Stormwater Management Measures
Maintenance Plan & Field Manuals

OPERATION AND MAINTENANCE MANUAL

PREPARED FOR
HSU PROPERTIES HOLDINGS LLC
FOR STORMWATER MANAGEMENT FACILITIES LOCATED ON
LOT 15.11, BLOCK 517.06
FRANKLIN TOWNSHIP
SOMERSET COUNTY, NEW JERSEY
February 2023
Revised February 2024

Deed Book _____, Page _____.
Filing Date: _____.

Party Responsible for Maintenance:

Hsu Properties Holdings LLC
30 Quail Run, Warren, NJ 07059
Phone: 732-500-6958

Craig W. Stires
Craig W. Stires, P.E.
N.J. License #39078

Prepared by:
Stires Associates, P.A.
ENGINNERS – SURVEYORS
ENVIRONMENTAL CONSULTANTS
43 West High Street
Somerville, NJ 08876
PHONE (908) 725-0230 FAX (908) 707-0831

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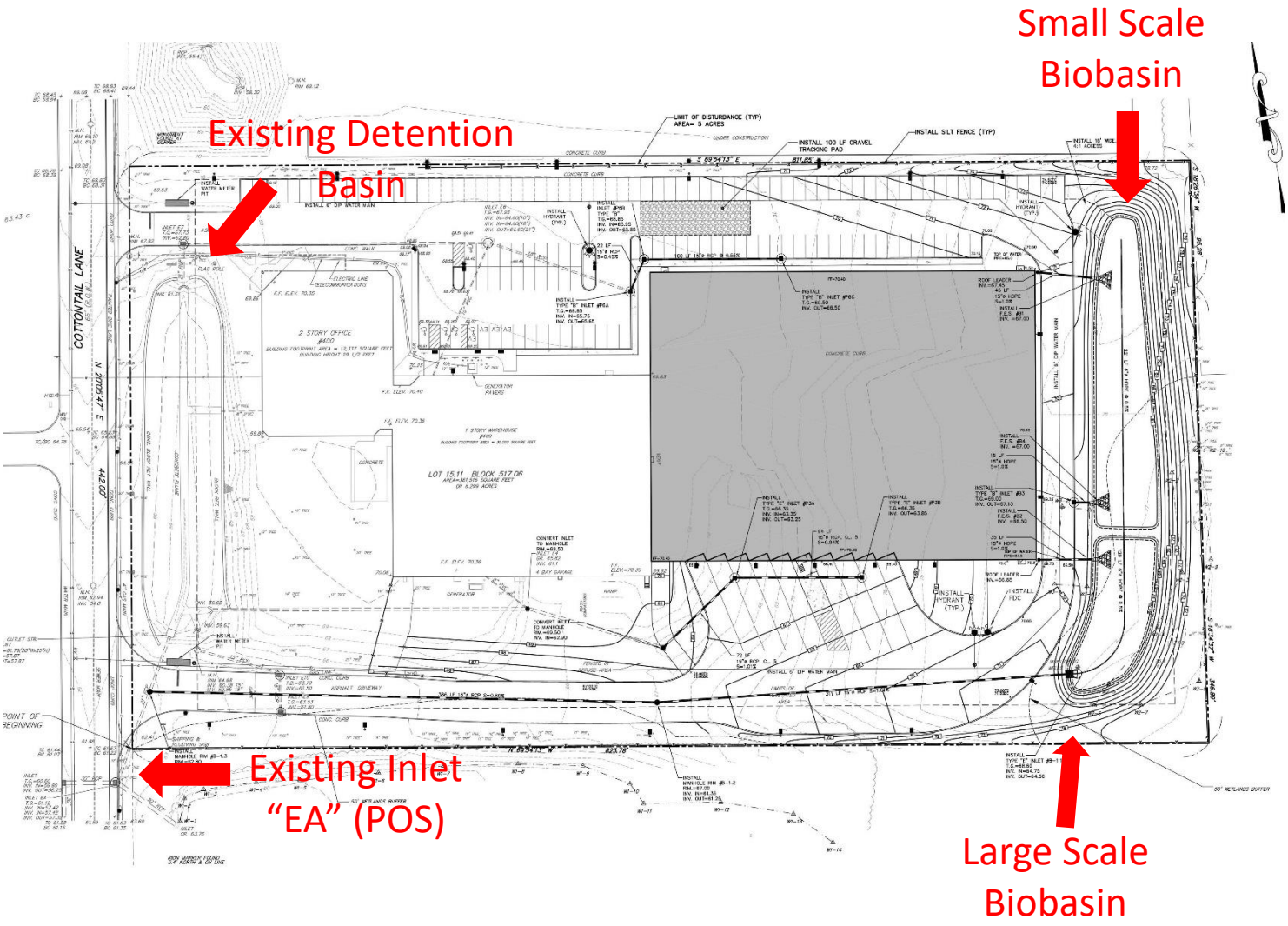
Part I- Maintenance Plan

List of Stormwater Management Measures

The stormwater management measures incorporated into this development are listed below. The corresponding Field Manuals for the stormwater management measures are located in Part II of the Maintenance Plan.

Type of Stormwater Management Measure	BMP No.	Location Description	State Plane Coordinates / Lat., Long.
Existing Detention Basin	Ex. Basin	West Property Line	N: 622766.55 E: 479143.54
Small Scale Bioretention Basin	SS-Bio	East Property Line	N: 622675.22 E: 479845.62
Large Scale Bioretention Basin	LS-Bio	East Property Line	N: 622507.99 E: 479812.87

Location Map



Description of Stormwater Management Measures

Existing Detention Basin

Design storm:

- Design Purposes:
  - Provides Water Quality and Quantity Control
  - 1.25 inches in 2 hours
  - 2-year Storm (3.31 inches);
  - 10-year Storm (5.02 inches);
  - 100-year Storm (8.38 inches)
- Dimensions: Variable

Small Scale Bioretention Basin

Design storm:

- Design Purposes:
  - Provides Water Quality Control - 80% TSS removal
  - 1.25 inches in 2 hours
- Dimensions: Variable

Large Scale Bioretention Basin

Design storm:

- Design Purposes:
  - Provides Water Quantity Control
  - 1.25 inches in 2 hours
  - 2-year Storm (3.31 inches);
  - 10-year Storm (5.02 inches);
  - 100-year Storm (8.38 inches)
- Dimensions: Variable

More detailed information regarding each specific measure is listed in the attached Field Manual.

Preventative and Corrective Maintenance Action Plan

As per N.J.A.C. 7:8-5.8(b) & (e), preventative and corrective maintenance shall be performed to maintain the function of the stormwater management measure, including, but not limited to, repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of non-vegetated linings. The maintenance plan must contain cost estimates for specific maintenance tasks, including the cost of sediment, debris, or trash removal.

As per N.J.A.C. 7:8-5.8(d), the maintenance of stormwater management facilities and any future revisions to it shall be recorded upon the deed of record for the property.

As per N.J.A.C. 7:8-5.8(g), operation & maintenance manual shall be evaluated by the person responsible for maintenance for updates and effectiveness at least once per year. The operation and maintenance manual shall be updated and recorded in the deed as needed at that time.

As per N.J.A.C. 7:8-5.8(h), the person responsible for maintenance shall retain and make available, upon request by any public entity with administrative, health, environmental, or safety authority over the site, this maintenance plan.

As per NJDEP BMP Manual Ch. 8 (March, 2021), maintenance plans should include procedures and equipment required to protect the safety of inspection and maintenance personnel.

As per NJDEP BMP Manual Ch. 8 (March, 2021), maintenance plans should include specific preventative and corrective maintenance tasks such as removal of sediment, trash, and debris; mowing, pruning, and restoration of vegetation; restoration of eroded areas; elimination of mosquito breeding habitats; control of aquatic vegetation; and repair or replacement of damaged or deteriorated components. Disposal of sediment, trash, debris and removed vegetation shall be taken to an approved Recycling facility from the list below or an approved facility outside of Somerset County.

As per NJDEP BMP Manual Ch. 8 (March, 2021), maintenance plans should include recommended corrective responses to various emergency conditions that may be encountered at the stormwater management measure. It should be noted that if the stormwater management measure includes a Class I or II dam as defined in the NJDEP Dam Safety Standards at N.J.A.C. 7:20, an emergency action plan for the dam is also required. See N.J.A.C. 7:20-1.7(f) for more information.

As per NJDEP BMP Manual Ch. 8 (March, 2021), the maintenance plan should address the maintenance of access points to the stormwater management measures in accordance with the following:

- all components of the stormwater management measures must be readily accessible for inspection and maintenance;
- trees, shrubs, and underbrush must be pruned or trimmed as necessary to maintain access to the stormwater management measure via roadways, paths, and ramps,

including paths through perimeter vegetation to permanent pools, aquatic benches, and safety ledges to allow for the inspection and control of mosquito breeding; and

- the exact limits of inspection and maintenance easements and rights-of-way should be specified on stormwater management measure plans and included in the maintenance plan.

Preventative Maintenance Actions

Inspection of stormwater facilities is the best form of preventative maintenance. These inspections can be as frequent as after each small storm event or annually. Obviously, the frequency of these inspections coincides with the level of maintenance.

