

Stormwater Management Operation and Maintenance Manual

For

Malvern School Properties, LP

Proposed Day School

*982 Georgetown-Franklin Turnpike
Block 28010, Lots 57 & 58
Township of Montgomery, Somerset County, NJ*

Prepared By:



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A handwritten signature in black ink, appearing to read 'Jeffrey S. Haberman', is written over a horizontal line.

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PROJECT DETAILS

A. Introduction and Description of Facilities:

The purpose of this report is to provide guidelines and information regarding the required maintenance for the proposed stormwater management facilities associated with the development of Block 28010, Lots 57 & 58 in the Township of Montgomery, Somerset County, New Jersey. The site is presently developed with a residential dwelling unit. The existing conditions of the tract have been verified by the Boundary and Topographic Survey, as prepared by Dynamic Survey LLC, dated 08/26/2022, last revised 09/07/2022. Additionally, our office conducted several field visits to the subject parcels to supplement information provided on the aforementioned survey and to aid in design of the proposed development. It is proposed to construct a day school with associated site amenities including landscaping, lighting, grading, parking and stormwater management facilities. The proposed stormwater management system includes a bioretention basin with an underdrain network.

The stormwater management facility will contribute toward the conveyance, storage, treatment and discharge of runoff generated by the proposed development. Every stormwater management system whether at grade or below grade, requires that basic periodic maintenance to be performed in order to maintain the proper functioning and operation of the system. This report will outline these procedures, further discuss responsibilities and highlight those responsible for performing said maintenance.

The proposed overall stormwater management system has been designed with a small-scale bioretention basin with underdrains. The bioretention basin accepts stormwater runoff from part of the roof leader conveyance system, the parking lot, and open space. The bioretention basin has been designed to meet the green infrastructure requirements set forth by NJAC 7:8.

Detailed information regarding the design of the overall stormwater management system can be found in the Stormwater Management, Groundwater Recharge, and Water Quality Analysis Report, prepared by Dynamic Engineering Consultants, PC. The following information can be considered a guideline for the continued maintenance including suggested inspection scheduling as well as performance objectives.

The existing and proposed facilities will require periodic inspections and maintenance. The following information can be considered a guideline for the continued maintenance including suggested inspection scheduling as well as performance objectives.

B. Project Contacts:

The applicant is responsible to maintain a detailed log of all preventative and corrective maintenance actions for the constructed stormwater facilities incorporated into the design, including record of all inspections and copies of all maintenance-related work orders.

The applicant is also responsible for maintenance to evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and deed as needed. The applicant shall retain a copy of this report onsite should a public entity request this report or documentation of said maintenance in the future.

Applicant:

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20 Creek Road
Glen Mills, PA 19342

Owner: Malvern School Properties, LP
 20 Creek Road
 Glen Mills, PA 19342
 Attn: Joseph Scandone
 (610)-888-9797

Design Engineer: Jeffrey S. Haberman, PE., PP.
 Dynamic Engineering Consultants, PC
 1904 Main Street
 Lake Como, NJ 07719
 (732) 974-0198

Party Responsible for Maintaining Proposed Bioretention Basin Malvern School Properties, LP
 20 Creek Road
 Glen Mills, PA 19342

As previously mentioned, this manual, including any future revisions, must be recorded upon the deed of record of the property.

C. Proposed Best Management Practices:

Bioretention Basin

The proposed bioretention basin has been designed to address the applicable aspects of N.J.A.C. 7:8, including stormwater quantity and quality requirements. Stormwater runoff for the proposed development will be conveyed to the basin via the roof leader conveyance system, overland flow, and the parking lot pipe conveyance system. Stormwater runoff detained in Basin ‘A’ is released through an outlet control structure to the stormwater conveyance system and is tributary to the existing basin located at the rear of the property.

The bioretention basin has been designed with underdrains, as well as a 6” sand layer under a minimum 18” topsoil layer to provide filtration of runoff to meet the water quality standards. If the basin bottom is disturbed during any preventative or corrective maintenance measures, the bottom of the basin shall be reestablished with the 6” layer of clean K5 sand covered with 18” of topsoil and seeded with the basin seed mix specified per appropriate design specifications.

Design Information

Reference design criteria under correctly functioning conditions is as follows.

Soil Bed Permeability Rate	0.2 in/hour	
Seasonal High Water Elevation	Not Encountered	
TSS Removal Rate	80%	
Design Storm Events		
Water Quality Storm	Rainfall Depth:	1.25 in
	Runoff Volume:	0.074 ac-ft
	Peak Outflow Rate	0.0 cfs
	Water Surface Elevation	129.99
2-Year Storm	Rainfall Depth:	3.34 in
	Runoff Volume:	0.139 ac-ft
	Peak Outflow Rate	1.09 cfs
	Water Surface Elevation	130.84

10-Year Storm	Rainfall Depth: Runoff Volume: Peak Outflow Rate Water Surface Elevation	5.11 in 0.191 ac-ft 3.37 cfs 131.50
100-Year Storm	Rainfall Depth: Runoff Volume: Peak Outflow Rate Water Surface Elevation	8.66 in 0.256 ac-ft 7.80 cfs 132.31

Outlet Control Structure (reference Drainage & Utility Plan, and Construction Details within Appendix):

OCS Storm Structure #200	
15" Pipe	126.42
5" Orifice (2)	130.00
12" Orifice	130.75
1' Weir	131.50
Top of Box	133.75

INSPECTION AND MAINTENANCE:

A. Routine Inspection and Maintenance of the Stormwater Management Facilities:

All stormwater management basins have been designed to control stormwater and reduce flooding and degradation of water quality. Without proper routine inspection and maintenance, the system may lose some or all of its capability to function to its full capacity. Lack of adequate maintenance at these facilities could lead to system failures.

A consulting Professional Engineer should perform regularly scheduled maintenance inspections of the stormwater facilities expected to receive and/or trap debris and sediment at least one (1) time each year as well as after every storm exceeding 1 inch of rainfall. The primary purpose of these inspections is to ascertain the operational condition and safety of the facilities, particularly the condition of the outlet structures, trash racks and other safety-related aspects. Inspections will also provide information on the effectiveness of regularly scheduled Preventative and Aesthetic Maintenance Procedures, and will help to identify where changes in the extent and scheduling of the procedures are warranted. Finally, the facility inspections should also be used to determine the need for and timing of Corrective Maintenance procedures.

