JERSEY CITY
STORMWATER MANAGEMENT PLAN

Prepared for:

Jersey City

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1.0 INTRODUCTION

This document presents the Stormwater Management Plan (SWMP) for the City of Jersey City (the City). The SWMP is required by the N.J.A.C 7:14A-25 Municipal Stormwater Regulations and has been created in accordance with N.J.A.C. 7:8, Stormwater Management Rules. The SWMP addresses groundwater recharge, stormwater quantity, and stormwater quality by implementing the General Permit requirements referred to as the statewide basic requirements (SBRs).

The goals of the Stormwater Management Rules N.J.A.C. 7:8-2.2 are stated below and incorporated into this SWMP. The Stormwater Management Rules are directed toward "new development" and provide the foundation to develop municipal stormwater management plans. New development is defined as any development that disturbs more than one acre of land or adds ¼ of an acre of impervious cover. The City must prepare and implement a Stormwater Pollution Prevention Plan (SPPP) that requires the preparation and adoption of a municipal stormwater management plan along with a stormwater control ordinance, and the incorporation of a local public education program. The SPPP also addresses the improper disposal of waste, illicit connection elimination and MS4 outfall pipe mapping, implementation of solids and floatable controls, proper maintenance yard operation and employee training. The City's SPPP planning forms are attached in Appendix B.

1.1 STORMWATER MANAGEMENT PLAN GOALS

The SWMP is a course of action for the City to reduce nonpoint sources of water pollution by developing a comprehensive and dynamic stormwater management plan. The City's SWMP is a series of strategies, designed in accordance with governmental agencies and laws, intended to reduce the amount of stormwater pollutants which enter local waterways. The goals of the City and SWMP, along with "How" they will be met, are as follows:

- Reduce Flood Damage: this goal is met by implementing the measures addressed in Section 4 through either non-structural or structural Best Management Practices (i.e. stormwater management measures) for achieving stormwater runoff quantity control.

- Minimize stormwater runoff from new developments: this goal is met by implementing the measures addressed in Section 4 through either non-structural or structural Best Management Practices (i.e. stormwater management measures) for achieving stormwater runoff quantity control.

- Reduce soil erosion from any developments or construction projects: this goal is met by requiring implementation of stormwater management measures described in Section 4.2 and 4.4 such that they satisfy the requirements of the Soil Erosion and Sediment Control Act, N.J.S.A 4:24-39 et seq. and implementing rules.

- Assure adequately designed culverts, bridges, and other in-stream structures: this goal is met by adhering to the design and performance standards for Structural Best Management Practices presented in Section 4.4 of the SWMP.

- Maintain groundwater recharge: this goal is met by implementing the measures addressed in Section 4 through either non-structural or structural Best Management Practices (i.e. stormwater management measures) for meeting groundwater recharge requirements.

- Preventing increases of Non Point Source (NPS) pollution: this goal is met by addressing the goal related to minimizing stormwater runoff pollutants described in Chapters 3 and 4.

- Maintain the biological integrity of streams and drainage channels: this goal is met by selecting the BMP's that are allocated a 'high' to 'medium' rating in Table 4.2: BMP's Applicable to Various Land Uses, Stormwater Management Goals, and Other Factors for meeting the groundwater recharge enhancement and runoff quality improvement goals.

- Minimizing stormwater runoff pollutants from new and existing developments: this goal is met by implementing the measures addressed in Section 4.2 through either non-structural or structural Best Management Practices (i.e. stormwater management measures) for achieving stormwater runoff quality control.

- Protecting public safety through proper design and operation of stormwater management facilities: this goal is met by requiring adherence to the design and performance standards discussed in Section 4.2 and requiring adoption of comprehensive safety measures, described in Section 3.3.3 and an operation and maintenance plan that meets the requirements described in Section 3.3.2.

To achieve these goals, this SWMP outlines specific stormwater design and performance standards for new development and preventive maintenance strategies to ensure the effectiveness of the stormwater management facilities. Safety standards for the stormwater infrastructure will be implemented to protect public safety.

1.2 STORMWATER DISCUSSION

Stormwater pollution is generated when rain or wash water runs over impervious surfaces such as pavement and building rooftops, and accumulates pollutants such as oil and grease, chemicals, nutrients, metals, and bacteria as it travels across land. Then the stormwater and pollutants enter the storm drain system and are disposed directly into our waterways. Pollutants include metals, suspended solids, hydrocarbons, pathogens and nutrients. Currently, stormwater is not generally pretreated prior to discharge.

The hydrologic cycle consists of inflows, outflows, and storage. Prior to urban development, stormwater was filtered through the land surface to the aquifer, or returned to the atmosphere through evapotranspiration or discharged from an aquifer to a stream as shown in the Figure 1-1. The percolation of water into the ground is an inflow to the aquifer. If the inflows to the aquifer are less than the outflows, the amount of water stored in the aquifer decreases. Increased urban development has increased impervious surfaces resulting in decreased groundwater recharge and has increased the volume and rate of stormwater runoff. The increased flow into waterways causes flooding, erosion, habitat destruction, decreased water quality, and reduced groundwater recharge.

2.0 BACKGROUND

2.1 MUNICIPAL INFORMATION

The City is 21.23 square miles (9,473 acres of land and 4,116 acres of water) located in Hudson County (Figure 2-1). Its geographic boundaries consists of the Hudson River to the East and the Hackensack River to the West, Newark Bay borders the southwest and the Upper Bay borders the southeast and Penhorn Creek runs along the northwest border. Political boundaries include Union City and Hoboken to the North, Hudson River and New York City make up the western border, Bayonne borders the South and Kearny and Secaucus are located to the East of the City. Two national monuments, Ellis Island and the Statue of Liberty located in the Hudson River, are also within the borders of the City but are not owned by the City.

The City's stormwater system discharges untreated stormwater into the bordering waterways. Figure 2-2 shows the Jersey City storm drain system. The City also has a combined wastewater and stormwater drainage system which services an area of 6,190 acres, as shown on Figure 2-2. The combined sewer area covers approximately 63% of the City's wastewater and stormwater drainage. The combined sewer areas are regulated by a separate permit for combined sewer overflow (CSO) since the CSOs are recognized as a point source pollutant. There are two CSO drainage areas in the City which are identified as Jersey City East Drainage Area and Jersey City West Drainage Area. The boundary between the two drainage areas consists of a ridge line running from north to south dividing the City's gravity sewer flows to the East and West pumping stations. The East drainage area is approximately 3,718 acres and flows to the City's East Pumping Station. The West drainage area is approximately 2,472 acres and flows to the City's West Pumping Station. The two drainage areas are further divided into eleven subdrainage areas on the west side and sixteen subdrainage areas on the east side. Although the CSO facilities are regulated under a separate permit, the CSO drainage areas are included in the SWMP for completeness since they discharge untreated stormwater, including wastewater, to the waterways.

2.1.1 Watershed Areas, Subwatershed Areas, Wetlands and Waterways

The City is located within two Watershed Management Areas (WMAs) identified as WMA07 and WMA05, which consists of the Arthur Kill watershed, and the Hackensack, Hudson, and

Pascack River watershed, respectively. The WMAs are made up of subwatersheds which are defined in the "HUC System," which is the national hydrologic unit code (HUC) system used by the United States Geological Survey. The NJDEP also utilizes the HUC system as a way to identify individual subwatershed areas. This plan examines the subwatersheds defined by 14-digit Hydrologic Unit Codes (HUC14). The HUC14s within the City are listed below. Table 2-1 lists the HUC 14 subwatershed areas. Figure 2-3 shows the HUC14 subwatershed areas within the City.

Table 2-1:
Subwatersheds (HUC14) in the City of Jersey City

Subwatershed	HUC14	WMA	SWMP Report Id
Hudson River	02030101170010	05	Hudson River
Hackensack River (below Amtrak Bridge)	02030103180100	05	Hackensack River
Newark Bay / Kill Van Kull	02030104010020	07	Newark Bay
Upper NY Bay / Kill Van Kull	02030104010030	07	Upper NY Bay

State and Federal wetland areas identified within the City consist of disturbed and managed wetlands, herbaceous wetlands, and saline marshes which are shown on Figure 2-4. There are 416 acres of state wetlands identified within the City and 392 acres of Federal wetlands. "Freshwater wetland" or "wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation; provided, however, that the Department, in designating a wetland, shall use the three-parameter approach (that is, hydrology, soils and vegetation) enumerated in the 1989 Federal Manual as defined in this section. These include tidally influenced wetlands which have not been included on a promulgated map pursuant to the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq. The wetland areas are protected by Freshwater Wetlands Protection Act Rules N.J.A.C. 7:7A.

The establishment of Total Maximum Daily Load (TMDLs) represents the assimilative or carrying capacity of a receiving water taking into consideration, point and nonpoint sources of pollution, natural background, and surface water withdrawals. Waste Load Allocations (WLA) are developed to identify contributors and the allowable quantities of pollutants that can be discharged to surface water without exceeding the waterbody's TMDL. Each WLA is intended to prevent adverse surface water quality impacts by setting load reduction goals for specific pollutants.

The DEP has designated a special level of protection for a number of waterways in New Jersey. This protection is known as Category One (C1). Category One waters typically provides drinking water, habitat for Endangered and Threatened species, and popular recreational and/or commercial species, such as trout or shellfish. The Surface Water Quality Standards (N.J.A.C. 7:9B) define Category One waters as follows:

> "Category one waters" means those waters designated in the tables in N.J.A.C. 7:9B-1.15(c) through (h), for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s). These waters may include, but are not limited to:
>
> 1. Waters originating wholly within Federal, interstate, State, county, or municipal parks, forests, fish and wildlife lands, and other special holdings that have not been designated as FW1 at N.J.A.C. 7:9B-1.15(h) Table 6;
>
> 2. Waters classified at N.J.A.C. 7:9B-1.15(c) through (g) as FW2 trout production waters and their tributaries;
>
> 3. Surface waters classified in this subchapter as FW2 trout maintenance or FW2
>
> 4. Nontrout that are upstream of waters classified in this subchapter as FW2 trout production;
>
> 5. Shellfish waters of exceptional resource value; or
>
> 6. Other waters and their tributaries that flow through, or border, Federal, State, county, or municipal parks, forests, fish and wildlife lands, and other special holdings.

According to rules for C1 waterbodies, a 300 ft. buffer is mandatory to prevent degradation to water quality. A buffer is also required on certain tributaries to C1 classified waterbodies. No waterbodies in the City of Jersey City have been designated as C1 Waterbodies.

The following waterways have been identified in the City and are shown on Figure 2-5.

- The Hackensack River (HUC14 id 02030103180100) is 32 miles long, and rises in Rockland County, New York and flows south through the Meadowlands to Newark Bay. The lower Hackensack is heavily industrialized and economically tied to the ports on Newark Bay and to the industrial development on the nearby Passaic River. The river's upper course is dammed to form three reservoirs that supply water to Rockland County, New York and Bergen counties in New Jersey. The River makes up the western border of the City. The Hackensack River is a C1 waterbody from the New York/New Jersey border to Oradell Dam, located north of Jersey City. C1 restrictions do not apply to the reach of the Hackensack River located in Jersey City. A TMDL for Nickel (Ni) has been established by the Environmental Protection Agency (EPA). The TMDL for Nickel is discussed on page 5-2.

