Operation and Maintenance Plan For Stormwater Management Measures Including Green Roof

Prepared For

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1.0 INTRODUCTION:

The New Jersey Administrative Code NJAC 7:8-5.8 entitled "Maintenance Requirements" sets forth rules and refers to the New Jersey Stormwater Best Management Practices manual (the BMP manual) by the New Jersey department of Environmental Protection (NJDEP). Chapter 8 of the BMP manual entitled "Maintenance and Retrofit of Stormwater Management Measures" specifically addresses the requirements for maintenance of a major development. Major development, as defined in NJAC 7:8-5.8 is any development that provides for ultimately disturbing one or more acres of land or increasing the amount of impervious surface by one quarter of an acre or more.

The project site is approximately 0.371-acres, located at 361-373 JFK Blvd. , Block 262, Lot 7,9 - within the Township of Bayonne, Hudson County, New Jersey. The proposed project is a residential building which includes HDPE pipe (ADS, Type N-12, 30" pipe) subsurface detention system.

Although this project is not considered a major development, this report is prepared to address the maintenance component of the code to ensure the effective, efficient, and enduring service of a particular storm water measure. This maintenance plan contains preventive and corrective maintenance tasks and procedures. The proposed stormwater management measures incorporate number of elements as outlined below.

2.0 STORMWATER MAINTENANCE OBJECTIVE:

The stormwater system constructed for this development is intended to treat, attenuate and convey the stormwater that impacts the development. This maintenance plan is prepared to ensure the system in place is operating efficiently and reliably. The responsible party shall ensure the long term/perpetual operation, maintenance, repair, and safety of the stormwater management facilities. In the event that the stormwater management facility becomes a danger to public safety or public health, or it is in need of maintenance, the responsible party shall take immediate action to remove the danger.

Maintenance procedures are required to maintain the intended operation and safe condition of the stormwater management facility by reducing the occurrence of problems and malfunctions. To be effective, maintenance shall be performed on a regular basis and include such routine procedures as training of staff, periodic inspections, silt and debris removal and disposal, upkeep of moving parts,

control of mosquitoes and other insects, and review of maintenance and inspection work to identify where the maintenance program could be more effective.

Repairs procedures are required to correct problem or malfunction at a stormwater management facility and to restore the facility's intended operation and safe condition. Based on the severity of the problem, repairs shall be performed on an as-needed or emergency basis and include such procedures as structural repairs, mosquito control, removal of debris, sediment and trash which threaten discharge capacity, erosion repair, snow and ice removal, fence repair, and restoration of vegetation.

In the event that the stormwater management facility becomes a danger to the public safety or public health, or if it is need of maintenance, the responsible party will have fourteen (14) days to initiate maintenance and repair of the facility in a manner that is approved by the municipal engineer or is designee.

3.0 FACILITY/RESPONSIBLE PARTY INFORMATION:

The facility and the person responsible for the preventive and corrective maintenance of the stormwater measures described herein are:

Facility: 1721-1723 JFK. Blvd.

Owner: YM Kennedy LLC
94 Belmont Ave.
Jersey City, NJ 07304

4.0 STORMWATER CONVEYANCE SYSTEM

This element is comprised of the series of pipes and cleanouts designed to collect and convey roof runoff to the proposed underground pipe detention basin. It consists of the closed system of pipe. The proposed conveyance system has adequate access for inspection and/or maintenance. The use of proposed conveyance system allows for an optimized development while minimizing disturbance and is consistent with the community's surroundings for this area.

4.1 General Maintenance

All conveyance systems including cleanouts, manholes, concrete chambers, and pipes are expected to receive and/or accumulate debris and sediment. These systems must be inspected for clogging and excessive debris and sediment accumulation four (4) times annually as well as after every storm exceeding 1 inch of rainfall. Sediment removal should take place when all runoff has drained from conveyance network and the systems are reasonably dry. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, county, state, and federal waste regulations.

4.2 Structural Components

All structural components, such as inlets, manholes, concrete chambers, should be inspected for cracking, subsidence, breaching, wearing, and general deterioration at least once annually. The condition of surrounding and above lying materials shall be inspected for evidence of potential failures or deterioration. Structural damages must be repaired promptly. Analysis of structural damage and the design of structural repairs shall only be undertaken by qualified personnel.

4.3 Other Maintenance Criteria

Water, mosquito control chemicals, and concrete repair materials may also be required depending on the structure condition.

Refer to the following Table for Schedule of Maintenance and Maintenance Requirements.