Routine maintenance of this facility should be separated into two (2) basic types: Functional Maintenance and Aesthetic Maintenance. Functional Maintenance is further broken down into two (2) categories: Preventative and Corrective. Aesthetic Maintenance, which is necessary to maintain the visual appeal and aesthetic quality of these facilities should be incorporated on the same schedule as the preventative maintenance efforts. Listed below are the Preventative, Corrective and Aesthetic Maintenance Procedures to be performed on a routine basis:

1. Preventive Maintenance Procedures:

The purpose of Preventative Maintenance is to maximize the effectiveness of the stormwater management aspects of the system so that it remains operational and safe as often as practicable, and to minimize the need for emergency or corrective maintenance. These procedures are as follows:

a) Grass Cutting:

A regularly scheduled program of mowing and trimming of grass at the basin during the growing season will help to maintain a tightly knit turf, and will also help to prevent diseases, pests and the intrusion of weeds. The actual mowing requirements of an area should be tailored to the specific site conditions, grass type, and seasonal variations in the climate. In general, lawn areas should be mowed at least once a month during the growing season and grass should not be allowed to grow more than 1 to 2 inches between cuttings. Allowing the grass to grow more than this amount prior to cutting it may result in damage to the grass' growing points and limit its continued healthy growth.

b) Grass Maintenance:

Grassed areas require periodic fertilizing, de-thatching and soil conditioning in order to maintain healthy growth and to provide bank stabilization. Additionally, provisions should be made to re-seed and re-establish grass cover in areas damaged by sediment accumulation, stormwater flow, or other causes. These tasks should be performed, or at least evaluated, on a quarterly basis.

c) Vegetative Cover

Trees, shrubs, and ground cover require periodic maintenance, including fertilizing, pruning, and pest control in order to maintain healthy growth. Vegetated areas must be inspected at least annually for erosion and scour as well as unwanted growth, which should be removed with minimum disruption to the remaining vegetation. The basin should be evaluated regularly to determine whether excessive plant growth is evident. A correction in the application of fertilizers can often solve these problems. Weeds, which have become a problem, can be cleared through harvesting by professional maintenance technicians.

Note: All use of fertilizers, mechanical treatments, pesticides and other means to ensure optimum vegetation health must not compromise the intended purpose of the storm water management facility. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

d) Removal and Disposal of Trash/Debris and Sediment:

All storm water management components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding one inch of rainfall. Such components may include the stormwater conveyance network (piping & inlet), the flared end sections, riprap, trash racks, and the outlet control structure.

Removal of trash and debris will prevent possible damage to trash racks and outlet structure openings and eliminate potential mosquito breeding habitats. Debris and trash must be properly hauled off the site and transferred to an approved disposal site.

The system should also be evaluated for excessive deposition of sediment. Accumulated sediment should be removed utilizing light weight equipment to avoid soil compaction before it threatens the storage volume of the system. Before de-sedimentation activities are performed, consideration should be given to evacuating all standing water from the system. This may be accomplished by clearing any blocked openings of the outlet structure or by mechanical means (pumping). Disposal of discharged water and sediment must comply with all local, county, state and federal regulations. Only suitable disposal sites should be utilized. If stable soil conditions exist on site, sediment deposition should not be an excessive maintenance issue. Should a recurrent stabilization situation develop, the inspector should identify the upstream sources of sediment and recommend required stabilization measures. Access has been provided for inspection and maintenance of the system and its components.

Sand Filter:

All sand filter components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Such components may include inlets and diversion structures, fore bays, sand beds, and overflows.

e) Sediment Removal and Disposal:

The basin should also be evaluated for excessive deposition of sediment. Accumulated sediment should be removed before it threatens the storage volume of the basin. Before de-sedimentation activities are performed, consideration should be given to evacuating all standing water from the basin. This may be accomplished by clearing any blocked openings of the outlet structure or by mechanical means such as pumping. If stable soil

conditions exist on-site, sediment deposition should not be an excessive maintenance issue. Should a recurrent stabilization situation develop, the inspector should identify the upstream sources of sediment and recommend required stabilization measures.

Sand Filter

Sediment removal should take place when all runoff has drained from the sand bed and the sand is reasonably dry. In addition, runoff should be drained or pumped from fore bays with permanent pools before removing sediment. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

f) Mechanical Components:

Mechanical components such as valves, sluice gates, pumps, fence gates, locks, and access hatches, should remain functional at all times. Regularly scheduled maintenance should be performed in accordance with the manufactures' recommendations. Additionally, all mechanical components should be operated at least once every three months to assure their continued performance.

g) Elimination of Potential Mosquito Breeding Habitats:

The most effective mosquito control program is one that eliminates potential breeding habitats. Almost any stagnant pool of water can be attractive to mosquitoes, and may become the source of a large mosquito population. A maintenance program dedicated to eliminating potential breeding areas is preferable to chemical means of controlling mosquitoes. The most important maintenance functions, is removal of all obstructions to natural flow patterns before stagnant water conditions can develop.

h) Observations After Rainfall:

This management measure involves monitoring the amount of time the bioretention basin takes to drain to ensure the basin is working properly. The bioretention basin should drain to the bottom in less than 72 hours. If significant increases or decreases are observed in the drawdown time, a qualified licensed Professional Engineer shall be contacted to evaluate the basin's bottom surface, subsoil and both groundwater and tailwater elevations to determine what corrective measures may need to be implemented.

Sand Filter:

This management measure involves monitoring the amount of time it would normally take to drain the maximum design storm runoff volume below the top of the filter's sand bed. This normal drain or drawdown time should then be used to evaluate the filter's actual performance. If significant increases or decreases in the normal drain time are observed, a qualified licensed Professional Engineer shall be contacted to evaluate the filter's sand bed, underdrain system, and tailwater levels to determine what corrective measures may need to be implemented to maintain the proper functioning of the filter.

i) Inspection of the Sand Bed:

The sand bed should be inspected at least twice annually. The infiltration rate of the sand bed material may also be retested. If the water fails to infiltrate 72 hours after the end of the stormwater quality design storm, corrective measures must be taken.

j) Maintenance of Bioretention Basin's Sand Layer:

The bottom sand layer in a surface bioretention basin should be inspected at least monthly as well as after every storm exceeding one inch of rainfall. The permeability rate of the soil below the basin may also be retested periodically. If the water fails to infiltrate within the given amount of time as mentioned above, corrective measures must be taken. Annual tilling by light equipment can assist in maintaining infiltration capacity and break up clogged surfaces. This task is to be followed by re-grading and leveling of the sand layer. The thickness of the sand layer should be checked to ensure that a minimum of 6" is maintained throughout the basin bottom area to ensure that the infiltration basin water quality treatment feature is operating correctly.

k) Vegetation Maintenance:

All landscaped areas within the aboveground basin shall be periodically inspected a minimum of once per month and every two weeks during growing season or after each mowing session. In general, mowing should occur at least once a month during the growing season. Clippings from the mowing operations shall be removed and disposed of in accordance with all local, state and federal regulations. Reseeding, if required, shall occur within spring or early fall. Summer and fall seeding can be successful with a light mulching of weed-free straw to conserve moisture.

