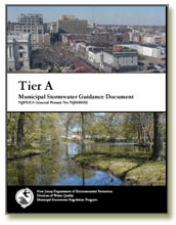
MUNICIPAL STORMWATER MANAGEMENT PLAN



for the

TOWNSHIP OF WATERFORD
(Camden County)

NJPDES Permit #NJG0151017
P.I. ID #167218
Tier A Municipal Stormwater General Permit

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Glossary of Terms

AMNET: .....Ambient Biomonitoring Network

AMs: .....Additional Measures

BMPs:.....Best Management Practices

EDPA: .....Effective Date of Permit Authorization

GIS: .....Geographic Information System

HUC: .....Hydrologic Unit Code

MS4: .....Municipal Separate Storm Sewer System

MSRP:.....Municipal Stormwater Regulation Program

MSWMP:.....Municipal Stormwater Management Plan

NJAC:.....New Jersey Administrative Code

NJDEP: .....New Jersey Department of Environmental Protection

NJPDES: .....New Jersey Pollutant Discharge Elimination System

NJIS:.....New Jersey Impairment Score

NJRSIS: .....New Jersey Residential Site Improvement Standards

OMs:.....Optional Measures

RSWMP:.....Regional Stormwater Management Plans

SBRs: .....Statewide Basic Requirements

TMDL: .....Total Maximum Daily Load

WMA:.....Water Management Area

USEPA: .....United States Environmental Protection Agency

USGS:.....United States Geological Survey

Definition of Terms

Development: 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/or any use or change in the use of any building or other structure, or land or extension of land, by any person, for which permission is required under the Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.).

In the case of development of agricultural lands, development means:

a. Any activity that requires a State permit.

b. Any activity reviewed by the County Agricultural Board (CAB) and the State Agricultural Development Committee (SADC).

c. Municipal review of any activity not exempted by the Right To Farm Act (N.J.S.A. 4:1C-1 et. seq.).

Erosion: The detachment and movement of soil or rock fragments by water, wind, ice or gravity.

HUC: 14 digit hydrologic code used by the USGS to identify the individual sub-watersheds that make up a larger watershed (known as a HUC11). The USGS has identified 921 HUC14 sub-watersheds within New Jersey that range in size between 0.1 and 42 square miles.

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

MS4: (Municipal Separate Storm Sewer); means a conveyance or system of conveyances (including roads, with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels or storm drains).

Non-Structural BMPS: Policies and procedures that manage land use in order to lessen the impacts of resource development and redevelopment on stormwater quality and quantity.

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

Solid/Floatable Materials: Sediment, debris, trash and other floating, suspended, or settleable solids.

Stormwater: Water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers (or other type of sewerage or drainage facilities), or is conveyed by snow removal equipment.

Structural BMPS: Stormwater management facilities designed and constructed for the treatment of stormwater with respect to quality and quantity. Examples of structural controls are vegetative strips, detention/water quality basins, and swirl separator.

Watershed: A geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

A. Introduction:

In 1987 the U.S. Environmental Protection Agency's (USEPA) Clean Water Act was amended to regulate the discharge of pollutants from non-point sources into U.S. waters via a National Pollutant Discharge Elimination permit. As a result in January 2004, the New Jersey Department of Environmental Protection (NJDEP) established a Municipal Stormwater Regulation Program (MSRP) and adopted a Phase II component to the New Jersey Pollutant Discharge Elimination System (NJPDES) permit to regulate such discharges throughout the State.

This permit is issued to all owners and operators of municipal separate storm sewer systems (MS4s), which include municipalities; federal, state and interstate agencies operating or maintaining highways; and various public complexes (e.g., universities and hospitals). The permit program establishes Statewide Basic Requirements (SBRs) that must be implemented to reduce non-point source pollutant loads from stormwater and better manage the stormwater runoff.

The NJDEP has issued a NJPDES Tier A Municipal Stormwater General Permit to the Township of Waterford. This permit was issued in March 2004 and the municipality's Effective Date of Permit Authorization (EDPA) is April 2004. In accordance with State regulations, this permit will need to be renewed every five years.

The permit authorizes all new and existing stormwater discharges to surface water and groundwater from municipal separate storm sewer systems (MS4s) that are owned or operated by the municipality. The overall goal of the permit is to reduce non-point source pollutant discharge to these waterbodies by implementing the NJDEP's SBRs (as outlined within Table 1).

In accordance with N.J.A.C. 7:14A-25 (Municipal Stormwater Regulations), the Township is required to develop a Municipal Stormwater Management Plan (MSWMP) to document the municipality's strategy in addressing groundwater recharge, stormwater quantity and stormwater quality impacts by incorporating stormwater design and performance standards for new development within the municipality.

This plan contains all of the required elements described in N.J.A.C. 7:8 (Stormwater Management Rules), addressing such issues as:

1. Minimizing impacts to groundwater recharge, stormwater quantity, and stormwater quality by incorporating stormwater design and performance standards for new major development (where major development is defined as a project that disturbs one of more acres of land).

   These standards are intended to minimize the adverse impacts of stormwater runoff on water quality and quantity, while minimizing the loss of groundwater recharges which provides essential baseflow to receiving waterbodies.

2. Describing long-term operation and maintenance measures for existing and future stormwater management facilities.

3. Developing a "build-out" analysis based upon existing zoning regulations and remaining lands available for development.

4. Reviewing and updating existing municipal ordinances, the municipal Master Plan, and other such planning documents to incorporate low impact development techniques into site planning and development.

5. Developing a mitigation strategy to be implemented when a variance or exemption of the design and performance standards is being sought. This section will identify specific stormwater management measures which can be used to lessen the impact of existing development.

Table 1: Tier 'A' SBR Requirements

1. Implementation of SBRs.
2. Public Notice.
3. Post-Construction Stormwater Management in New Development and Redevelopment: a. Stormwater Management Plan. b. Stormwater Control Ordinance. c. Residential Site Improvement Standards. d. BMP Operation and Maintenance. e. Storm Drain Inlet Design Standards for New Construction.
4. Local Public Education: a. Local Public Education Program. b. Storm Drain Labeling.
5. Improper Disposal of Wastes: a. Pet Waste Ordinance. b. Litter Ordinance. c. Improper Waste Disposal Ordinance. d. Wildlife Feeding Ordinance. e. Yard Waste Ordinance / Collection Program.
6. Illicit Connection Elimination and MS4 Outfall Pipe Mapping: a. MS4 Outfall Pipe Mapping. b. Illicit Connection Elimination Program. c. Illicit Connection Ordinance.
7. Solid and Floatable Controls: a. Street Sweeping. b. Storm Drain Inlet Retrofitting. c. Stormwater Facility Maintenance. d. Road Erosion Control Maintenance. e. Outfall Pipe Stream Scouring Remediation.
8. Maintenance Yard Operations: a. De-icing Material Storage. b. Fueling Operations. c. Vehicle Maintenance. d. Good Housekeeping Practices.
9. Employee Training.

B. Goals:

The goals of this Municipal Stormwater Management Plan are to:

1. Reduce flooding damage (including damage to life and property).
2. Minimize to the maximum 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, bridges and in-stream structures.
5. Maintain groundwater recharge.
6. Prevent, to the greatest extent feasible, an increase in non-point source 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:
    a. Restore, enhance and maintain the chemical, physical and biological integrity of the waters of the State.
    b. Protect public health.
    c. Safeguard fish and aquatic life and scenic and ecological values.
    d. Enhance the domestic, municipal, recreational, industrial and other uses of water.
9. Protect public safety through the proper design and operation of stormwater basins.

To achieve these goals, this plan outlines specific stormwater design and performance standards for new development. The plan also provides the following:

- Proposes stormwater management controls to address impacts from existing development.
- Includes preventative and corrective maintenance strategies to ensure long-term effectiveness of stormwater management facilities.
- Outlines safety standards for stormwater infrastructure to be implemented to protect public safety.

Through this plan the municipality will endeavor to reduce the amount of pollutants discharging to our surface and ground waters as a result of land development and urbanization.

C. Stormwater Discussion:

The Hydrologic Cycle:

Water is essential to sustaining life on earth and although it is an abundant resource that covers a majority of our planet, almost 93% of our water resides in the oceans and as a result is toxic to humans and many plants and animals. Therefore maintaining and sustaining our clean freshwater resources is vital to our existence.

In order to sustain clean freshwater, it is necessary to understand how water is recycled through the hydrologic cycle. This cycle (depicted within Figure A) begins with the evaporation of water from surficial water surfaces (such as oceans, rivers, lakes, streams, etc.) and transpiration of water from plants and soils. Then as moist air is lifted into the atmosphere, it cools and the water vapor condenses to form clouds. The moisture within the clouds are then transported around the globe until it precipitates back to the earth's in the form of rain or snow.