Maintenance Item	**Schedule**	**Inspection Requirement**	**Maintenance Requirement**
Visual Inspection	Four (4) Times Annually After Every Rainfall Exceeding One Inch	Inspect all grates, manholes and inlets for buildup of sediment/trash/debris. Evaluate on-site upstream and downstream conveyance systems for clogging or trash sediment buildup.	Removed excess sediment, trash, debris from grates and/or within inlets and pipes. If present, remediate clogging.
Structural Components – Visual Inspection	Once Annually	Inspect all structural components for cracking, subsidence, breaching, wearing, and general deterioration.	If required, consult engineer to determine safety and/or stability of the system. Repair structural components as required.

5.0 HIGH DENSITY POLYETHYLENE (HDPE) PIPE SUBSURFACE DETENTION SYSTEM

A HDPE retention/detention system is comprised of a series of pipes and fittings that form an underground storage area, which retains or detains storm water runoff from a given area. As sediment and debris settle out of the detained stormwater, build up occurs that requires the system to be regularly inspected and cleaned in order for the system to perform as originally designed. The following provides the guidelines for inspection and maintenance of an HDPE underground storage system.

5.1 System Accessories and Fittings

A. Concentric Reducers

Concentric Reducers are fittings that transition between two pipes, either in line with one another or at perpendicular angles. The centerlines of the two pipes are at the same elevation. When a concentric reducer is used to connect the manifold pipe to the lateral pipes, most debris will be trapped in the manifold pipe.

B. Eccentric Reducers

Eccentric Reducers are fittings that transition between two pipes, either in line with one another or at perpendicular angles. The inverts of the two pipes are at the same elevations. When an eccentric reducer is used to connect the manifold pipe to the lateral pipes, most debris will follow the flow of the storm water into the lateral pipes.

C. Riser

Each retention/detention system typically has risers strategically placed for maintenance and inspection of the system. These risers are typically 24" in diameter or larger and are placed on the manifold fittings.

D. Manholes for cleaning access

30" manholes are placed on the manifold fittings. They are used for entrance of a pipe from a vacuum truck or a water-jetting device.

5.2 System Maintenance Overview

Maintaining a clean and obstruction-free retention/detention system helps to ensure the system performs the intended function of the primary design. Buildup of debris may obstruct flow through the laterals in a retention system or block the entranceway of the outlet pipe in a detention system. This may result in ineffective operation or complete failure of the system. Additionally, surrounding areas may potentially run the risk of damage due to flooding or other similar issues.

5.3 Inspection/Maintenance Frequency

All retention/detention systems must be cleaned and maintained. Underground systems may be maintained more cost effectively if these simple guidelines are followed. Inspection should be performed at a minimum of once per year. Cleaning should be done at the discretion of individuals responsible to maintain proper storage and flow. While maintenance can generally be performed year round, it should be scheduled during a relatively dry season.

5.4 Pre-Inspection

A post-installation inspection should be performed to allow the owner to measure the invert prior to accumulation of sediment. This survey will allow the monitoring of sediment build- up without requiring access to the retention/detention system. The following is the recommended procedure for pre-inspections:

1. Locate the riser section or cleanouts of the retention/detention system. The riser will typically be 24" in diameter or larger and the cleanouts are usually 4", 6" or 8" in diameter.

2. Remove the lid of the riser or clean outs.

3. Insert a measuring device into the opening and make note to a point of reference on the stick or string. (This is done so that sediment build up can be determined in the future without having to enter the system).

5.5 Inspection/Maintenance

A retention/detention system should be inspected at a minimum of one time a year or after major rain events if necessary. The following is the recommended procedure to inspect system in service:

1. Locate the riser section of the retention/detention system. The riser will typically be 24" in diameter or larger.

2. Remove the lid from the riser.

3. Measure the sediment buildup at each riser and cleanout location. Only certified confined space entry personnel having appropriate equipment should be permitted to enter the retention/detention System.

4. Inspect each manifold, all laterals, and outlet pipes for sediment build up, obstructions, or other problems. Obstructions should be removed at this time.

5. If measured sediment build up is between 5% - 20% of the pipe diameter, cleaning should be considered; if sediment build up exceeds 20%, cleaning should be performed at the earliest opportunity. A thorough cleaning of the system (manifolds and laterals) shall be performed by either manual methods or by a vacuum truck.

Debris, trash, sediment, and other waste materials removed from the basins shall be disposed of at a suitable disposal site and in accordance with all applicable local, state and federal waste regulations.

6.0 OUTLET STRUCTURES

Special attention should be given to the removal of floating debris (leaves, paper, trash, branches, and other manmade and natural materials), which can clog the devices. The benefits of debris removal include:

- Reducing the chance of clogging in the outlet structures and other facility components.
- Reducing potential mosquito breeding habitats.
- Improving facility performance.

6.1 Structural Components

All structural components must be inspected at least annually for cracking, subsidence, spalling, erosion, and general deterioration. Repairs shall be done in timely manner. Analysis of structural damage and the design of structural repairs shall only be undertaken by qualified personnel.

