises mostly by convection. This means that warm, humid air will rise, while cooler air will flow downward. As the warmer air rises, the water vapor will lose energy, causing its temperature to drop. The water vapor then has a change of state into liquid or ice.

- **Precipitation:** the process of water being released from clouds as rain, sleet, snow, or hail. Precipitation begins after water vapor, which has condensed in the atmosphere, becomes too heavy to remain in atmospheric air currents and falls.

- **Infiltration:** the process when precipitation reaches the Earth's surface and seeps into the ground. The amount of water that infiltrates the soil varies with the degree of land slope, the amount and type of vegetation, soil type and rock type, and whether the soil is already saturated by water. The more openings in the surface (cracks, pores, joints), the more infiltration occurs. Water that doesn't infiltrate the soil flows on the surface as runoff.

- **Runoff:** Precipitation that reaches the surface of the Earth but does not infiltrate the soil. Runoff can also come from melted snow and ice. When there is a lot of precipitation, soils become saturated with water. Additional rainfall can no longer enter it. Runoff will eventually drain into creeks, streams, and rivers, adding a large amount of water to the flow. Surface water always travels towards the lowest point possible, usually the oceans. Along the way some water evaporates, percolates into the ground, or is used for agricultural, residential, or industrial purposes.

- **Evapotranspiration:** the process of water evaporating from the ground and transpiration by plants. Evapotranspiration is also the way water vapor re-enters the atmosphere. Evaporation occurs when radiant energy from the sun heats water, causing the water molecules to become so active that some of them rise into the atmosphere as vapor. Transpiration occurs when plants take in water through the roots and release it through the leaves, a process that can clean water by removing contaminants and pollution.

4.2 Effects of Development

Development and redevelopment of land can dramatically alter the hydrologic cycle (refer to Figure 1) of a site and, ultimately, an entire watershed. Prior to land development and disturbance, native vegetation can either directly intercept precipitation or draw that portion that has infilitrated into the ground and return it to the atmosphere through evapotranspiration. Development can remove this beneficial vegetation and replace it with lawn or impervious cover, reducing the site's evapotranspiration and infiltration rates. Clearing and grading a site can remove depressions that store rainfall.

Construction activities may also compact the soil and diminish its infiltration ability, resulting in increased volumes and rates of stormwater runoff from the site. Impervious areas that are connected to each other through gutters, channels, and storm sewers can transport runoff more quickly than natural areas. This shortening of the transport or travel time quickens the rainfall-runoff response of the drainage area, causing flow in downstream waterways to peak faster and higher than natural conditions. These increases can create new and aggravate existing downstream flooding and erosion problems and increase the quantity of sediment in the channel. Filtration of runoff and removal of pollutants by surface and channel vegetation is eliminated by storm sewers that discharge runoff directly into a stream.

Increases in impervious area can also decrease opportunities for infiltration which, in turn, reduces stream base flow and groundwater recharge**. Reduced base flows and increased peak flows produce greater fluctuations between normal and storm flow rates, which can increase channel erosion. Reduced base flows can also negatively impact the hydrology of adjacent wetlands and the health of biological communities that depend on base flows. Erosion and sedimentation can destroy habitat resulting in some species unable to adapt to these conditions.**

5.0 DESIGN AND PERFORMANCE STANDARDS

In 2004, the Township of Neptune adopted an ordinance to establish minimum stormwater management standards required for major development. The ordinance encourages nonstructural or low impact techniques in order to maintain flood control, groundwater recharge, and pollutant reduction. The standards of the ordinance are intended to minimize the stormwater runoff quantity and quality in receiving Township water bodies and maintain groundwater recharge, while meeting erosion control measures. The following sections will discuss several requirements of the ordinance, which are based on the *New Jersey Best Management Practices Manual*.

5.1 Design Standards

As per N.J.A.C. 7:8-5, stormwater management measures for major development shall be developed to meet the erosion control, groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards. Major development includes any development that provides for ultimately disturbing one (1) or more acres of land or increasing impervious surface by one-quarter (1/4) acre or more. Disturbance is considered the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation.