The frequency of the preventative maintenance actions listed here is adopted from Chapter 9, BMP Manual of Structural Stormwater Management Measures. Design engineer and responsible party should adjust the frequency of preventative maintenance actions according to the situations of the stormwater management measures in the development.

The owners and/or their successors or assigns shall maintain the facilities located on the subject lot. This includes all inlets, piping, and basins. All stormwater inlets shall be inspected after each rainstorm to remove any debris and or garbage that may have collected on or near each inlet.

The existing detention basin was designed to provide water quality and quantity control as part of the approval for Raritan Computer Inc. The existing outlet structure provides water quality with a nine (9") inch Vortechnics hydro-break at the base of the concrete swale and quantity control is provided by a 20"W x 25"H orifice. As outlined in the Stormwater Report, the motor vehicle and impervious surface areas to the existing basin are proposed to be reduced. This net reduction of coverage, plus keeping the hydrographs the same or less, allows the existing basin to be utilized. In proposed conditions, the existing water quality is being maintained; and, although not required by the regulations, the existing quantity control is being improved by increasing the orifice size to 48"W x 25"H and adding bioretention basins.

Preliminary soil testing for the purpose of recharge was performed on 02/07/23 by Engineering & Land Planning (E&LP) and is included as part of this manual. Due to the poor recharge results, soil reclassification was performed on 11/14/23 by French & Parrello Associates (FPA). A separate report entitled, "Hydraulic Soil Group Reclassification" dated December 18, 2023, was submitted by FPA to Stires Associates to be included with the stormwater applications.

A small scale bioretention basin has been designed to provide water quality treatment for proposed improvements. The basin will consist of a layer of plant material along with plantings within the bottom of the basin. The components serve to provide water quality treatment for the small storms that drain to the basin. During lower storm events, the runoff will enter the basin and drain through the soil and plant media which provides the water quality treatment to separate out sediment, debris, and grease/oils from the runoff. Since the percolation of the soils in the basin are not permeable, the runoff will drain through the soil and plant media to an underdrain system. Storm events larger than the Water Quality Design Storm will exit the small scale bioretention basin over the spillway into a large scale bioretention basin.

A large scale bioretention basin has been designed as bioretention basin to provide for detention, but will also have a bottom that consists of a layer of plant material along with plantings within the bottom of the basin. The runoff will drain through the soil and plant media to an underdrain system and discharge through an outlet structure.

The soil media is critical to the function of the bioretention basin and should be inspected a minimum of four (4) times a year and after every storm exceeding one (1") inch of rainfall to

ensure that the soils do not become compacted as they will tend to clog and not allow the smaller storms to drain through the media properly.

The upper portion of the basins and the side slopes will be a meadow mix and should only need mowing once or twice during the growing season and be based on site and weather conditions. Unwanted growth should be removed when observed with minimal disruption to the basin slopes. The vegetative cover should be maintained at 85%. If vegetation has more than 50% damage the area should be reestablished in accordance with original specifications. All work should be done without the use of fertilizers or pesticides whenever possible. When starting or restoring vegetation, biweekly inspection of the growth should be performed during the first growing season and until the vegetation is established. Vegetation should be inspected for health, density and diversity a minimum of twice a year during growing and non-growing seasons. To ensure grass vigor, maintain as an upland meadow by cutting no shorter than 3 to 5 inches high.

All small storm events shall drain within 72 hours. If the basins do not drain within that time, further evaluation of the basin structures should be performed. The owners and engineer should inspect the facility and determine appropriate maintenance procedures to restore the proper function.

Frequency	**Preventative Maintenance Actions** (list specific preventative maintenance actions and the required frequency)	**Stormwater Measures/ No.** (list specific stormwater management measures pertinent to the Frequency
Monthly	- All grass portions of the basins shall be cut at least once per month during the growing season and all leaves, grass clippings and other debris will be removed as needed with each grass cutting to ensure that the outlet structure remains clean. - Inspect outlet structure for debris	ALL Basins Outlet Structure
Quarterly	Quarterly inspection - Sediment removal of basin, inlets, outlet structure - Inspect plant media and vegetation in basin	ALL Basins; Outlet Structure Bioretention Basins
Semiannual	- Sediment removal of basin, inlets, outlet structure - Vegetation should be inspected for health, density and diversity a minimum of twice a year during growing and non-growing seasons. To ensure grass vigor, maintain as an upland meadow by cutting no shorter than 3 to 5 inches high.	ALL Basins; Outlet Structure

Annual	- Basin Structural Inspection	ALL Basins
Biennial	- Review and inspect plant media and supplement/replace as needed	Bioretention Basins
Unscheduled	- Quick inspection after every 1″ rain	ALL Basins
(Other)	- All leaves and other debris must be removed as needed during the months of October and November and a final clean-up of the basin must be performed during the first two (2) weeks of December.	ALL Basins

Corrective Maintenance Actions

Depending on many factors, such as the performance of preventative maintenance actions, weather, or unexpected incidents, corrective maintenance requirements may not be precisely anticipated; however, a list of potential corrective maintenance actions may assist the responsible party in planning and estimating costs in advance.

Potential Corrective Maintenance Actions	Stormwater Management Measures/No.
Corrective maintenance tasks - Repair/replacement of eroded or damaged riprap apron - Repair/replacement of missing or damaged trash racks - Repair/replacement of outlet pipes or orifices - Revegetation of eroded side slope, aquatic bench, marsh, basin bottom, grass swales, etc. - Rake/aerate plant media within bioretention area - Supplement Plant media as needed	SS and LS Bioretention Basins; Outlet Structure

The corrective maintenance actions should be also listed in the Field Manuals for the specific stormwater management measures on the site.

Inspection and Logs of All Preventative and Corrective Maintenance

As per N.J.A.C. 7:8-5.8(f), the person responsible for maintenance shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

As per NJDEP BMP Manual Ch. 8 (Feb, 2004), a maintenance plan shall include a schedule of regular inspections and tasks, and detailed logs of all preventative and corrective maintenance performed on the stormwater management measure, including all maintenance-related work orders. The person with maintenance responsibility must retain and, upon request, make available the maintenance plan and associated logs and other records for review by a public entity with administrative, health, environmental, or safety authority over the site.

Inspection Checklists in the Field Manual for the stormwater management measures on this site include:

- Field Manual for Surface Extended Detention Basin
- Field Manual for Bioretention System

The logs of all inspections, and both preventative and corrective maintenance performed should be attached in the "**Maintenance Logs and Inspection Records**" section. See Part II of the Maintenance Plan

Maintenance Personnel, Equipment, Tools, and Supplies

As per NJDEP BMP Manual Ch. 8 (Feb. 2004), maintenance plans should include equipment, tools, and supplies necessary to perform the various preventative and corrective maintenance tasks specified in the plan. Sources of specialized, proprietary, and nonstandard equipment, tools, and supplies should also be provided.

This section applies to both maintenance tasks that are performed by in-house personnel or are outsourced. The design engineer has to list the required amount of maintenance personnel, equipment, tools, and supplies necessary to perform the various preventative and corrective maintenance tasks specified in the plan. In addition, the sources of specialized, proprietary, and nonstandard equipment, tools and supplies for specific measures, such as manufactured treatment devices should also be listed.

Maintenance Personnel/Equipment/Tools/Supplies

Personnel/Equipment/Tools Name	Quantity
General maintenance crew	
Clip board, a pencil and the inspection checklist - the inspection checklist is included in the following section.	
Standard 6-foot collapsible ruler.	
Camera - photographs or observed portions of the facilities will provide a measure of performance when comparing past and present maintenance practices or conditions.	
Probe - any stiff light stick or rod with a blunt tip of sufficient strength to penetrate soil. The probe can provide information on conditions below the surface of the dam such as the depth and softness of a saturated area.	
Weed whacker - can be used to clear non-visible areas and to perform routine maintenance on the embankments.	
Shovel – can be used to clear debris in front of outlet structure orifices and grating.	
Flashlight - a flashlight can be used to observe the inside of the Structures and outlet piping.	
Maintenance at the basin may include heavy equipment including the following: 1. Chain saw. 2. Stump grinder 3. Wheelbarrow. 4. Lawnmower 5. Backhoe. 6. Dump truck. 7. Debris / Contaminant Collectors 8. Debris / Contaminant Containers 9. Vacuum Truck or a water-jetting device	
Sources of the following materials should be identified for immediate use if warranted 1. Native, silty sand for filling erosion rills and gullies. 2. Topsoil mixture, fertilizer and seed 3. Large stone rip rap for emergency repairs caused by erosion. 4. Synthetic geofabric netting and stakes to prevent seed and topsoil from blowing.	

Approved Disposal and Recycling Sites within Somerset County

Facility Name	Waste Type	Location	Phone
Active Recycling Corp.	BB, C	15 Polhemus Lane, Bridgewater, NJ	908-722-8484
Stavola Construction Materials, Inc.	A, C	810 Thompson Ave., Bridgewater, NJ	
Trap Rock	A, BB, C	Laurel Ave (Route 603) Franklin, NJ	609-924-0300
Vollers Excavating, Inc.	A, BB, C, W	3311 US Route 22 East, Branchburg, NJ	908-725-1026
Weldon Asphalt Company	A, BB, C	1 New Providence Road, Watchung, NJ	973-663-2010

Additional facilities may be found on the State of New Jersey, Department of Environmental Protection Division of Sustainable Waste Management Website for Class B Recycling Facilities.