At the ground surface, the fallen precipitation can do either of the following, after which the cycle begins once again:

- Collect within surficial water surface bodies (where it evaporates back into the atmosphere).
- Percolate into the earth's surface and become groundwater.

  In such cases, the groundwater is stored within the soil and eventually either seeps back into the oceans, rivers, and streams, or is released into the atmosphere through transpiration (as water is taken in and released by plants).
- Travels along the earth surface as runoff where it empties into lakes, rivers and streams and is carried back to the oceans.

Land Development Impacts:

However, land development pressure and its associated stormwater impacts have become a serous threat to our freshwater resources. Increases in impervious surface coverage, and hence subsequently stormwater runoff can cause significant water quality, quantity and recharge issues.

Land development can disrupt and adversely impact this natural cycle by impacting local watersheds (see Figure B). Prior to development, native vegetation within a watershed intercepts precipitation where it is either collected in surficial waterbodies or is infiltrated into the ground. Development can remove this beneficial vegetation and replace it with lawn or impervious cover, reducing the site's evapotranspiration and infiltration rates. Site clearing and grading can also remove depressions which store rainfall.

Construction activities compact surficial soils and diminish their infiltration ability, resulting in increased stormwater runoff volumes and discharge rates. Impervious areas that are connected to each other through gutters, channels, and stormsewers 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.

Increases in impervious area can also decrease opportunities for stormwater infiltration and can more readily mobilize and transport pollutants which ultimately results in reduced stream base flows and groundwater recharge amounts. Reduced base flows combined with increased peak flows produce greater fluctuations between normal and storm flow rates resulting in increased 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 increased sediment loadings can alter stream geometries and destroy habitat from which some species are not to adapt to.

Studies have shown that stormwater runoff from urban and industrial areas typically contain the same types of pollutants that are found within industrial wastewater discharges. Such pollutants can include heavy metals, pesticides, herbicides, fertilizers, synthetic organic food wastes, oil, solvents, etc. Removing surface vegetation decreases the natural filtration of pollutants from stormwater runoff. The result is higher pollutant loadings within the stormwater runoff from streets, parking lots, construction sites and industrial facilities which are transported through storm sewers and ultimately discharge into downstream receiving waterbodies.

Land development can also adversely affect water quality and stream biota in more subtle ways. For example, stormwater falling on impervious surfaces or stored within detention or retention basins can become heated and raise the temperature of the downstream waterway, which in turn adversely affects cold water fish species such as trout. Trees along stream banks removed by development adversely impacts stream shading and degrade bank stabilization.

It is therefore critical during development that stormwater be properly managed to maximize onsite infiltration and minimize the potential for soil erosion and pollutant transport.

Figure A: The Overall Hydrologic Cycle

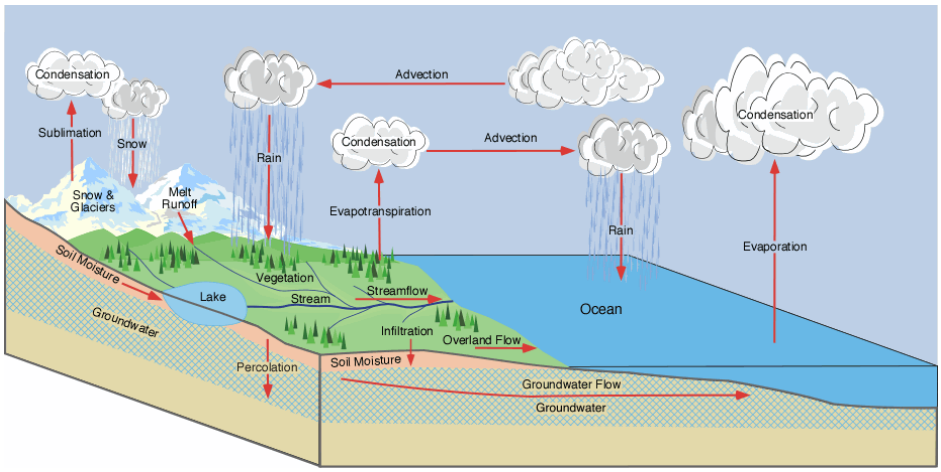
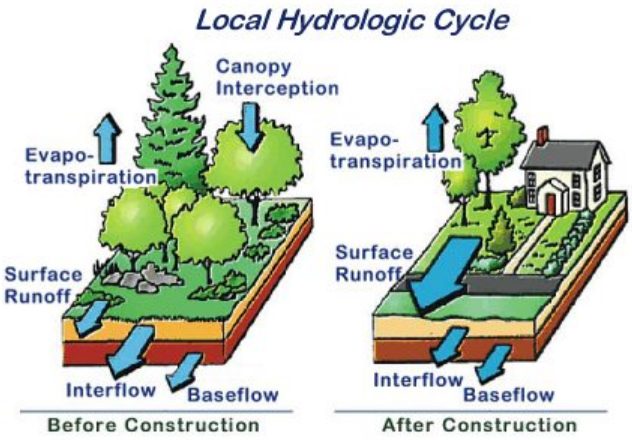


Figure B: The Local Hydrologic Cycle



D. Background:

Geographics:

Waterford Township is located in the southeast portion of Camden County, New Jersey and resides completely within the Pinelands. The municipality is bounded by the following seven municipalities:

- To the north and east by Medford and Shamong Townships (both within Burlington County).
- To the south by Hammonton (Atlantic County).
- To the west by Berlin Township, Berlin Borough, Winslow Township and Chesilhurst Borough (all within Camden County).

The municipality has a total land area of ±36.26 square miles and only ±0.07 square miles (or 0.19%) of this area is comprised of surface waterbodies. It should be noted that the eastern and parts of the southern portion of the municipality are designated as State park lands (i.e., Wharton State Park). These lands encompass ±21.78 square miles of (or 60%) of the entire municipality. As such development within these areas is significantly restricted.

Figures 1 thru 14 depict the municipal boundary in relation to various geographic, zoning, land use and other miscellaneous features. As depicted within Figure 4, most of the existing development is situated within the northwest corner of the municipality.

As depicted within Figures 1 and 8, the municipality has large areas of wetlands distributed throughout the municipality, especially within the sections of the Township within the Wharton State Park. All wetlands drain to the Mullica River basin and there are no C1 Special Resource Areas assigned to any of the waterways.

Waterford Township lies in the NJDEP Water Region 3 coastal watershed (a.k.a. Atlantic Coast region). Within this region lie smaller watershed management areas (WMA) of which Waterford Township lies within WMA 14 (i..e, Mullica River). WMAs are further subdivided into sub-watersheds of which 10 sub-watersheds are situated within Waterford Township. The entire municipality drains to the Mullica River watershed via three major tributaries (Mullica River, Sleeper Branch and Clark Branch).

A layout of the groundwater recharge areas within the municipality is shown in Figure 11.

Population Data:

In accordance with the 2000 Census, the municipality's population was 10,494 which equates to a population density of 290 persons per square mile. Since 1990, the population has remained relatively consistent, dropping by 446 persons (or 4%) over the ten year period. Because the entire municipality lies within the Pinelands boundaries, development pressures will be confined by the Pinelands Commission's rules and regulations. The large expanse of open space further confines population growth to areas outside of the State park.

Water Quality Assessments:

As previously mentioned, studies have shown that stormwater and urban runoff can contain the same types of pollutants that are found within industrial wastewater discharges and therefore the NJDEP considers such discharges to be significant sources of pollutants that may be causing, threatening to cause, or contributing to the impairment of the water quality and beneficial uses of the receiving waterbodies in New Jersey.

Therefore in the early 1970's, the NJDEP began biological monitoring of New Jersey's waters. In 1992, the NJDEP established the Ambient Biomonitoring Network (AMNET) in order to monitor aquatic biota within New Jersey's watersheds. Using a five year monitoring cycle, AMNET monitors benthic macroinvertebrate populations from over 800 sites throughout the state. Macroinvertebrates are used as indicators of water quality since various select species can only be found in high quality waters. The sampling of these organisms was conducted in a semi-quantitative fashion.

Water Quality Assessments conducted by both the NJDEP and the NJ Water Supply Authority are used to identify the impairment of a number of waterbodies in New Jersey. Streams are classified as non-impaired, moderately impaired or severely impaired based on the AMNET data. This 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.

In addition to the AMNET data, the NJDEP and other regulatory agencies collect water quality chemical data on the streams in the State.

TMDLs:

A 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 NJPDES permits to discharge) and non-point sources (which includes stormwater runoff from agricultural areas and residential areas) in addition to 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.

The New Jersey Integrated Water Quality Monitoring and Assessment Report [305(b) and 303(d) Integrated List] is required by the Federal Clean Water Act to be prepared biennially and is a valuable source of water quality information. This combined report presents the extent to which New Jersey waters are attaining water quality standards, and identifies waters that are impaired. Sublist 5 of the Integrated List constitutes the list of waters impaired or threatened by pollutants, for which one or more TMDLs are needed.