5.1.1 Exemptions

Redevelopment projects are exempt from the groundwater recharge standards provided that the redevelopment involves disturbance only of previously disturbed areas. Additionally, a 50% total suspended solids (TSS) removal rate is required for proposed redevelopment projects involving only existing areas of impervious cover. Groundwater recharge requirements do not apply to projects subject to stormwater from areas of high pollutant loading and industrial stormwater exposed to “source material.” High pollutant loading areas are areas in industrial and commercial developments where solvents and/or petroleum products are loaded/unloaded, stored, or applied, areas where pesticides are loaded/unloaded or stored; areas where hazardous materials are expected to be present in greater than 'reportable quantities' as defined by the United States Environmental Protection Agency (EPA). "Source material" includes 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.

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 re-vegetated upon completion.
2. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable.
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 at N.J.A.C. 7:8-5 may be obtained for the enlargement of an existing public roadway or railroad, or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

1. There is a public need for the project that cannot be accomplished by any other means.
2. Through an alternatives analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of N.J.A.C. 7:8-5 to the maximum extent practicable.
3. In order to meet the requirements at N.J.A.C. 7:8-5 existing structures currently in use, such as homes and buildings would need to be condemned.
4. That an applicant does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under 3 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate for requirements of N.J.A.C. 7:8-5 that were not achievable on-site.

5.1.2 Groundwater Recharge

The minimum design and performance standards for groundwater recharge require that the applicant 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 previously discussed, groundwater recharge is prohibited from sites with high pollutant loading or industrial stormwater exposed to “source material.” 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). Adjacent properties also must consider the proximity of contaminated material.

All groundwater recharge analyses must be conducted using the New Jersey Groundwater Recharge Spreadsheet available through the *New Jersey Stormwater Best Management Practices Manual* (herein referred to as the BMP Manual, online at www.njstormwater.org). Refer to Figure A-3 in Appendix A for Neptune Township Recharge Areas. The professional engineer (or qualified hydrogeologist or geologist) 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 surgical 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.

For all structural and nonstructural infiltration measures, it is necessary to determine soil characteristics, the permeability (hydraulic conductivity) of the underlying soils and bedrock (where bedrock is shallow), and depth to groundwater on a subject property prior to designing infiltration measures. The applicant's professional must demonstrate the hydraulic viability of any proposed structural groundwater recharge measure through hydraulic testing. In order to meet the requirements for groundwater recharge, the applicant is strongly encouraged to design nonstructural stormwater BMPs identified in 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 this plan.

5.1.3 Stormwater Quantity

In order to control stormwater runoff quantity impacts, the design engineer shall complete one of the following:

1. 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. 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. 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 preconstruction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed. The percentages shall not be applied to post-construction stormwater runoff into tidal

flood hazard areas if the increased volume of stormwater runoff will not increase flood damages below the point of discharge.

In tidal flood hazard areas within the Township, stormwater runoff quantity analysis in accordance with (1), (2) and (3) above shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of discharge.

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

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 8, 2004, and incorporated herein by reference as amended and supplemented (refer to the National Weather Service: http://hdsc.nws.noaa.gov/hdsc/pfds/ for the rainfall frequency data). This methodology is additionally described in Technical Release 55 - Urban Hydrology for Small Watersheds (TR-55), dated June1986, 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 *Standards for Soil Erosion and Sediment Control in New Jersey*. Refer to the National Weather Service: http://hdsc.nws.noaa.gov/hdsc/pfds/ for the IDF curves; or

3. **DelMarVa Peak Rate Factor: As part of more accurately modeling existing conditions in the Shark River Watershed, utilizing regionalized factors in the calculation of stormwater runoff is critical. The DelMarVa peak rate factor (PRF) replaces the national average PRF in the dimensionless unit hydrograph used by the NRCS stormwater runoff prediction methodologies. The DelMarVa hydrograph has been formally recommended for use in the coastal plain of New Jersey and should be required for all hydrologic analyses in this watershed.**

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, the design engineer shall take into account the effects of tailwater in the design of structural stormwater management measures.

Runoff quantity can be controlled using both nonstructural and structural BMPs as discussed in this plan. For design guidance on the various BMPs to satisfy the requirements of this plan, the applicant's professionals should refer to the BMP Manual.