- Penhourn Creek (HUC14 id 02030103180100) is a tributary to the Hackensack River. The Creek, is a narrow, shallow non-navigable ditch, which collects stormwater from a small drainage area.

- Hudson River – (HUC 14 id 02030101170010) The Hudson River is a tidal river which flows south to New York Bay.

- Upper New York Bay - (HUC 14 id 02030104010030) New York Bay is divided into an Upper Bay and Lower Bay which are connected by the Narrows and fed by the Hudson River. Ellis Island, The Statue of Liberty, and Governors Island are located within the Upper New York Bay. The Upper New York Bay borders Jersey City. New York Bay serves regional and national shipping.

- Newark Bay – (HUC 14 id 02030104010020) is located at the mouth of the Hackensack and Passaic Rivers. Newark Bay serves regional and national shipping. The Bay drains through the Kill Van Kull and Arthur Kill. This highly industrialized bay is contaminated, especially with dioxin. It is spanned by the Newark Bay Bridge connecting Jersey City and Newark.

2.1.2 Population

The image of the City is more reflective of the City of New York located across the Hudson River. The population of the City is approximately 240,055 (Census 2000) within a land area of 14.9 square miles. Table 2-2 contains population and housing unit data.

Table 2-2:
Housing Units and Population in Jersey City

Year	Housing Units	Population	Percent Growth
1980*	87,999	223,532	
1990*	90,723	228,537	2.2%
2000*	93,648	240,055	5%
2010 (projected)**	Not Available	265,610	10.6%
2020 (projected)**	Not Available	296,340	11.6%

* United States Census
** North Jersey Transportation Planning Authority

2.1.3 Groundwater Recharge Areas

Groundwater recharge (GWR) is defined by the NJDEP as the water that infiltrates the ground and reaches the water table regardless of the underlying geology. GWR supports aquifer recharge, stream baseflow and wetlands. The GWR for the City was not calculated by the NJDEP and NJGS Report GSR-32. The City is an urbanized area with significant amounts of impervious surface that has relatively little groundwater recharge capability regardless of underlying soils. Approximately 55 percent of the City's surface area is impervious (0.00 inches/year).

According to the Rules, a "major development" project, which is one that disturbs at least 1 acre of land or creates at least 0.25 acres of new or additional impervious surface, must include nonstructural and/or structural stormwater management measures that prevent the loss of groundwater recharge at the project site. Urban redevelopment and certain linear development projects are exempt from the groundwater recharge requirements. The Stormwater Management Rules require that a proposed major land development comply with one of the following two groundwater recharge requirements:

- Requirement 1: That 100 percent of the site's average annual pre-developed groundwater recharge volume be maintained after development; or

- Requirement 2: That 100 percent of the difference between the site's pre- and post-development 2-Year runoff volumes be infiltrated.

While the Stormwater Management Rules require groundwater recharge, in Jersey City they are not emphasized for the following reasons:

- There are no public ground water well supplies in Jersey City and surrounding cities
- There is a risk of groundwater contamination due to leaching from Chromium contaminated soils locate in Jersey City.

2.1.4 Wellhead Protection Areas

A Wellhead Protection Area (WHPA) is a map area calculated around a Public Community Water Supply (PCWS) and Non Public Community Water Supply (NPCWS) wells that delineates the horizontal extent of groundwater captured by a well pumping at a specific rate over a 2 (Tier 1), 5 (Tier 2), and 12 (Tier 3) year period of time. The WHPA delineations were conducted in response to the Safe Drinking Water Act Amendments of 1986 and 1996 as part of the Source Water Area Protection Program (SWAP). The delineation depicts the time of travel that a groundwater contaminant could be expected to reach a PCWS or NPCWS. There are no PCWS, NPCWS or WHPA located within the City.

2.1.5 Flood Sensitive Areas

Figure 2-2 shows a number of known flood sensitive areas that are within the boundaries of dark lined ellipses shown on this map. These known flood sensitive areas have been identified by the JCMUA Chief Engineer as being areas that flood more frequently than other locations in Jersey City. All of these areas are within the combined sewer system subdrainage areas and not within stormsewer subdrainage areas. Jersey City's sewer system is very sensitive to storm events, and storms of almost any intensity will cause flooding somewhere in the City. The addition of more than 0.25 acres of impervious cover must be accompanied by additional detention in both the stormwater and CSO areas of the City.

2.2 EXISTING STORMWATER MANAGEMENT SYSTEM

The City has completed the Stormwater Pollution Prevention Plan Forms which are attached in Appendix B. The SPPP outlines how the City will prevent stormwater pollution from new and existing land areas.

2.3 LAND USE / BUILD-OUT ANALYSIS

Land use effects groundwater and surface water quantity and quality. Pervious surfaces such as forested and wetland areas benefit water quality by absorbing water and filter out pollutants. Stormwater runoff increases over impervious surfaces and causes erosion and flooding. The following table shows the land use classifications for the City:

Table 2-3:
Land Use Classifications and Percent Impervious Surface Area

Land Use / Landcover	Total Acres	% Impervious
High/ Medium Residential	2856.20	64%
Commercial	1316.58	89%
Industrial	1539.71	86%
Mixed Urban	2474.89	34%
Forest, Wetlands	1139.00	1%
Barren Land	145.66	8%

Figure 2-6 shows the relative distribution of the various land uses in the city. A detailed land use analysis was conducted within each subwatershed area of the City. The subwatershed areas are defined in Section 2.1.1 and illustrated in Figure 2-3. The land use coverage in the

City is based on the 1995/1997 land use / land cover (LU/LC) geographic information system (GIS) dataset from the NJDEP and shown on Figure 2-7.

The full build out analysis was conducted by subwatershed within the municipality. The full build out analysis presents the maximum acreage of land area available for development or redevelopment. The constrained and non-constrained areas are shown on Figure 2-8. Constrained areas include wetlands, water, and the meadowlands. To complete the full build out analysis the following information was determined:

- The City was divided into subwatersheds (HUC14).
- The total land area of each subwatershed within the City was determined.
- The LU/LC within each subwatershed area was calculated in acres.
- The total area of constrained lands within each subwatershed was calculated in acres.
- Constrained lands consist of wetlands and waterways.

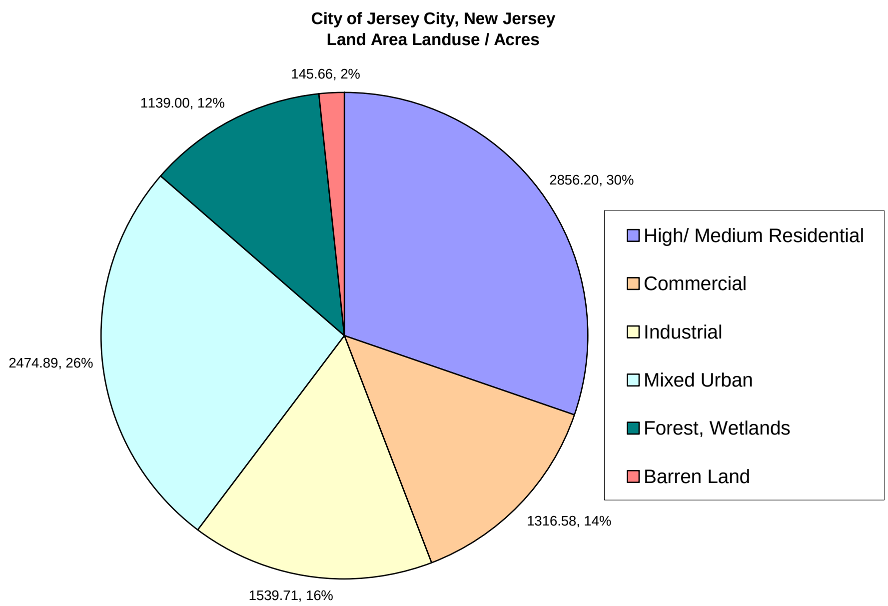

Figure 2-6: Distribution of Land Use / Land Cover

The City has no agricultural or low density housing areas. Fifty six percent of the City is high density land use typical of an urban city. According to the land use distribution within the city a full build out analysis was not required because there is less than 640 acres (1 square mile) of vacant, developable land. However, due to the variable rate of redevelopment in the City, a build out and analysis has also been included.

2.4 POLLUTANT LOADING SUMMARY

Table 2-4 shows Area Pollutant Loading Factors which were taken from the New Jersey Stormwater Best Management Practices Manual, as well as from current literature on those values not available from NJDEP. The land use for each subwatershed was taken from the 1995/97 LULC NJDEP GIS layer.

Table 2-4:
Nonpoint Source Analysis: Area Pollutant Loading Factor per Land Use in lbs./Acre/Year.

LU/LC	TP	TN	TSS	NH3-N	LEAD	ZINC	COPPER	CADMIUM	BOD	COD	NO2+NO3	Ni
High/ Medium Residential	1.4	15	140	0.65	0.2965	0.335	0.453	ns	25.6	152.6	1.7	0.0286
Low/Rural Residential	0.6	5	100	0.02	0.217	0.172	0.19	ns	ns	ns	0.1	0.0286
Commercial	2.1	22	200	1.9	0.955	0.873	0.784	0.002	42.1	662.6	3.1	0.0286
Industrial	1.5	16	200	0.2	1.409	1.598	0.93	0.003	31.4	ns	1.3	0.0286
Mixed Urban	1	10	120	1.75	3.215	1.743	1.529	0.0025	67.2	184.8	3.55	0.0286
Agriculture	1.3	10	300	ns	0.071	0.089	0.027	ns	15.45	ns	ns	0.0286
Forest, Water, Wetlands	0.1	3	40	ns	0.009	0.018	0.027	ns	9.2	2	0.3	0.0286
Barren Land	0.5	5	60	ns	ns	0.002	ns	ns	3.1	ns	ns	0.0286

Annual non point source (NPS) loads for each subwatershed were calculated using the following loading equation: *Load = Loading Coefficients x Area*

The loading coefficients per land use are in pounds per acre per year (lbs/acre/yr). The loading equation provides an approximation for annual NPS loads on a subwatershed basis per land use. This allows for the comparison of loading between subwatershed areas and provides a method to prioritize areas for restoration and/or preservation.

The stormwater management measures used to reduce the average annual TSS and nutrient loads can be non-structural and/or structural. To achieve the reduction requirements, they must be designed to treat the stormwater runoff generated by various design storms variable rate rainfall event. Nonstructural and structural stormwater management measures, also known as Best Management Practices (BMPs), are presented in Chapter 3.0 and 4.0.

The Full-Buildout Analysis and Annual Pollutant Loads at Full Buildout are shown on Tables 2-5 and 2-6, respectively.

2.5 The Water Quality and Health of the Waterbodies in Jersey City

The Water Quality of the Waterbodies in Jersey City is addressed in the 2006 Integrated Water Quality Monitoring and Assessment Report (Report) issued by the NJDEP. The Report shows that all four HUC 14 subwatersheds of which the City is a part contain impaired waterbodies. The Report defines an impaired waterbody as one that does not attain one or more of the surface water quality standards despite the implementation of technology based effluent limits. Water quality data used to determine impairment comes from a number of sources (outlined in Appendix F of the Report) including Ambient Biomonitoring Network (AMNET). There are no AMNET monitoring sites in Jersey City or Hudson County. Impairments are listed in Table 2-7 and should be taken into account during the implementation of future stormwater BMPs. It should be noted that Penhorn Creek is located in the Hackensack River (below Amtrak bridge) assessment unit, which is not immediately obvious from the assessment unit's name.