6.2 Maintenance Schedule:

Maintenance for the structure shall be performed as follows:

- The structure is to be cleared and inspected after each major storm.
- The structure is to be cleared and inspected each quarter regardless of storm activity.

7.0 REQUIRED EQUIPMENT FOR MAINTENANCE

The equipment required to facilitate the stormwater management procedures described in this operation and maintenance plan will include :

1. A stadia rod to measure depth of sediment.
2. Gas detectors to measure any gas buildup in structures.
3. OSHA required safety equipment.
4. If required, CCTV to monitor any sediment buildup.
5. Shovels, lighting equipment, wheel barrow, etc.
6. Debris hauling truck.
7. Personal Protective Equipment (PPE) like hard hat, gloves, work boots, etc.
8. Portable high pressure jet to perform cleaning if clogged.
9. In the event of mechanical lifting being required, a backhoe shall be used.

8.0 MAINTENANCE RECORDS AND REPORTING

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All inspections, regular maintenance, and required repairs shall be documented. Written maintenance and repair records for all stormwater management elements shall be maintained for at least five years by the responsible party, and shall be provided to the municipality and/or NJDEP upon request

Detailed Logs of all inspections, preventative and corrective maintenance performed on the stormwater management system shall be filed and kept on-site, including all maintenance related work orders.

The maintenance logs shall include the following information:

1 – The name of the person(s) performing the inspection/maintenance.
2 – The date that the inspection/maintenance was performed.
3 – The location of the inspection/maintenance.
4 - A clear description of the inspection and type of maintenance/corrective actions preformed.
5 – Any observations and comments.

9.0 GREEN ROOF MAINTENACE AND REPORTING

Maintenance OF All green roof components, including plant material, growing medium, filter fabric, drainage layer, waterproof membranes, and roof structure should be inspected for proper operations, integrity of the waterproofing, and structural stability throughout the life of the green roof. Achieving plant coverage greater than 95% is the single most important aspect to create a thriving, healthy rooftop.

During the first two years, green roofs should receiving regular watering during establishment, approximately 1" per week. A typical green roof planted with plugs will achieve 50% coverage during the first growing season and should be fully covered after the second growing season. During the first two years, a green roof should be inspected monthly during the growing season. Maintenance activities include weeding, supplemental planting and vegetation assessment. After the initial inspection maintenance should occur one to two times a year after vegetation has been established. Maintenance activities include weeding, filling in bare spots with plugs or seeds, and replacing any media that has eroded. Plant material should be maintained to provide 95% plant cover. During the growing season, supplemental irrigation or fertilizing with a slow release NPK fertilizer may be necessary. Irrigation may also be needed during extended periods of hot, dry weather. Irrigation, although not recommended, can be accomplished either through hand watering or automatic sprinkler systems if necessary during the establishment period.
in simplest terms, is a vegetated roof. The vegetation varies, but must be suitable to the local climate and be drought tolerant, unless a method of irrigation is also installed. Installation generally consists of a waterproof membrane installed over a suitably constructed roof deck. For in-situ installations, an under-drain drainage system is installed over the membrane. A lightweight engineered soil is installed on top of the under-drain, as fill dirt or topsoil is typically too heavy to use in rooftop applications. The engineered soil is then planted with select vegetation. If a modular system is selected, the drainage system may already be incorporated into the design, along with the soil and vegetation, depending on the manufacturer. The substrate material and depth are also factors that influence the efficiency of the green roof to store and/ or treat stormwater. Roofs consisting of relatively thin soil layers, called extensive roofs, are not as heavy as the intensive roofs, which are covered with thicker soil layers

ROOF MEMBRANE

The roof membrane must be sufficiently designed and installed to pond a minimum of 1-inch of water at the most shallow point on the roof for 24 hours without leaks. This should be tested in the same manner as shower pans are tested under the building code. Additionally, special consideration should be given for the plant root structure and prevention of soil migration during membrane selection. A root barrier may also be required to protect the waterproof membrane integrity. The under-drain drainage system should be designed for the selected plant's tolerance for drought and varying soil moisture contents by maintaining the proper balance of moisture and aerobic conditions

within the soil media for optimum vegetation sustainability. Design provisions should address higher volume rainfall events to keep excessive amounts of water from ponding on top of the soil, to prevent erosion, and to prevent soil media saturation for extended periods. Structural calculations shall be submitted that demonstrate the structure's ability to sustain the additional loading of the green roof appurtenances plus the maximum water weight that could be stored.

ISPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan for the green roof system should be developed in accordance with the membrane manufacturer's instructions and plant species selected. At a minimum, maintenance inspections should be performed at least four times per year. The maintenance plan should include provisions for vegetation maintenance and replacement as needed to maintain a minimum 80% coverage/survival rate in order to sustain Stormwater quality and/or detention credits. Irrigation may be required initially in order to establish the roof vegetation and to supply water under severe drought conditions. Any requirements for initial or intermittent use of fertilizer and pesticides for disease or insect control should be identified in the plan. Plant species should be carefully selected to minimize intermittent fertilizer and pesticide applications.

Each green roof installation shall be inspected by the agency responsible for issuing the Stormwater quality or detention credits to check compliance with the approved drawings before final acceptance is issued and the proper credits are approved. At a minimum, the following items should be checked during the inspection:
(a) Results from porosity testing (for non-modular installations).
(b) Certification of planting to be used
(c) Certification from a registered Professional Engineer or registered Architect that the green roof, including membrane, drain system and engineered soil system, was installed per the approved (permitted) drawings and operates as designed. Drawings of the green roof installation

Once the green roof is installed and established, additional inspections will be required in order to properly maintain the vegetation, drainage system and roof membrane. Routine inspections should be conducted and associated maintenance activities performed on the following:
(a) Joints at adjoining walls, roof penetrations for vents, electrical and air conditioning conduits should be inspected regularly for leaks. The ceilings located directly below the green roof installation should also be visually inspected for signs of water staining or leaking.
(b) (c) (d) Overview Designated drainage paths and drainage system components should be inspected to ensure proper surface drainage is maintained and that the soil layer is drained to prevent excessively saturated soils. Vegetation selected to tolerate drought conditions may rot or die if the soil is allowed to become saturated for extended periods.

Vegetation should be visually inspected to identify weeds, accumulated trash or debris, dead or dying vegetation, disease or other infestation problems requiring maintenance attention. Weeds and dead vegetation should be removed on a regular basis, especially right after the roof is planted. If a certain plant or grass species continues to die, that plant or grass should be removed and replaced with a more tolerant species. Certified professionals should only be used to apply chemical applications for the control of disease or insects at trouble spot locations. Trimming and pruning should be done in accordance with horticulture practices to keep vegetation aesthetically groomed.

Sample Inspection and Maintenance Log

Property Name: Property Owner:

Property Address:_____

Inspection Date:_____ Type of Inspection: □ Quarterly □ Semi-annually
□ After Heavy Rainfall Event
□ Annually
□ Other:_

Inspector(s): _____

_____

Equipment: _____
_____
_____
_____
_____
_____
_____

Items	**Observations**	**Maintenance Needed? (Y/N)**	**Type of Maintenance Required**	**Comments** (Describe maintenance completed and if needed maintenance was not conducted, note when it will be done)
Visual Site Inspection (General)				
Visual Inspection (Structural)				
Inlets/Manholes				
Roof Leader/Header System				
Pipe Conveyance System				
Subsurface Detention System				
Outlet Control Structure				
Surrounding Site				
Miscellaneous				

GREEN ROOF MAINTENANCE

The following checklist procedures shall be followed to ensure that the green roof is working properly.

Operation Checklist

Project Address: _____

Inspected by: _____
Date: _____

Inspection Item	**(YES/NO/N.A)**	**Notes**
Weeding has been completed		
Plant replacement has been completed if deemed necessary		
Periodic fertilization has been performed if deemed necessary		
Soil testing should be performed annually, the last required test has been performed already		
Seasonal cleanup and leak testing has been performed as necessary. Manual leak test is done by filling with water and doing visual check.		
Maintenance inspection should be performed annually, the last required inspection has taken place, refer to Maintenance Checklist.		

Maintenance Checklist

Project Address: _____

Inspected by: _____
Date: _____
Project information:

Date of green roof installation:_____

Irrigation immediately prior to inspection:
Amount: _____
Frequency and duration: _____
Other notes:
_____
_____
_____

Inspection Item	**Criteria**	**Additional Notes**
Growing conditions during inspection	Air temperature _____ Soil moisture (e.g. wet, dry etc.) _____ Sunny or cloudy (circle) Date of last rainfall: _____ Have actions items from last inspection been addressed? _____	
Vegetation	Percent cover of healthy acceptable plant species: _____ Diversity (number) of acceptable species: _____ Percent cover of weeds – list species in notes: _____	
Dominant species, note all species 5% cover or more	List including name, percent cover, and any notes _____ _____ _____ _____	

	_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	
Signs of plant stress	Noted below including % cover of plants showing signs of stress and possible causes: _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	
Irrigation	Do any broken drip or supply lines, or any other irrigation components need repair? _____ _____ _____ _____ Is there evidence of uneven irrigation levels, such as desiccated (dried-out) media or marshy (water saturated) conditions? If so, note on as-built plan. _____ _____ _____ _____ Does irrigation regime need to be adjusted? _____ _____ _____ _____	