5.1.4 Water Quality

The New Jersey Department of Environmental Protection (NJDEP) has established an Ambient Biomonitoring Network (AMNET) to document the health of state's waterways. The major goal of AMNET is to establish a network of waterbody sites that would adequately represent New Jersey's major drainage basins and NJDEP's Watershed Management Areas (WMA). AMNET samples over 800 stream sites statewide, with approximately 200 sites in each of five major drainage basins (upper and lower Delaware, Northeast, Raritan and Atlantic) once every five years. Based on the AMNET data, waterways are classified as:

- Non-impaired,
- Moderately impaired, or
- Severely impaired.

The data is used to generate the New Jersey Impairment Score (NJIS), which is based on a number of biometrics related to benthic macroinverebrate community dynamics. Biological monitoring, involves the collection and analysis of stream macroinvertebrate communities as indicators of water or habitat quality. Benthic macroinverebrate sampling is relatively easy and inexpensive, and is sensitive to environmental impacts from both point and non-point sources of pollution. However, it cannot replace chemical monitoring, toxicity testing, and other standard environmental measurements.

The NJDEP along with other regulatory agencies also collect chemical data to determine the health quality of waterways. Based on the data, the NJDEP develops a Total Maximum Daily Load (TMDL) for the pollutants for each waterway. Total Maximum Daily Load (TMDL) is the amount of a particular pollutant that a stream, lake, pond, river, estuary or other waterbody can sustain without violating NJDEP water quality standards. Once a TMDL is established, responsibility for reducing pollution among both point sources (pipes) and diffuse sources is assigned. Diffuse "sources" include, but are not limited to run-off, leaking underground storage tanks, unconfined aquifers, septic systems, stream channel alteration, and damage to a riparian area.

In addition to monitoring the biological health of waterways, chemical data is gathered by the NJDEP, the Monmouth County Health Department, and other organizations, and used to determine the health of Neptune's waterways. Table 3, "2004 Integrated List of Waterbodies" has been created from the New Jersey Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)) for waterbodies associated with Neptune Township. This list is then broken down into five sublists based on priority. The streams on Sublist 5 are classified as being the most severely impaired or threatened, whereas the streams on Sublist 1 are the least threatened or impaired. The NJDEP then prioritizes the most severely impaired stream on the Sublist 5 into three (3) categories (high, medium and low) based on the priority or the need for mitigation of the impairment.

Table 3: 2004 Integrated List of Waterbodies

Sublist #	Watershed Region	WMA	Station Name/Waterbody	Site ID	Parameters	Data Source
4	Atlantic Coast	12	Deal Lake-12	1, Deal Lake	Phosphorus	NJDEP Clean Lakes, Monmouth Co HD
5	Atlantic Coast	12	Deal Lake-12	1, Deal Lake	Fecal Coliform	NJDEP Clean Lakes, Monmouth Co HD
1	Atlantic Coast	12	Hollow Brook at Route 35 in Neptune Township	10	Phosphorus, Nitrate	Monmouth Co HD
3	Atlantic Coast	12	Hollow Brook at Route 35 In Neptune Township	10	pH, Total Suspended Solids	Monmouth Co HD
4	Atlantic Coast	12	Hollow Brook at Route 35 in Neptune Township	10	Fecal Coliform	Monmouth Co HD
5	Atlantic Coast	12	Jumping Brook at Corlies Ave in Neptune	AN0480	Benthic Macroinvertebrates	NJDEP AMNET
5	Atlantic Coast	12	Jumping Brook at Green Grove	01407720	pH	NJDEP/USGS Data
3	Atlantic Coast	12	Jumping Brook at Green Grove	01407720	Dissolved Oxygen, Dissolved Solids, Total Suspended Solids	NJDEP/USGS Data
1	Atlantic Coast	12	Jumping Brook at Green Grove	01407720	Phosphorus, Fecal Coliform, Temperature, Dissolved Oxygen, Nitrate, Unionized Ammonia	NJDEP/USGS Data
1	Atlantic Coast	12	Jumping Brook near Neptune	01407760	Phosphorus, Temperature, Dissolved Oxygen, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
5	Atlantic Coast	12	Jumping Brook near Neptune	01407760	Fecal Coliform, pH	NJDEP/USGS Data
1	Atlantic Coast	12	Jumping Brook-Tidal	R06	Dissolved Oxygen	NJDEP Coastal Monitoring
5	Atlantic Coast	12	Musquash Brook at Brighton Ave in Neptune Township	11	Fecal Coliform	Monmouth Co HD
5	Atlantic Coast	12	Shark River at Remsens Mills Rd in Neptune	AN0482	Benthic Macroinvertebrates	NJDEP AMNET
5	Atlantic Coast	12	Shark River Estuary	Shark River Estuary-1	Dissolved Oxygen, Total Coliform	NJDEP Coastal Monitoring, Shellfish Monitoring
1	Atlantic Coast	12	Shark River Estuary	Shark River Estuary-1	Fecal Coliform	NJDEP Coastal Monitoring, Shellfish Monitoring
1	Atlantic Coast	12	Shark River near Neptune	01407750, EWQ0482	pH, Dissolved Oxygen, Nitrate, Dissolved Solids, Unnionized Ammonia	NJDEP/USGS Data, EWQ
3	Atlantic Coast	12	Shark River near Neptune	01407750, EWQ0482	Temperature, Total Suspended Solids	NJDEP/USGS Data, EWQ
5	Atlantic Coast	12	Shark River near Neptune	01407750, EWQ0482	Phosphorus, Fecal Coliform	NJDEP/USGS Data, EWQ
1	Atlantic Coast	12	Shark River-Tidal	R06	Dissolved Oxygen	NJDEP Coastal Monitoring