All landscaped areas shall be inspected for invasive plant species. Invasive species should be removed immediately and properly disposed of at an approved disposal site.

Reference the Landscaping Plan within the Appendix for appropriate plantings within bioretention basins.

l) Bioretention Underdrain Inspection Points:

The Bioretention Basin is designed to include a network of 4" perforated pipe underdrains installed at a 2% slope. The underdrain is the only outflow of stormwater runoff that infiltrates into the basins' planting soil bed; the basin is not designed to infiltrate into the subsoil and a liner is proposed to capture and convey runoff into the underdrains.

Clean-out inspection ports are located at the ends of all underdrain pipes, with WQ, 2-, 10-, 100- year design storm elevations indicated on the cleanout risers; these elevations are to be referenced to ensure the bioretention basin are functioning as designed during storms of the same magnitude.

m) Inspection and Reporting

Regularly scheduled inspections of the facility should be performed by a consulting Professional Engineer. The primary purpose of the inspections is to ascertain the operational condition and safety of the facility. Inspections will also provide information on the effectiveness of regularly scheduled Preventative and Aesthetic Maintenance procedures. It should be noted that, in addition to regularly scheduled inspections, an informal inspection should be performed during every visit to stormwater management facilities by maintenance or supervisory personnel.

The recording of all maintenance work and inspections provides valuable data on the condition of the stormwater management facilities. Review of this information will also help to establish more efficient and beneficial maintenance procedures and practices. All

recorded information should be directed to the owner of the facility for review and subsequent follow-up on recommendations. Inspection and maintenance checklists and logs are included in the Appendix of this manual.

2. Corrective Maintenance Procedures:

a) Removal of Debris and Sediment:

Sediment, debris and trash which threaten the discharge capacity of the system should be removed immediately with the use of light weight equipment to avoid soil compaction and properly disposed. As noted previously, it is recommended that all water be evacuated from the system with a pump before any significant amount of sediment, settled debris or trash is removed from the system. The lack of an available disposal site should not delay the removal of trash, debris and sediment. Temporary disposal sites should be utilized if necessary.

b) Structural Repairs:

Structural damage to outlet and inlet structures, trash rack, access hatches, and walls as a result of vandalism, flood events, settlement or other causes must be repaired promptly. The urgency of the repairs will depend upon the nature of the damage and its effects on the safety and operation of the facility. The analysis of structural damage and the design and performance of structural repairs should only be undertaken by the consulting Professional Engineer.

c) Embankment and Slope Repairs:

Damage to embankments, and side slopes must be repaired promptly. This damage can be the result of rain or flood events, vandalism, animals, vehicles or neglect. Typical problems include settlement, scouring, cracking, sloughing, seepage and rutting. The urgency of the repairs will depend upon the nature of the damage and its effect on the safety and operation of the facility. The analysis of the damage and the design and performance of geotechnical repairs should only be undertaken by qualified personnel and under the direction of a consulting Professional Engineer. All basin embankments shall be inspected quarterly and after each significant storm greater than one (1) inch of rainfall. Any damage or indication of erosion shall be immediately inspected by a professional engineer.

d) Dewatering:

It may be necessary to remove ponded water from within a malfunctioning basin. This ponding may be the result of a blocked principal outlet or poor bottom drainage. Portable pumps may be necessary to remove the ponded water temporarily until a permanent solution can be implemented.

e) Weed Harvesting:

It may be necessary to remove congested weeds from the basin. Companies with specialized harvesters should be contacted to perform these operations. Note that such work may require the approval of various regulatory agencies.

f) Extermination of Mosquitoes:

If neglected, basins can become an ideal mosquito breeding area. The extermination of mosquitoes will usually require the services of the County Mosquito Commission. If mosquito control in the facility becomes necessary, the preventative maintenance program should be re-evaluated, and more emphasis should be placed on control of mosquito breeding habitats.

g) Erosion Repair:

Vegetative cover or other protective measures are necessary to prevent the loss of soil due to the forces of wind and water. Where a re-seeding program has not been effective in maintaining a non-erosive vegetative cover, or other factors have exposed soils to erosion, corrective steps should be initiated to prevent further loss of soil that may result in danger to the stability of the facility. Soil loss can be controlled by a variety of materials and methods, including rip-rap, gabion lining, geotextile fabrics, sod, seeding, concrete lining and re-grading.

h) Elimination of Trees, Brush, Roots, and Animal Burrows:

The stability of embankments can be impaired by large roots and animal burrows. Additionally, burrows can present a safety hazard for maintenance personnel. Trees and brush with extensive, woody root systems should be completely removed to prevent destabilization and the creation of seepage routes. Roots should also be completely removed to prevent decomposition within the embankment. Root voids and burrows should be filled with material similar to the existing material, and capped just below grade with stone, concrete or other material. If the filling of the burrows does not discourage the animals from returning, further measures should be taken to either move the animal population or to make critical areas of the facility unattractive to them.

i) Snow and Ice Removal:

Accumulations of snow and ice can threaten the functioning of the inlets, outlets and emergency spillways. Provision of the equipment, material and personnel to monitor and remove snow and ice from critical areas will assure the function of the facility during the winter months.

3. Aesthetic Maintenance Procedures:

Aesthetic Maintenance, although not required to keep the basin operational, will maintain the visual appeal of the facility and will benefit everyone within the local community. Aesthetic Maintenance can also reduce the amount of required Preventative and Corrective Maintenance.

a) Graffiti Removal

The timely removal of graffiti will restore the aesthetic quality of the basin. Removal can be accomplished by paint or other cover, or removal with scrapers, solvents or cleansers. Timely removal is important to discourage further graffiti and other acts of vandalism.

b) Grass Trimming/Landscape Maintenance:

The lawn areas around the basin shall be mowed on a regular basis as necessary to maintain the lawn at a height of 2 to 3-inches. These areas shall also be fertilized twice a

year, once in the spring and once in the fall. Fertilizer for lawn areas shall be 10-20-10 applied at a rate of 11 lbs. per 1,000 sf. or as determined by a soil test. Any bare, dead or damaged lawn areas shall be re-seeded in accordance with the original procedures as outlined in the Soil Erosion and Sediment Control Plans using the same mix and seeding rates. Stabilization of bare or damaged areas shall be done in a timely fashion so as to avoid exposing the soil to erosion.

If season prevents the re-establishment of turf cover, exposed areas should be stabilized with straw or salt hay mulch as described in the Soil Erosion and Sediment Control Plan until permanent seeding can be done. Seeding can be done between March 15th and June 15th and between September 15th and December 1st, only if adequate water is provided.

The shrubs around the basin should also be maintained in order to promote a neat appearance and healthy, vigorous growth. All shrubs should be allowed to grow together in masses as shown on the plans and not pruned into individual plants. The planting beds should be mulched with hardwood mulch every two (2) years in order to provide a suitable growing medium for the shrubbery and to retain moisture around the root zones.