Cost Estimate

As per N.J.A.C.7:8-5.8(b), cost estimates of maintenance tasks, including, but not limited to, sediment, trash and debris removal must be included in the maintenance plan. Below is an illustration of a cost breakdown and estimation for maintenance of stormwater management measures. The design engineer should estimate the cost based on the expected maintenance required for each stormwater management measure. The actual costs may vary with factors such as local requirements, equipment, personnel, weather, and maintenance methods.

COST ESTIMATES

Cost Overview

Cost Type	Cost	Details
Cost of sediment, trash, and debris removal		
General cost for routine maintenance (e.g., quarterly maintenance)		Table A
General cost – unscheduled maintenance		Table B
Cost associated with special tasks for specific stormwater measures (e.g., biennial sand replacement for sand filter)		Table C
Total cost		

Table A: General cost for routine maintenance (e.g., quarterly maintenance)

Cost Type	Required Quantity	Unit Price	Cost
Personnel			
Crew	2 Man for Half Day	$60/hr	$240.00
Supervisor	1 Man	$50/hr.	$200.00
Equipment			
Truck	4 Hours	$50/hr	$200.00
Mower	4 Hours	$50/hr	$200.00
Supplies			
Seed	6 bags @ 50 lbs	$170/bag	$1020.00
Debris Removal			
Truck Load	1 Truck Load	$500/Load	$500.00
Subtotal			$2360.00
Overhead			200%
Total Cost			**$4720.00**

Table B: General cost – unscheduled maintenance in a year (e.g., inspection after 1 inch of rain)

Cost Type	Required Quantity	Unit Price	Cost
Personnel			
Crew	1 Man for 1 hour	$30/hr	$30.00
Subtotal			$30.00
Overhead			200%
Total Cost			**$60.00**

Table C: Cost associated with special tasks for specific stormwater measures (e.g., biennial plant media replacement)

Cost Type	Required Quantity	Unit Price	Cost
Personnel			
Crew	2 Man for Half Day	$60/hr	$240.00
Supervisor	1 Man	$50/hr.	$200.00
Equipment			
Truck	4 Hours	$50/hr	$200.00
Lightweight backhoe rental	4 Hours	$50/hr	$200.00
Supplies			
Plant Media	300 CY	$6/CY	$1800.00
Subtotal			$2640.00
Overhead			200%
Total Cost			**$5280.00**

Safety Measures and Procedures

As per NJDEP BMP Manual Ch. 8 (Feb. 2004), maintenance plans should include procedures and equipment required to protect the safety of inspection and maintenance personnel.

Safety Regulations and Requirements

While most maintenance work is in open space and primarily related to lawn and yard maintenance, all personnel shall be familiar with all OSHA regulations and Confined-Space Entry regulations.

Training Plan and Records

As per NJDEP BMP Manual Ch. 8 (February 2004), maintenance training begins with a basic description of the purpose and function of the overall stormwater management measure and its major components. Such understanding will enable maintenance personnel to provide more effective component maintenance and more readily detect maintenance-related problems. Depending on the size, character, location, and components of each stormwater management measure, maintenance personnel may also require training in specialized inspection and maintenance tasks and/or the operation and care of specialized maintenance equipment. Training should also be provided in the need for and use of all required safety equipment and procedures.

I. Training Plan

Types of Training

- Mandatory Stormwater Management Basic Training and Field Manual Usage Training for new maintenance crews
- Occupational Safety Training
- Subcontractor training, if applicable

Content of Training

- **Stormwater Management Basic Training**
    - Purposes and Functions of BMPs

      Example Training Material
        - NJDEP Stormwater BMP Manual, Chapter Nine: Structural Stormwater Management Measures
            - Chapter 9.7 Small Scale Bioretention Systems
            - Chapter 10.1 Large Scale Bioretention Systems
            - Chapter 11.2 Extended Detention Basins (Non-GI)

More training information is available at NJ Stormwater.org (http://www.nj.gov/dep/stormwater/training.htm)

- Vegetation Care

  Example Training Material
    - NJDEP Stormwater BMP Manual, Chapter Seven: Landscaping *(provides information on vegetation and landscaping for stormwater management measures)*
    - Other

- Field Manual Usage Training

Example Training Material
- Field Manuals attached to this Maintenance Plan
- Other

- Equipment and Tools Operation Training

  Example Training Material
  - Equipment or tool manufacturer's Operation & Maintenance Manual
  - Other

- Occupational Safety Training

  Example Training Material
  - OSHA Training
  - Equipment or tool manufacturer's Operation & Maintenance Manual
  - Other

II. Training Records

Training attendance sheets should be attached by the responsible party after each training.

Annual Evaluation of the Effectiveness of the Plan

As per N.J.A.C. 7:8-5.8(g), the person responsible for maintenance shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed.

The responsible party should evaluate the effectiveness of the maintenance plan by comparing the maintenance plan with the actual performance of the maintenance. The items to evaluate may include, but not limited to,

- Whether the inspections have been performed as scheduled;
- Whether the preventive maintenance has been performed as scheduled;
- Whether the frequency of preventative maintenance needs to increase or decrease;
- Whether the planned resources were enough to perform the maintenance;
- Whether the repairs were completed on time;
- Whether the actual cost was consistent with the estimated cost;
- Whether the inspection, maintenance, and repair records have been kept.

If actual performance of those items has been deviated from the maintenance plan, the responsible party should find the causes and implement solutions in a revised maintenance plan.

Annual Evaluation Records

Evaluator(s)	Date of Evaluation	Decision
		__Maintain current version OR __Revise current version - Revision date _____ (also update the last revision date on the cover page) __Requires a new deed recording (also update the last recording information on the cover page)
		__Maintain current version OR __Revise current version - Revision date _____ (also update the last revision date on the cover page) __Requires a new deed recording (also update the last recording information on the cover page)
		__Maintain current version OR __Revise current version - Revision date _____ (also update the last revision date on the cover page) __Requires a new deed recording (also update the last recording information on the cover page)

Documents

Please attach the following:

Transfer Agreement
As per N.J.A.C. 7:8-5.8(b), if the maintenance plan identifies a person other than the developer as having the responsibility for maintenance, the plan shall include documentation of such person's agreement to assume this responsibility, or the developer's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

Deed
As per N.J.A.C. 7:8-5.8(d), if the person responsible for maintenance is not a public agency, the maintenance plan and any future revisions shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

As-Built Drawings with Drainage Plans
As per NJDEP BMP Manual Ch. 8 (March, 2021), as-built construction plans of the stormwater management measure and copies of pertinent construction documents, such as laboratory test results, permits, and completion certificates should be included in this Maintenance Plan.

Landscaping Plan for the Stormwater Management Measures
As per NJDEP BMP Manual Ch. 8 (March, 2021), if there is a Landscaping Plan for the stormwater management measures, it should be included in this Maintenance Plan.

Permeability Test/Infiltration Test Report
As per NJDEP BMP Manual Ch. 8 (March, 2021), if a permeability test or infiltration test is required and available, the reports for pre-construction and post-construction testing should be included in this Maintenance Plan.

Soil Boring Logs
As per NJDEP BMP Manual Ch.8 (March, 2021), if any soil borings were taken prior to construction, a copy of the soil boring logs should be included in this Maintenance Plan.

Local, State, Federal Permits
As per NJDEP BMP Manual Ch. 8 (March, 2021), local, state, or federal permits related to the stormwater management measures for this development should be included in this Maintenance Plan. See Cost Estimate Section of This Maintenance Plan for more information.

The requirement to obtain State permits depends on specific circumstances, such as, but not limited to, the specific design of the stormwater management measures, the maintenance actions, the access and disturbance, the disposal methods, the location of disposal, the method to empty a basin, the method to dredge the basin, the pollutants in the basin, the damages to the basin, and the method to repair the basin.

Check Maintenance Guidance in NJDEP Stormwater Management Website for details and links to the relevant permits and program areas (http://www.njstormwater.org).

Safety Regulations and Requirements

As per NJDEP BMP Manual Ch. 8 (March, 2021), all local ordinances and state and federal regulations regarding occupational safety should be included in this Maintenance Plan.

Devices/Tools/Equipment Operation and Maintenance Manual and Warranties

As per NJDEP BMP Manual Ch. 8 (March, 2021), maintenance, repair, and replacement instructions for specialized, proprietary, and nonstandard equipment, tools, supplies, manufacturers' product instructions, and user manuals should be included in this Maintenance Plan.