Source: http://www.nj.gov/dep/wmm/sgwqt/wat/integratedlist/2004report.html

Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from the developed site, expressed as an annual average. Stormwater management measures shall only be required for water quality control if an additional one-quarter (1/4) acre of impervious surface is being proposed on a development site. The requirement to reduce TSS does not apply to any stormwater runoff in a discharge regulated under a numeric effluent limitation for TSS imposed under the New Jersey Pollutant Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A, or in a discharge specifically exempt under a NJPDES permit from this requirement. The water quality design storm is 1.25 inches of rainfall in two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm, as reflected in Table 4 below.

Table 4: Water Quality Design Storm Distribution

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

The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures. For purposes of TSS reduction calculations, Table 5 presents the presumed removal rates for certain BMPs designed in accordance with the *New Jersey Stormwater Best Management Practices Manual*.

Table 5: TSS Removal Rates for BMPs

Best Management Practice	TSS % Removal Rate
Bioretention Systems	90
Constructed Stormwater Wetland	90
Extended Detention Basin	40-60
Infiltration Structure	80
Manufactured Treatment Device	See Section 528.5.C
Sand Filter	80
Vegetative Filter Strip	60-80
Wet Pond	50-90

TSS reduction shall be calculated based on the removal rates for the BMPs in the above table. Alternative removal rates and methods of calculating removal rates may be used if the design engineer provides documentation demonstrating the capability of these alternative rates and methods to the Township Engineer. A copy of any Township approved alternative rate or method of calculating the removal rate shall be submitted to the NJDEP.

If more than one BMP in series is necessary to achieve the required 80 percent TSS reduction for a site, use the following formula to calculate TSS reduction:

$$R = A + B - (A \times B)/100$$

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% TSS removal rate shall apply to each drainage area, unless the runoff from the subareas converge on site in which case the removal rate can be demonstrated through a calculation using a weighted average.

Stormwater management measures shall also be designed to reduce, to the maximum extent feasible, the post-construction nutrient load of the anticipated load from the developed site in stormwater runoff generated from the water quality design storm. In achieving reduction of nutrients to the maximum extent feasible, the design of the site shall include nonstructural strategies and structural measures that optimize nutrient removal while still achieving the performance standards identified above.