Concerns:

AMNET has no stream monitoring sites established within Waterford Township's boundaries, but has established the following 6 local biological monitoring sites (additional information and sampling results for these sites are provided in Table 2):

1. AN0565 located on Sleeper Branch (near Tremont Ave).

   The sample was taken from Hays Mill Creek.

2. AN0571 located on Nescochague Creek (at Wharton Ave).

   The sample was taken from Albertson Brook.

3. AN0562 located on the Mullica River (at Burnt House Road).

   The sample was taken from the river itself.

4. AN0566 located on Sleeper Branch (at Parkdale).

   The sample was taken from the branch itself.

5. AN0567 located on Clark Branch (at Burnt Mill Road).

   The sample was taken from the branch itself.

6. AN0568 located on Price Branch (at Burnt Mill Road).

   The sample was taken from the branch itself.

Based upon the AMNET sampling results presented within Table 2 below, both the Nescochague Creek and Clarks Branch were found to be moderately impaired while Prices Branch was found to be severely impaired.

In addition to water quality problems, many of the streams within the municipality have exhibited water quantity problems including flooding, stream bank erosion and diminished baseflow in its streams. Many of the culverts associated with road crossings in the municipality are undersized. During sever storm events, these undersized culverts do not have adequate capacity, thereby causing a backwater effect and flooding of upstream tributary areas and roadways.

These culverts were designed for much different hydrologic conditions (i.e., less impervious area) than presently exist within the municipality. As the impervious cover increases within the municipality, the peak rates and volumes of stream flows will also increase. The increased amount of stormwater will cause stream bank erosion, unstable areas at roadway/bridge crossings, and degraded stream habitats.

The impervious increases will also decrease the local groundwater recharge rates which ultimately results in decreased base flows to streams during dry weather periods. Lower base flows can have a negative impact on instream habitat during the summer months.

Conclusion:

The Township's waterways have many uses including recreation and wildlife habitat. Water quality protection requires a diverse program aimed at those who drain to our streams. The

growth within the municipality could threaten water quality in a number of ways, which include the following:

1. Everyday human activities send many types of pollutants into lakes and streams, including oils and hydrocarbons from automobiles, trash, pesticides and fertilizers from landscaping, and sediment resulting from construction sites and intensive land uses.
2. Increases in impervious surfaces due to buildings and pavement send more water more quickly to creeks and streams. This can contribute to erosion, changes in stream temperature, and changes in the types and amounts of pollutants the water gathers as it drains.
3. Urban development creates new pollution sources as population density increases and brings with it proportionately higher levels of vehicle emissions, vehicle maintenance wastes, municipal sewerage, pesticides, household wastes. Pet wastes, trash, etc. which can be washed into the storm drains system. Urban areas generally contribute a higher level of pollutant load in streams than rural areas.

The NJDEP has not established TMDLs for any waterbodies within the municipality. However in the future should TMDLs be established for any waterbody, they should be incorporated into this document.

Table 2: AMNET Biological Monitoring Data

** All sites received a Habitat rating of Optimal.*

Site	Sampling Waterway	Water GIS	Site Location	Quad
AN0565	Hays Mill Ck	Sleeper Branch	Tremont Ave	Medford Lakes
AN0571	Albertson Bk	Nescochague Ck (Albertson Ck, Blue Anchor Bk)	Wharton Ave	Hammonton
AN0562	Mullica R	Mullica River	Burnt House Rd	Hammonton
AN0566	Sleeper Br	Sleeper Branch	Parkdale	Hammonton
AN0567	Clarks Br	Clark Branch	Burnt Mill Rd	Hammonton
AN0568	Prices Br	Price Branch	Burnt Mill Rd	Hammonton

Site	1st Sample Impairment Score 94/95	Impairment Rating	2nd Sample Impairment Score 99/00	Impairment Rating	Habitat Score
AN0565	30	None	27	None	189*
AN0571	15	Moderate	12	Moderate	177*
AN0562	27	None	27	None	170*
AN0566	30	None	24	None	193*
AN0567	21	Moderate	9	Moderate	167*
AN0568	12	Moderate	3	Severe	183*

E. Design and Performance Standards:

The municipality will adopt the design and performance standards for stormwater management measures as presented in N.J.A.C. 7:8-5 to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving waterbodies. Because the entire municipality lies within the Pinelands Area all design and performance standards shall also meet the regulations of the Pinelands Commission (N.J.A.C. 7:50-6.84). The design and performance standards include the language for maintenance of stormwater management measures consistent with the stormwater management rules at N.J.A.C. 7:8-5.8 (Maintenance Requirements) and language for safety standards consistent with N.J.A.C. 7:8-6 (Safety Standards for Stormwater Management Basins). The ordinances will be submitted to the County for review and approval within 24 months of the effective date of the Stormwater Management Rules.

During construction, municipal inspectors will observe the construction of the project to ensure that the stormwater management measures are constructed and function as designed.

F. Plan Consistency:

The municipality is not within a Regional Stormwater Management Planning Area and no TMDLs have been developed for waters within the Township; therefore the plan does not need to be consistent with any Regional Stormwater Management Plans (RSWMPs) or any TMDLs. Should an RSWMP or TMDLs be developed in the future this MSWMP will be updated to be consistent.

However the plan must be consistent with the rules and regulations of all of the following agencies:

1. The Pinelands Commission's Comprehensive Management Plan regarding development and mitigation.

   Under this plan all development within the municipality is confined to areas of allowable growth which have been defined by both the Pinelands Commission and the municipality.

2. The New Jersey Residential Site Improvement Standards (NJRSIS) as required by N.J.A.C. 5:21.

   In order to remain consistent with this standard, the municipality will utilize the most current update of the NJRSIS in their review of residential and ultimately site plan developments.

   The MSWMP will be updated to be consistent with any future updates to the NJRSIS.

3. The Camden County Soil Conservation District.

   The municipal stormwater management ordinance requires all new development and redevelopment plans to comply with New Jersey's Soil Erosion and Sediment Control Standards.

   During construction, municipal inspectors will observe onsite soil erosion and sediment control measures and report any inconsistencies to the Camden County Soil Conservation District.

G. Nonstructural Stormwater Management Strategies:

Since the municipality is completely located within the Pinelands, the Township shall be subjected to the Pinelands stormwater management strategies and ordinances. The Township is in the process of adopting a stormwater management ordinance that is based on the model ordinance published by the Pinelands Commission.

H. Land Use / Build-Out Analysis:

General:

Since there is more than one square mile of combined vacant and agricultural lands throughout the municipality, build-out analyses and pollutant loading projections have been included within the MSWMP as required by N.J.A.C. 7:8 and 7:14A-25.

As a municipality matures towards its full land use potential, land development can tend to adversely impact both water quality and quantity. When lands are cleared and land uses become intensified (e.g. constructing housing developments on previously farmed agricultural lands), adverse impacts to water quality and quantity typically are manifested through stormwater runoff due to increases in impervious surface coverages and the accumulation and mobilization of pollutants.

As a result, downstream receiving waterbodies and ecosystems become impaired as flooding events are increased and intensified from the new impervious surface areas. Water quality is further degraded as increased stormwater pollutant loads enter the waterbodies and alter the chemical, physical and biological integrity of the receiving waters.

Therefore the build-out analyses and pollutant loading projections have been developed as a tool that the municipality can use to assess potential impacts from land development and stormwater runoff. The analysis projects and compares pollutant loadings generated by both present and future (built-out) land use covers. The methodology underlying the analysis and projections are generally based on the NJDEP's methodology specified within their regulations and guidance documents.

From the results of the analysis, the municipality is able to quantifiably project the impacts from development onto surface waters. Using this tool, the municipality can then develop better strategies to minimize, manage and/or mitigate these impacts through improved stormwater management and construction practices and via modifications to land use and zoning.

The analysis should be considered a tool to be used as an initial step towards assessing and quantifying adverse impacts from development and stormwater runoff. However as indicated by the following listing of reservations that we have identified in implementing the NJDEP's build-out and pollutant loading methodology, the analysis does have several apparent flaws that need to be realized when evaluating its results:

- The methodology greatly over-simplifies the complex hydrologic and pollutant transport mechanisms associated with these processes.
- The methodology does not account for the transient nature of development within a given watershed as it ignores the differences in time over which build-out will occur (assuming that all development will actually realize its full build-out and that they will all occur at relatively the same the time).

  The more probable scenario being one portion of a watershed within a specific zone may take 10 years to reach its build-out potential, while another portion may need 100 years or more to achieve full build-out.

- The impervious surface coverage analysis presumes that all development within a zone will realize its maximum impervious coverage permitted by the zone and that the municipality will not substantially change the maximum coverage permitted.