Attach Documents Here

Preliminary Soil Test Results (02/07/23)

140 West Main Street
High Bridge, NJ 08829
T: 908.238.0544 F: 908.238.9572
Clinton | Asbury Park | Denville | Philadelphia

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Soil Log and Interpretation

1 Soil Log #: SL-1 Date of Soil Log: 2/7/23 Method: Profile Pit
2 Log:

Depth (inches)	Munsell Color Name & Symbol; Estimated Textural Class; Estimated Volume % Coarse Fragments; Structure; Consistence; Mottling Abundance, Size and Contrast
0 - 8"	Topsoil;
8 - 61"	5YR 4/4; Clay Loam; 25% Gravel, 20% Cobble, 15% Rock; Few, Medium, Distinct Mottling @ 12-23" 10YR 7/1 in Color; SAB, Dry, Friable;
61 - 108"	5YR 3/4; Clay Loam; 25% Gravel, 20% Cobble, 10% Stone; SAB, Moist, Friable; Refusal @ 108"

3 Ground Water Observations:
X Seepage Observed - Depth (inches): 65"
X Pit Flooded - Depth (inches): 85" after 24 hours of observation

4 Soil Limiting Zones (Check ALL applicable categories):
X Fractured Rock Substratum - Depth to Top: 8"
____ Massive Rock Substratum - Depth to Top: ____
____ Excessively Coarse Horizon - Depth Top to Bottom: ____
____ Excessively Coarse Substratum - Depth to Top: ____
____ Hydraulically Restrictive Horizon - Depth Top to Bottom: ____
____ Hydraulically Restrictive Substratum - Depth to Top: ____
____ Perched Zone of Saturation - Depth Top to Bottom: ____
X Regional Zone of Saturation - Depth to Top: 12"

5 I hereby certify that the information furnished on this form is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

Signature of Site Evaluator: _____ Date: _____
Signature and Seal of Professional Engineer: _____
License #: 24GB04258200 Date: _____

140 West Main Street
High Bridge, NJ 08829
T: 908.238.0544 F: 908.238.9572
Clinton | Asbury Park | Denville | Philadelphia

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Soil Log and Interpretation

1 Soil Log #: SL-2 Date of Soil Log: 2/7/23 Method: Profile Pit
2 Log:

Depth (inches)	Munsell Color Name & Symbol; Estimated Textural Class; Estimated Volume % Coarse Fragments; Structure; Consistence; Mottling Abundance, Size and Contrast
0 - 8"	Topsoil;
8 - 47"	5YR 4/4; Clay Loam; 15% Gravel, 10% Cobble, 5% Rock; Few, Medium, Distinct Mottling @ 22-33" 10YR 7/1 in Color; SAB, Dry, Friable;
47 - 94"	5YR 3/4; Clay Loam; 25% Gravel, 20% Cobble, 15% Stone; SAB, Moist, Friable; Refusal @ 94"

3 Ground Water Observations:
X Seepage Observed - Depth (inches): 82"
____ Pit Flooded - Depth (inches): ____ after ____ hours of observation

4 Soil Limiting Zones (Check ALL applicable categories):
X Fractured Rock Substratum - Depth to Top: 47"
____ Massive Rock Substratum - Depth to Top: ____
____ Excessively Coarse Horizon - Depth Top to Bottom: ____
____ Excessively Coarse Substratum - Depth to Top: ____
____ Hydraulically Restrictive Horizon - Depth Top to Bottom: ____
____ Hydraulically Restrictive Substratum - Depth to Top: ____
____ Perched Zone of Saturation - Depth Top to Bottom: ____
X Regional Zone of Saturation - Depth to Top: 22"

5 I hereby certify that the information furnished on this form is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

Signature of Site Evaluator: _____ Date: _____
Signature and Seal of Professional Engineer: _____
License #: 24GB04258200 Date: _____

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Clinton | Asbury Park | Denville | Philadelphia

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Soil Log and Interpretation

1 Soil Log #: SL-3 Date of Soil Log: 2/7/23 Method: Profile Pit
2 Log:

Depth (inches)	Munsell Color Name & Symbol; Estimated Textural Class; Estimated Volume % Coarse Fragments; Structure; Consistence; Mottling Abundance, Size and Contrast
0 - 8"	Topsoil;
8 - 82"	Fill Material, Brick, Concrete, Metal, Organic Material;
82 - 121"	5YR 3/4; Clay Loam; 25% Gravel, 20% Cobble, 15% Stone; SAB, Moist, Friable; Refusal @ 121"

3 Ground Water Observations:
X Seepage Observed - Depth (inches): 101"
____ Pit Flooded - Depth (inches): ____ after ____ hours of observation

4 Soil Limiting Zones (Check ALL applicable categories):
X Fractured Rock Substratum - Depth to Top: 82"
____ Massive Rock Substratum - Depth to Top: ____
____ Excessively Coarse Horizon - Depth Top to Bottom: ____
____ Excessively Coarse Substratum - Depth to Top: ____
____ Hydraulically Restrictive Horizon - Depth Top to Bottom: ____
____ Hydraulically Restrictive Substratum - Depth to Top: ____
____ Perched Zone of Saturation - Depth Top to Bottom: ____
X Regional Zone of Saturation - Depth to Top: 101"

5 I hereby certify that the information furnished on this form is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

Signature of Site Evaluator: _____ Date: _____
Signature and Seal of Professional Engineer: _____
License #: 24GB04258200 Date: _____

140 West Main Street
High Bridge, NJ 08829
T: 908.238.0544 F: 908.238.9572
Clinton | Asbury Park | Denville | Philadelphia

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Soil Log and Interpretation

1 Soil Log #: SL-4 Date of Soil Log: 2/7/23 Method: Profile Pit
2 Log:

Depth (inches)	Munsell Color Name & Symbol; Estimated Textural Class; Estimated Volume % Coarse Fragments; Structure; Consistence; Mottling Abundance, Size and Contrast
0 - 8"	Topsoil;
8 - 49"	5YR 4/4; Clay Loam, Fill Material; 15% Gravel, 10% Cobble, 5% Stone; SAB, Moist, Friable;
49 - 140"	5YR 4/4; Clay Loam; 30% Gravel, 20% Cobble, 10% Stone; Common, Coarse, Prominent Mottling @ 94-109", 10YR 7/1 in Color; SAB, Moist, Friable

3 Ground Water Observations:
X Seepage Observed - Depth (inches): 86"
____ Pit Flooded - Depth (inches): ____ after ____ hours of observation

4 Soil Limiting Zones (Check ALL applicable categories):
X Fractured Rock Substratum - Depth to Top: 49"
____ Massive Rock Substratum - Depth to Top: ____
____ Excessively Coarse Horizon - Depth Top to Bottom: ____
____ Excessively Coarse Substratum - Depth to Top: ____
____ Hydraulically Restrictive Horizon - Depth Top to Bottom: ____
____ Hydraulically Restrictive Substratum - Depth to Top: ____
____ Perched Zone of Saturation - Depth Top to Bottom: ____
X Regional Zone of Saturation - Depth to Top: 86"

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Signature and Seal of Professional Engineer: _____
License #: 24GB04258200 Date: _____

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Municipality: Franklin Township Block: 517.06 Lot: 15.11

Soil Log and Interpretation

1 Soil Log #: SL-5 Date of Soil Log: 2/7/23 Method: Profile Pit
2 Log:

Depth (inches)	Munsell Color Name & Symbol; Estimated Textural Class; Estimated Volume % Coarse Fragments; Structure; Consistence; Mottling Abundance, Size and Contrast
0 - 8"	Topsoil;
8 - 45"	5YR 4/4; Clay Loam, Fill Material; 15% Gravel, 10% Cobble, 5% Stone; SAB, Moist, Friable;
45 - 125"	5YR 4/4; Clay Loam; 30% Gravel, 20% Cobble, 5% Stone; SAB, Moist, Friable

3 Ground Water Observations:
____ Seepage Observed - Depth (inches): ____
____ Pit Flooded - Depth (inches): ____ after ____ hours of observation

4 Soil Limiting Zones (Check ALL applicable categories):
X Fractured Rock Substratum - Depth to Top: 45"
____ Massive Rock Substratum - Depth to Top: ____
____ Excessively Coarse Horizon - Depth Top to Bottom: ____
____ Excessively Coarse Substratum - Depth to Top: ____
____ Hydraulically Restrictive Horizon - Depth Top to Bottom: ____
____ Hydraulically Restrictive Substratum - Depth to Top: ____
____ Perched Zone of Saturation - Depth Top to Bottom: ____
____ Regional Zone of Saturation - Depth to Top: ____

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Signature of Site Evaluator: _____ Date: _____
Signature and Seal of Professional Engineer: _____
License #: 24GB04258200 Date: _____

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Clinton | Asbury Park | Denville | Philadelphia

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Soil Log and Interpretation

1 Soil Log #: SL-6 Date of Soil Log: 2/7/23 Method: Profile Pit
2 Log:

Depth (inches)	Munsell Color Name & Symbol; Estimated Textural Class; Estimated Volume % Coarse Fragments; Structure; Consistence; Mottling Abundance, Size and Contrast
0 - 8"	Topsoil;
8 - 44"	5YR 4/4; Clay Loam, Fill Material; 15% Gravel, 10% Cobble, 5% Stone; SAB, Moist, Friable;
44 - 120"	5YR 4/4; Clay Loam; 30% Gravel, 20% Cobble, 5% Stone; SAB, Moist, Friable

3 Ground Water Observations:
____ Seepage Observed - Depth (inches): ____
____ Pit Flooded - Depth (inches): ____ after ____ hours of observation