Pruning of shrubs should also be done on a regular basis to maintain the shape and appearance of the shrub masses. The height of the shrubs may vary according to the plants natural growth habits, but should not exceed 6-feet. Pruning should be done as necessary throughout the year to remove dead branches and to control new growth. Any pruning, other than the removal of dead branches, should be done in either late winter/early spring or after the shrub has flowered in the spring.

In the event that a shrub should experience more than 2/3 die back, it should be replaced in kind as soon as possible in either the spring or fall planting season. The replacement shrub should be the same species as the original and installed at the size and condition as specified on the original landscape plans. If, for any reason, a substitution of species or size must be made, it shall be subject to the approval of the project Professional Engineer.

The trees surrounding the basin areas shall be maintained regularly to ensure good health and exhibit an attractive appearance. Their maintenance should include fertilization twice annually, with one application in the spring and another in early fall. The trees shall be pruned in the late winter or early spring. However, dead branches should be removed as soon as they are noticed. Care should be taken to avoid cutting off the central leader of a tree if one is present.

If a tree is severely damaged or experiences more than 2/3 die back, it should be replaced in either the spring or fall planting season, whichever comes first. The only exception to this is if the replacement tree has a fall transplanting hazard. Replacement trees should be planted at the same size and condition as specified on the landscape plans. Any tree or shrub maintenance, tree pruning or plant material substitution of species or size shall be subject to the approval of the project Professional Engineer.

c) Control of Weeds

Although a regular grass maintenance program will minimize weed intrusion, some weeds will appear. Periodic weeding, either chemically or mechanically, will help to maintain a healthy turf, and keep grassed areas looking attractive. Application of chemicals should be monitored closely so as not to affect the ecosystems within the detention basin. Excessive growth of weeds within the basin can be controlled mechanically as discussed in the previous section.

4. Recording and Logging of all Maintenance Activities:

The recording of all maintenance work and inspections provides valuable data on the facility's condition. Review of this information will also help to establish more efficient and beneficial maintenance procedures and practices. All recorded information should be directed to the owners of the basin for review and subsequent follow-up on recommendations. Data obtained from informal inspections should be retained; however, this data does not have to be submitted to NJDEP. A copy of all records and logs of maintenance activities shall be submitted to the Township Engineer annually for review.

5. Summary of Maintenance Procedures:

Preventative Maintenance

- a) Grass Cutting
- b) Grass Maintenance
- c) Vegetative Cover
- d) Removal and Disposal of Trash/Debris and Sediment
- e) Sediment Removal and Disposal
- f) Mechanical Components
- g) Elimination of Potential Mosquito Breeding Habitat
- h) Observation After Rainfall
- i) Inspection of the Sand Bed
- j) Maintenance of Bioretention Basin's Sand Layer
- k) Vegetation Maintenance
- l) Inspection and Reporting
- m) Bioretention Underdrain Inspection Points

Corrective Maintenance

- a) Removal of Debris and Sediment
- b) Structural Repairs
- c) Embankment and Slope Repairs
- d) Dewatering
- e) Weed Harvesting
- f) Extermination of Mosquitoes
- g) Erosion Repair
- h) Elimination of Trees, Brush, Roots, and Animal Burrows
- i) Snow and Ice Removal

Aesthetic Maintenance

- a) Graffiti Removal
- b) Grass Trimming/Landscape Maintenance
- c) Control of Weeds

B. Bioretention Basin Maintenance

1. General Maintenance

- Proper and timely maintenance is essential to continuous, effective operation; therefore, an access route must be incorporated into the design, and it must be properly maintained.

- All structural components must be inspected, at least once annually, for cracking, subsidence, spalling, erosion and deterioration.
- Components expected to receive and/or trap debris and sediment must be inspected for clogging at least four times annually, as well as after every storm exceeding 1 inch of rainfall.
- Sediment removal must take place when all runoff has drained from the planting bed and the basin is dry.
- Disposal of debris, trash, sediment and other waste material must be done at suitable disposal/recycling sites and in compliance with all applicable local, state and federal waste regulations.
- In systems with underdrains, the underdrain piping must be connected, in a manner that is easily accessible for inspection and maintenance, to a downstream location.
- Access points for maintenance are required on all enclosed areas within a small-scale bioretention system; these access points must be clearly identified in the maintenance plan. In addition, any special training required for maintenance personnel to perform specific tasks, such as confined space entry, must be included in the plan.
- Stormwater BMPs may not be used for stockpiling of plowed snow and ice, compost, or any other material.
- A detailed, written log of all preventative and corrective maintenance performed on the smallscale bioretention system must be kept, including a record of all inspections and copies of maintenance related work orders. Additional maintenance guidance can be found at https://nj.gov/dep/stormwater/maintenance_guidance.htm

2. Vegetated Areas

- Bi-weekly inspections are required when establishing/restoring vegetation.
- A minimum of one inspection during the growing season and one inspection during the nongrowing season is required ensure the health, density and diversity of the vegetation.
- Mowing/trimming of vegetation must be performed on a regular schedule based on specific site conditions; perimeter grass should be mowed at least once a month during growing season
- Grasses within the small-scale bioretention system must be carefully maintained with lightweight equipment, such as a hand-held line trimmer, in order to maintain the permeability of the system.
- Vegetative cover must be maintained at 85%; damage must be addressed through replanting in accordance with the original specifications.
- Vegetated areas must be inspected at least once annually for erosion, scour and unwanted growth; any unwanted growth should be removed with minimum disruption to the remaining vegetation.
- All use of fertilizers, pesticides, mechanical treatments and other means to ensure optimum vegetation health must not compromise the intended purpose of the bioretention system.

3. Drain Time

- The planting bed should be inspected at least twice annually to determine if the permeability of the bed has decreased.
- The design drain time for the maximum design storm runoff volume must be indicated in the maintenance manual.
- If the actual drain time is significantly different from the design drain time, the components must be evaluated, and appropriate measures taken to return the bioretention system to the original tested as-built condition.

- If the bioretention system fails to drain the Water Quality Design Storm within 72 hours, corrective action must be taken and the maintenance manual revised accordingly to prevent similar failures in the future.
- The water surface elevation for each of the design storms must be indicated on the maintenance plan and in the maintenance logs to facilitate inspections. It is suggested that indelible markings be drawn or physical markers be set on the inside of the outlet control structure as visual indicators of the design storm water surface elevations

C. Rip Rap Maintenance

1. General Maintenance

- Rip Rap must be inspected, at least once annually, for spalling, erosion and deterioration.
- Sediment and debris removal should be performed when observed.
- If vegetation is observed it should be properly removed.
- Disposal of debris, trash, sediment and other waste should be done at a suitable disposal/recycling facility and in accordance with all applicable local, state and federal waste regulations.