  In addition, there are several zones that do not specify a maximum impervious coverage. In such maximum coverages from similar zones were assigned to these zones.

- The NJDEP presented little information about the origin and conditions that apply to their land cover pollutant loading coefficients for total phosphorus, total nitrogen and total suspended solids.

  For example, it is unclear as to what climatic, soils, hydrologic, geologic, topographic, and vegetative conditions these coefficients represent. Also the NJDEP does not specify what stormwater runoff controls were employed in generating the coefficients.

  Without this information, it is not possible to fully understand the implications of the pollutant loadings using these coefficients.

  As discussed later within the report, the model is largely dependent on only a few input parameters (predominantly land area, zoning parameters and the NJDEP land cover coefficients). Since zoning parameters and land areas can be accurately identified and quantified (via GIS technology), the proper implementation and use of accurate coefficients is essential to the accuracy of the results generated by the model.

- Because the NJDEP methodology projects pollutant loadings for only total phosphorus, total nitrogen and total suspended solids, the pollutant loading projections are biased against agricultural land uses.

  Specifically the NJDEP pollutant loading coefficients for agriculture are two to three times greater than those specified for low density residential development. As a result, the annual pollutant loadings are then two to three times lower for land transitioning from agriculture to residential development than if it were to remain as an agricultural use.

  This may be misconstrued to imply that the loss of agricultural lands to residential development is somehow desirable. Furthermore, because of the significant amount of agricultural land within the municipality, this methodology implies that residentially and commercially developed lands are less prone to the impacts of non-point source pollution, which is not the case.

  It is recognized that agricultural land uses are fundamentally important and vital to society, and as such the municipality does not advocate residential development (or any other development) as being more preferable to agricultural development.

  As the NJDEP continues their research and implementation of the build out analyses throughout the state, these coefficients may be refined and loading coefficients for new pollutants published.

Accordingly the build-out analyses and pollutant loading program has been developed to permit adjustments to the values of the coefficients and to allow the model to be expanded to include other contaminant loading coefficients of concern.

- The NJDEP's land cover coefficients do not appear to consider or incorporate the new stormwater management techniques now required by the New Jersey stormwater regulations and the new LID BMP strategies. Furthermore, most developments within the municipality have required some form of stormwater control for 20 years or more.

  The NJDEP land cover coefficients therefore may be very conservative with respect to present development conditions and greatly overestimate the adverse impacts at build-out.

- In addition to total phosphorus, total nitrogen and total suspended solids, there are a number of other pollutants associated with non-point source pollution and stormwater runoff that are generated and mobilized through land development. These include among other parameters, petroleum hydrocarbons, metals, and pathogenic organisms which are not currently accounted for by the NJDEP methodology.

- Malfunctioning and/or inadequate onsite wastewater disposal systems are believed to be a major source of non-point source pollution. The NJDEP methodology does not account for pollution resulting from such onsite systems.

Despite these reservations, the build-out analyses and pollutant loading projections are valuable tools for assessing the potential impacts from development and stormwater runoff. The build-out analysis and pollutant loading projections have been developed with the flexibility to easily adjust the pollutant loading coefficients, zoning and other elements of the analysis and projections. The municipality utilized GIS data management and mapping software to perform these analyses in order to create the flexibility to adjust these parameters for each watershed or even HUC14 within the municipality.

Process:

The following GIS based method was used for the build-out analyses and pollutant loading projections and to prepare the figures presented within this report.

1. Identify and characterize the HUC14 watersheds within the municipality.

   Using the NJDEP's GIS mapping data for HUC14s, the 12 HUC14s drainage areas within Waterford Township were identified, their boundaries delineated (see Figure 13), and the results saved within a GIS feature layer.

   Then through the use of ESRI's ArcGIS mapping software, the total land areas for each of the HUC14 watersheds were determined (and summarized in Table 3 below) based on the delineated watershed's digital feature attributes.

Table 3: HUC14 Drainage Areas

HUC14 ID	HUC14 Sub-Watershed Name	Area (acres)
02040301160010	Alquatka Branch	17.84
02040301160020	Mullica River (above Jackson Road)	3,565.73
02040301160030	Mullica River (Rt 206 to Jackson Road)	3,774.52
02040301160050	Hays Mill Creek (above Tremont Ave)	2,725.96
02040301160060	Sleeper Branch (Rt 206 to Tremont Ave)	6,209.01
02040301160080	Pump Branch (below 74d53m road)	293.71
02040301160090	Clark Branch (above/incl Price Branch)	2,877.15
02040301160100	Blue Anchor Brook	45.71
02040301160110	Albertson Brook / Gun Branch	2,490.34
02040301160120	Great Swamp Branch (above Rt 206)	192.45
02040301160140	Mullica River (39d40m30s to Rt 206)	568.46
02040301160150	Mullica R (Pleasant Mills to 39d40m30s)	404.04
	Total:	23,164.92

2. Identify the Township's land use zones.

   Using the Township's GIS mapping data of their land use zoning districts (see both Figure 3 and Attachment 1 for an overview of these zones), the zones were overlaid over the HUC14 drainage areas to identify and delineate the land use zones within each individual HUC14 drainage area.

3. Identify and calculate all existing impervious land covers within each HUC14 watershed.

   The existing impervious land covers were determined using photometric mapping techniques on the NJDEP's 2002 digital aerial photography. The amounts of impervious land cover within each HUC14 were then calculated by zone (see Figures 12A-12L and Attachment 2).

4. Identify and calculate all existing constrained lands within each HUC14 drainage area.

   Using a combination of the NJDEP's and the municipality's GIS mapping data, the lands constrained from future development (including such lands identified as surficial waterbodies, wetland areas, Category One resource protection areas and their associated 300 foot buffers, designated open space and protected park areas) were identified and merged into a GIS feature layer (see Figure 5).

   This layer was then overlaid on the both the HUC14 and the municipal land use zoning feature layers and the amount of impervious land cover within each HUC14 were then calculated by zone (see Figures 12A-12L and Attachment 2).

5. Calculate the land areas available for development and redevelopment within each HUC14 watershed.

   The land areas available for development and redevelopment were then calculated by subtracting the constrained lands from the total land areas for each HUC14 (see

Attachments 1 and 2). In essence the land available for development is the agricultural, forest and/or barren lands and the land available for redevelopment consist of the eligible existing residential, commercial and industrially zoned parcels.

6. Calculate the potential additional impervious surface coverage assuming full development.

   Using the maximum impervious surface coverage percentages specified within the municipal ordinance, the potential additional impervious surface coverage was calculated by multiplying land areas available for development and redevelopment by the maximum impervious surface coverage.

7. Estimate non-point source pollutant load for each HUC14 drainage area.

   Non-point source pollutant loads were calculated for each HUC14 using the land use pollutant loads published in the NJDEP Stormwater BMP Manual 2004 (see Table 4 below) multiplied by the amount of potential maximum developable land areas within each municipality.

   For purposes of his analysis, the pollutants were limited to total phosphorus, total nitrogen and total suspended solids. However the analysis can be expanded in the future to include other contaminants of concern.

Table 4: Pollutant Loads by Land Cover

Land Cover	Total Phosphorus Load (lbs/acre/year)	Total Nitrogen Load (lbs/acre/year)	Total Suspended Solids Load (lbs/acre/yr)
High, Medium Density Residential	1.4	15	140
Low Density, Rural Residential	0.6	5	100
Commercial	2.1	22	200
Industrial	1.5	16	200
Urban, Mixed Urban, Other Urban	1.0	10	120
Agricultural	1.3	10	300
Forest, Water, Wetlands	0.1	3	40
Barrenland/Transitional Area	0.5	5	60

Source: NJDEP Stormwater BMP Manual 2004 (Appendix C, Table C-2).

Results:

The results of the land use/build-out analysis are detailed in Attachment 2 and summarized below in Table 5 (for the potential maximum pollutant loadings) and Table 6 (for the potential increased impervious surface coverages).