4 Soil Limiting Zones (Check ALL applicable categories):
X Fractured Rock Substratum - Depth to Top: 44"
____ Massive Rock Substratum - Depth to Top: ____
____ Excessively Coarse Horizon - Depth Top to Bottom: ____
____ Excessively Coarse Substratum - Depth to Top: ____
____ Hydraulically Restrictive Horizon - Depth Top to Bottom: ____
____ Hydraulically Restrictive Substratum - Depth to Top: ____
____ Perched Zone of Saturation - Depth Top to Bottom: ____
____ Regional Zone of Saturation - Depth to Top: ____

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Signature of Site Evaluator: _____ Date: _____
Signature and Seal of Professional Engineer: _____
License #: 24GB04258200 Date: _____

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APPLICATION FOR PERMIT TO CONSTRUCT/ALTER
AN INDIVIDUAL SUBSURFACE SEWAGE DISPOSAL SYSTEM

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Form 3g - Basin Flooding Test Data

1 Test # BF-1 Reference Soil Log SL-2 Date Tested 2/7/23

2 Depth of Pit (ft) 5.5

3 Area of pit (ft^2) 50

4 Description of rock substratum within test zone:
Type of Rock Frac. Shale
Name of Formation Brunswick
Average Fracture Spacing >2"
Type of Fractures
___ Open (wide), clean - width of openings (mm) ___
X Open (wide), infilled with fines - width of opening (mm) ___
___ Tight (closed)
Orientation of Fractures:
X Horizontal (parallel to pit bottom) or nearly so
___ Inclined
___ Vertical (parallel to sides of pit) or nearly so
Hardness of Rock:
___ Rippable with hand tools
X Not rippable with hand tools, rippable by machine
___ Not rippable by machine

5 Time/Date of 1st basin flooding 9:44 am 2/7 Volume of water added, gal. 375

6 Result of 1st basin flooding:
___ Basin drained within 24 hours - indicate time/date (No Drainage)
X Basin not drained within 24 hours

7 Time/Date of 2nd basin flooding ___ Volume of water added, gal. ___

8 Result of 2nd basin flooding:
___ Basin drained within 24 hours - indicate time/date ___
___ Basin not drained within 24 hours

9 I hereby certify that the information furnished on Form 3g of this application (and the attachments thereto) is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

Signature of Site Evaluator ___ Date ___
Signature and Seal of Professional Engineer ___
License # 24GB042582 Date ___

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APPLICATION FOR PERMIT TO CONSTRUCT/ALTER
AN INDIVIDUAL SUBSURFACE SEWAGE DISPOSAL SYSTEM

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Form 3g - Basin Flooding Test Data

1 Test # BF-2 Reference Soil Log SL-3 Date Tested 2/7/23

2 Depth of Pit (ft) 8.33

3 Area of pit (ft^2) 50

4 Description of rock substratum within test zone:
Type of Rock Frac. Shale
Name of Formation Brunswick
Average Fracture Spacing >2"
Type of Fractures
____ Open (wide), clean - width of openings (mm) ____
X Open (wide), infilled with fines - width of opening (mm) ____
____ Tight (closed)
Orientation of Fractures:
X Horizontal (parallel to pit bottom) or nearly so
____ Inclined
____ Vertical (parallel to sides of pit) or nearly so
Hardness of Rock:
____ Rippable with hand tools
X Not rippable with hand tools, rippable by machine
____ Not rippable by machine

5 Time/Date of 1st basin flooding 10:40 am 2/7 Volume of water added, gal. 375

6 Result of 1st basin flooding:
____ Basin drained within 24 hours - indicate time/date (~2" Drainage Within 24 Hours)
X Basin not drained within 24 hours

7 Time/Date of 2nd basin flooding ____ Volume of water added, gal. ____

8 Result of 2nd basin flooding:
____ Basin drained within 24 hours - indicate time/date ____
____ Basin not drained within 24 hours

9 I hereby certify that the information furnished on Form 3g of this application (and the attachments thereto) is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

Signature of Site Evaluator ____ Date ____
Signature and Seal of Professional Engineer ____
License # 24GB042582 Date ____

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APPLICATION FOR PERMIT TO CONSTRUCT/ALTER
AN INDIVIDUAL SUBSURFACE SEWAGE DISPOSAL SYSTEM

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Form 3g - Basin Flooding Test Data

1 Test # BF-3 Reference Soil Log SL-4 Date Tested 2/7/23

2 Depth of Pit (ft) 6.5

3 Area of pit (ft^2) 50

4 Description of rock substratum within test zone:
Type of Rock Frac. Shale
Name of Formation Brunswick
Average Fracture Spacing >2"
Type of Fractures
___ Open (wide), clean - width of openings (mm) ___
X Open (wide), infilled with fines - width of opening (mm) ___
___ Tight (closed)
Orientation of Fractures:
X Horizontal (parallel to pit bottom) or nearly so
___ Inclined
___ Vertical (parallel to sides of pit) or nearly so
Hardness of Rock:
___ Rippable with hand tools
X Not rippable with hand tools, rippable by machine
___ Not rippable by machine

5 Time/Date of 1st basin flooding 11:41 am 2/7 Volume of water added, gal. 375

6 Result of 1st basin flooding:
___ Basin drained within 24 hours - indicate time/date (~2" Drainage Within 24 Hours)
X Basin not drained within 24 hours

7 Time/Date of 2nd basin flooding ___ Volume of water added, gal. ___

8 Result of 2nd basin flooding:
___ Basin drained within 24 hours - indicate time/date ___
___ Basin not drained within 24 hours

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Signature of Site Evaluator ___ Date ___
Signature and Seal of Professional Engineer ___
License # 24GB042582 Date ___

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APPLICATION FOR PERMIT TO CONSTRUCT/ALTER
AN INDIVIDUAL SUBSURFACE SEWAGE DISPOSAL SYSTEM

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Form 3g - Basin Flooding Test Data

1 Test # BF-4 Reference Soil Log SL-5 Date Tested 2/7/23

2 Depth of Pit (ft) 6.25

3 Area of pit (ft^2) 50

4 Description of rock substratum within test zone:
Type of Rock Frac. Shale
Name of Formation Brunswick
Average Fracture Spacing >2"
Type of Fractures
___ Open (wide), clean - width of openings (mm) ___
X Open (wide), infilled with fines - width of opening (mm) ___
___ Tight (closed)
Orientation of Fractures:
X Horizontal (parallel to pit bottom) or nearly so
___ Inclined
___ Vertical (parallel to sides of pit) or nearly so
Hardness of Rock:
___ Rippable with hand tools
X Not rippable with hand tools, rippable by machine
___ Not rippable by machine

5 Time/Date of 1st basin flooding 12:24 pm 2/7 Volume of water added, gal. 375

6 Result of 1st basin flooding:
___ Basin drained within 24 hours - indicate time/date (~2" Drainage Within 24 Hours)
X Basin not drained within 24 hours

7 Time/Date of 2nd basin flooding ___ Volume of water added, gal. ___

8 Result of 2nd basin flooding:
___ Basin drained within 24 hours - indicate time/date ___
___ Basin not drained within 24 hours

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Signature of Site Evaluator ___ Date ___
Signature and Seal of Professional Engineer ___
License # 24GB042582 Date ___

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APPLICATION FOR PERMIT TO CONSTRUCT/ALTER
AN INDIVIDUAL SUBSURFACE SEWAGE DISPOSAL SYSTEM

Municipality: Franklin Township Block: 517.06 Lot: 15.11

Form 3g - Basin Flooding Test Data

1 Test # BF-5 Reference Soil Log SL-6 Date Tested 2/7/23

2 Depth of Pit (ft) 9

3 Area of pit (ft^2) 50

4 Description of rock substratum within test zone:
Type of Rock Frac. Shale
Name of Formation Brunswick
Average Fracture Spacing >2"
Type of Fractures
____ Open (wide), clean - width of openings (mm) ____
X Open (wide), infilled with fines - width of opening (mm) ____
____ Tight (closed)
Orientation of Fractures:
X Horizontal (parallel to pit bottom) or nearly so
____ Inclined
____ Vertical (parallel to sides of pit) or nearly so
Hardness of Rock:
____ Rippable with hand tools
X Not rippable with hand tools, rippable by machine
____ Not rippable by machine

5 Time/Date of 1st basin flooding 1:15 pm 2/7 Volume of water added, gal. 375

6 Result of 1st basin flooding:
____ Basin drained within 24 hours - indicate time/date (~6" Drainage Within 24 Hours)
X Basin not drained within 24 hours