Special water resource protection areas shall be established along all waters designated Category One at N.J.A.C.7: 9B and perennial or intermittent streams that drain into or upstream of the Category One waters as shown on the Figure A-2 in Appendix A or in the County Soil Surveys, within the associated HUC14 drainage. These areas shall be established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries significance of those established Category One waters. These areas shall be designated and protected as follows:

1. 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 "Standards for Soil Erosion and Sediment Control in New Jersey." 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 "Standards for Soil Erosion and Sediment Control in New Jersey," then stabilization measures may be placed within the special water resource protection area, provided that these stabilization measures are not 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 Freehold Soil Conservation District staff to identify necessary stabilization measures.

Specific recommendations for water quality compliance are included in this plan. For detailed design guidance for the BMPs mentioned, refer to the *New Jersey Stormwater Best Management Practices Manual*.

5.2 Performance Standards

In order to ensure proper operation of all structural and nonstructural stormwater management measures, the Township of Neptune shall require that all projects considered major development incorporate maintenance plans for proposed stormwater management measures. These plans are essential to the long-term functionality of structural and nonstructural best management practices. All BMPs must be properly maintained to ensure long-term functionality. 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 NJDEP BMP Manual.

If an individual 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 individual 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 individual 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 the Township of Neptune 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, inspectors representing Neptune Township 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 individual responsible for maintenance of the stormwater management structures associated with all major development projects.

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, Neptune Township will implement a program requiring all responsible parties to submit annual statements and certifications documenting the operation and maintenance of their facilities to the Township's Director of Engineering and Planning and also Public Works Department. 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. Failure**

to comply with said requirements is enforceable by penalty under Neptune Township Code Chapter 1.

6.0 BEST MANAGEMENT PRACTICES (BMPS)

6.1 Nonstructural Stormwater Strategies

With the increasing emphasis on nonpoint source 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 Low Impact Development (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, low impact development 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 regional stormwater management measure, structural BMP of a large scale measure (except drywells, vegetated roofs, and rain gardens on single-family residential lots) designed to meet the above identified design standards shall be subject 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.

As described above, effective low impact development includes the use of both nonstructural and structural stormwater management measures known as LID-BMPs. Of the two, nonstructural LID-BMPs play a particularly important role. The proposed NJDEP Stormwater Management Rules at N.J.A.C. 7:8 require in Section 5.2(a) that the design of any development that disturbs at least one (1) acre of land or increases impervious surface by at least one-quarter (1/4) acre must incorporate nonstructural stormwater management strategies "to the maximum extent practicable." Such a development is defined in the Rules as a "major development." As such, nonstructural LID-BMPs are to be given preference over structural

BMPs. Where it is not possible to fully comply with the Stormwater Management Rules solely with nonstructural LID-BMPs, they should then be used in conjunction with LID and standard structural BMPs to meet the Rules' requirements.

More precisely, to achieve the Rules' design and performance standards, the NJDEP Stormwater Management Rules requires the maximum practical use of the following nine nonstructural strategies at all major developments:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.
2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces.
3. Maximize the protection of natural drainage features and vegetation.
4. Minimize the decrease in the pre-construction "time of concentration."
5. Minimize land disturbance including clearing and grading.
6. Minimize soil compaction.
7. Provide low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.
8. Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas.
9. Provide preventative source controls.

In addition, an applicant seeking approval for a major development must specifically identify which and how these nine nonstructural strategies have been incorporated into the development's design. Finally, for each of those nonstructural strategies that were not able to be incorporated into the development's design due to engineering, environmental, or safety reasons, the applicant must provide a basis for this contention.

While the nonstructural stormwater management strategies listed above represents a wide range of both objectives and practices, the following strategies can be directly addressed through the use of specific nonstructural LID-BMPs that can be grouped into four general categories:

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

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. Despite low impact development being a relatively new aspect of stormwater management, many municipalities and agencies have already incorporated low impact development goals and strategies into their own regulations and, with the advent of the NJDEP Stormwater Management Rules, those that haven't will be required to do so. Therefore, additional nonstructural strategies and/or specific nonstructural LID-BMPs aside from those described in this chapter may have already been incorporated into a municipality's land development regulations or will be in the near future. In light of the site specific nature of LID-BMPs, these regulations may also discourage or prohibit the use of specific LID-BMPs for engineering, safety, or maintenance reasons. Consideration should also be given to having a pre-design meeting and/or site walk with pertinent regulators and technical reviewers to review local regulations and optimize the site's nonstructural stormwater management design.