Table 2-7: Jersey City's Impaired Subwatersheds

Watershed Management Area	Assessment Unit ID	Assessment Unit Name	Pollutant of Concern	Ranking
5	02030103180100-01	Hackensack R (below Amtrak bridge)	Dioxin	Moderate
5	02030103180100-01	Hackensack R (below Amtrak bridge)	Dissolved Oxygen	Moderate
5	02030103180100-01	Hackensack R (below Amtrak bridge)	Mercury	Moderate
5	02030103180100-01	Hackensack R (below Amtrak bridge)	PCBs	Moderate
5	02030103180100-01	Hackensack R (below Amtrak bridge)	pH	Moderate
5	02030103180100-01	Hackensack R (below Amtrak bridge)	Turbidity	Low
5	02030101170010-01	Hudson River	PCBs	Moderate
5	02030101170010-01	Hudson River	Dioxin	Moderate
5	02030101170010-01	Hudson River	Pollutant Unknown	Low
7	02030104010020-02	Newark Bay / Kill Van Kull (74d 07m 30s)	Dioxin	Moderate
7	02030104010020-02	Newark Bay / Kill Van Kull (74d 07m 30s)	PAHs	Moderate
7	02030104010020-02	Newark Bay / Kill Van Kull (74d 07m 30s)	PCBs	Moderate
7	02030104010020-02	Newark Bay / Kill Van Kull (74d 07m 30s)	Pesticides	Moderate
7	02030104010030-02	Upper NY Bay / Kill Van Kull (74d07m30s)	Dioxin	Moderate
7	02030104010030-02	Upper NY Bay / Kill Van Kull (74d07m30s)	PAHs	Moderate
7	02030104010030-02	Upper NY Bay / Kill Van Kull (74d07m30s)	PCBs	Moderate
7	02030104010030-02	Upper NY Bay / Kill Van Kull (74d07m30s)	Pesticides	Moderate

The Report also shows that each of the assessment units is on one or more sublists. Assessment units are placed on sublists based on the degree of attainment of a specified use, the amount of data available for determining attainment, and the cause or source of non-attainment. Table 2-8 presents the sublist designations for uses designated in the Report for each assessment unit.

Table 2-8: 2006 Integrated List Sublist Designations for Assessment Units of which Jersey City is Part

Table WMA	Assessment Unit ID	Assessment Unit Name	Aquatic Life (General) Sublist No.	Primary Contact Recreation Sublist No.	Secondary Contact Recreation Sublist No.	Drinking Water Supply Sublist No.	Agricultural /Industrial Water Supply Sublist No.	Shellfish Harvest	Fish Consumption
5	02030101170010-01	Hudson River	5	3	3	N/A	N/A	N/A	3
5	02030103180100-01	Hackensack River (below Amtrak bridge)	5	3	3	3	3/2	N/A	5
7	02030104010020-02	Newark Bay / Kill Van Kull (74d 07m 30s)	5	N/A	3	N/A	N/A	N/A	5
7	02030104010030-02	Upper NY Bay / Kill Van Kull (74d07m30s	5	N/A	3	N/A	N/A	N/A	5

Notes:
Sublist 2 - The designated use is assessed and attained but one or more designated uses in the assessment unit are not attained and/or there is insufficient information to make a determination.
Sublist 3 - Insufficient data is available to determine if the designated use is attained.
Sublist 5 - The designated use is not attained or is threatened by a pollutant(s) and a TMDL is required.
N/A indicates that the designated use does not apply to an assessment unit.

3.0 DESIGN AND PERFORMANCE STANDARDS

3.1 GENERAL DISCUSSION

The City has adopted the design and performance standards for stormwater management measures presented in N.J.A.C 7:8-5. These standards are designed to minimize the adverse impacts of stormwater runoff on water quality, water quantity, and loss of groundwater recharge in receiving water bodies. The standards for these measures also address erosion control. This plan also incorporates a maintenance plan consistent with N.J.A.C. 7:8-5.8 for stormwater management measures and safety standards consistent with N.J.A.C. Safety Standards for Stormwater Management Basins. These standards and measures are adopted by the municipality by means of the Stormwater Management Ordinance presented in Appendix A.

To ensure compliance with these standards, City inspectors will observe the construction of future projects and make certain that the stormwater management measures are constructed and function as designed.

The plan emphasizes that to the maximum extent practicable, the major stormwater management standards must be met by incorporating nonstructural stormwater management strategies consistent with N.J.A.C. 7:8-5.3 and described in Section 4.2 of this plan. It is upon exhaustion of all possible nonstructural strategies that structural stormwater management measures must be considered to ensure compliance with the standards incorporated in this plan.

3.2 MAJOR GOALS

The major goals of stormwater management measures, structural or non-structural, are to control erosion, sedimentation, infiltration and groundwater recharge, and control stormwater runoff quality and quantity impacts of major development. These specific goals are as follows:

3.2.1 Erosion and Sedimentation Control

The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A 4:24-39 et seq. More specifically, erosion and sedimentation controls are regulated by the Soil Conservation Districts in each county which ensure compliance with *Standards for Soil Erosion and Sediment Contro*l, (July 1999).

3.2.2 Groundwater Recharge

The minimum design and performance standards for groundwater recharge are those established under N.J.A.C. 7:8-5.4. The design engineer for the developer is provided with a choice of two methods to ensure that loss of groundwater recharge is being mitigated. The engineer must either demonstrate that 100 percent of the average annual pre-construction recharge volume is being maintained, or that the increase of stormwater runoff volume due to construction for the two-year storm is infiltrated. It must be noted that groundwater recharge design and performance standards do not apply to projects in an “urban redevelopment area” or in areas that fall under the following categories:

- Industrial and commercial areas with solvent/petroleum related activity.
- Areas where hazardous/toxic materials may be present.
- Areas with high risks of toxic material spills (e.g. gas stations and vehicle maintenance facilities).
- Areas where stormwater runoff is exposed to industrial materials or machinery that could act as a pollutant source.

Jersey City doesn’t emphasize groundwater recharge due primarily to the fact that they have no water wells and that the soil is contaminated with chromium which could also contaminate the water.

3.2.3 Stormwater Runoff Volume and Peak Abatement

The minimum design and performance standards for controlling stormwater runoff quantity impacts are those established under N.J.A.C. 7:8-5.4. Using the assumptions and factors for stormwater runoff calculations, the developer's design engineer must demonstrate one of the following:

- For stormwater leaving the site, post-construction runoff hydrographs for two, ten and 100-year storm (the design storms) events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events.
- There is no increase in peak runoff rates of stormwater leaving the site for the two, ten 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.
- The post-construction peak runoff rates for the two, ten and 100-year storm events are 50, 75, and 80 percent, respectively, of the pre-construction peak runoff rates.

The engineer must provide proof that these criteria can be met by using SWMM 5, XP-SWMM, TR-55 or the Rational Method model in order to provide adequate proof that these criteria can be met. If more than three pipes or conveyance reaches are necessary for the proposed developments, the TR-55 or Rational Methods may not be appropriate and are not recommended.

3.2.4 Reduction of Stormwater Runoff Pollutant Quantities

The minimum design and performance standards controlling stormwater runoff quantity impacts are those established under N.J.A.C. 7:8-5.5. Measures for stormwater quality control are only required for proposed developments that create an additional one-quarter acre of impervious surface. The stormwater management measures must be designed to remove 80% of the post-construction total suspended solids (TSS) load in stormwater runoff generated from the water quality design storm. The design storm is defined as 1.25 inches of rainfall in two hours with the hourly distribution shown in Table 3.1.

TABLE 3-1: Distribution of a 1.25-inch 2 hour Storm in New Jersey

Minutes	Cumulative Rainfall (inches	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 engineer must use this distribution with one of the aforementioned models in order to provide adequate proof that the 80% TSS requirement can be met. If more that three pipes or conveyance reaches are necessary for the proposed development, the TR-55 or Rational Method may not be appropriate. Reduction of post-construction nutrient load, to the maximum extent feasible, from the runoff of a water quality design storm must also be accomplished by the stormwater management measures.

3.3 DEVELOPER REQUIREMENTS

Developers constructing new developments or retrofitting old developments must not only meet the stormwater management goals discussed in the previous sections, but also achieve four other requirements. Developers must comply with the Natural Heritage Program, create stormwater management maintenance plans for each stormwater management method or technology they use, institute safety requirements outlined in N.J.A.C. 7.8-6, and comply with total maximum daily load requirements.

3.3.1 Natural Heritage Program Compliance

In response to the New Jersey Department of Environmental Protection’s Natural Heritage Program, developers required to institute stormwater management measures shall ensure that the best management practice selected avoids damage to habitats of threatened and endangered species, particularly the swamp pink (*Helonias bullata*) and the bog turtle (*Clemmys muhlnebergii*). Developers should submit a request for information regarding endangered species in the selected project site. The request consists of a short letter explaining the project, a USGS quad map delineating project site boundaries, and a completed data request form. The data request form is available on the NJDEP website at http://www.nj.gov/dep/parksandforests/natural/heritage/datareq.html. Additional information regarding the Natural Heritage Program is available at http://www.nj.gov/dep/parksandforests/natural/heritage/. It should be noted that average turn around time for a request is two weeks. A minimum charge of $20 (plus $20 per hour for each additional hour, billed in half hour increments) will be assessed for each request.

3.3.2 Stormwater Management Maintenance Plans

N.J.A.C. 7.8-5.8(a) requires each stormwater management measure to have a maintenance plan. The maintenance plan must contain the names, addresses, and telephone numbers of the persons responsible for maintenance practices. It must also contain specific preventative and corrective tasks, an inspection and task schedule, maintenance cost estimates, and logs of all maintenance activities performed. In addition to the required information, the maintenance plan should contain sources of tools and equipment required for maintenance, corrective responses for emergencies, safety plans for maintenance practices, a list of disposal and recycling sites, copies of warranties for measure components, and copies of relevant construction documents. The maintenance plan should also contain information on access to the site, personnel training, and impacts of the stormwater management measure’s aesthetics on the surrounding area.

Upon completion of the maintenance plan, copies shall be provided to the stormwater management measure’s owner and operator as well as the County, the designated stormwater review agency for the City. The title and date of the plan and the name, address, and telephone number of the party responsible for measure maintenance must be recorded on the deed to the property on which the measure is located. If requested, the person responsible for plan maintenance must furnish the plan and any associated logs or records to public entities with administrative, health, environmental or safety authority over the site. More information regarding stormwater measure maintenance is available in Chapter 8 of the *New Jersey Best Management Practices Manual*: Maintenance and Retrofit of Stormwater Management Measures.

3.3.3 Safety

N.J.A.C. 7.8-6.2 sets safety requirements for best management practices involving stormwater basins. Requirements are set for trash racks, overflow grates and escape provisions. These requirements apply to all best management practices involving basins, such as wet ponds and detention basins. All basins and ponds with open water shall be enclosed and secured from public access with a minimum 6-foot tall steel fence or other material approved for use by the City's building department. Variances and exemptions to the following safety requirements can only be granted if the reviewing agency finds that the variance or exemption will not be a threat to public safety.

3.3.3.1 Trash Racks

Trash racks, much like the grates over storm water catch basins, are designed to catch trash and debris and prevent clogging. Trash racks are to be installed at the intake to the outlet from the stormwater management basin. They are to have parallel bars spaced no farther than six inches apart and shall not negatively affect the flow of the outlet. Average flow through the trash rack should not exceed 2.5 ft/s over the course of a storm. Trash racks shall be constructed from rigid, durable, corrosion-resistant material capable of withstanding a load of 300 psi.