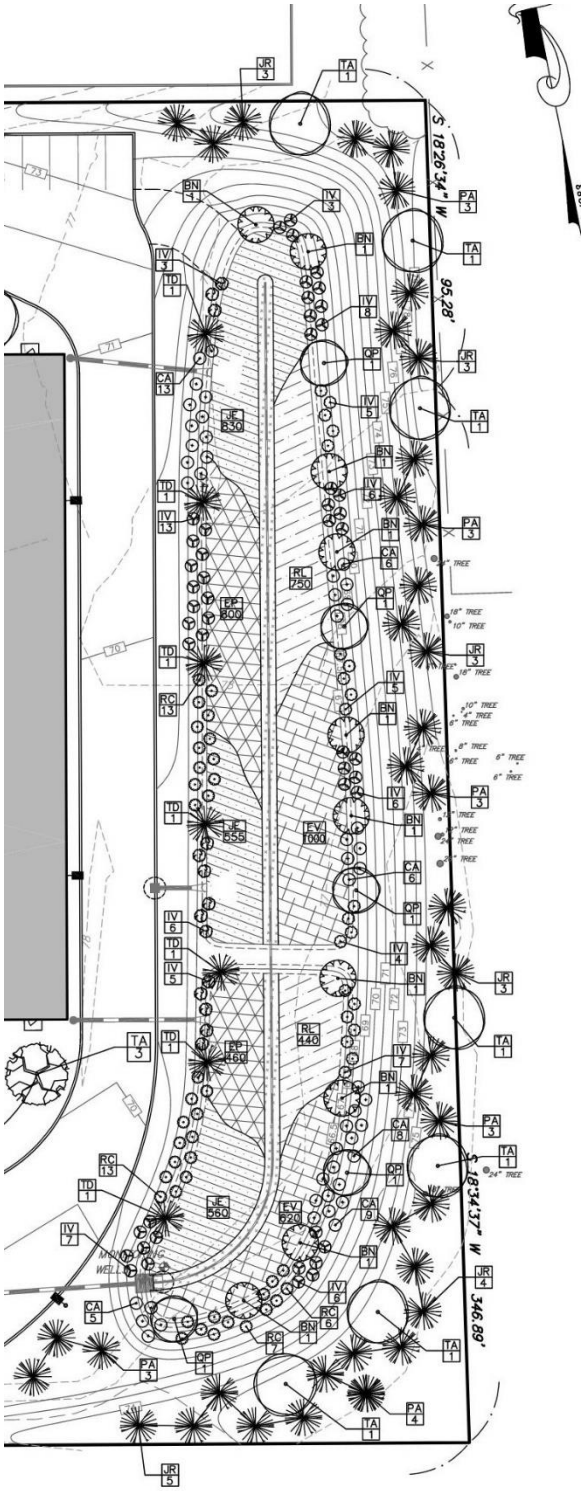
7 Time/Date of 2nd basin flooding ____ Volume of water added, gal. ____

8 Result of 2nd basin flooding:
____ Basin drained within 24 hours - indicate time/date ____
____ Basin not drained within 24 hours

9 I hereby certify that the information furnished on Form 3g of this application (and the attachments thereto) is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

Signature of Site Evaluator ____ Date ____
Signature and Seal of Professional Engineer ____
License # 24GB042582 Date ____

Small Scale and Large Scale Bio Basins Landscape Plan



Bio Basins Planting Schedule

BIORETENTION BASIN PLANTING SCHEDULE

QTY.	KEY	BOTANICAL NAME	COMMON NAME	SIZE	ROOT	REMARKS
3	AS	Alnus serrulata	Smooth Alder	ns	#3	✿
8	BN	Betula nigra	River Birch	5-6'	ns	✿
46	CA	Cornus amomum	Silky Dogwood	ns	#2	✿
1286	EV	Elymus virginicus	Virginia Wild-rye	2"	plug	✿ 18" O.C.
1334	EP	Eupatorium perfoliatum	Boneset	2"	plug	✿ 18" O.C.
50	IV	Ilex verticillata	Winterberry Holly	ns	#2	✿
1527	JE	Juncus effusus	Soft Rush	2"	plug	✿ 18" O.C.
47	MP	Morella pensylvanica	Northern Bayberry	ns	#2	✿
62	RC	Photinia pyrifolia	Red Chokeberry	ns	#2	✿
3	QB	Quercus bicolor	Swamp White Oak	5-6'	B&B	✿
3	QP	Quercus palustris	Pin Oak	5-6'	B&B	✿
725	RL	Rudbeckia laciniata	Cutleaf Coneflower	2"	plug	✿ 18" O.C.
41	SD	Salix discolor	Pussy Willow	ns	#2	✿
2300	SC	Schoenoplectus cyperinus	Woolgrass	2"	plug	✿ 18" O.C.
14	TD	Taxodium distichum	Bald Cypress	5-6'	B&B	✿

✿ Denotes a native plant.

Part II- Field Manuals

File this Corrective Maintenance Record in the Maintenance Log after performing maintenance.

Surface Extended Detention Basin
As Shown on the Location Map

NOTE

This Field Manual is intended to be editable and adjustable in accordance with the design of stormwater management measures, the site conditions, and the special needs of responsible party. The Engineer should supplement information and best management practice to assist the responsible party to perform maintenance.

Table of Contents

Extended Detention Basin Overview

Functionality

An extended detention basin is a stormwater management facility that temporarily stores and attenuates stormwater runoff.

Type of BMP – Dry Basin / Extended Detention Only

An extended detention basin is a type of **dry** basin. This extended detention basin is designed for **detention only** and is **not** designed to infiltrate runoff; therefore, the basin may not be completely dry after the **design detention time** (see the Hydrology Design Targets in the Basic Design Information section). However, standing water in excess of 72 hours is a sign of basin failure. It may also contribute to mosquito breeding and other health and safety issues. Therefore, all dry basins must fully drain within 72 hours of the most recent rainfall. The design drain time shall be closely monitored to ensure potential failure is recognized early. **Proper care and attention in the long-term maintenance of the stormwater management measure is critically important to the safety and health of the public.**

Basic Design Information for Existing Basin

The existing detention basin was designed to provide water quality and quantity control as part of the approval for Raritan Computer Inc. The existing outlet structure provides water quality with a nine (9") inch Vortechnics hydro-break at the base of the concrete swale and quantity control is provided by a 20"W x 25"H orifice.

As outlined in the Stormwater Report, the motor vehicle surface area to the existing basin is proposed to be reduced by over 2,000 square feet. The impervious surface area to the existing basin is also proposed to be reduced by approximately 1,000 square feet. This net reduction of coverage to the existing basin, plus keeping the hydrographs the same or less, allows the existing basin to be utilized. In proposed conditions, the existing water quality is being maintained; and, although not required by the regulations, the existing quantity control is being improved by increasing the orifice size to 48"W x 25"H and adding bioretention basins.

Hydraulic Design Targets

1. Design Parameters (Existing Detention Basin for Proposed Conditions with Reduced Coverage to the basin)

	Water Quality Design Storm	2-year storm	10-year storm	100-year storm
Rainfall Depth (inches)	1.25 inch in 2 hours	3.31 inches in 24 hours	5.03 inches In 24 hours	8.38 inches In 24 hours
Runoff Volume (cubic feet)	12,327	42,863	70,480	126,542
Peak Flow Rate (cfs)	0.11	0.15	3.20	16.32
Water Surface Elevation (feet)	60.31	61.77	62.17	62.95

2. The emergency spillway is at EL. 63.90 feet

Basin Configuration Targets

1. Outlet Information:

Outlet Description	Outlet Type	Orifice Size / Weir Length	Invert Elevation
Water Quality	Vortechnics Hydro-break	9″	57.87
Outlet #2	Rectangular Orifice	48″W x 25″H	61.79
Outlet #3	Grate	48″x48″	63.87
Outlet #4	Spillway	25′	63.90

2. The basin does not appear to be lined.

Critical Maintenance Features

1. Grass clippings shall be collected from the basin and properly disposed.
2. Trash racks and discharge outlet shall be cleaned frequently.
3. Remove sediment in low flow channel.
4. (Others to be added by the design engineer, if necessary)

Visual Aid for Dry Type Stormwater Basin Inspection

(Note: Basins shown here include various types of dry basins, not limited to the category of basin in this field manual.)

Issue:	The inlet is not properly drained, assuming it has not rained within 72 hours.
Corrective Action:	Clear and remove sediment. Check whether the water table is at or above the bottom of the forebay. Also check the permeability of the underlying soil, if necessary.
Preventative Action:	Routine inspections and removal of sediment from the forebay.

Issue:	The Inflow pipe is clogged by sediment and vegetation.
Corrective Action:	Clear and remove sediment and unwanted vegetation.
Preventative Action:	Routine inspection and removal of sediment and unwanted vegetation.

Issue:	The Inflow pipe is entirely clogged by sediment and trees.
Corrective Action:	Clear and remove sediment and trees.
Preventative Action:	Routine inspection & removal of sediment and unwanted vegetation.

Issue:	The excessive sediment in inflow pipe (shown above) might be caused by a blockage of flow to the basin due to excessive vegetation and overgrown trees.
Corrective Action:	Clear and remove trees and vegetation. If necessary, re-grade the bottom slope to ensure the flow properly spreads over the basin bottom.
Preventative Action:	Routine inspection and removal of sediment and unwanted vegetation.

Issue:	Eroded inflow apron.
Corrective Action:	Repair apron.
Preventative Action:	Routine inspection and rehabilitation, if necessary.

Issue:	The vegetation loss and the blackish soil may indicate frequent inundation.
Corrective Action:	Check the permeability rate of the soil and the water table elevation. Replace the soil if necessary.
Preventative Action:	Routine inspection and tilling/aeration, if necessary.

Issue:	The low flow channel has excessive accumulation of sediment and debris. The outflow orifice is clogged by a trash bag and debris. Note that there is no trash rack installed.
Corrective Action:	Check the permeability rate of the soil and the water table elevation. Replace the soil if necessary.
Preventative Action:	Routine inspection and cleaning.

Issue:	Trash rack is damaged.
Corrective Action:	Repair the trash rack.
Preventative Action:	Routine inspection, especially after large storm events. Tighten any loose bolts and repair structural flaws.