D. Maintenance Equipment & Materials

1. Transportation Equipment

- a) Trucks for Transportation of Materials
- b) Trucks for Transportation of Equipment
- c) Vehicles for Transportation of Personnel

2. Debris, Trash and Sediment Removal Equipment

- a) Portable pump for dewatering with sediment bag

3. Miscellaneous Equipment

- a) Shovels
- b) Rakers
- c) Wheel Barrows
- d) Gloves
- e) Brooms

4. Standard Mechanics Tools

5. Tools for Maintenance of Equipment

6. Materials

- a) Topsoil
- b) Fill
- c) Seed
- d) Soil Amenities (Fertilizer, Lime, etc.)
- e) Chemicals (Pesticides, Herbicides, etc.)
- f) Mulch
- g) Spare Parts for Equipment

E. Checklists and Logs

The Appendix of this report contains sample checklists and logs regarding various aspects of the system maintenance and inspection. A brief description of the use of each form is listed below:

1. "Maintenance Work Order and Checklist" – a comprehensive form outlining both required and completed maintenance work.
2. "Maintenance Log" – a summary table for recording of all maintenance work at the site.
3. "Inspection Log" – a summary table for recording the results of all inspection of the system.

F. Estimated Maintenance Costs & Tasks

The following is a summary of the required maintenance tasks and associated costs in written and tabular form:

- Inspections to be performed by a consulting engineer on an annual basis. - **\$1,000.00.**
- Inspections to be performed by the property owner and/or a maintenance designee on a monthly basis and/or after a storm event exceeding 1 inch of rainfall– **Minimal cost associated – Owners responsibility - \$500.00.**
- Stormwater conveyance system and outlet control structure access for debris removal to be performed on an annual basis and/or as inspection routine dictates - **\$2,000.00.**
- Surface debris removal including garbage and organic matter to be performed in conjunction with lawn and grounds maintenance, includes leave removal in the Fall and removal of excessive amounts of snow, if necessary, in the Winter. These tasks are encouraged as necessary to maintain safe operating conditions (twice a month from Spring through Winter recommended or on as needed basis) - **\$1,000.00.**

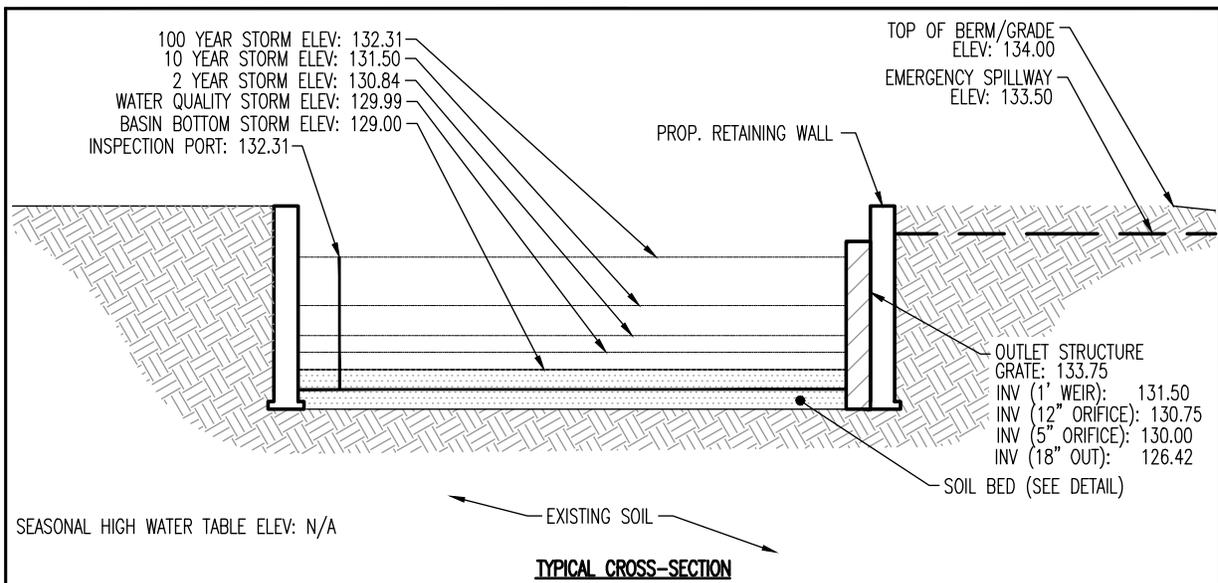
Maintenance Schedule Summary

Task Identification	Task Frequency	Task Estimated Cost
Inspection by licensed professional consulting engineer	Once (1) per year	\$1,000.00/Each
Inspection by property owner and/or maintenance designee	Once (1) per month (or after a storm event exceeding 1 inch of rainfall)	\$500.00/Each
Debris removal from stormwater conveyance system (inlets, pipes, manholes, flared end sections, and outlet control structure)	Once (1) per year	\$2,000.00
Surface debris removal (garbage & organic matter) including leaves in the Fall and snow in the Winter	Twice (2) per month (or on needed basis)	\$1,000.00/Each

APPENDIX

BMP LOCATION MAP

BIORETENTION BASIN SYSTEM DETAILS

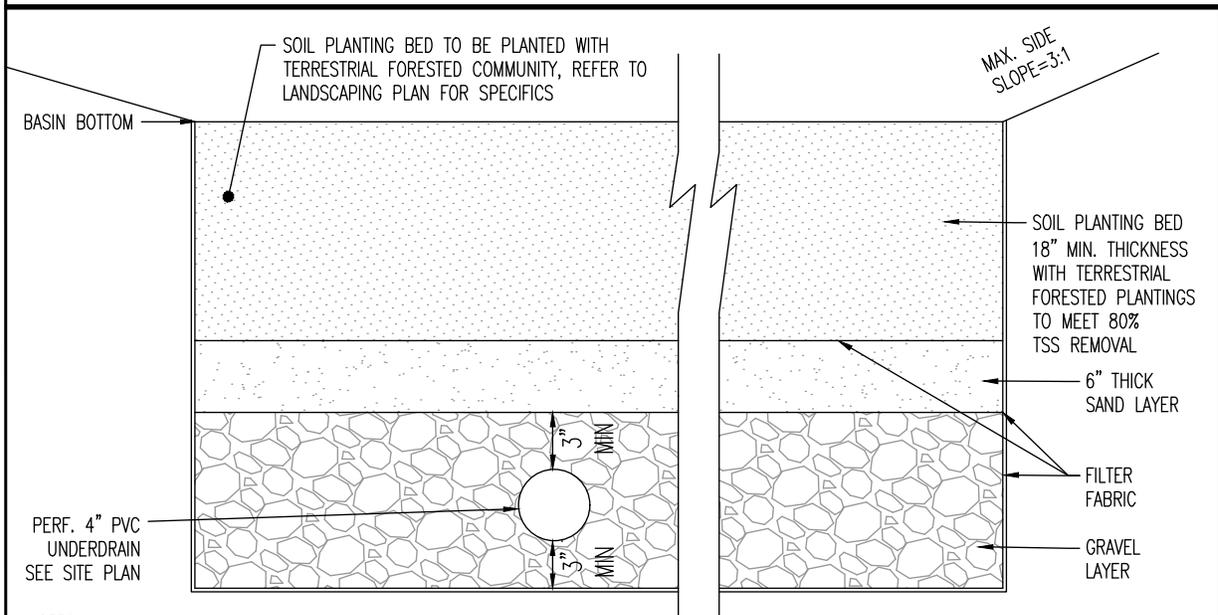


NOTES:

1. REFER TO BIORETENTION SOIL BED DETAIL FOR PLANTING BED SPECIFICATIONS.
2. CONTRACTOR OR OWNER TO ENGAGE QUALIFIED GEOTECHNICAL ENGINEER TO TEST SOIL PERMEABILITY AND PROVIDE CONSTRUCTION PHASE INSPECTIONS OF THE BASIN BOTTOM SOILS AND FILL MATERIALS WITHIN ANY PROPOSED INFILTRATION OR RETENTION BASIN TO COMPARE RESULTS TO DESIGN CRITERIA.
3. CONTRACTOR SHALL PROVIDE A RECORD OF THE REPLACEMENT MATERIAL USED AND ITS CORRESPONDING PERMEABILITY RATE. REFER TO THE TEST PIT AND/OR SOIL BORING RECORDS AND STORMWATER MANAGEMENT REPORT TO CONFIRM THE DEPTH OF THE ZONE OF INFILTRATION.
4. BASIN CONSTRUCTION MUST NOT COMPACT SOILS BELOW BASIN BOTTOM.
5. PROPOSED INSPECTION PORTS ARE TO BE LOCATED AT UPSTREAM AND DOWNSTREAM END OF PERFORATED UNDERDRAIN PIPES AND EXTEND ABOVE THE SURFACE OF THE SOIL BED. THE DEPTH OF RUNOFF OF THE 100-YEAR DESIGN STORM MUST BE PERMANENTLY MARKED WITH PAINT ON ALL INSPECTION PORTS.

BIORETENTION BASIN DETAIL

NOT TO SCALE

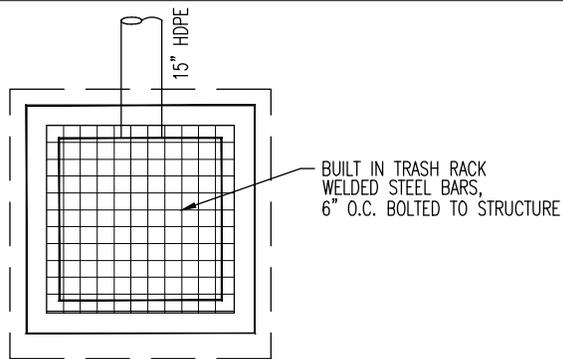


NOTES:

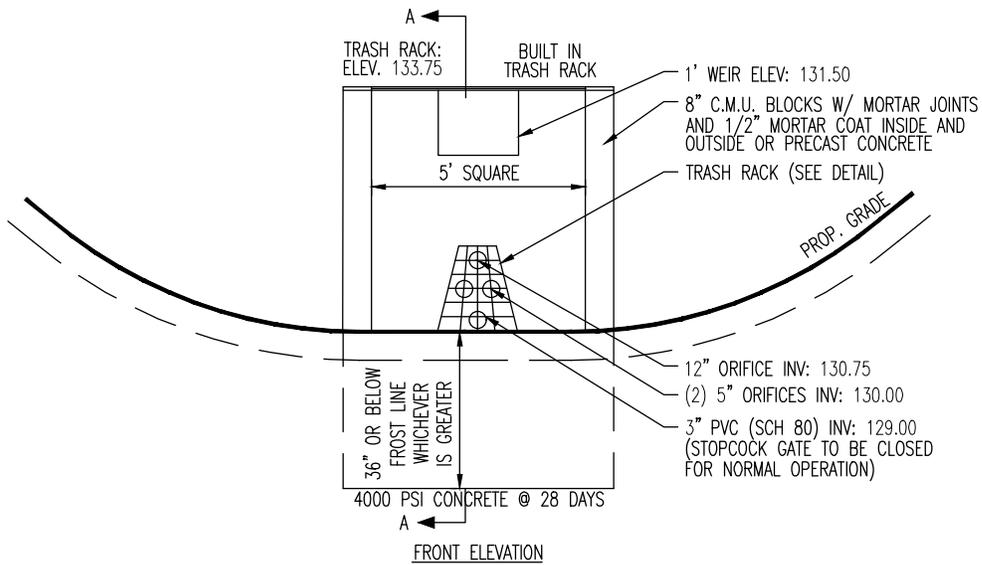
1. SAND LAYER MUST HAVE A MINIMUM THICKNESS OF 6 INCHES AND CONSIST OF CLEAN MEDIUM AGGREGATE CONCRETE SAND (AASHTO M-6/ASTM C-33). TO ENSURE PROPER SYSTEM OPERATION, THE SAND LAYER MUST HAVE A PERMEABILITY RATE AT LEAST TWICE AS FAST AS THE DESIGN PERMEABILITY RATE OF THE PLANTING SOIL BED.
2. SOIL BED MUST CONTAIN THE FOLLOWING MIX BY VOLUME: 85 TO 95% SAND, WITH NO MORE THAN 25% OF THE SAND AS FINE OR VERY FINE SANDS; NO MORE THAN 15% SILT AND CLAY WITH 2% TO 5% CLAY CONTENT. THE ENTIRE MIX MUST THEN BE AMENDED WITH 3 TO 7% ORGANICS, BY WEIGHT.
3. CONTENT OF ANY SOIL MIXED ON-SITE MUST BE CERTIFIED BY A LICENSED PROFESSIONAL ENGINEER IN THE STATE OF NEW JERSEY.
4. GRAVEL LAYER MUST CONSIST OF 0.5 TO 1.5 INCH CLEAN BROKEN STONE OR PEA GRAVEL (AASHTO M-43).
5. SOIL BED MATERIAL MUST BE FREE OF CONTAMINANTS.
6. PH OF SOIL BED MATERIAL IS RECOMMENDED TO RANGE FROM 5.5 TO 6.5.
7. SOIL BED MATERIAL MUST BE PLACED IN LIFTS NOT TO EXCEED 6 INCHES.