3.3.3.2 Overflow Grates

Overflow grates are designed to prevent obstruction of overflow structures. An overflow grate shall be secured to the outlet but shall also be removable. Open spaces in the grate shall be no greater than two inches across the smallest dimension. Like trash racks, overflow grates shall be constructed from rigid, durable, corrosion-resistant material capable of withstanding a load of 300 psi and/or H-20 loading if trucks will possibly drive over the grates.

3.3.3.3 Escape Provisions

Stormwater basins with outflows shall incorporate permanent ladders, steps, rungs or other escape methods into the basin's structure. Basins more than 2.5 feet deep must have safety ledges. These safety ledges shall consist of two steps, each four to six feet in width. The first step shall be 1.5 to 2 feet below the permanent water surface, and the second step shall be located 1 to 1.5 feet above the permanent water surface. Dams, embankments and berms used in stormwater basins shall not have a slope greater than 3:1 horizontal.

3.3.4 Total Maximum Daily Load (TMDL) and Waste Load Allocations (WLAs)

Developers should be aware of and comply with Waste Load Allocations. These quantities are determined based on the substance's sources, point and nonpoint. The sum of the waste load allocations is equal to the total maximum daily load or TMDL. TMDLs are developed for water bodies that cannot meet the surface water requirements after installation of effluent-based treatment measures. The TMDL establishes Waste Load Allocations (WLA).

The State of New Jersey has a four phase process for TMDLs. A proposed TMDL is considered 'proposed' when it is published for public review in the New Jersey Register as a proposed amendment to the appropriate water quality management plan. Next, public comments are incorporated and the TMDL is submitted to EPA Region 2 for a 30-day review period. The TMDL is 'established' during this phase. The third phase is approval of the amendment by EPA Region 2. The TMDL is considered 'adopted' after it has been approved by EPA Region 2 and adopted by NJDEP as a water quality management plan amendment. The process ends when the amendment's adoption notice is published in the New Jersey Register. Developers should consult the Plan Consistency chapter of this report for TMDLs in effect in Jersey City. More information on TMDLs including a list of TMDLs in New Jersey can be found on the NJDEP's website at http://www.state.nj.us/dep/watershedmgt/tmdl.htm. Developers are required to remove pollutants to achieve the specified annual pollutant load for their proposed land area development, which is the WLA.

3.4 EXEMPTIONS AND WAIVERS

All developments disturbing more than one acre of land or creating more than one quarter of an acre of impervious surface are subject to the stormwater treatment standards outlined in N.J.A.C. 7.8-5.4 and 5.5, with specific exemptions for urban redevelopment areas, high pollutant loading and runoff from source material outlined in N.J.A.C. 7.8-5.4(a)2ii and 2iii. Waivers may be granted for developments in areas subject to tidal influence where non-tidal water surfaces do not exist. Three types of linear development projects are exempt from the groundwater recharge and the stormwater quality and quantity requirements set forth in N.J.A.C. 7.8-5.4 and 5.5:

1. Underground utility line construction projects (provided that disturbed areas are revegetated upon project completion);

2. Aboveground utility line construction projects (provided that pre-project conditions are maintained to the maximum extent possible); and

3. Public pedestrian access projects, such as sidewalks or trails that are less than 14 feet wide (provided the access is constructed from permeable material).

Waivers from strict compliance with N.J.A.C. 7.8-5.4 and 5.5 can be obtained for projects concerning the enlargement of an existing public roadway, enlargement of a public railroad or the construction or enlargement of a public pedestrian access if the following four criteria are met:

1. The waiver applicant shows public need for the project and it cannot be accomplished any other way;

2. The applicant completes an alternatives analysis showing that the use of nonstructural and structural stormwater management measures complies with N.J.A.C. 7.8-5.4 and 5.5 (i.e.; the major goals discussed in Section 3.2) to the maximum extent practicable;

3. The applicant shows that compliance with N.J.A.C. 7.8-5.4 and 5.5 would require existing structures currently in use to be condemned; and

4. The applicant does not own or have rights to areas that would allow for additional mitigation opportunities that are not achievable on-site. This item, however, is not applicable to the City's SWMP since mitigation is permitted under the criteria set in Chapter 6.0.

4.0 SPECIFIC BEST MANAGEMENT PRACTICES (BMPS)

4.1 LOW IMPACT DEVELOPMENT VERSUS STRUCTURAL BMPS

Effective low impact development includes the use of both nonstructural and structural stormwater management measures that are a subset of a larger group of practices and facilities known as Best Management Practices or BMPs. The BMPs utilized in low impact development, known as LID-BMPs, focus first on minimizing both the quantitative and qualitative changes to the pre-developed hydrology of a site through nonstructural practices and then providing treatment as necessary through a network of structural facilities distributed throughout the site. In doing so, low impact development places an emphasis on nonstructural stormwater management measures, seeking to maximize their use prior to utilizing structural BMPs.

Nonstructural BMPs used in low impact development seek to reduce stormwater runoff impacts through sound site planning and design. Nonstructural LID-BMPs include such practices as minimizing site disturbance, preserving important site features, reducing and disconnecting impervious cover, flattening slopes, utilizing native vegetation, minimizing turf grass lawns, and maintaining natural drainage features and characteristics. Structural BMPs used to control and treat runoff are also considered LID-BMPs if they perform these functions close to the source of runoff. As such, they are typically smaller than standard structural BMPs. Structural LID-BMPs include various types of basins, filters, surfaces, and devices located on individual lots in a residential development or throughout a commercial, industrial, or institutional development site in areas not typically suited for larger, centralized structural facilities.

4.2 LOW IMPACT DEVELOPMENT OR NONSTRUCTURAL BMPS

The City will review its ordinances and provide a list of the sections in the City land use and zoning ordinances that are to be modified to incorporate nonstructural stormwater management strategies. Once the ordinance texts are completed, they will be submitted to the County for review and approval. A copy will also be submitted to the NJDEP.

4.2.1 Buffers

The ordinance will require buffer areas along all lot and street lines separating residential uses from arterial and collector streets, separating a nonresidential use from either a residential use or residential zoning district line, and along all street lines where loading and storage areas can be seen from the street. The landscape requirements for these buffer areas in the existing section will not recommend the use of native vegetation. The language of this section will require the use of native vegetation, which requires less fertilization and watering than non-native species. Language will be included to allow buffer areas to be used for stormwater management by disconnecting impervious surfaces and treating runoff from these impervious surfaces. The City should determine if this section will require preservation of natural wood and tracts and limit land disturbance for new construction.

4.2.2 Cluster Development

The ordinance will provide for a cluster development option to preserve land for public and agricultural purposes, to prevent development on environmentally sensitive areas, and to aid in reducing the cost of providing streets, utilities and services in residential developments. The cluster option is a tool for reducing impervious roads and driveways. The option allows for smaller lots with smaller front and side yard setbacks than traditional development options. It also minimizes the disturbance of large tracts of land, which is a key nonstructural stormwater management strategy. The cluster option will require that a percentage of the total tract be preserved as common open space for residential area. The cluster option will not require that 25 percent of the green or common area be landscaped with trees and/or shrubs. This language will promote the use of native vegetation, which requires less fertilization and watering than non-native ornamental plants. Although the cluster option requires public concrete sidewalks to be installed along all streets, the option requires paths in open space to be mulched or stone to decrease the impervious area.

4.2.3 Vegetated Swale Curbs and Gutters

The ordinance will require that concrete curb and gutter, concrete curb, or Belgian block curb be installed along every street within and fronting on a development whenever possible. This section may allow for curb cuts or flush cuts with curb stops to allow vegetated swales to be used for stormwater conveyance and to allow the disconnection of impervious areas.

4.2.4 Use of Natural Swales for Drainage

The ordinance will require that all streets be provided with inlets and pipes where the same are necessary for proper drainage and it will encourage the use of natural vegetated swales instead of inlets and pipes.

4.2.5 Permeable Pavement Driveways and Access Ways

The ordinance will describe the procedure for construction of any new driveway or access way to any street and will promote the use of pervious paving materials to minimize stormwater runoff and promote groundwater recharge.

4.2.6 Preservation of Natural Features

The ordinance will require that natural features such as trees, brooks, swamps, hilltops, and views be preserved whenever possible, and that care be taken to preserve selected trees to enhance soil stability and landscaped treatment of the area. This section will allow developers to expand trees to forested areas, to ensure that leaf litter and other beneficial aspects of the forest are maintained in addition to the trees.

4.2.7 Vegetation on Roofs

The ordinance will require that roofs or rooftops be lined with a vegetated cover, when feasible. The vegetated roof will retain stormwater and aid in the reduction of stormwater runoff.

4.2.8 Restrictions on Nonconforming Uses, High Impervious Area Structures or Lots

The ordinance will not permit proposed additions to existing single family homes proposing additions that will exceed the maximum percent of impervious cover. The homeowner will be required to reduce or mitigate the impact of the additional impervious surfaces unless the stormwater management plan for the development provided for these increases in impervious surfaces. This mitigation effort must address water quality, flooding, and groundwater recharge.

4.2.9 Off-site and Off-tract Improvements

The ordinance will describe essential off-site and off-tract improvements. Language will be added to this section to require that any off-site and off-tract stormwater management and drainage improvements must conform to the design and performance standards described in this plan.

4.2.10 Off-street Parking and Loading

The ordinance will include details of off-street parking and loading requirements. All parking lots with more than 10 spaces and all loading areas will be required to have concrete or Belgian block curbing around the perimeter of the parking and loading areas. This section will also require that concrete or Belgian block curbing be installed around all landscaped areas within the parking lot or loading areas. It will also allow for flush curb with curb stop, or curbing with curb cuts to encourage developers to allow for the discharge of impervious areas into landscaped areas for stormwater management whenever possible. Language will also be added to allow for use of natural vegetated swales for the water quality design storm, with overflow for larger storm events into storm sewers. This section will promote the usage of pervious paving in areas providing overflow parking, vertical parking structures, smaller parking stalls, and shared parking.

4.2.11 Shade Trees

The ordinance will encourage land owners and home owners to plant shade trees in their yards. In addition to this section, the City will have a Tree Preservation Ordinance that restricts and otherwise controls the removal of mature trees throughout the City. This ordinance recognizes that the preservation of mature trees and forested areas is a key strategy in the management of environmental resources, particularly watershed management, air quality, and ambient heating and cooling. These sections will set out a “critical footprint area” that extends beyond the driveway and building footprint where clearing of trees cannot occur. This will comply with minimizing land disturbance, which is a nonstructural stormwater management strategy. These sections will require the identification of forested areas, and that a percentage of forested areas are protected from disturbance.

4.2.12 Use of Narrow Streets

The ordinance will describe the requirements for streets in the City. The City has several street classifications, with various right-of-way widths. Street paving widths are a function of the number of units served, whether a street is curbed, whether on-street parking is permitted, whether the interior streets serve lots of two acres or larger, and whether on-site topographical constraints allow design flexibility. Depending on these factors, paving width for secondary local streets has a range from 20 to 32 feet. This section will encourage developers to limit on-street parking to allow for narrower paved widths. This section will also require that cul-de-sacs 35 foot turning radius be minimized to reduce impervious area. Normal radius cul-de-sacs with landscaped islands will be used as planted tree or pond areas or designed with flush curbs with a reinforced shoulder to accommodate larger equipment and emergency vehicles.