A well maintained detention basin

File this Corrective Maintenance Record in the Maintenance Log after performing maintenance.

Bioretention Systems
Bio Basins as shown on the Location Map

NOTE

This Field Manual is intended to be editable and adjustable in accordance with the design of stormwater management measures, the site conditions, and the special needs of responsible party. The Engineer should supplement information and best management practice to assist the responsible party to perform maintenance.

Table of Contents

Bioretention System Overview

Functionality

Bioretention systems are used to remove a wide range of pollutants, such as suspended solids, nutrients, metals, hydrocarbons, and bacteria from stormwater runoff. They can also be used to reduce peak runoff rates and increase stormwater infiltration when designed as a multi-stage, multi-function facility.

A bioretention system can be configured as either a bioretention basin or a longer, narrower bioretention swale. In general, a bioretention basin has a flat bottom while a bioretention swale may have sloping bottom. Runoff storage depths above the soil bed surface are typically shallow. The TSS removal rate for bioretention systems is 80 or 90 percent, depending upon the thickness of the soil planting bed and the type of vegetation grown in the bed.

Proper care and attention in the long-term maintenance of the stormwater management measure is critically important to the safety and health of the public.

Type of BMP – Dry Basin / Infiltration

A bioretention system is a type of **dry** basin. Dry basins must fully drain within 72 hours of the most recent rainfall. Standing water in excess of 72 hours is a sign of basin failure. It may also contribute to mosquito breeding and other health and safety issues. The design drain time shall be closely monitored to ensure that potential failure is recognized early.

A bioretention system with infiltration can also be designed for extended detention, in which case it will attenuate peak flows from storms larger than the Water Quality Design Storm.

Basic Design Information
Small Scale Bioretention Basin

Hydrology Design Targets

1. The bioretention system is designed as an (online) system.
2. The design drain time is 24.30 hours (100-yr storm).
3. Preliminary soil testing was performed on 02/07/23 and the results are included as part of this report. Additional soil testing was performed on 11/14/23 and the results are included in a separate report as an addendum.
4. The system is designed to drain through the plant media, sand layer, and gravel layer to an underdrain system that directs runoff to the outlet structure. Larger storms will pass over the spillway into a large scale bioretention basin.

Hydraulic Design Targets

1. Design parameters

	Water Quality Design Storm	2-year storm	10-year storm	100-year storm
Rainfall Depth (inches)	1.25 inch in 2 hours	3.31 inches in 24 hours	5.03 inches In 24 hours	8.38 inches In 24 hours
Runoff Volume (cubic feet)	4,182	14,723	24,306	43,865
Peak Flow Rate (cfs)	0.45	0.92	5.88	12.82
Water Surface Elevation (feet)	67.26	67.52	67.63	67.72

Note: The design engineer shall fill out the table in accordance with the design of the stormwater management measure. If the item is not applicable, enter **N/A** in the table.

2. The emergency spillway is at EL. 67.50

Basin Configuration Targets

3. Planting Soil Bed
    - The depth of the soil planting bed is 1.5 feet.
    - Mixture of the planting soil consists of 85-95 % of sand. (with no more than 25% of the sands as fine or very fine sands; no more than 15% silt and clay with 2% to 5% clay content). The organic matter shall be within 3 % to 7 %.
    - The pH of the planting soil should be in the range of 5.5 and 6.5.

- Filter fabric is placed along the sides and bottom of the soil planting bed.
- The system is designed with a planting soil permeability rate of 3 inches/hour (pre-construction) and _____ inches/hour (post-construction – tested on (___/___/___.

4. Outlet Information:

Outlet Description	Outlet Type	Orifice Size / Weir Length	Invert Elevation
Water Quality Underdrain	Perforated HDPE	6 in diameter	66.25
Outlet #1	Spillway	50 ft	67.50
Outlet #2			
Outlet #3			

5. Vegetation
   - The vegetation type to be used in this bioretention system is (site-tolerant grasses, **terrestrial forested community**). A Landscaping Plan is included in the Reference Documents section of this field manual.

For a bioretention system designed with an underdrain, the following also applies.

6. Underdrain
   - The manifold pipe is six (6″) inches in diameter, perforated, at a slope of 0.5%. (Note: The cleanout pipe shall **NOT** be perforated.)
   - The material used for the filter fabric is 12 oz. non-woven geotextile.
   - The gravel layer surrounding the underdrain consists of three (3″) inches of gravel above the underdrain and three (3″) inches of gravel below the underdrain.

Critical Maintenance Features

5. No heavy equipment on the basin surface.
6. Remove vegetation strictly in accordance with the landscaping plan.
7. Grass clippings shall be collected from the basin and properly disposed.
8. Keep the appearance of the basin aesthetic.

Basic Design Information
Large Scale Bioretention Basin

Hydrology Design Targets

1. The bioretention system is designed as an (online) system.
2. The design drain time is 40 hours (100-year storm).
3. Preliminary soil testing was performed on 02/07/23 and the results are included as part of this report. Additional soil testing was performed on 11/14/23 and the results are included in a separate report as an addendum.
4. The system is designed to drain through the plant media, sand layer, and gravel layer to an underdrain system that directs runoff to the outlet structure and will discharge through the lowest invert in the outlet structure.

Hydraulic Design Targets

1. Design parameters

	Water Quality Design Storm	2-year storm	10-year storm	100-year storm
Rainfall Depth (inches)	1.25 inch in 2 hours	3.31 inches in 24 hours	5.03 inches In 24 hours	8.38 inches In 24 hours
Runoff Volume (cubic feet)	7,275	25,788	42,602	76,927
Peak Flow Rate (cfs)	0.43	0.56	0.68	0.85
Water Surface Elevation (feet)	67.16	67.64	68.25	69.44

Note: The design engineer shall fill out the table in accordance with the design of the stormwater management measure. If the item is not applicable, enter **N/A** in the table.

2. The emergency spillway is at EL. 70.65.

Basin Configuration Targets

1. Planting Soil Bed
    - The depth of the soil planting bed is 1.5 feet.
    - Mixture of the planting soil consists of 85-95 % of sand. (with no more than 25% of the sands as fine or very fine sands; no more than 15% silt and clay with 2% to 5% clay content). The organic matter shall be within 3 % to 7 %.
    - The pH of the planting soil should be in the range of 5.5 and 6.5.
    - Filter fabric is placed along the sides of the soil planting bed.

- The system is designed with a planting soil permeability rate of 3 inches/hour (pre-construction) and _____ inches/hour (post-construction – tested on (___/___/___.

2. Outlet Information:

Outlet Description	Outlet Type	Orifice Size / Weir Length	Invert Elevation
Water Quality Underdrain	Perforated HDPE	6 in diameter	66.25
Outlet #1	Circular Orifice	2.5 in diameter	67.25
Outlet #2	Grate	48 in x 48 in	69.50

3. Vegetation
   - The vegetation type to be used in this bioretention system is (site-tolerant grasses, **terrestrial forested community**). A Landscaping Plan should be included in the Reference Documents section of this field manual.

For a bioretention system designed with an underdrain, the following also applies.

4. Underdrain
   - The manifold pipe is six (6") inches in diameter, perforated, at a slope of 0.5%. (Note: The cleanout pipe shall **NOT** be perforated.)
   - The material used for the filter fabric is 12 oz. non-woven geotextile.
   - The gravel layer surrounding the underdrain consists of three (3") inches of gravel above the underdrain and three (3") inches of gravel below the underdrain.

Critical Maintenance Features

1. No heavy equipment on the basin surface.
2. Remove vegetation strictly in accordance with the landscaping plan.
3. Grass clippings shall be collected from the basin and properly disposed.
4. Keep the appearance of the basin aesthetic.

Visual Aid for Bioretention System Inspection

Reference Documents

Documents to be placed in this field manual should include the following:

- As-built Drawings with Drainage Plans
- Soil Boring Logs
- Permeability Test (Pre-construction)
- Permeability Test (Post-construction)

Attach Reference Documents Here

Inspection Checklist / Maintenance Actions
Bioretention System

Checklist (circle one)**:** Quarterly / Annual / Monthly / Special Event Inspection

Checklist No. _____ **Inspection Date:** _____

Date of most recent rain event: _____

Rain Condition (circle one):
Drizzle / Shower / Downpour / Other _____

Ground Condition (circle one):
Dry / Moist / Ponding / Submerged / Snow accumulation

The inspection items and preventative/corrective maintenance actions listed below represent general requirements. The design engineer and/or responsible party shall adjust the items and actions to better meet the conditions of the site, the specific design targets, and the requirements of regulatory authorities.