BIORETENTION SOIL BED DETAIL

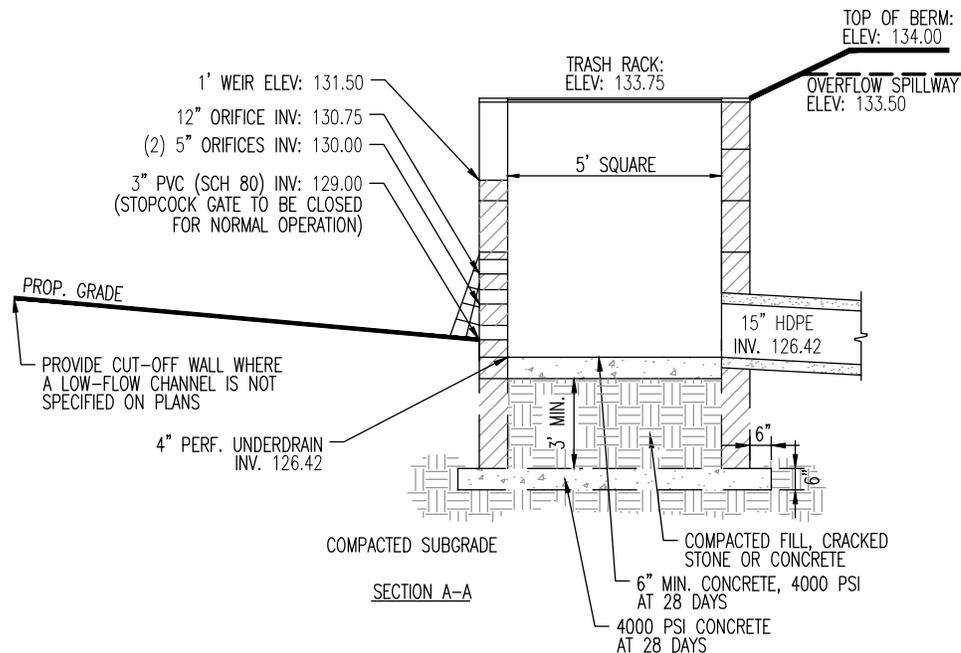
NOT TO SCALE



PLAN VIEW



FRONT ELEVATION



SECTION A-A

OUTLET CONTROL STRUCTURE DETAIL

NOT TO SCALE

MAINTENANCE WORK ORDER AND CHECKLIST

**MAINTENANCE WORK ORDER AND CHECKLIST
FOR STORMWATER MANAGEMENT FACILITIES**

NAME OF FACILITY: _____
 LOCATION: _____ DATE: _____
 WEATHER: _____ WORK STARTED: _____
 MAINTENANCE PERFORMED BY: _____ WORK COMPLETED: _____

A. PREVENTATIVE MAINTENANCE			
WORK ITEMS	ITEMS REQUIRED	ITEMS DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRASS CUTTING			
A. BOTTOMS			
B. EMBANKMENTS AND SIDE SLOPES			
C. PERIMETER AREAS			
D. ACCESS AREAS AND ROADS			
E. OTHERS			
2. GRASS MAINTENANCE			
A. FERTILIZING			
B. RE-SEEDING			
C. DE-THATCHING			
D. PEST CONTROL			
E. OTHERS			
3. VEGETATIVE COVER			
A. FERTILIZING			
B. PRUNING			
C. PEST CONTROL			
D. POISONOUS PLANTS			
E. OTHERS			
4. TRASH AND DEBRIS REMOVAL			
A. BOTTOMS			
B. EMBANKMENTS AND SIDE SLOPES			
C. PERIMETER AREAS			
D. ACCESS AREAS AND ROADS			
E. INLETS			
F. OUTLETS AND TRASH RACKS			
G. OTHERS			
5. SEDIMENT REMOVAL			
A. INLETS			
B. OUTLETS AND TRASH RACKS			
C. LOW FLOW CHANNELS			
D. BOTTOMS			
E. OTHERS			
6. PEST CONTROL			
A. GEESE			
B. MOSQUITO BREEDING			
C. RODENTS / RODENT HOLES			
D. OTHERS			
7. STRUCTURAL REPAIRS			
A. VALVES			
B. SLUICE GATES			
C. PUMPS			
D. FENCE GATES			
E. LOCKS			
F. ACCESS HATCHES			
G. OTHER:			
8. POND MAINTENANCE			
A. AERATION EQUIPMENT			
B. DEBRIS AND TRASH REMOVAL			
C. WEED REMOVAL			
D. OTHER:			
9. OTHER PREVENTIVE MAINTENANCE			
A. PARKING LOT SWEEPING			
B. EMPTYING TRASH RECEPTACLES			
C. PUMPS AND VALVES			
D. ELECTRICAL PANEL AND WIRING			
E. DEWATERING			
F. GRAFFITI REMOVAL			
E. OTHER:			

B. CORRECTIVE MAINTENANCE			
WORK ITEMS	ITEMS REQUIRED	ITEMS DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. REMOVAL OF DEBRIS AND SEDIMENT			
2. STRUCTURAL REPAIRS			
3. EMBANKMENTS AND SIDE SLOPES			
4. DEWATERING			
5. BASIN MAINTENANCE			
6. CONTROL OF MOSQUITOES			
7. EROSION REPAIR			
8. FENCE REPAIR			
9. SNOW AND ICE REMOVAL			
10. SAND LAYER REPLACEMENT			
11. OTHER			

C. AESTHETIC MAINTENANCE			
WORK ITEMS	ITEMS REQUIRED	ITEMS DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRAFFITI REMOVAL			
2. GRASS TRIMMING			
3. WEEDING			
4. OTHERS			

GENERAL NOTES AND REMARKS:

WORK ORDER PREPARED BY: _____

WORK COMPLETED BY: _____

MAINTENANCE LOG

**MAINTENANCE LOG
FOR STORMWATER MANAGEMENT FACILITIES**

NAME OF FACILITY: _____
 LOCATION: _____ DATE: _____
 WEATHER: _____ WORK STARTED: _____
 MAINTENANCE PERFORMED BY: _____ WORK COMPLETED: _____