4.2.13 Steep Slopes

This ordinance would require terraced landscaping design or other flow velocity reduction methods be used with steep slope areas. One option is to construct flumes designed in accordance with “Standard for Slope Protection Structures” of the *Standards for Soil Erosion and Sediment Control in New Jersey*, which would follow the philosophy of moving the "fast" flows off the steep slopes without erosion to an area where the stormwater can be managed more effectively.

4.3 STRUCTURAL BEST MANAGEMENT PRACTICES BMPs

These BMPs should only be considered when nonstructural BMPs do not meet the goals identified in Section 3.2. These structural BMPs are as follows:

4.3.1 Bioretention Basins

Bioretention systems filter stormwater runoff through vegetative layer planted on a soil layer and convey the water downstream by means of an underdrained sand layer below the soil bed. These systems are used to remove a wide range of pollutants including suspended solids, nutrients, metals, hydrocarbons, and bacteria. They are also capable of reducing peak runoff rates and increasing stormwater infiltration if design features related to providing additional storage, and hydraulics that raise the invert of lowest outlet above the maximum design storm water surface, are incorporated into the design.

Runoff from both residential and nonresidential developments, impervious areas and lawns can be handled by bioretention systems. They can be installed in lawns, median strips, parking lot islands, unused lot areas, and certain easements. Detailed information for designing bioretention systems is provided in Chapter 9.1 of the *New Jersey Stormwater Best Management Practices Manual.* Some of the critical design criteria are discussed below.

Bioretention basins must be designed with enough storage volume to treat the runoff volume generated by the stormwater quality design storm (as calculated from methods described in Chapter 5 of the *New Jersey Stormwater Best Management Practices Manual*) without overflow. The surface area should be large enough such that the maximum water depth during treatment is 12 inches in a basin and 18 inches in a swale. The hydraulics of the soil bed and the sand underdrain should be such that the entire volume of a stormwater quality design storm can be drained within 72 hours. This in turn requires adherence to the soil permeability criteria discussed later. In conducting field or laboratory testing to determine soil permeability, a safety factor of two shall be applied to account for temporal variations due to continued operation of the basin. The system must be designed with enough hydraulic capacity so as to safely convey stormwater to downstream drainage systems. Any stormwater management measures classified as dams under the NJDEP Dam Safety Standards stipulated by N.J.A.C. 7:20 must also meet the overflow requirements of these standards.

The applicability of using bioretention systems depends on a few important criteria. Because bioretention basins rely upon an underdrain system to rapidly convey runoff to downstream areas after filtration, a high Seasonal High Water Table (SHWT) can be detrimental to a bioretention basin's effectiveness. Bioretention basins are appropriate when the SHWT is at least 1 foot below the bottom of the bioretention basin's underdrain during non-drought conditions. Furthermore, if the system relies on infiltration through the soil layer underneath the system instead of an underdrain, soil permeability must be greater than 0.5 inches/hour to ensure proper functioning (based on design criteria for Infiltration Basins, another BMP described in Chapter 9.5 of the *New Jersey Stormwater Best Management Practices Manual*). Bioretention systems should not be planned in areas where removal of mature trees would be involved.

4.3.2 Constructed Stormwater Wetlands

Constructed stormwater wetlands use vegetation to maximize the removal of pollutants from runoff through settling, uptake, and filtration while providing a means for erosion and flood control. The wetlands are designed to temporarily store runoff in shallow pools that provide suitable conditions for growth of wetland plants. Constructed stormwater wetlands can also be used to reduce peak runoff rates if designed as a multi-function, multi-stage facility and owing to the vegetation, can provide wildlife habitat and aesthetic features to the development.

The wetlands consist of three zones: the permanent pool, marsh, and semi-wet zones. Depending on the presence and relative storage volume of the zones, these systems can be classified as pond wetland, marsh wetland, or extended detention wetland. Pond wetlands are more appropriate when higher pollutant removal efficiencies are required. They have also been demonstrated to be the most reliable in terms of overall performance compared to the other types. Detailed information for designing constructed stormwater wetlands is provided in Chapter 9.2 of the *New Jersey Stormwater Best Management Practices Manual*. Some of the critical design criteria are discussed below.

The total volume of the three zones must equal the design runoff volume. An exception can be made for systems designed as extended detention wetlands. The detention time requirements in the semi-wet zone of an extended detention wetland (above the normal standing water level) are identical to those for an extended detention basin. The requirements state that the detention time must be long enough such that a minimum of 10 percent of the runoff volume generated by the stormwater quality design storm remains in the basin 24 hours after the peak basin water surface and maximum runoff storage volume is achieved.

Constructed stormwater wetlands are appropriate when sufficient drainage area requirements, dry weather base flow, and soil permeability requirements are met. Depending on the type of constructed wetland, the minimum drainage area to a constructed stormwater wetland ranges from 10 acres i.e. 2 football fields, for extended detention, to 25 acres i.e. 5 football fields for pond/marsh wetlands. The reliability of pollutant removal tends to increase as the stormwater wetland to watershed ratio increases. Dry weather base flows are an important criteria for marsh wetlands where it is necessary to support emergent plants and minimize mosquito breeding. Since the marsh area is quite large in this type of wetland, the drainage area requirements are greater. The greater marsh area necessitates greater rates of normal inflow to generate the required flow velocities and volume changeover rates. Thus, the design engineer must conduct a water budget which demonstrates that there will be a continuous supply of water to sustain the constructed stormwater wetland. It must also be demonstrated that the dry periods will not exceed two months since periods of a longer duration have been shown to be detrimental to the plant community richness. The location of the bedrock relative to the surface is an important criteria for determining the appropriateness of constructed wetlands. The high excavation costs in cases where bedrock in close to the surface may make these systems infeasible. Due to the critical function served by the permanent pool that must be maintained in constructed stormwater wetlands, the soil at the wetland site must be sufficiently impermeable to prevent excessive seepage, otherwise construction of an impermeable liner or other soil modifications will be necessary. This stormwater management measure is best suited for medium-fine texture soils (such as loams and silt loams) as they are ideal for establishing vegetation, surface water retention, groundwater recharge, and capture of pollutants. Constructed stormwater wetlands are also constrained by available land area requirements due to the minimum setback requirements from the following structures:

- Septic System Leach Field – 50 ft. Distance
- Septic System Tank – 25 ft. Distance
- Property Line – 10 ft. Distance
- Private Well – 50 ft. Distance

4.3.3 Dry Wells

Dry wells may either be structural chambers or excavated pits filled with aggregate that are designed to serve as subsurface storage facilities receiving and temporarily storing stormwater runoff from roofs of structures. The stored runoff is held until it infiltrates into the surrounding soils.

The primary purpose of a dry well is to reduce the volume of stormwater runoff caused by roofs of buildings (which is a major component of the overall increased runoff volume from development sites) by providing storage capacity and promoting infiltration. Thus, it greatly facilitates groundwater recharge and can be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules. Dry wells are ideally suited for reducing the amount of stormwater quality design storm runoff volume that must be treated by other downstream stormwater management facilities, thereby indirectly enhancing water quality. Detailed information for designing dry wells is provided in Chapter 9.3 of the *New Jersey Stormwater Best Management Practices Manual*. A detailed discussion relating to the use of this measure to meet the groundwater recharge requirements of the NJDEP Stormwater Management rules is presented in Chapter 6 of the *New Jersey Stormwater Best Management Practices Manual*. Some of the critical design criteria are discussed below.

Dry wells must be designed with enough hydraulic capacity to treat the total runoff volume generated by the dry well's maximum design storm. This in turn is determined by the dry well's proposed use, whether it is intended to handle a groundwater recharge storm or a stormwater quality design storm. The design should ensure that the entire runoff volume from the maximum design storm will be drained within 72 hours. The bottom of a dry well must be at least 2 feet above the seasonal high water table or bedrock and be as level as possible to uniformly distribute runoff infiltration over the subgrade soils. Furthermore, construction of a dry well must be conducted without compacting the subgrade soils. This must achieved by equipment placed outside the dry well whenever possible.

The applicability of dry wells as a stormwater management measure is influenced by a variety of factors. Dry wells cannot be used to directly comply with the suspended solids and nutrient removal requirements mandated by the NJDEP Stormwater Management Rules under N.J.A.C. 7:8 as they are primarily designed for handling roof runoff, which has a relatively low level of expected pollutants. Consequently, dry wells are inappropriate for use in the following areas where high pollutant or sediment loading is anticipated as this entails the potential for groundwater contamination:

- Industrial and Commercial areas with solvent/petroleum related activity
- Areas with a probability of presence of hazardous/toxic materials
- Areas with high risks of toxic material spills (eg. gas stations and vehicle maintenance facilities)
- Areas where stormwater runoff is exposed to industrial materials or machinery that could be a source of pollutants.

Dry wells must not be used where their installation would create a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of subsurface sewage disposal systems and other subsurface structures.

Stemming from the fact that dry wells rely entirely upon infiltration, their use is applicable only when subgrade soils conform to the required permeability rates presented below:

Table 4-1
Design Permeability Rates Required for Dry Wells and Infiltration Basins

Maximum Design Storm	Minimum Design Permeability Rate (inches/hour)
Groundwater Recharge	0.2
Stormwater Quality	0.5

Dry wells are recommended only for storms smaller than or equal to stormwater quality design storm. Approval for the use of dry wells for larger storm events is contingent upon review of and the criteria for design, construction, and maintenance for such systems by all applicable reviewing agencies. If the dry well is used for storms greater than the Groundwater Recharge Storm, then this management measure can only be constructed in areas with Hydrologic Soil Group A and B Soils.

Group A soils are sand, loamy sand, or sandy loam soils which have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils are silt loam or loam soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Soil with the more impermeable clays should be avoided for use with this BMP.

Finally, drainage area requirements stipulate that the maximum drainage area to a dry well must be 1 acre.

4.3.4 Extended Detention Basins

Extended detention basins are designed for temporary storage of runoff. They are basins constructed through filling and/or excavation which detains runoff inflows and provides a conducive environment for settlement of pollutants before being conveyed downstream through an outlet structure. These systems are usually designed as multi-staged facilities wherein the higher stages of the basin attenuate peak rates of runoff from large storms, thereby providing flood and erosion control, while the lower stages store runoff from stormwater quality design storms for extended time periods to enhance pollutant removal through sedimentation.

This stormwater management measure is used for both stormwater quality and quantity management. The TSS removal that can be achieved through this measure is strongly dependent on the duration of detention time provided in the basin. They are suited for use at residential, commercial, and industrial development sites where significant increases in runoff from development is expected. Detailed information for designing Extended Detention Basins is provided in Chapter 9.4 of the *New Jersey Stormwater Best Management Practices Manual*. Some of the critical design criteria are discussed below.