	For Inspector			For Maintenance Crew
Component No. Component Name	Inspection Item and Inspection Item No.		Result	Preventative / Corrective Maintenance Actions
A Basin Bed	1	Standing water is present after the design drain time The observed drain time is approximately _____ hours.	Y__ N__	Recheck to determine if there is standing water after 72 hours If standing water is present longer than 5 days, report to mosquito commission. Remove any sediment buildup Check the soil permeability Till the soil bed with rotary tiller or disc harrow Replace the planting soil, if necessary Work Order # _____
	2	Excessive sediment, silt, or trash accumulation on basin bed	Y__ N__	Clean pretreatment system Remove silt, sediment, and trash
	3	Erosion or channelization is present	Y__ N__	Check whether the flow bypass or diversion device is clogged Re-grade the infiltration bed Work Order # _____
	4	Animal burrows/rodents are present	Y__ N__	Pest control Work Order # _____
Note:				

	For Inspector			For Maintenance Crew
Component No. Component Name	Inspection Item and Inspection Item No.		Result	Preventative / Corrective Maintenance Actions
A Basin Bed	5	Uneven bed	Y__ N__	Use light equipment to resurface the bed Work Order # _____
	6	Evidence of sinkholes or subsidence	Y__ N__	Monitor for sinkhole development
B Vegetation	1	Large spot(s) showing bare soil	Y__ N__	Vegetative cover must be maintained at 85%. Revegetate the entire basin if 50% or more vegetation has been lost. Check Landscaping plan for guidance (if available) Work Order # _____
	2	Invasive plants are present	Y__ N__	Remove the invasive plants and restore the vegetation in accordance with the landscaping plan Work Order # _____
	3	The vegetation in the basin has been mowed or removed	Y__ N__	Revegetate the system in accordance with the vegetation plan Work Order # _____ Note: The vegetation in a bioretention system should **not** be mowed or removed
Note:				

	For Inspector			For Maintenance Crew
Component No. Component Name	Inspection Item and Inspection Item No.		Result	Preventative / Corrective Maintenance Actions
C Bioretention System Embankment and Side Slopes	1	Signs of erosion, soil slide or bulges, seeps and wet spots, loss of vegetation, or erosion on the basin slope	Y__ N__	Check for excessive overland runoff flow through the embankment. Check for any sink hole development Direct the overland runoff to the forebay or pretreatment area Restabilize the bank Work Order # _____
	2	Overgrown perimeter vegetation	Y__ N__	Mow the vegetation on the perimeter of the embankment Work Order # _____ Note: Mowing of vegetation should only take place in the area **outside** the basin. Dense vegetation must be maintained in the basin.
D Outlet	1	Trash or debris accumulation more than 20%	Y__ N__	Clean and remove Determine source of trash and address to reduce future maintenance costs or basin failure
	2	Trash rack is damaged or rusted greater than 50% Trash rack is bent, loose, or missing parts	Y__ N__	Repair or replace trash rack Work Order #_____
	3	Outlet components (e.g., orifice plates or weir plate) skewed, misaligned, or missing	Y__ N__	Repair or replace component Work Order #_____
	4	Discharge pipe apron is eroded or scoured	Y__ N__	Restabilize the discharge riprap apron Work Order #_____
Note:				

	For Inspector			For Maintenance Crew
Component No. Component Name	Inspection Item and Inspection Item No.		Result	Preventative / Corrective Maintenance Actions
E Emergency Spillway	1	Trees or excessive vegetation present	Y__ N__	Remove trees and roots, and restore berms if necessary Work Order #_____
	2	Damaged structure	Y__ N__	Repair Work Order #_____
F Miscellaneous	1	Fence: broken or eroded parts	Y__ N__	Repair or replace Work Order #_____
	2	Gate: missing gate or lock	Y__ N__	Repair or replace Work Order #_____
	3	Sign/plate: tiled, missing, or faded	Y__ N__	Repair or replace Work Order #_____
	4	Excessive or overgrown vegetation blocking access to the basin	Y__ N__	Clear, trim, or prune the vegetation to allow access for inspection and maintenance Work Order #_____
Note:				

Follow Up Items (Component No. / Inspection Item No.):

_____

Associated Work Orders: # _____, # _____, # _____, # _____, # _____

_____	_____	_____
Inspector Name	Signature	Date

Report issues to the local authority and mosquito commission as required by local ordinances and regulatory authorities.

File this checklist in the Maintenance Log after performing maintenance.

Preventative Maintenance Record

Corresponding Checklist No. _____
Component No._____, Inspection Item No._____

Work Logs

Activities	Components	Date Completed
Sediment/debris removal **Sediment removal should be taken place when the basin is thoroughly dry.**	A1/A2/A3 – Pretreatment – **N/A**	
	A – Basin Bed	
	B – Bioretention System Embankment and Side Slopes	
	C – Outlet	
Vegetation removal	A1/A2/A3 – Pretreatment – **N/A**	
	A – Basin Bed	
	B – Bioretention System Embankment and Side Slopes	
	C – Outlet	
	D – Emergency Spillway	

Vegetation is removed by _____ (type of equipment) 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 stormwater management measure. The fertilizer applied is _____ (type), and _____ (quantity per usage) is applied _____ (frequency of use).

Debris, sediment, and trash are handled (onsite / by _____ (contractor name) to disposal site _____). (See Part I: Maintenance Plan – Disposal Plan Section)

Crew member:_____/_____ **Date:** _____
(name/ signature)

Supervisor:_____/_____ **Date:** _____
(name/ signature)

File this Preventative Maintenance Record in the Maintenance Log after performing maintenance.

Corrective Maintenance Record

1. **Work Order #** _____ **Date Issued** _____

2. **Issue to be resolved:**
(e.g., orifice plate is loose and bent)

3. The issue was from **Corresponding Checklist** _____, **Component No.** (e.g., D – Outlet), **Inspection Item No.** (e.g., 2, 3) _____.

4. **Required Actions**

Actions	Planned Date	Date Completed
Install new bolts to fix the orifice plate		
Repair/replace the trash rack		
Restabilize side slope (indicate location)		
Repair riprap apron with 100 cubic yards of aggregate		
Revegetate		
(If there are additional tasks, list them here.)		

5. **Responsible person(s):**
_____

6. **Special requirements**
   - Time of the season or weather condition :_____
   - Tools/equipment:_____
   - Subcontractor (name or specific type):_____

Approved by _____/_____ **Date** _____
(name/signature)

Verification of completion by _____/_____ **Date** _____
(name/signature)

File this Corrective Maintenance Record in the Maintenance Log after performing maintenance.

Stormwater Management Measures Maintenance Plan

Maintenance Logs and Inspection Records

NOTE

This Maintenance Logs and Inspection Records are intended to be editable and adjustable in accordance with the design of stormwater management measures, the site conditions, and the special needs of responsible party. The Engineer should supplement information and best management practice to assist the responsible party to perform maintenance.

Table of Contents

Inspection Checklist Log

1. **The responsible party shall report issues to the local authority and mosquito commission as required by local ordinances and regulatory authorities.**
2. The maintenance crew should fill out the checklist in the field manual when performing each inspection/maintenance task.
3. After the maintenance task is performed, the checklist should be filed in the Maintenance Plan and recorded in the log below.

Cycle of Inspection	Stormwater Management Measure No.	Checklist No.	Date(s) of Inspection
(2nd Quarter) 06/26/2020			06/26/2020
(2nd Quarter) 06/10/2022			06/10/2022
(3rd Quarter) MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Inspection; e.g., after 1" rain) MM/DD/YYYY			
(1st Quarter) MM/DD/YYYY			
(2nd Quarter) MM/DD/YYYY			
(3rd Quarter) MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Inspection; e.g., after 1" rain) MM/DD/YYYY			
(1st Quarter) MM/DD/YYYY			
(2nd Quarter) MM/DD/YYYY			
(3rd Quarter)			

Cycle of Inspection	Stormwater Management Measure No.	Checklist No.	Date(s) of Inspection
MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Inspection; e.g., after 1″ rain) MM/DD/YYYY			
(1st Quarter) MM/DD/YYYY			
(2nd Quarter) MM/DD/YYYY			
(3rd Quarter) MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Inspection; e.g., after 1″ rain) MM/DD/YYYY			
(1st Quarter) MM/DD/YYYY			
(2nd Quarter) MM/DD/YYYY			
(3rd Quarter) MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Inspection; e.g., after 1″ rain) MM/DD/YYYY			

Continue the table when necessary.

Attach the Inspection Checklist after each inspection

Preventative Maintenance Log

Maintenance Schedule	Stormwater Management Measure No.	Preventative Maintenance Record No.	Date(s) of Maintenance
(1st Quarter) MM/DD/YYYY			
(2nd Quarter) MM/DD/YYYY			
(3rd Quarter) MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Maintenance work; e.g., after 1″ rain) MM/DD/YYYY			
(1st Quarter) MM/DD/YYYY			
(2nd Quarter) MM/DD/YYYY			
(3rd Quarter) MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Inspection; e.g., after 1″ rain) MM/DD/YYYY			

Continue the table when necessary.

Attach the Preventative Maintenance Record after each maintenance task performed

Corrective Maintenance Log

Maintenance Schedule	Stormwater Management Measure No.	Corrective Maintenance Record No.	Date(s) of Maintenance
(1st Quarter) MM/DD/YYYY			
(2nd Quarter) MM/DD/YYYY			
(3rd Quarter) MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Maintenance work; e.g., after 1″ rain) MM/DD/YYYY			
(1st Quarter) MM/DD/YYYY			
(2nd Quarter) MM/DD/YYYY			
(3rd Quarter) MM/DD/YYYY			
(4th Quarter) MM/DD/YYYY			
(Unscheduled Inspection; e.g., after 1″ rain) MM/DD/YYYY			

Continue the table when necessary

Attach the Corrective Maintenance Record after each maintenance task performed