Finally, 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, municipality, or local soil conservation district, regarding pre-developed hydrologic conditions.

The following vegetation and landscaping nonstructural measures should be considered in land development proposed within Neptune Township.

6.1.1 Vegetation and Landscaping Nonstructural Measures

- ***Preservation of existing natural vegetated areas***

  This should be considered throughout the design of a land development. There are several 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 in these areas in particular. The maintenance responsibilities for this technique are minimal in that the area should be placed in an easement or deed restricted to ensure that the natural vegetation is not removed.

- ***Native ground cover***

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

- ***Vegetative Filters/Buffers***

  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. When upland woods are retained in their natural state, they break the force of falling rain. This prevents the soil from washing away and being carried into streams, wetlands, and potable water supply reservoirs. Wooded hillsides are especially critical in this regard. Removal of ground cover and topsoil during and after construction on steep slopes accelerates runoff and resulting erosion, impacting waters below.

  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. Vegetative filters should be cleaned out after large rainfall events and at least once (1) per year.

6.1.2 Minimizing Site Disturbance

- ***Minimizing land disturbance***

  Minimizing land disturbance 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 can help reduce post-development site runoff volumes and pollutant loads and maintain existing groundwater recharge rates and other hydrologic characteristics by preserving existing 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. The applicant will ensure compliance by including these requirements in soil erosion and sediment control plans, construction plans, and contract documents.

6.1.3 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. The following impervious area management techniques may be considered for major development projects proposed within the Township.

- ***Minimizing parking area and driveways***

  Parking area and driveway requirements are mandated by the Neptune Township Land Development Ordinance and, in the case of residential areas, the Residential Site Improvement Standards (RSIS). The RSIS provide 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.

- ***Unconnected impervious areas***

  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.

- ***Vegetated Roofs***

  Vegetated roofs, also known as green roofs, are an innovative way to reduce impervious surfaces at development sites. A vegetated or green roof consists of a lightweight vegetated planting bed that is installed on a new or existing roof. Vegetated roofs can be implemented using specialized commercial products. It is important to note that the structural integrity of the roof must be taken into consideration when designing a green roof. The Township Building Code Official must be consulted prior to use of this technique. Except for periodic limited or as needed fertilization and watering, a meadow-like planting of perennial plants can require minimal maintenance.

6.1.4 Time of Concentration (Tc) Modifications

Changes in peak flow result from changes in the Time of Concentration (Tc) from drainage areas, with longer times yielding smaller peak runoff rates and shorter times causing greater ones. Site factors that affect drainage area 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 may be given for the factors presented below.

- ***Surface roughness changes***

  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.

- ***Slope reduction***

  Ground slope is an important factor in determining drainage area 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.

- ***Vegetated conveyance***

  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.

6.2 Structural Best Management Practices

As mentioned previously, wherever possible, all major development projects proposed in the Neptune 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 and Director of Public Works must evaluate the ability to clean out the proposed 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). It is incumbent upon the owner to maintain the stormwater management measures on their property and provide yearly certification for same. **This shall include but not be limited to providing and establishing proper vegetation, minimize invasive species, routine maintenance cleaning. The yearly certification shall be submitted to both the Public Works Superintendent and also the Department of Engineering and Planning. Maintenance plans for each particular development and each BMP shall be submitted to the Planning Board Engineer at time of Board review and upon review and**

approval of same, as part of resolution compliance said plan shall be forwarded to the Public Works Superintendent and the Department of Engineering and Planning.

The *New Jersey Stormwater Best Management Practices Manual* identifies several structural stormwater options. The Township recommends the following:

- ***Bioretention system***

  A bioretention 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. Effective bioretention system performance requires regular and effective maintenance.

- ***Constructed stormwater wetland***

  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 is 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 full range of ecological functions. It is important to note that a constructed stormwater wetland must be able to maintain its permanent pool level. Effective constructed stormwater wetland performance requires regular and effective maintenance. **This type of BMP shall only be encouraged for commercial properties, since the constructed wetland may result in a potential mosquito breeding area.**

- ***Dry well***

  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 and groundwater is not shallow. Effective dry well performance requires regular and effective maintenance.