Extended detention basins should be designed to treat the runoff volume generated by the water quality design storm (as calculated from methods described in Chapter 5 of the *New Jersey Stormwater Best Management Practices Manual*). The detention time in extended detention basins must long enough such that a minimum of 10 percent of the runoff volume generated by the stormwater quality design storm remains in the basin 24 hours after the peak basin water surface and maximum runoff storage volume is achieved. Any stormwater management measure classified as a dam under the NJDEP Dam Safety Standards stipulated by N.J.A.C. 7:20 must also meet the overflow requirements of these standards. Owing to sediment removal and its consequent accumulation over the course of operation of these basins, a loss of detention time volume must be accounted for in the design. This could be achieved by increasing the initial maximum storage volume for compensation of the inevitable loss later. To increase the degree of sedimentation, narrow basin configurations with length to width ratios from 2:1 to 3:1 should be designed. The designer must avoid reducing surface area of the basin since shallow basins with larger surface area will provide better pollutant removal efficiencies than smaller, deeper basins.

The depth to the seasonal high water table (SHWT) can be a limiting condition since interception of groundwater by the basin can result in a loss of storage volume, mosquito breeding, and difficulty maintaining the basin bottom. Extended detention basins are appropriate only when the SHWT is at least one foot below the lowest elevation in the basin. Soil conditions on the site should be such that it is neither relatively impermeable (USDA Hydrologic Soil Group "D"), leading to problems associated with standing water, nor very permeable (Group "A") sue to excessive seepage into groundwater and the ramifications of possible contamination. Furthermore, close proximity to bedrock could increase excavation costs associated with such systems, making them infeasible. Finally, in Karst landscapes, other alternatives to detention basins should be examined.

4.3.5 Infiltration Basins

Infiltration basins are facilities constructed with highly permeable soils and no structural outlet to discharge runoff in order to promote infiltration to the surrounding soils. They provide temporary storage of the stormwater runoff from a stormwater quality design storm though they can be combined with an extended detention basin to provide additional storage volume for larger storms thereby accomplishing stormwater quantity management as well. This stormwater management measure relies upon the infiltration of runoff though underlying soil as well as biological and chemical activity within the soil to achieve pollutant removal.

Infiltration basins are primarily used on development sites that must achieve pollutant removal as well as reduce peak rate and total runoff volume. They may also be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rule. A detailed discussion relating to the use of this measure to meet the above mentioned rule is presented in Chapter 6 of the *New Jersey Stormwater Best Management Practices Manual*. Appropriate soil and drainage area conditions can permit the combination of an infiltration basin with a detention basin to provide runoff quantity control in the detention portion of the basin. This would involve raising the invert of the lowest stormwater quantity control outlet above the maximum stormwater quality design storm water surface. Detailed information for designing Infiltration Basins is provided in Chapter 9.5 of the *New Jersey Stormwater Best Management Practices Manual*. The most critical design criteria for these systems are identical to those for dry wells described earlier. In addition to those requirements, infiltration basins classified as dams under the NJDEP Dam Safety Standards stipulated by N.J.A.C. 7:20 must also meet the overflow requirements of these standards.

Similar to the limitations of other BMPs that rely on infiltration, such as Dry wells, infiltration basins are inappropriate for use in areas where high pollutant or sediment loading is anticipated as this entails the potential for groundwater contamination. Chapter 9.5 of *the New Jersey Stormwater Best Management Practices Manual* mentions specific land uses which preclude dry wells as an alternative. These are briefly summarized below:

- Industrial and commercial areas with solvent/petroleum related activity
- Areas with a probability of presence of hazardous/toxic materials
- Areas with high risks of toxic material spills (eg. gas stations and vehicle maintenance facilities)
- Areas where stormwater runoff is exposed to industrial materials or machinery that could be a source of pollutants.

Infiltration basins must not be used where their installation would create a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of subsurface sewage disposal systems and other subsurface structures.

As stated in Section 4.3.3, stemming from the fact that this measure relies largely upon infiltration, its use is applicable only when subgrade soils conform to the required permeability rates presented Table 4.1.

If the basins are used for storms greater than the Groundwater Recharge Storm, then this management measure can only be constructed in areas with Hydrologic Soil Group A and B Soils: sands, loamy sands, sandy loams, silt loams, or loam.

The feasibility of using infiltration basins as a stormwater control measure for attenuation of water quality problems is considerably influenced by the quality of runoff entering the basin. This makes it imperative to determine the pollutants expected to be present in the runoff and their possible impacts on groundwater quality. This analysis must be complimented by ascertaining whether the existing soil column below the infiltration basin are capable of attenuating the pollutants or let them pass through to the groundwater table. It has been shown that certain soils are only partially capable of treating bacteria and soluble forms of nitrogen, phosphorous, and other pollutants such as pesticides and road salts. In general, it is observed that soils that exhibit the highest permeability, thereby making them optimal candidates for infiltration basin design, also have the least ability to treat problematic pollutants. In these cases, the developers design engineer must consider pretreatment of soluble pollutants prior to entry into the infiltration basin. These pretreatment measures could include vegetative filters, bioretention systems (in which case the standard underdrain can be replaced by the infiltration basin), and certain sand filters. If enhancement of the treatment systems is not possible on the site, the native soil below the proposed basin should be augmented or replaced by soils with greater pollutant removal rates if there is any indication that groundwater quality might be compromised.

Other constraints that may limit the applicability of infiltration basins are proximity to geologic and ecologically sensitive areas in the vicinity of the site. Infiltrations basins should be avoided in areas containing foundations (to avoid seepage problems), near drinking water supply wells, and where surrounding slopes are greater than 10 percent. Finally, infiltration basins must be avoided if a minimum distance of 100 feet from adjacent drinking water supply wells cannot be ensured.

4.3.6 Manufactured Treatment Devices

Manufactured treatment devices (MTDs) are pre-fabricated stormwater treatment structures used to remove pollutants from stormwater runoff. These devices use one or more of a variety of treatment methods, including settling, filtration, and vegetative components. Manufactured treatment devices can only be used to treat stormwater if their pollutant removal rates are certified by the NJDEP Division of Science, Research and Technology. For this reason, the City is advising the developers that they will consider such devices as a water quality control measure but the developer/owner is responsible for ensuring that this water quality goal is met. MTDs are best suited to treat runoff from small areas with a high percentage of impervious cover (such as small parking lots and gas stations) where the stormwater runoff contains a large amount of sediment and hydrocarbons.

4.3.6.1 Vortechnics

The Vortechs © system manufactured by Vortechnics is one example of a manufactured treatment device that has been used in New Jersey. Stormwater enters a grit chamber where vortex separation removes large particles. From the grit chamber, the stormwater passes under a baffle wall, behind which floatables are trapped. The water is removed from the system as it passes through an orifice or weir in a flow control wall (depending on the water level in the system), and into the outflow. Vortechs © systems have been used in Harding Township, NJ and at the Continental Airport Terminal at Newark Liberty International Airport. Information on these two projects is presented in Appendix E.

4.3.6.2 CDS

The Inline Unit manufactured by CDS Technologies is another example of a manufactured treatment system. Like the Vortechs © system, the Inline Unit relies on vortexing to remove suspended solids. Solids enter the separation chamber where vortexing causes them to settle in the sump, where they remain until the unit is cleaned. The treated stormwater flows through a separation screen (which traps floatables) and under an oil baffle before it reenters the storm drain. CDS Technologies reports that the Inline Unit removes 80% of total suspended solids and 100% of floatables.

4.3.7 Pervious Paving Systems

Pervious paving systems are utilized to reduce runoff from areas that would ordinarily be paved with conventional pavement materials. There are three types of pervious paving systems: porous paving, use of permeable pavers with a storage bed, and use of permeable pavers without a storage bed. Porous paving consists of a layer of porous asphalt over a storage bed of broken stone. The use of permeable pavers is similar to that of porous pavement, where impervious concrete blocks are laid out in a pattern that allows water to infiltrate through spaces between pavers and into the storage bed. The use of either porous paving or permeable pavers results in a reduction in the volume of stormwater runoff and up to an 80% reduction in total suspended solids (TSS) content. These two systems allow runoff to infiltrate the surface and be stored in a storage layer until the water can infiltrate the subgrade soils. The third system, use of permeable pavers without a storage bed, functions similarly to the others, but with a much shorter retention time due to lack of a storage bed. This shorter retention time does not allow for significant TSS removal.

Pervious paving systems are not appropriate for use in areas where high pollutant or sediment loading is expected, as infiltration of these waters can lead to groundwater contamination. Standards for Pervious Paving Systems (Chapter 9.7 of the *New Jersey Stormwater Best Management Practices Manual*) contains a list of example areas in which pervious paving systems are not to be used. Pervious paving systems should not be used in areas where they may increase the risk of basement seepage or flooding, cause groundwater flooding, or interfere with subsurface structures such as septic systems.

Because porous pavement and permeable pavers with storage beds require permeable soils beneath the storage bed to properly function, they can only be used in areas with Hydrologic Soil Group A and B soils. Part 618.35(b) of the National Soil Survey Handbook defines Group A soils as those with low runoff potential. Group A soils have high infiltration rates even when wet, and are generally sands and gravels. Group B soils have moderate infiltration rates and are moderately fine to moderately coarse in texture.

Porous paving should not be used in areas that are sandy in adverse weather, as the sand will clog the surface pores. Care should also be taken when using pervious pavement in areas where salt is applied, as it may infiltrate the water table. The use of pervious paving systems should be limited to areas such as parking lots, sidewalks, emergency access lanes, single family residence driveways, and other areas not subject to high traffic or heavy vehicles. Porous paving systems should be vacuum-swept and hosed down a minimum of four times a year to remove particulate materials that may have become lodged in the surface. Permeable pavers should be maintained according to manufacturer's recommendations.

4.3.8 Sand Filters

A sand filter uses the processes of sedimentation, filtration and absorption to remove hydrocarbons, metals, floatables, bacteria and sediment from stormwater. Sand filters can be surface, subsurface or perimeter sand filters. All three types of sand filters typically consist of four sections: a forebay or sedimentation basin, a filtration basin, an underdrain and an overflow. Water enters the sedimentation basin, where floatables and heavy sediments leave the water column before entering the filtration basin. In the filtration basin, the stormwater runoff travels through a sand bed. The filtered runoff leaves the filter through an underdrain system and enters either a stormwater drainage system or surface waters. The overflow allows stormwater in excess of the volume of the pore space in the sand bed to leave the system without traveling through the sand bed or underdrain and immediately be discharged.

The sedimentation basin should be sized to accommodate one-half the design storm runoff volume. The sand bed should be sized to hold one-half of the design storm runoff volume. The sand bed's volume includes the sand, pore spaces in the sand, and the water above the sand bed surface that has not yet entered the bed itself. Sample schematics and general design criteria for the three types of sand filters are available in Chapter 9.9 of the *New Jersey Stormwater Management Practices Manual*, Standards for Sand Filters. Additional design criteria are available in 'Standards for Sand Filters', Chapter 40 of *Standards for Soil Erosion and Sediment Control in New Jersey*.

Sand filters are not recommended for use in areas where stormwater runoff contains large amounts of coarse sediment or organic material such as leaves. This sediment will quickly clog the filter and lead stormwater to bypass the filter bed and pass immediately to the overflow without treatment. If a sand filter must be used to treat this type of water, it should be paired with additional stormwater treatment technology that can act as pretreatment. Filter media must be periodically replaced to avoid clogging. Use of impermeable basin or chamber bottoms can prevent contaminated runoff from coming into contact with groundwater. Sand filters should not be used in areas where high concentrations of toxic pollutants are expected in the runoff.

Sand filters are effective at removing contaminants from large amounts of water with low concentrations of coarse particulates. They are intended to be used for water quality enhancement rather than increasing groundwater recharge or decreasing stormwater runoff volume. Sand filters are best suited to treat runoff from small impervious areas with a low sediment load, such as rooftops, parking lots, and urban areas with drainage areas up to five acres[1].