Table 5: Pollutant Loading Summary (Build-out Conditions)

HUC14 ID	HUC14 Sub-Watershed Name	Area (acres)	TP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)
02040301160010	Alquatka Branch	17.24	0	0	0
02040301160020	Mullica River (above Jackson Road)	3,573.05	2,579	26,055	289,147
02040301160030	Mullica River (Rt 206 to Jackson Road)	3,768.40	127	1,056	21,328
02040301160050	Hays Mill Creek (above Tremont Ave)	2,730.62	2,366	23,651	271,778
02040301160060	Sleeper Branch (Rt 206 to Tremont Ave)	6,206.30	1,248	11,181	195,157
02040301160080	Pump Branch (below 74d53m road)	295.92	42	319	9,583
02040301160090	Clark Branch (above/incl Price Branch)	2,878.78	1,185	9,654	247,422
02040301160100	Blue Anchor Brook	46.38	27	209	6,264
02040301160110	Albertson Brook / Gun Branch	2,486.36	539	4,144	124,320
02040301160120	Great Swamp Branch (above Rt 206)	192.17	203	1,560	46,809
02040301160140	Mullica River (39d40m30s to Rt 206)	565.83	2	14	406
02040301160150	Mullica R (Pleasant Mills to 39d40m30s)	403.30	1	4	113
	Total:	23,164.35	8,319	77,847	1,212,327

TP = Total phosphorous
TSS = Total nitrogen
TSS = Total suspended solids

Table 6: Land Use/Build-Out Calculation Summary

HUC14 ID	HUC14 Sub-Watershed Name	Total Area (acres)	Existing Imperv. Area (acres)	Build-Out Imperv. Area (acres)	Imperv Increase
02040301160010	Alquatka Branch	17.24	0.00	0.00	0.0%
02040301160020	Mullica River (above Jackson Road)	3,573.05	236.07	559.51	237.0%
02040301160030	Mullica River (Rt 206 to Jackson Road)	3,768.40	13.27	19.62	147.9%
02040301160050	Hays Mill Creek (above Tremont Ave)	2,730.62	287.74	450.81	156.7%
02040301160060	Sleeper Branch (Rt 206 to Tremont Ave)	6,206.30	94.63	200.88	212.3%
02040301160080	Pump Branch (below 74d53m road)	295.92	3.86	5.62	145.6%
02040301160090	Clark Branch (above/incl Price Branch)	2,878.78	36.80	158.61	431.0%
02040301160100	Blue Anchor Brook	46.38	0.28	4.12	1471.4%
02040301160110	Albertson Brook / Gun Branch	2,486.36	8.71	80.68	926.3%
02040301160120	Great Swamp Branch (above Rt 206)	192.17	0.58	31.09	5,360.3%
02040301160140	Mullica River (39d40m30s to Rt 206)	565.83	1.35	0.00	0.0%
02040301160150	Mullica R (Pleasant Mills to 39d40m30s)	403.30	0.38	0.00	0.0%
	Total:	23,164.35	683.67	1,510.94	221.0%

Imperv. = Impervious
Develop. = Developable

Ultimately land development under build-out conditions is projected to produce the following pollutant loadings throughout the entire municipality:

1. Entire Municipality (All Watersheds):

    a. ±8,319 lbs/year for total phosphorus.

    b. ±77,847 lbs/year for total nitrogen.

    c. ±1,212,327 lbs/year for total suspended solids.

In addition the impervious surface coverages throughout the municipality are expected to more than double under maximum build-out conditions. The coverage of existing impervious in 1995 was determined to be ±683.67 acres (or ±3% of the total area of the municipality), while the total impervious coverage under build-out conditions is projected to be ±2,195 acres (or ±8% of the total area of the municipality).

It should be noted that there may be some values within the table that report land areas or pollutant loadings as having zero values. In reality their values may be slightly greater than zero but are reported as zero due to numeric rounding of the value.

Conclusions:

Although the scope of the land use/build-out analysis was limited to total phosphorous, nitrogen and suspended solids, any significant increases to the stormwater pollutant loadings under full build-out land development conditions shall only cause further degradation of water quality within receiving waterbodies.

In addition with the amount of impervious surface coverage expected to more than double under build-out conditions, stormwater management strategies need to be established to reduce the potential for increased flood frequencies, volumes and soil erosion concerns that accompany dramatic increases in such impervious coverage. In general, impervious coverage percentages greater than 10 to 15% may be indicative of potential watershed impairment from stormwater and land development. Accordingly, since the total impervious coverage under build-out conditions is projected to be ±8% of the total area of the municipality, the Township should make all efforts to maintain (or even minimize) future amounts of impervious cover so as not to impair the watershed.

This analysis is the first step in understanding the impacts that future development will have on water quality and quantity. The Township should therefore be proactive in developing strategies to minimize, manage and/or mitigate these impacts through such mechanisms as additional stormwater management control techniques and possible changes to the land use zoning.

Included within this plan, and also in the New Jersey Stormwater Management Regulations and guidance documentation, are strategies to minimize, manage and/or mitigate build-out impacts through the use of improved stormwater management techniques and construction practices. In addition, modifications to current land use and zoning will change the build-out impacts and the municipality's GIS data can be used to evaluate the results of such changes.

I. Mitigation Plans:

General:

As presented within Section E of this plan, the required design and performance standards for stormwater management measures are identified for land use developments deemed to be major developments. However in some instances site specific conditions may prevent strict compliance with these standards.

In accordance with NJAC 7:8-4.2(c)11, there are provisions that grant Planning and Zoning Boards the ability to issue variances and/or exemptions from these standards in such cases where an Applicant can satisfactorily demonstrate that they are not able to comply with a given standard(s) at the site in question.

In such cases, the governing Board may grant a variance or exemption from strict compliance with these standards if a mitigation plan is approved by the Board and the implementation of such a plan is identified as a condition of the project's approval.

Therefore the purpose of this section of the plan is to outline the mitigation plan options that are available to developments that fall into this category.

Mitigation Project Criteria:

In order to select an appropriate mitigation project to respond to a requested waiver/exemption requires, an assessment of the impact that would result from the requested deviation from full compliance with the standard(s) in the drainage area affected by the proposed project is required.

For example, a waiver for stormwater quantity requirements must focus on the impacts of increased runoff on flooding, considering both quantity and location. Stormwater quality mitigation must aim to prevent an increase in pollutant load to the waterbodies that would be affected by the waiver/exemption. Ground water recharge mitigation must seek to maintain the base flow and aquifer recharge in the area that would be affected by the waiver/exemption.

For the purpose of this discussion, the term "sensitive receptor" is used to refer to a specific area or feature that would be sensitive to the impact assessed above.

Selection of an appropriate mitigation project for a requested waiver/exemption must adhere to the following requirements:

1. The project must be within the same Pinelands drainage area that would contribute to the receptor impacted by the project. Note that depending on the specific performance standard waived, the sensitive receptor and/or the contributory area to that receptor may be different. If there are no specific sensitive receptors that would be impacted as the result of the grant of the waiver/exemption, then the location of the mitigation project can be located anywhere within the municipality, and should be selected to provide the most benefit relative to an existing stormwater problem in the same category (quality, quantity or recharge).

2. Legal authorization must be obtained to construct the project at the location selected. This includes the maintenance and any access needs for the project in the future.

3. The project should be close to the location of the original project, and if possible, be located upstream at a similar distance from the identified sensitive receptor. This distance should not be based on actual location, but on a similar hydraulic distance to the sensitive receptor. For example, if the project for which a waiver is obtained discharges to a tributary, but the closest location discharges to the main branch, it may be more beneficial to identify a location discharging to the same tributary.

4. For ease of administration, if sensitive receptors are addressed, it is preferable to have one location that addresses any and all of the performance standards waived, rather than one location for each performance standard.

5. It must be demonstrated that implementation of the mitigation project will result in no adverse impacts to other properties.

6. Mitigation projects that address stormwater runoff quantity can provide storage for proposed increases in runoff volume, as opposed to a direct peak flow reduction.

Mitigation criteria consideration and specific plans are listed in the following two subsections. Mitigation projects must include a detailed plan and schedule defining the implementation of the mitigation project(s). A mitigation plan may include more than one mitigation project in order to achieve the objectives of location and/or impact offsets.

The Stormwater Coordinator will be responsible for developing and maintaining the list of mitigation projects that are acceptable to the municipality.

Mitigation Project Criteria Considerations:

1. Stormwater Quantity Considerations

   Increased stormwater runoff volume from new development can cause damages to property and habitat due to increased flood elevations and/or flood velocities. Mitigation project areas can include locations that will provide for additional storage and slower release of excess stormwater.

   Mitigation of stormwater quantity can be accomplished by increasing flood storage areas along the waterway, creating new best management practices (BMPs) to control previously uncontrolled runoff or by retrofitting existing stormwater structures to decrease the volume and peak of runoff.

   In areas adjacent to the stream, a hydrologic and hydraulic analysis can be performed to determine if increasing storage capacity would offset the additional volume of runoff and associated peak increase from sites upstream of the storage area. Increases in the storage capacity of an existing structure, such as upstream of a bridge or culvert, can also be considered provided that it is demonstrated that such an increase does not exacerbate flooding at other areas.

   Note that work in regulated areas, such as floodplains and wetlands must be performed in accordance with applicable regulations such as the Flood Hazard Area Control Act

Rules and the Freshwater Wetland Act Rules. Also, many areas of open space in New Jersey have received funding by the Department's Green Acres Program and many of those encumbered lands have restrictions placed on them as a result of that funding.

Any and all restrictions placed on these lands must be investigated by the municipality before these areas can be utilized for mitigation to ensure that there are no conflicts.