- ***Extended Detention Basin***

  An extended detention basin is a facility constructed through filling to create a berm and/or excavation to form a hole 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. **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. Extended detention basin performance requires regular and effective maintenance. All new stormwater management basins within the Borough 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.

- ***Manufactured Treatment Device***

  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 and Director of Public Works must be consulted about each manufactured treatment device proposed and consideration should be given to maintenance, training, and future costs to the Township before approval.

- ***Pervious paving***

  Pervious paving materials can be used at some site locations in the Township to replace standard impervious pavement in parking lots and driveways in the Township. For all sites where pervious paving is proposed, care should be taken in assessing soil conditions, high groundwater conditions, and potential sources of contamination. 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. Careful consideration must be given to freezing weather and to drainage and flooding if clogging occurs. Effective pervious paving system performance requires regular and effective maintenance.

- ***Sand filter***

  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.

- ***Vegetative filter***

  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 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. 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. Effective vegetated filter strip performance requires regular and effective maintenance.

- ***Rain Barrel***

  A rain barrel is a rainwater harvesting system that is connected to a down spout tube from a house or building and is a simple retrofit that a homeowner can perform. Rain barrels collect, store and divert rooftop runoff during a rain shower for use during dryer weather. Saving rainwater to use during the dry months using rain barrels is an ancient practice that is again becoming popular. A rain barrel is a perfect reservoir for watering landscapes and ornamental and vegetable gardens. All systems should use covered barrels or cisterns that keep the water from accumulating leaves (and going septic) and keep the standing water from encouraging mosquito breeding.

7.0 PLAN CONSISTENCY

The Township is not within a Regional Stormwater Management Planning Area and no TMDLs have been developed for waters within the Township; therefore this plan does not need to be consistent with any regional stormwater management plans (RSWMPs) nor any TMDLs. If any RSWMPs or TMDLs are developed in the future, this Municipal Stormwater Management Plan will be updated to be consistent.

The Municipal Stormwater Management Plan is consistent with the Residential Site Improvement Standards (RSIS) at N.J.A.C. 5:21. The municipality has been utilizing the most current update of the RSIS in the stormwater management review of residential areas. This Municipal Stormwater Management Plan will be updated to be consistent with any future updates to the RSIS.

All new development and redevelopment plans must comply with New Jersey's Soil Erosion and Sediment Control Standards. During construction, Freehold Soil Conservation District inspectors will observe on-site soil erosion and sediment control measures and report any inconsistencies.

The Township has reviewed the Master Plan and Land Development Ordinance, and has identified sections which require modification in order to incorporate nonstructural stormwater management strategies. In accordance with the Municipal Land Use Law, Neptune Township Ordinance "AN ORDINANCE AMENDING AND SUPPLEMENTING THE LAND DEVELOPMENT ORDINANCE OF THE TOWNSHIP OF NEPTUNE, BY ADDING SECTION 528 ENTITLED STORMWATER MANAGEMENT AND SECTION 811.01 ENTITLED ENVIRONMENTAL IMPACT STATEMENT" has been submitted to the Monmouth County Planning Board and neighboring municipalities.

The ordinance has been written and adopted in accordance with the Stormwater Management Rules. A copy will be sent to the New Jersey Department of Environmental Protection (NJDEP). In addition, the Township is in the process of amending sections of the Land Development Ordinance. This will include revisions to Article V – Performance and Design Standards.

8.0 LAND USE/BUILD-OUT ANALYSIS

The Monmouth County Planning Board has completed the buildout analysis as part of their Cross Acceptance Plan. Reference is made to the Monmouth County 2004 Cross Acceptance Report.

In October 2004, Neptune Township adopted a "Strategic Revitalization Plan". This plan identified several areas of the Township in need of revitalization through the creation of new gateways along the highway corridors into Neptune and its Midtown area. The plan identified the need to revitalize and redevelop the West Lake Avenue area by developing a neighborhood center and proposed the creation of a "transit village" in the Bradley Park section (near the Bradley Beach train station). In addition, the plan identified the potential for redevelopment and enhancement along the Shark River waterfront. The Township will continue the planning process for these areas outlined in the "Strategic Revitalization Plan". This will include further analysis of the existing land uses, zoning districts, and permitted density. The land uses for Neptune Township are shown in the figure in the Appendix.