4.3.9 Vegetative Filters

Vegetative filters are areas designed to remove suspended solids and pollutants from stormwater runoff as it flows through a vegetated area. The total suspended solids removal efficiency of a vegetative strip depends on its length and the type of plants used in the strip. Information on calculating TSS removal efficiency is available in Chapter 9.10 of the *New Jersey Stormwater Best Management Practices Manual*, Standards for Vegetative Filters. Vegetative strips can treat drainage from pervious surfaces less than 150 feet in length and impervious surfaces less than 100 feet in length, and must be a minimum of 20 feet in length in both cases. Plants used in vegetative strips can range from native grasses to forest floor vegetation, but it must be dense and healthy. More information on plant selection for vegetative filters can be found in Chapter 7 of the *New Jersey Stormwater Best Management Practices Manual*, Landscaping. Additional design criteria are available in 'Standards for Vegetative Filter Strips', Chapter 41 of *Standards for Soil Erosion and Sediment Control in New Jersey*.

Vegetative filters are only effective where runoff can enter and leave the strip as a sheet of flow. To achieve this goal, vegetative filters must be mildly sloped with a uniform grade. Slopes of less than five percent are the most efficient, as steeper slopes require a longer treatment strip. The drainage area must also be uniformly graded to allow the flow to enter the strip as a sheet. Soil type plays a role in determining the slope of a vegetative strip. This information can be found in County Soil Surveys or through soil investigations.

The use of a vegetative strip as a stormwater treatment method works best in areas such as parking and residential lots. Vegetation must be trimmed regularly and inspected for density and diversity at least twice annually.

[1] *Standards for Sediment Control in New Jersey*, July 1999.

4.3.10 Wet Ponds

Wet ponds, also known as retention basins, are intended to provide both permanent and temporary stormwater runoff storage. A wet pond treats stormwater through the processes of sedimentation and bacterial pollutant removal that occur during long-term storage of stormwater runoff. They are designed to hold a predetermined volume of stormwater for enough time to allow sufficient sedimentation and bacterial pollutant removal to occur to meet the 80 percent TSS removal goal. Techniques for calculating runoff volume are described in Chapter 5 of the *New Jersey Stormwater Best Management Practices Manual*: Computing Stormwater Runoff Rates and Volumes.

Wet ponds require sufficient dry weather or base flow to maintain a water depth of three to six feet in the permanent pool. Deeper pools allow thermal stratification and shallower pools allow algal blooms (much like those in swamps) and resuspension of sediment. The base or dry weather flow not only maintains the water level in the wet pond, but controls mosquito breeding and prevents stagnation. The incorporation of a fountain can also help control these problems. The use of aquatic vegetation in the pond’s landscaping not only enhances the aesthetic value of the pond, but can limit algae growth and aid in regulation of the pond’s water temperature.

Ponds must be designed with a length to width ratio of at least 1.5 to 1 to allow stormwater sufficient time for sedimentation and bacterial pollutant removal to occur. Soils in the site must be sufficiently impermeable to prevent seepage. If the soils are too permeable, an impermeable liner may be used. Wet ponds need a minimum drainage area of 20 acres and a permanent pool surface area of at least 0.25 acres. The drainage area should have a slope of less than 15 percent. Additional design criteria are available in ‘Standards for Wet Ponds’, Chapter 42 of *Standards for Soil Erosion and Sediment Control in New Jersey*.

Due to space requirements, wet ponds are not a good choice in urban areas. Wet Ponds should not be sited in natural ponds or wetlands. They are a good option for residential and commercial areas where the nutrient load in the stormwater runoff is expected to be high.

4.4 COMPARISON BMPS FOR VARIOUS LAND USES AND GOALS

Table 4-2 presents information concerning the structural and nonstructural BMPs discussed earlier in this chapter. The purpose of this table is to aid future developers in the process of selecting a BMP appropriate for use at their particular site.

In addition to presenting BMP applicability, Table 4-2 also rates the ability of each BMP to meet the stormwater management goals presented in N.J.A.C. 7.8-5.4 and 5.5, which are discussed in Section 3.2 of this report. The table also ranks BMPs by cost, design complexity and construction complexity relative to the other BMPs. This table does not take all possible BMPs into account, rather those discussed in this chapter. There are many types of BMPS which have not been discussed, as this municipal stormwater management plan is intended to act as a starting point rather than an absolute guide. Information regarding additional structural and low-impact BMPs is available from the EPA's website at http://www.epa.gov/owm/mtb/mtbfact.htm under the 'Storm Water' subheading.

4.5 BMPS IN SERIES

The total suspended solids (TSS) removal rates for individual BMPs and these rates are presented in Table 4-2. These are the official NJDEP-adopted removal rates stated in Table 4-1 of the *New Jersey Stormwater Best Management Practices Manual*. The Stormwater Management Rule requirement of 80 percent TSS reduction in the post construction runoff from a land development site that increases impervious surface by 0.25 acres or more can, however, also be met by arranging multiple BMPs in series if it is deemed that a single BMP by itself would be inadequate. The total removal rate of such a BMP treatment train is computed by applying the removal rate of the second BMP applied to the fraction of the TSS loading remaining after the runoff has been processed by the first BMP. The equation to be used for calculating the total TSS removal rate for two BMPs in series is as follows:

R = A + B – [(A x B)/100]

where:

R = Total TSS Removal Rate

A = TSS removal rate of Upstream BMP

B = TSS removal rate of Downstream BMP

General guidelines for selecting the order of the individual BMPs in a series are presented in Chapter 4 of the New Jersey Stormwater Best Management Practices Manual. These are summarized below:

- BMPs should ideally be arranged upstream to downstream in ascending order of TSS and Nutrient removal rate.
- BMPs should be arranged from upstream to downstream so that the BMP with the greater ease of sediment removal is placed upstream.
- BMPs should be preliminarily arranged in accordance with their relative TSS removal rates. The arrangement should be subsequently refined by considering relative nutrient removal rates followed by considerations of ease of sediment removal.

5.0 PLAN CONSISTENCY

5.1 REGIONAL COMPLIANCE

As of the date on which this plan was submitted, Jersey City is not within a Regional Stormwater Management Planning Area. This plan, therefore, does not need to be consistent with any regional stormwater management plans (RSWMPs). If any RSWMPs are developed in the future, this Municipal Stormwater Management Plan will be updated in order to remain consistent. Hudson County created a new master plan in 2002, and this Municipal Stormwater Management Plan is consistent with the master plan. This plan is also consistent with the goals of presented in the January 2004 Meadowlands Commission Master Plan, specifically preserving and enhancing wetlands and natural resources and working towards long term sustainability.

This plan is consistent with the Residential Site Improvement Standards (RSIS) outlined in N.J.A.C. 5.21. The City will use the most current RSIS in the stormwater management review process for future residential developments. This municipal storm water management plan will be updated in order to remain consistent with the RSIS.

5.2 TOTAL MAXIMUM DAILY LOAD: PHOSPHOROUS AND NICKEL

A total maximum daily load (TMDL) requirement for phosphorous was approved for Lincoln Park Lakes in June 2003. The phosphorous loading capacity for Lincoln Park Lakes was determined to be 33 kg Total Phosphorous/year, including an 11 kg margin of safety. The only phosphorous sources to the lakes are air deposition and stormwater runoff, with stormwater runoff constituting 21.5 of the 22 kilograms of total phosphorous load entering the lake under the approved TMDL. Developers in the Lincoln Park Lakes Lakeshed shall remove all phosphorous from their runoff to comply with the approved TMDL. This plan is in compliance with these TMDLs and will be updated should Jersey City institute additional ordinances or measures. This plan will also be updated upon the adoption of the TMDL as an amendment to the Northeast Water Quality Management

Plan. Detailed information on this TMDL including a lake shed map and land use distribution is available in Appendix J.

A TMDL requirement for nickel was adopted in December 1999. This TMDL set the load allocation of nickel that can be discharged into the Hackensack River at 4.98 lbs/day. The stormwater waste load allocation (WLA) is 0.81 lbs/day. It should also be noted that a phosphorous TMDL was approved in September 2003 for Lincoln Park Lakes. This plan is in compliance with these TMDLs and will be updated should Jersey City institute additional ordinances or measures to comply with the TMDLs. Please refer to Appendix J for more information on the nickel and phosphorous TMDLs.

A simple mathematical analysis supports the idea that new developments should not be permitted to discharge stormwater runoff containing nickel. As previously stated, the current stormwater waste load allocation (WLA) for nickel is 0.81 lbs Ni/day, or 295.85 lbs Ni/year. If this WLA is applied uniformly over the New Jersey portion of the Hackensack River Watershed, a fraction of the 295.85 lbs Ni/year should be allocated to Jersey City. Jersey City contains 3,595 acres of the 87,033-acre Hackensack River Watershed. Of these 3,595 acres, 2,265 acres (63%) are served by a CSO system and the remaining 1,330 acres are served by stormwater sewer systems. These 1,330 acres compose 1.5% of the total area of the New Jersey portion of the Hackensack River Watershed. Jersey City should be allocated 1.5%, or 4.5 lbs Ni/year, of the total 295.85 lbs Ni/year entering the Hackensack River. It should be noted that Watershed Management Area 5 is composed of the Hackensack River Watershed, the Hudson River Watershed, and the Pascack River Watershed (which is a tributary of the Hackensack River, and thus included in the Hackensack River Watershed for the purposes of this report).

The nickel concentrations calculated in the buildout analysis portion of this report are adjusted to account for fraction of the City's area served by CSOs. It can be estimated that Jersey City's stormwater currently contributes 36.0 lbs Ni/year to the Hackensack River. Using this figure and the allocated 4.5 lbs Ni/year, developers will be required to reduce the nickel present in stormwater runoff by 87.5%, leaving only a small amount of nickel in runoff treated using a best management practice. It should be noted that for the purposes of both the buildout and this analysis all types of land cover were assumed to contribute equally to the nickel content of stormwater runoff.

6.0 STORMWATER CONTROL AND MITIGATION PLANS FOR PROPOSED LAND DEVELOPMENT IN THE CITY

Each new development that occurs after April 1, 2006 will require the completion of an approved Stormwater Control Plan or a Stormwater Mitigation Plan for the site that is being developed. Stormwater Control Plans are the normal method that will be used to implement stormwater controls that are consistent with the requirements stated in this Municipal Stormwater Management Plan at the site being proposed for development. Stormwater Mitigation Plans are an alternative to the Stormwater Control Plan that is offered by the City when constrained, restricted, or other unusual circumstances prevent the developer/owner from implementing stormwater controls at the actual site development location. Mitigation will only be acceptable to the City if unusual circumstances prevent the developer from meeting the requirements of this Municipal Stormwater Management Plan at the site development, or if it can be demonstrated that implementing a stormwater mitigation will result in a greater environmental benefit to the waterbody.

6.1 STORMWATER CONTROL PLAN REQUIREMENTS

Under normal circumstances when stormwater controls can be provided at the site, the site developer will be required to obtain an approved Stormwater Control Plan (SCP) for any site development planned after April 1, 2006. The SCP is required to provide stormwater BMPs that meet the requirements in Chapter 3.0 and/or 4.0 of this Municipal Stormwater Management Plan at the site that is being developed unless unusual circumstances prohibit application of any of these BMPs at the site. In this case, the developer will be required to mitigate in accordance with Section 6.2.