A. PREVENTATIVE MAINTENANCE					
WORK ITEMS	ITEMS REQUIRED	DATE REQUIRED	ITEMS DONE	DATE DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRASS CUTTING					
A. BOTTOMS					
B. EMBANKMENTS AND SIDE SLOPES					
C. PERIMETER AREAS					
D. ACCESS AREAS AND ROADS					
E. OTHERS					
2. GRASS MAINTENANCE					
A. FERTILIZING					
B. RE-SEEDING					
C. DE-THATCHING					
D. PEST CONTROL					
E. OTHERS					
3. VEGETATIVE COVER					
A. FERTILIZING					
B. PRUNING					
C. PEST CONTROL					
D. POISONOUS PLANTS					
E. OTHERS					
4. TRASH AND DEBRIS REMOVAL					
A. BOTTOMS					
B. EMBANKMENTS AND SIDE SLOPES					
C. PERIMETER AREAS					
D. ACCESS AREAS AND ROADS					
E. INLETS					
F. OUTLETS AND TRASH RACKS					
G. OTHERS					
5. SEDIMENT REMOVAL					
A. INLETS					
B. OUTLETS AND TRASH RACKS					
C. LOW FLOW CHANNELS					
D. BOTTOMS					
E. OTHERS					
6. PEST CONTROL					
A. GEESE					
B. MOSQUITO BREEDING					
C. RODENTS / RODENT HOLES					
D. OTHERS					
7. STRUCTURAL REPAIRS					
A. PIPES					
B. FLARED END SECTIONS					
C. INLETS					
D. MANHOLES					
E. OUTLET CONTROL STRUCTURES					
F. LOW FLOW CHANNELS					
G. RIP-RAP					
H. EMERGENCY SPILLWAY					
I. ACCESS AREA / ROADS					
J. FENCE					
K. TRASH RACKS					
L. OTHERS					

8. BASIN REPAIR					
A. EROSION					
B. SAND LAYER REPLACEMENT					
C. HARMFUL POLLUTANT REMOVAL					
D. BASIN LAYER					
E. SNOW / ICE REMOVAL					
F. OTHERS					
9. UNDERGROUND BASIN MAINTENANCE					
A. BOTTOMS					
B. OUTLETS AND TRASH RACKS					
C. ACCESS HATCHES					
D. OTHERS					
10. INFILTRATION BASIN MAINTENANCE					
A. TILING BOTTOM					
11. POND MAINTENANCE					
A. AERATION EQUIPMENT					
B. DEBRIS AND TRASH REMOVAL					
C. WEED REMOVAL					
D. PERMANENT POOL LEVEL					
E. OTHERS					
11. OTHER PREVENTIVE MAINTENANCE					
A. PARKING LOT SWEEPING					
B. EMPTYING TRASH RECEPTACLES					
C. PUMPS AND VALVES					
D. ELECTRICAL PANEL AND WIRING					
E. DEWATERING					
F. GRAFFITI REMOVAL					
E. OTHERS					

B. CORRECTIVE MAINTENANCE					
WORK ITEMS	ITEMS REQUIRED	DATE REQUIRED	ITEMS DONE	DATE DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. REMOVAL OF DEBRIS AND SEDIMENT					
2. STRUCTURAL REPAIRS					
3. EMBANKMENTS AND SIDE SLOPES					
4. DEWATERING					
5. BASIN MAINTENANCE					
6. CONTROL OF MOSQUITOES					
7. EROSION REPAIR					
8. FENCE REPAIR					
9. SNOW AND ICE REMOVAL					
10. SAND LAYER REPLACEMENT					
11. OTHER					

C. AESTHETIC MAINTENANCE					
WORK ITEMS	ITEMS REQUIRED	DATE REQUIRED	ITEMS DONE	DATE DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRAFFITI REMOVAL					
2. GRASS TRIMMING					
3. WEEDING					
4. OTHERS					

GENERAL NOTES AND REMARKS:

MAINTENANCE COMPLETED AND BASED ON ALL AREAS VISIBLE AND ACCESSIBLE AT THE TIME OF INSPECTION.

WORK PERFORMED BY: _____

SIGNED: _____ DATE: _____

INSPECTION CHECKLIST

**INSPECTION CHECKLIST
FOR
STORMWATER MANAGEMENT FACILITIES**

NAME OF FACILITY: _____
 LOCATION: _____
 WEATHER: _____ DATE: _____

FACILITY ITEM	O.K. ¹	ROUTINE ²	URGENT ³	COMMENTS
1. EMBANKMENTS AND SIDE SLOPES				
A. VEGETATION				
B. LININGS				
C. EROSION				
D. SETTLEMENT				
E. SLOUGHING				
F. TRASH AND DEBRIS				
G. SEEPAGE				
H. AESTHETICS				
I. OTHER:				
2. BOTTOMS (DETENTION AND INFILTRATION)				
A. VEGETATION				
B. EROSION				
C. STANDING WATER				
D. SETTLEMENT				
E. TRASH AND DEBRIS				
F. SEDIMENT				
G. AESTHETICS				
H. OTHER:				
3. LOW FLOW CHANNELS (DETENTION)				
A. VEGETATION				
B. LININGS				
C. EROSION				
D. SETTLEMENT				
E. STANDING WATER				
F. TRASH AND DEBRIS				
G. SEDIMENT				
H. OTHER:				
4. PONDS (RETENTION)				
A. VEGETATION				
B. SHORELINE EROSION				
C. AERATION EQUIPMENT				
D. TRASH AND DEBRIS				
E. SEDIMENT				
F. WATER QUALITY				
G. OTHER:				
5. INLET STRUCTURE				
A. CONDITION OF STRUCTURE				
B. EROSION				
C. TRASH AND DEBRIS				
D. SEDIMENT				
E. AESTHETICS				
F. OTHER:				
6. OUTLET STRUCTURE				
A. CONDITION OF STRUCTURE				
B. EROSION				
C. TRASH AND DEBRIS				
D. SEDIMENT				
E. MECHANICAL COMPONENTS				
F. AESTHETICS				
G. OTHER:				

7. EMERGENCY SPILLWAY				
A. VEGETATION				
B. LINING				
C. EROSION				
D. TRASH AND DEBRIS				
E. OTHER:				
8. PERIMETER				
A. VEGETATION				
B. EROSION				
C. TRASH AND DEBRIS				
D. FENCES AND GATES				
E. AESTHETICS				
G. OTHER:				
9. ACCESS ROADS				
A. VEGETATION				
B. ROAD SURFACE				
C. FENCES AND GATES				
D. EROSION				
E. AESTHETICS				
F. OTHER:				
10. MISCELLANEOUS				
A. EFFECTIVENESS OF EXIST. MAINT. PROGRAM				
B. DAM INSPECTIONS				
C. POTENTIAL MOSQUITO HABITATS				
D. MOSQUITOES				

- (1) ITEM CHECKED IS IN GOOD CONDITION, AND THE MAINTENANCE PROGRAM IS ADEQUATE.
- (2) ITEM CHECKED REQUIRES ATTENTION, BUT DOES NOT PRESENT AN IMMEDIATE THREAT TO THE FUNCTION OR OTHER FACILITY COMPONENTS.
- (3) THE ITEM CHECKED REQUIRES IMMEDIATE ATTENTION TO KEEP THE FACILITY OPERATIONAL OR TO DAMAGE TO OTHER FACILITY COMPONENTS.
- (4) PROVIDE EXPLANATION AND DETAILS IF COLUMNS 2 OR 3 ARE CHECKED.

GENERAL NOTES AND REMARKS (REFER TO ITEM NUMBER IF APPLICABLE)

INSPECTOR: _____