Some examples of areas or features sensitive to changes with regard to flooding include:

- Culverts and bridges - these features may constrict flow and cause flooding or may provide storage that, if lost, would cause downstream flooding problems.
- Property subject to flooding - areas of concern include those where there is historical evidence of recurrent problems, particularly if exacerbated over time because of increasing impervious surface in the contributing watershed.
- Eroding/widening stream banks or channels - particularly if due to changes in hydrology due to effects of development.
- Category One waters - flooding affects could alter habitat that was the basis for the designation.
- Wetlands - changes in hydrology can affect viability of wetlands, either by increasing or decreasing volumes and velocities of water discharging to the wetlands.

2. Stormwater Quality Considerations

Stormwater quality is regulated for the purpose of minimizing/preventing non-point source pollution from reaching the waterway. Mitigation for stormwater quality can be achieved either by directing the runoff from the water quality design storm into a natural area where it can be filtered and/or infiltrated into the ground, by constructing a new BMP to intercept previously untreated runoff or by retrofitting existing stormwater systems that previously did not provide sufficiently for water quality.

Existing forested and other vegetated non-wetland areas can also be used as a water quality mitigation area if runoff is discharged as sheet flow through the area in a non-erosive manner, and the vegetated area is restricted from future development. A discussion of the appropriate widths for these vegetative filters is provided in Chapter 9 of the New Jersey Stormwater Best Management Practices Manual (BMP Manual).

If a mitigation project cannot be identified that would compensate for a waiver related to water quality, and provided the project requiring a waiver would not result in a measurable change in water quality relative to TSS and nutrients, the mitigation project could be designed to address another parameter of concern in the watershed (as indicated by an impairment listing and/or an adopted TMDL) for which stormwater is a source, such as fecal coliform.

Some examples of areas or features sensitive to water quality changes include:

- Trout associated waters - chemical pollutants and temperature effects can diminish viability of populations.

- Lakes, ponds or other impoundments - these waterways are sensitive to addition of nutrients.
- Threatened and endangered species or their habitats - sensitive to both quality and quantity changes.
- Drinking water supplies - adverse affects on quality can increase the cost of treatment or threaten the use.
- Category One waters - an issue where quality was the basis of the designation waterways with a water quality or use impairment-deterioration of quality in an impaired waterway will increase the cost and challenge of restoration.

3. Ground Water Recharge Considerations

   Recharge is regulated to maintain the availability of ground water as a water supply source as well as to provide a stable source of baseflow in streams.

   There are two requirements associated with the recharge standard. The first is that 100 percent of the site's average annual pre-developed ground water recharge volume be maintained after development, and the second is that 100 percent of the difference between the site's pre- and post-development 2-year runoff volumes be infiltrated.

   To mitigate for groundwater recharge design requirements, either computational method can be utilized to determine the volume lost that needs to be provided by the mitigation project.

   One method to accomplish ground water recharge mitigation is to discharge runoff as sheet flow across a vegetated area to allow for the infiltration of runoff. It should be noted that, if this measure is used, calculating compliance with the recharge standard is limited to the 2-year storm standard, given existing methods.

   Some examples of areas or features sensitive to ground water recharge changes include:

   - Springs, seeps, wetlands, white cedar swamps - sensitive to changes in ground water level/hydrology.
   - Threatened and endangered species or their habitats - some are sensitive to changes in ambient ground water levels.
   - Streams with low base flow or passing flow requirements - would be particularly sensitive to changes in hydrology.
   - Aquifer recharge zones - loss of recharge in these areas can adversely affect ground water supply.
   - Category One waters - loss of base flow can affect many of the bases for designation.

Mitigation Projects:

The applicant can select one of the following projects listed to compensate for the deficit from the performance standards resulting from the proposed project. More detailed information on the projects can be obtained from the Township Engineer. Listed below are specific projects that can be used to address the mitigation requirement.

1. Projects:

   a. Groundwater Recharge:

      i) Sappling Run Stormwater Basin

      Sappling Run is a 50-lot residential subdivision with a stormwater basin that is dedicated to the Township and frequently experiences recharge problems.

      Solution:

      This basin requires studies to determine the reason for the lack of infiltration. After the cause of the basin malfunction is identified, measures should be taken to increase its recharge efficiency.

      ii) C. William Haines Boulevard Stormwater Basin

      There are several basins within the business corridor of C. William Haines Boulevard that frequently experience recharge problems. The basins currently only accommodate the discharge from the surrounding roadways, but there is considerable potential for additional development in this area.

      Solution:

      If the land discharging to the basins is further developed it will be necessary to conduct studies to determine ways to increase the basin's recharge efficiency in order to handle the increased runoff.

   b. Water Quality:

      i) Senior Citizens Center Parking Lot

      The Senior Citizens Center is situated along East Atlantic Avenue at its intersection with Harrison Avenue. The center's large parking lot generates a large amount of oils and silts from vehicles.

      Solution:

      This project and its stormwater management facilities were developed before the current stormwater management criteria were in effect. Therefore it is necessary to conduct studies to determine methods of retrofitting the existing stormwater management facility to minimize the pollutant and total suspended solids loadings that are generated by the parking lot runoff.

      ii) Assumption Church and School

      The parking lot and grounds of Assumption church/school are major contributors to the flooding problem at the intersection of Cooper Road and Carl Hasselhan Drive. Furthermore, the size of the parking lot generates a large amount of oil, grease and silt that flows into the intersection.

      Solution:

      There is currently a project in the process of being implemented to deal with the flooding issues of the intersection, the amount of total suspended solids that will flow into the proposed stormwater management facilities still needs to be addressed. Therefore it is necessary to conduct studies to determine methods

of retrofitting the existing stormwater management facility to minimize the pollutant and total suspended solids loadings that are generated by the parking lot runoff.

iii) C. William Haines Boulevard Stormwater Basin

There are several basins within the business corridor of C. William Haines Boulevard. that may have water quality issues. The large areas of impervious cover that discharge into these stormwater management facilities generate a large amount of oil, grease and silt.

Solution:

Because this project and its stormwater basin were developed before the current stormwater management criteria were in effect. Therefore it is necessary to conduct studies to determine methods of retrofitting the existing stormwater management facility to minimize the pollutant and total suspended solids loadings that are generated by the parking lot runoff.

c. Water Quantity:

i) Bellevue Avenue and Garden Avenue Intersection:

Due to a lack of a comprehensive stormwater management system in the area of the Bellevue Avenue and Garden Avenue intersection, frequent flooding is experienced at low points along the roadway.

Solution:

At a minimum, some type of infiltration system should be employed at the low points, incorporating permission from private property owners. The ultimate resolution would be a stormwater management design for the entire drainage corridor.

ii) Bartram/Auburn Avenue Alley:

The alleyway along Bartram and Auburn Avenues (between 3rd and 4th Avenues) floods frequently. The northern properties along the alley are higher than the southern properties causing runoff to flow onto the southern properties.

This area requires a remedy which will either intercept the runoff or increase the on-site recharge of the northern properties. This can be accomplished with swales and infiltration.

Solution:

Study the watershed in question and evaluate whether the runoff can be intercepted and re-directed away from the southern properties, or whether the runoff can be recharged onsite (via swales and infiltration trenches) near the northern properties. The resulting solution should then be implemented.

iii) Third and Camila Avenues Stream Corridor (tributary to the Mullica River):

The stream corridor between Third Avenue and Camila Avenue (which is a paper street) poses flooding concerns to existing houses built along the corridor.

Solution:

Study the watershed in question and evaluate how the stream channel cross-section can be reconfigured to mitigate the flooding concerns. The resulting solution should then be implemented.

iv) Camila Avenue Drainage Swales:

There are four houses constructed near the intersection of Camila and Gardens Avenues that have attempted to fill-in their drainage swales (replacing the swales with undersized drainage piping) in an attempt to increase their usable front yard areas. These pipes are inadequately sized and have become filled with sediment and debris, and contribute to the flooding concerns within the area.

Solution:

Study the watershed in question and evaluate whether larger pipes can correct the flooding issue or whether the swales need to be reinstituted. The resulting solution should then be implemented.

v) Lorkim Lane Cul-De-Sac (Hayes Mill Creek watershed):

The retention basin at this cul-de-sac is at a higher elevation than the two main roads providing access to this area. At the end of the cul-de-sac, one of the existing homes is constructed below the elevation of the roadway. There is no means of intercepting the cul-de-sac's stormwater before it travels down the resident's driveway and into their garage. Some type of intercepting inlet or swale between the problem property and the neighbor could potentially remedy the situation.

Solution:

Study the watershed in question and evaluate what can be done to mitigate the flooding issues. The resulting solution should then be implemented.

vi) Acorn Drive Drainage Swale (tributary to the Mullica River):

The Acorn Drive drainage swale is used to convey stormwater for approximately 100 homes. The swale experiences backups during excessive rain events which are attributable to a bottleneck at the downstream Oak Knoll Avenue culvert.