The contents of a Stormwater Control Plan that can be approved by the City must contain the following:

- A completed checklist of the items listed below.
- A written letter of request describing the proposed development from the land owner or developer to the City Planning Department including the Site Address with corresponding Lot and Block number.

- An existing site plan at scale 1 inch = 50 feet shall be completed indicating all features, superstructures, substructures, utilities, waterbody boundaries, topography, and separate location map.

- A proposed development site plan shall be completed using the existing site plan as a base map and indicate all proposed contours and BMPs identifying how this site will be modified to meet the stormwater control requirements in this Municipal Stormwater Management Plan.

- An explanation of the type and number of stormwater BMPs and goals that will be implemented on the development site plan to comply the confirmed stormwater management goals must be furnished. The explanation must describe the size, design criteria, details, estimated pollutant removal rates, materials, and other characteristics of each BMP and how they will meet the goals and other requirements of this Municipal Stormwater Management Plan.

- A maintenance plan, as defined in N.J.A.C. 7:8-5.8, must be completed and submitted to the City upon installation of a stormwater BMP. The maintenance plan shall also include standard operating procedures shall be provided for each BMP. The OWNER is responsible for performing the standard operating procedure and maintenance.

- Calculations and/or hydrologic model simulations that demonstrate that all of the hydrologic peak flow control and treatment goals of this Municipal Stormwater Management Plan are met. Groundwater recharge is not a high priority stormwater management goal within the limits of Jersey City do to the absence of recharge locations.

- A schedule for completion of a Stormwater Mitigation Plan for Site Address with Lot and Block number along with the proposed time period for design and construction.

Upon submittal of the Stormwater Control Plan, the City will review the SCP and issue a notice within 3 weeks stating that the Plan is “Approved”, “Approved-as-Corrected”, needs revisions by noting “Revise and Resubmit” or “Unacceptable”. If the Plan is “Approved” or “Approved-as-Corrected” the developer may proceed with the development provided that all other City and State permits have been acquired as required by NJAC and that all of the minor corrections shown in the “Approved-as-Corrected” Plan are made. If the Plan is marked “Revise and Resubmit” then it has the potential to be approved and may be resubmitted once the revisions and modifications are made but the developer is not permitted to proceed with the development until it is

"Approved" or "Approved-as-Corrected". "Unacceptable" Stormwater Control Plans will not be reviewed if resubmitted since they do not appear to present an acceptable plan to the City that will meet the Municipal Stormwater Control Plan.

6.2 STORMWATER MITIGATION PLAN REQUIREMENTS

In the event that the site developer cannot meet the requirements in Chapter 3.0 and/or 4.0 of the Stormwater Management Plan due to site constraints, insufficient area, or other justifiable reasons, the City will consider granting a variance on a case by case basis using Alternate Area Mitigation or other approved and regulatory agency accepted methods.

Mitigation will only be considered for approval by the City if the following requirements are met:

- A written letter of request for mitigation is formally submitted by the land owner or developer to the City Planning Department indicating Site Address with corresponding Lot and Block number.
- This request must state the reason(s) that justify why they cannot meet the storm water planning criteria on their specific site or why the proposed the proposed mitigation will be better for the environment.
- The request must clearly identify who the land owner and developer is that is requesting the mitigation and the request must be signed by both entities.
- The request must include a schedule for completion of a Stormwater Mitigation Plan along with Site Address with Lot and Block number and proposed time period for design and construction.
- The proposed method of mitigation must be within the boundaries of Watershed Management Area 5 or 7 where the boundaries and municipalities are identified in Figure 6-1 and must address all sensitive receptors identified as by Jersey City Stormwater Control Plan Review staff.
- Site development locations in Jersey City proposing mitigation for stormwater controls must do so in which ever Watershed Management Area (WMA) the site to be developed is to be located. WMA 5 developments must mitigate in WMA5. WMA 7 developments must mitigate in WMA7.
- Mitigation shall be in conformance with the limitations of Section 6.2.4.

- The mitigation plan shall include a Stormwater Control Plan for the area to be mitigated and a site plan of the site to be developed such that they can be used to compare area and stormwater calculation on each site.

- Mitigation must address all sensitive receptors as defined in the "Guidance for Development of a Mitigation Plan, February 2006". The primary sensitive receptors in Jersey City are, but are not limited to, the following

    - Restricted channels, streams, or sewer pipe areas as determined by the JCMUA.
    - Wetlands in the NJ Meadowlands region and other areas as identified by JCMUA staff.
    - Waterbodys with TMDLs , or Water quality or use impairment such as the the Hackensack River located to the north west of Jersey City and the Lincoln Park Lakes
    - Areas sensitive to street flooding or sewer surcharging (see Fig 2-2)

- All of the administrative requirements listed in the "Guidance for Development of a Mitigation Plan, February 2006" (See Appendix I)

Upon submittal of the request for mitigation, the City will review the request and issue a notice stating that the request to submit a mitigation plan is "Approved" or "Unacceptable". If approved, the developer has approval to submit to the City a full Stormwater Mitigation Plan as described in their request. The City approval process will use the same submittal review method as required for a Stormwater Control Plan submittal. All Mitigation Plans are still required to demonstrate compliance with the MSWMP by implementation of one or more of the stormwater controls described in Chapters 3.0 and, if needed, Chapter 4.0. The specific mitigation conditions are described in more detail in the following sections.

6.2.1 Alternate Area Mitigation

Alternate Area Mitigation is the only mitigation that is currently considered applicable by the regulatory agencies and the City at the present time. Alternate Area Mitigation involves implementation of a Stormwater Control Plan at an alternate City and County location other than the developed site. For example, certain city owned sections of the 150 foot buffer zone along the Hackensack River may be available for implementing stormwater BMPs which may be able to act as a substitute equivalent to counter the stormwater impacts from the site being developed where stormwater BMPs cannot be implemented.

If a request for this form of mitigation is approved by the City, the developer would be required to complete a Stormwater Mitigation Plan which would include the similar submittal items as described in the Stormwater Control Plan describe above but with the following modifications and additional requirements:

- Calculations to quantify the difference in the stormwater impacts between the pre-existing site conditions and the developed site conditions of the proposed development.

- A site plan of the existing conditions at the proposed mitigation site and with the proposed stormwater BMPs.

- Calculations that show that the goals of the MSWMP can be met at the mitigation site that will offset the impacts at the developed site.

If the selected BMP is a Constructed Wetland for this mitigation plan, the area determined necessary to mitigate the stormwater impacts from the developed site must be 2 to 1 or double due to the risk of low survival associated with Constructed Wetlands. Mitigation of any kind cannot be allowed to encroach or impose other adverse impacts or threats on existing State or Federal Wetlands, Waters, Inter-tidal areas, or other sensitive environmental areas. See Figure 2-4 for known buffer zones and/or Wetland boundaries.

6.2.2 Effluent Pollutant Trading

The U.S.E.P.A. introduced the concept of Effluent Trading; however, this concept is a relatively new and developing area within EPA regulations. The City does not consider it as a possible option at the present time because the concept is relatively new and no formal policy is known to exist that addresses how this mitigation procedure should be implemented. Therefore, the City would consider effluent trading option only if letters which promote this concept are obtained from the land owner, the County, and either the U.S.E.P.A or NJDEP and the US Corps of

Engineers if the City believes that they have jurisdiction in regard to the proposed effluent trading action.

6.2.3 Mitigation Bank Contributions

This method of mitigation requires the purchase of buffer strips, wetlands or intertidal mitigation credits from known mitigation banks that have been accepted in the past for this purpose by the U.S. Army Corps of Engineers or the NJDEP Land Use Regulation Program (LURP). While it is accepted by most regulatory agencies, there are currently no known sources for Mitigation Banks within WMA 5 and 7, Until these types of banks become available they will not be considered for Jersey City stormwater mitigation and control.

6.2.4. Mitigation limitations:

- Effluent Pollutant Trading or any other mitigation shall be prohibited for developments determined to influence the Phosphorus levels into the Lincoln Park Lakes.

- Effluent Pollutant Trading and other mitigation for developments creating stormwater discharges to the Hackensack River, particularly regarding nickel, shall be limited to trading only on sites located with the boundaries of the Hackensack River that have the same Nickel TMDL. A developer developing a site that discharges to the Hackensack River will not be permitted to address the stormwater requirements by use of Effluent Pollutant Trading or other mitigation unless approval letters are provided by the County and NJDEP or USEPA and US Corps of Engineers (Corps), if deemed under the Corps jurisdiction.

- All Effluent Pollutant Trading and other mitigation shall address appropriate level of stormwater controls for all sensitive receptors and pollutants of concern being discharged to the waterbodies around Jersey City as determined by the 305(b) report and 303(d) lists as issued by NJDEP and USEPA.

- The stormwater water hydrologic controls at the mitigation site need to meet the hydrologic criteria requirements at the developed site and may not be substituted with water quality controls that do not meet the hydrologic criteria. Similarly, the stormwater quality controls at the mitigation site need to meet the water quality criteria at the developed site and may not be substituted with hydrologic controls that do not meet the water quality criteria.

7.0 MUNICIPAL STORMWATER MANAGEMENT PLAN HISTORY AND SCHEDULED UPDATES

The City's Municipal Stormwater Management Plan will be updated as required but at least every 6 years. During the initial stages of the MSWMP development the review, modification, and revision process is scheduled as follows:

- The first submittal of the Jersey City Municipal Storm Water Management Plan and SPPP Forms to Hudson County Division of Planning and the NJDEP were made April 1, 2005. Minor editorial changes were made afterward and it was reissued in June 2005.

- The JCMUA made a presentation to there Planning Board on November 29, 2005. The Municipal Storm Water Management Plan was revised based on comments received during that presentation and an additional meeting with the City's Planning Department and other City Agencies and Departments regarding ordinances. The revisions were submitted to the JCMUA on October 29, 2006 as supplements to be added to the SWMP.

- As per the requirements of NJAC 7:8, the Jersey City Planning Board adopted the SWMP shortly thereafter. This approval was required before County review could begin.

- As per the requirements of NJAC 7:8, the City Council first adopted the Ordinance 07-056 regarding Stormwater Control. Ordinance 07-056 was adopted on April 11, 2007 and an amendment with Penalties (Ordinance 07-133) was adopted August 08, 2007.

- Afterwards comments on Ordinance 07-056 and the SWMP dated June 2005 were received from a Hudson County Division of Planning in a letter dated June 19, 2007.

- This current SWMP update (June 2005 amended August 2008) includes all these previous revisions as well as the responses to the County consultant's comments dated June, 19 2007 and July 2008.

- Future updates or revisions to the SWMP will occur on an as needed basis when determined to be necessary by the Jersey City Municipal Utilities Authority and the Jersey City Planning Department or at a minimum once every 6 years.

APPENDIX A

STORMWATER ORDINANCES

APPENDIX B

THE STORMWATER POLLUTION PREVENTION PLAN (SPPP) FORMS

FOR THE CITY OF JERSEY CITY

APPENDIX C

N.J.A.C. 7:8 "STORMWATER MANAGEMENT"

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EPA BMP FACT SHEETS AND

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GUIDANCE FOR DEVELOPMENT OF A MITIGATION PLAN

FEBRUARY 2006

Appendix J

TMDLs and

Amendment to the

Northeast Water Quality Management Plan

Appendix K

SOPs