In accordance with the NJDEP regulations, the Township is not required to complete its build-out analysis prior to February 2006. The Township will adopt the MSWMP and amend it to include the build-out analysis in order to meet the deadline.

9.0 MITIGATION PLAN

A mitigation plan is provided for a proposed development when the applicant is granted a variance or exemption from the stormwater management design and performance standards. The project must provide the unique or unusual circumstances, to why it is not practical or viable to meet the standards of stormwater management regulations (NJAC 7:8-1.1 et seq.). Mitigation is to be utilized as an alternative proposal to correct or improve a stormwater condition. The proposed alternatives are suppose to encourage and provide, additional groundwater recharge benefits, or protection from stormwater runoff quality and quantity from previously developed properties that do not currently meet the design and performance standards outlined in the Municipal Stormwater Management Plan. The developer must ensure the long-term maintenance requirements are met.

Municipal Criteria:

It is incumbent upon the Municipal Planning Board when they grant variances from the NJDEP regulations that the following NJDEP and municipal requirements are met:

- **The mitigation project must be implemented in the same drainage area as the proposed development;**
- **The mitigation project must be completed for the performance standard for which the variance or exemption is requested and must provide a comparable benefit to that which is being waived;**
- **The proposed mitigation project must address one of the following:**
  - **Additional groundwater recharge benefits;**
  - **Water quality improvements;**
  - **Water Quantity reduction;**
- **The developer is required to ensure long term maintenance of the proposed mitigation project. This shall include but not be limited to the maintenance requirements as outlined in the NJDEP BMP Manual;**
- **The applicant shall provide sufficient information and documentation to the satisfaction of the Municipal Board and their professionals that the variance can be granted and mitigation can be approved with no detrimental impact on the environment and/or adjoining properties;**

- **The applicant/developer shall enter into a developer's agreement with the municipality. The subject agreement shall address issues related to the mitigation project, specifically construction and maintenance.**

Mitigation projects should also be as close in terms of hydrology and hydraulics to the proposed development/redevelopment as possible. The developer must ensure the long-term maintenance of the project including all maintenance required in Chapters 8 and 9 of the *NJDEP Stormwater BMP Manual*. Projects must be proposed on an equivalent basis. Developers must propose a mitigation project that is equivalent to the type requested in the variance. This means a "stormwater quality" variance can only be mitigated by a "stormwater quality" mitigation project. Proposed mitigation projects cannot adversely impact the existing environment.

Applicant/Developer Criteria

It is the developer's responsibility to provide a detailed study of any proposed mitigation project, and must provide the Township with a proposed mitigation plan for review and approval prior to granting final approval for site development. Developers should include the following in a Mitigation Plan:

- **Mitigation project name, owner name and address, developer name and address, mitigation project location, drainage area, cost estimate;**
- **Proposed mitigation strategy and impact to sensitive receptor, what is being impacted, mitigated, and how;**
    - **Groundwater Recharge mitigation may include rehabilitation of existing detention or retention basins; installation of permeable pipe underdrains; and or other proposed and approved projects that would encourage infiltration of runoff to groundwater recharge;**
    - **Stream Corridor Protection mitigation projects may include bank stabilization, restoration of floodplain areas, vegetation improvement/enhancement and/or other proposed and approved projects that protect the stream corridors;**
    - **Water Quality/Water Quantity mitigation projects may include installation of BMP's within the municipal drainage system and/or outfall locations; total suspended solid and nutrient load reduction, desilting and Desnagging of stream corridors, rehabilitation of culverts and/or ditches in major watershed basins. Rehabilitation of existing ponds, lakes and waterways and/or other proposed and**

approved projects that would result in meeting water quality and water quantity improvements.

- **Legal authorization required for construction and maintenance;**
- **Responsible party, including required maintenance, who will perform the maintenance, proposed cost of maintenance, and how it will be funded;**
- **All other permits required for construction of the mitigation project;**
- **Cost estimate of construction inspection; and**
- **Reason a waiver or exemption is requested and supporting evidence.**