Solution:

Study the watershed in question and evaluate whether the Acorn Drive drainage swale and/or the Oak Knoll Avenue culvert can be modified to

mitigate the flooding issues. The resulting solution should then be implemented.

vii) Louden Avenue Drainage Area:

The drainage area along Louden Avenue (between Medford Road and Richards Avenue) is prone to flooding during excessive rain events.

Solution:

Study the watershed in question and design a comprehensive stormwater management system to mitigate the flooding issues. The resulting solution should then be implemented.

It should be noted that the Township does own property between Medford Road and Louden Avenue which potentially could be used to help alleviate the problem.

viii) Willow Way Infiltration Basin (Hayes Mill Creek watershed):

The Willow Way retention basin is municipally owned and in need of remediation. The basin never drains and may be constructed within the groundwater table.

Solution:

Study the watershed in question and evaluate whether the basin can be redesigned to help alleviate the permanent pool of water within the basin. The resulting solution should then be implemented.

2. If a suitable site cannot be located in the same drainage area as the proposed development (as discussed in above Option 1a), the mitigation project may provide mitigation that is not equivalent to the impacts for which the variance or exemption is sought, but that addresses the same issue.

   For example, if a variance is granted because the 80% TSS requirement is not being met, the selected project may address water quality impacts due to a fecal impairment.

The municipality may also allow a developer to provide funding or partial funding to the municipality for an environmental enhancement project that has been identified in a MSWMP. The funding agreement must be in a form that is acceptable to the municipality. In addition, the funding must be equivalent to the cost to implement the mitigation outline above, including costs associated with purchasing the property or easement for mitigation, and the cost associated with the long-term maintenance requirements of the mitigation measure for which an exception is granted. The municipality must expend any contributions collected within 5 years of their receipt.

J. Optional Measures:

The municipality is including the following BMPs as Optional Measures (OMs) to further prevent or reduce the pollution of the waters within the municipality. Since these measures are optional, it should be noted that since if they are not implemented, the municipality will not be considered to be in violation of the permit.

Wildlife Management:

1. Issue:

   The Canada goose (Branta canadensis) is probably the most commonly recognized bird in New Jersey, and with good reason. New Jersey currently has about 85,000 geese, which places us with the highest density of Canada geese in the United States (12 geese per square kilometer).

   However, this wasn't always the case. In 1967, one subspecies, the Aleutian Canada goose, was listed as endangered by the U.S. Fish and Wildlife Service. This was primarily due to the introduction of a non-native arctic fox species to their nesting island, which became predatory on the defenseless geese. This introduction led to a population decline to approximately 800 geese. The Canada goose population was declining so rapidly that state and federal biologists resorted to importing thousands of mating pairs of geese from the Midwest in the 1960's to ensure their survival in the Mid-Atlantic States. Under the cover of the 1916 Migratory Bird Treaty (which prohibited spring shooting, limited the shooting season, and put a quota system on bag limits) and the federal wildlife agency, the geese began to thrive.

   Today, Canada geese populations are broken down into two distinct groups: the migratory population and the resident population. Currently, the migratory population is below management objectives and thus is still strictly protected by the U.S. Fish and Wildlife Service and the 1916 Migratory Bird Treaty. The resident population, however, continues to grow at an alarming rate. If nothing is done to control the resident geese in the Atlantic flyway, their population is estimated to exceed 1.6 million by 2012.

2. Control Methods:

   This OM addresses the concerns raised by the ever increasing Canada goose population in New Jersey, and the impacts they have on our environment.

   Canada geese are grazers and their diet consists mainly of grasses and other green vegetation. They tend to be attracted to urban sites with short lawns, and they will almost always choose fertilized lawns over unfertilized lawns. For these reasons geese are often found congregating on golf courses, school grounds, playgrounds, sports fields and any other well-manicured lawn.

   Canada geese nest in the spring and their nesting sites are usually surrounded by (or are very close to) water. Water provides the geese with access to food, drink and an escape from predators. Nesting females also tend to use the same nesting site year after year, which makes it difficult to remove them once they breed in an area. In addition to this, once a year the geese begin a complete molt of their flight feathers. During this period

the geese will be unable to fly, thus making it necessary for them to be in areas near water with a close food source.

These characteristics of the Canada goose, in addition to their increasing populations, often conflict with human interests, necessitating some form of management. Depending on the severity of the problem, non-lethal or lethal methods may be chosen. The management control methods listed below are only recommendations and may be implemented as needed. However, using two or more of the following techniques will provide better results than relying on just one method.

a. Non-Lethal Control Measures:

i) Barriers:

Barriers can be effective in small areas where the geese tend to walk from their feeding source to the water. A low fence or other such barrier (e.g., high vegetation) that prevents the geese from easily moving from grassy areas to the water may be all that is needed to solve the problem. Fencing works best during their summer molt when the birds cannot fly into the water. The barriers can either be permanent or temporary.

ii) Overhead Wire Grids:

Overhead wire grids are typically made out of polypropylene lines and placed over a body of water, which is usually supported by fiberglass rod posts that are evenly spaced around the perimeter. The overhead wire grid prevents the geese from landing in the water by reducing the long take-off and landing zones needed by the Canada geese.

A two-strand perimeter fence should also surround the area to deny entry to the pond from the sides.

iii) Scare Decoys:

Scare decoys, such as the Dead Canadian Goose, will discourage geese from nesting or feeding near a body of water. This method is typically most effective where the problem area is small in size.

iv) Repellants:

Repellants are substances that can be sprayed on the lawn to deter the geese by making the grass taste bad to them. Biodegradable deterrents using human-safe food flavoring derived from grapes (methyl anthranilate) can be sprayed on an area and will last about 14 days per application.

Other deterrents contain an ultraviolet repellant to visually deter the birds. Before this method is used, however, local regulations must be checked to ensure use near ponds or wetlands.

v) Sound Deterrents:

Sound deterrents must be in place early in the season to be effective. Sound deterrents can be as simple as banging on ordinary pots and pans, or as

complex as pistol-launched pyrotechnics, firecrackers, or liquid propane gas cannons.

To be most effective the sound deterrents should go off under the birds as they come in to land. Sound deterrents are the best option for large-scale geese problems, but may not be suitable for residential or public areas. Additionally, a permit to discharge a firearm may be required.

vi) Visual Deterrents:

Visual deterrents include items such as balloons, streamers, flags and scarecrows. Large red, white, yellow, or mylar balloons have proven to be most effective. They should be filled with helium and tethered on a monofilament line to scare the geese.

To increase the balloons' effectiveness, large eyespots can be drawn upon them. Any visual deterrent used should be moved periodically to make sure that the geese don't become accustomed to them.

vii) Hazing:

Hazing the geese includes chasing the geese from any area where they are not welcome. People or livestock herding dogs that are trained to chase geese can be used to haze the geese, however special permits may be required to use dogs to haze geese. This can be an effective method of control in areas where noise and appearance are important considerations.

viii) Education:

Educating the public is a very important part of goose management. Many times people attract large number of geese to an area by feeding them. By feeding the geese, they are only encouraged to stay in the area. (Many people also don't realize that bread is not a nutritional food source for geese and can actually harm them).

In addition to educating the public about not feeding the geese, they should also be made aware of the ideal habitat of the Canada goose, and what they can do to make their property less attractive to the geese. Since geese typically like to live near ponds, access to these ponds should be limited.

In the springtime, the ponds can be fenced off or high vegetation can be allowed to grow around the pond. If the pond has an aerator, it should be turned off in the wintertime to allow the pond to freeze over. Also, old goose nests or goose nest platforms should be removed (no permit is required to remove these).

b. Lethal Control Measures:

i) Hunting:

The most effective, but controversial, method of population control of the Canada geese is to allow a hunting season for them. Several states, including New Jersey, currently have a hunting season for Canada geese. There are

presently three hunting seasons for Canada geese in New Jersey with bag limits ranging from two to five geese:

- The regular Canada goose season.
- September season.
- Winter season.

More information can be found on this topic by visiting the following websites:

- New Jersey Fish and Wildlife webpage (www.njfishandwildlife.com)
- NJDEP webpage (www.state.nj.us/dep/fgw)

ii) Egg Addling, Oiling, or Replacing:

One means of population control for the Canada goose is to ensure that they don't produce offspring. The easiest way to accomplish this is to alter their eggs so that they are no longer viable. There are several ways that this can be done, however it should be kept in mind that if a goose cannot find its egg or realizes that it has been tampered with, it will simply find a new nest and lay more eggs. In addition these methods can be very time consuming and dangerous. The nest must be watched for times when the geese are not nearby so that they do not see their eggs being tampered with. If the geese do see someone near their nest they may become aggressive.

Egg addling means that the eggs are shaken to mix up the contents, or a small hole is poked in the shell so that the inside can be stirred up. Both of these methods will destroy the egg, making sure it does not hatch.

Egg oiling involves rubbing a thin layer of oil on the outside of the entire shell. This prevents the egg from "breathing" and suffocates it.

Replacing the real eggs with wooden or other artificial eggs may also be effective. Remember, if the eggs are simply removed, the geese will just lay more. If the eggs are replaced with artificial eggs, the geese will continue to incubate them as if they were real.

Although the resident population of the Canada goose continues to grow at an alarming rate (and continue to claim more and more recreational areas as their own) the major complaint is not attributed to what they take from these areas, but rather what they leave behind. The average Canada goose produces two to four pounds of droppings a day. These droppings can contain salmonella bacteria that persist (in wet droppings) for up to one month.

Substances that are derived from goose droppings can cause water quality problems, including noxious algal blooms, beach closings, and the spread of fowl related diseases.

When geese droppings are allowed to enter the water the nutrient level increases. This can lead to excessive plant and algal growth, which is directly related to a loss of habitat and wildlife including fish kills and eutrophication.

Eutrophication can permanently change the character of a lake by increasing the organic content, eventually converting it into marsh and land areas.

Many beach closings have also been attributed to geese. When an excessive number of geese congregate near a beach or waterway, their fecal matter can sometimes overload the normal capacity of a beach to absorb natural wastes, thus degrading the water quality and requiring the area to close to the public.

Finally, geese can be responsible for the spread of some fowl related diseases. Among these are viral, bacterial and parasitic diseases, to which only waterfowl are susceptible.

The costs associated with implementing this optional measure can be highly variable, depending on the method(s) chosen and the frequency they must be repeated. Additionally, some of the options are more time consuming or require special permits which may add to the pre-existing cost of the actual control measure.

While it is difficult to quantify the benefits an area will receive through managing goose populations, it is reasonable to assume that any reduction in their population will have a positive effect on the environment. The amount of benefits received will depend on the severity of the problem in the first place, the method(s) chosen to control the goose populations and how frequently the control methods are repeated.

More information can be found on this topic by visiting the following websites:

- www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf
- www.fw.umn.edu/research/goose/html/default.html
- www.wildlifedamagecontrol.com/canadageese.htm
- www.pacd.org/resources/lake_notes/geese02.htm
- www.ai.org/dnr/fishwild/goose.htm
- www.birdcontrolsupplies.com/bobbexg.htm
- www.dnr.state.mi.us/wildlife/pubs/gooseconflictcontrol.asp
- www.wnrmag.com/stories/1998/dec98/geese.htm

Retrofit of Existing Stormwater Management Measures:

For more information on this topic please see Chapter 8 of the New Jersey Stormwater Best Management Practices Manual.

More information can be found on this topic by visiting the following website:

- www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Road De-icing:

Road de-icing is a common practice during and after winter storms. Essentially it consists of applying salt (NaCl), or other types of de-icing materials, to lower the freezing temperature of the precipitation. Lowering the freezing temperature of the snow and ice causes it to melt quicker, and allows motorists to travel roadways safely. Excessive use of de-icers can be environmentally detrimental due to increasing sediment loads and soluble materials entering surface and ground water. The excessive use of de-icers may adversely affect roadside vegetation, pollute waterways and/or groundwater, as well as adversely affect aquatic life or cause corrosion.

However, the use of road salt is a public safety issue as well as a water quality issue. The short term need for clear, safe winter roadways outweighs the environmental impacts. None of the recommendations here are to be construed as advocating the reduction of de-icing efforts to the point of jeopardizing public safety. Rather, most are simple techniques that can be easily integrated into existing de-icing practices that can reduce the impact on surface and ground water quality.

Road salts were identified in the early 1970's as a pollutant source after high levels of sodium, calcium and chloride were found in public water supply wells. Aside from contaminating potable surface and ground water, high levels of sodium chloride can kill roadside vegetation, impair aquatic ecosystems and corrode infrastructure such as bridges, roads and stormwater management devices.

Application of typical de-icers and alternative de-icers should be considered when formulating a deicing policy. New, safer alternatives are being developed that may lesson our dependence on traditional de-icers. Alternative de-icing materials and techniques should be considered whenever possible.

1. Application of De-icing Materials:

   In general, the DEP promotes the smart use of salt and other de-icing materials. This concept encourages municipalities, commercial facilities and others to consider a wide range of options when formulating a management policy on the application of de-icing materials.

   These de-icing policies should take into consideration storm characteristics, roadway conditions, road characteristics, the type and availability of equipment, and availability and need of alternative de-icing materials (other than NaCl). Reduced application rates and alternative de-icing practices should be incorporated in environmentally sensitive areas, areas that drain to surface drinking water sources (reservoirs), and groundwater recharge areas (e.g., ground water supply wells, and wellhead protection areas). Reduced application rates may also be considered on secondary roads or on other roads rarely traveled (traffic density).

   One of the most effective means in preventing over-application is the use of calibrated spreaders, which ensure delivering de-icing materials at the predetermined optimal application rate. Automated controls on spreaders are recommended to ensure a consistent and correct application. The spreader should be calibrated prior to a snow storm event and periodically during the snow season, regardless of whether or not automatic or manual controls are used.

A regular schedule of maintenance for snow removing equipment (including salt spreaders) should be incorporated into a snow management policy. Poor maintenance of the snow removal equipment is often responsible for excessive salt use. Guidelines for the calibration of spreaders and determination of application rates are given in the EPA document Manual for De-icing Chemicals: Application Practices.

Salting is recommended for snowfalls of less than two inches and for road surfaces with packed snow already on the road surfaces. A management policy of salting of roadways should consider factors such as length and duration of the snowfall and initial conditions of the roadway which will be salted. The salting of road surfaces after the snow has accumulated will only result in the applied rock salt being removed with the snow when plowed.

2. De-icing Materials and Alternative De-icing Materials:

In most instances winter de-icing materials consist of rock salt (NaCl) or a combination of rock salt and sand. The effectiveness of this mixture is significantly reduced at temperatures below 25º F. As a result, it is not practical to increase the amount of rock salt when spreading below 25º F. At temperatures lower than 25º F, rock salt can be applied with calcium chloride (CaCl), which increases the effectiveness of the deicer at temperatures down to -25º F.

Various mixtures of sodium chloride, calcium chloride and sand can be used depending on the sensitivity of the area. The State of Connecticut recommends a 7:2 sand pre-mix be used in sensitive areas. Pre-mix is 3.5 parts sodium chloride and 1 part calcium chloride by weight. Use of higher ratios of calcium salts is recommended environmentally since calcium poses fewer problems than sodium.

New de-icing materials are periodically developed which are more environmentally friendly and can be used in sensitive areas or as an alternative to traditional de-icers. In some instances, the costs of these new materials are prohibitive on a large-scale basis but they could be used in smaller target areas.

One of the best alternatives to de-icing materials is sand. Sand has no de-icing properties but when used as a mix with rock salt, can be helpful in areas where increased traction is needed and where a reduction of rock salt is desired. Ash and cinders are another low tech alternative to calcium chloride. While using sand, gravel, ash and cinders reduce the amount of sodium, they have their own environmental problems, specifically, causing sedimentation and increasing suspended solids in receiving waters.

NOTE: The NJDEP does not promote the use of any specific product discussed below.

a. Calcium Chloride: Has a lower freezing point than rock salt. Absorbs moisture readily and stays on the pavement longer than rock salt. Used in "wetting" of roadways prior to snowfall.

b. Calcium Magnesium Acetate: Less effective, better environmentally.

c. Magnesium Chloride: Basically as effective as calcium chloride in adhering to the road surface and has comparable freezing temperature.

d. Potassium Acetate: Does not have the chloride residual problems associated with other de-icers. Does not cause corrosion and has a low environmental impact.

e. Potassium Chloride: Is similar in performance and cost to calcium chloride and magnesium chloride. Has a similar chloride residual problem.

f. Urea: Less corrosive than rock salt and has little to no effect on roadside vegetation.

2. Reduction of the Application of De-icing Materials:

Remote sensors along roadways can be used to determine which parts of roadways have ice on them. Some sensors can detect ice as thin as 0.005 inches. Using this technology will enable the effective delivery of de-icing material to sections of roadway that need it most rather than spreading on the entire roadway.

The state of Vermont has used a strategy that employs an application curve for efficient salting. Application rates vary with temperature. The study "Smart Salting: A Winter Maintenance Strategy" is available from the Vermont Agency of Transportation.

Structural controls are another way to reduce over-application of de-icing materials. Snow fences are used to keep snow from being blown into drifts. Studies show that fences minimize costs associated with snow clearing, reduce the formation of compacted snow, and reduce the need for chemicals. Mechanical snow removal costs approximately 100 times more than trapping snow with fences.

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