

Stormwater Management Operation and Maintenance Plan

Littleton Drive Affordable Housing Project Wareham, Massachusetts

Prepared for:

**Pennrose Properties, LLC
50 Milk Street, 16th Floor
Boston, MA 02109**

Prepared by:

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Stormwater Management Maintenance Plan
Littleton Drive Housing Development
Wareham, MA

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Stormwater Management Maintenance Plan
Littleton Drive Housing Development
Wareham, MA

1.0 OWNER AND RESPONSIBILITY FOR MAINTENANCE

Pennrose Properties, LLC is responsible for the financing and continuous operation, maintenance and required emergency repair for the stormwater management system and associated drainage network.

Owner: Pennrose Properties, LLC
50 Milk Street, 16th Floor
Boston, MA 02109

Contact: TBD

Name:

Email:

Ph:

Signed: _____

Date: _____

2.0 INTRODUCTION

This Guide provides a general description of the function and maintenance requirements for the Stormwater Management System for the Littleton Drive Housing Development. Proper maintenance is vital to their long-term success.

The proposed stormwater management includes a green stormwater infrastructure (GSI) approach to filter, infiltrate and store stormwater runoff prior to discharge. Therefore, the maintenance provider is required to familiarize themselves with this Guide and inspect and maintain the following GSI practices, as indicated on the construction drawings, and as outlined in this maintenance guide throughout the year.

PRETREATS AND FILTERS

- [Bioretention Area](#)
 - A shallow depression in the landscape designed to collect, move, hold, and treat stormwater as it infiltrates through a soil matrix to remove phosphorus and reduce stormwater runoff prior to discharge to the storm drain system

STORES AND INFILTRATES

- [Surface Infiltration Basin](#)
 - An excavated surface depression designed to infiltrate runoff. Pretreatment must occur prior to the runoff discharging to infiltration basin for runoff sourced from parking lots and other impervious cover with higher potential pollutant loads.
- [Underground Recharge Chambers](#)
 - The underground recharge chambers are designed to store and infiltrate runoff. The underground chambers include an overflow structure to slowly release runoff from larger storm events to the drainage system.

3.0 FUNCTION & MAINTENANCE

How Does Green Infrastructure Work?

GSI is nature-based approach to stormwater treatment and management. These stormwater practices or “treatment areas” are designed to mimic nature and use the natural filtration properties of soil and plants to remove pollutants from stormwater runoff prior to discharging to the drainage system. GSI relies on the following five basic design elements, or steps, to function properly.

1. **Collect (drainage gutters to paved flumes)**
2. **Capture Sediment (Pretreatment)**
3. **Move Water (Pipes)**
4. **Treat and Manage (Stores, Filters, and Infiltrates)**
5. **Overflows (Structure)**

These five steps will be referenced throughout this Guide. If one of these steps does not function properly, the entire system can be compromised and the GSI practice itself could be

contributing to maintenance problems. This can lead to a landscape nuisances, more frequent maintenance, and costly repairs/improvement.

What is required for Maintenance?

As these are nature-based systems that often rely on plant care, the maintenance for GSI typically falls under landscape and general site maintenance services. The regularly scheduled maintenance as outlined in this Guide is critical to ensure proper function, maintain infiltration rates and storage capacity and preserve the pollutant removal capabilities as well as the visual appearance. Regularly scheduled maintenance can prevent deficiencies in the effectiveness of the systems, due to sediment build-up, damage, or deterioration.

General maintenance includes the following:

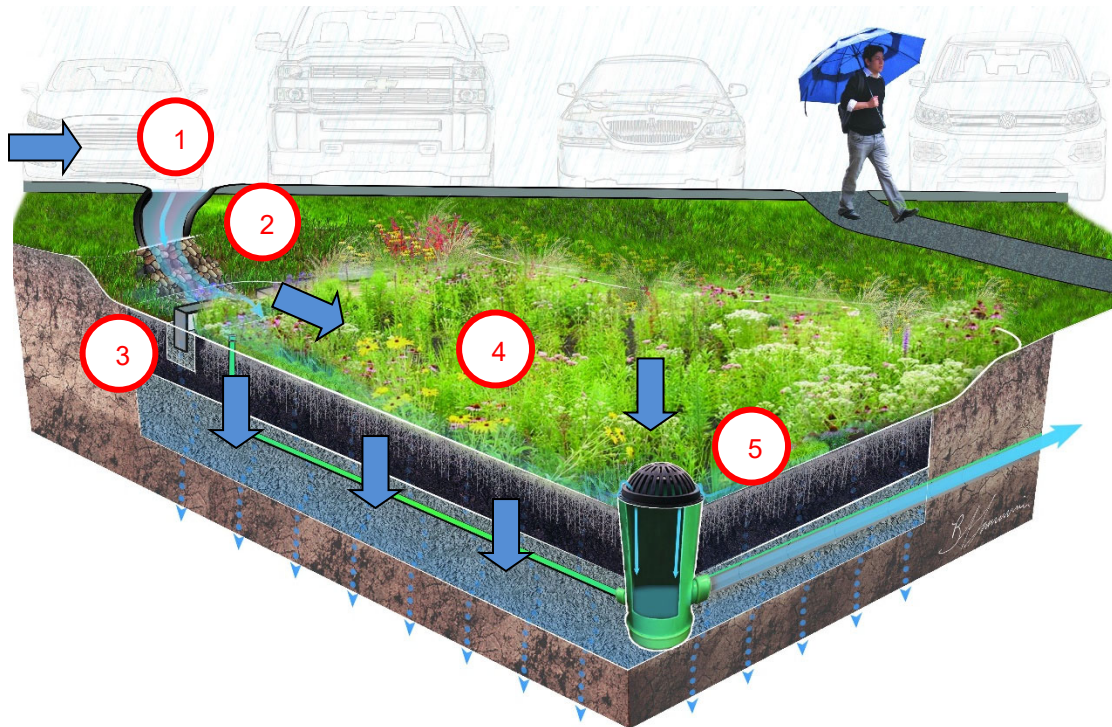
1. Removing sediment from the pretreatment practices used to capture sediment.
2. Maintaining the proper drainage function and pollutant removal capacity of the systems.
3. Maintaining healthy native, trees, plants, and vegetative cover as well as the removal of unwanted weeds.

It is recommended that all practices be maintained regularly as part of the routine landscape maintenance or at a minimum four times per year and after major rain events.

- **Early Spring:** during spring cleanup
- **Summer:** during lawn mowing and other routine maintenance
- **Early Fall:** when leaves begin to fall
- **Late Fall/Early Winter:** after all the leaves have fallen during leaf removal
- **After major storm events:** 2" of rain or greater.

The following sections describes the general function and landscape maintenance of each practice. Included in the appendices is a specific maintenance checklist for each practice type along with a plan showing the location of the items to be inspected and maintained.

3.1 Bioretention Area



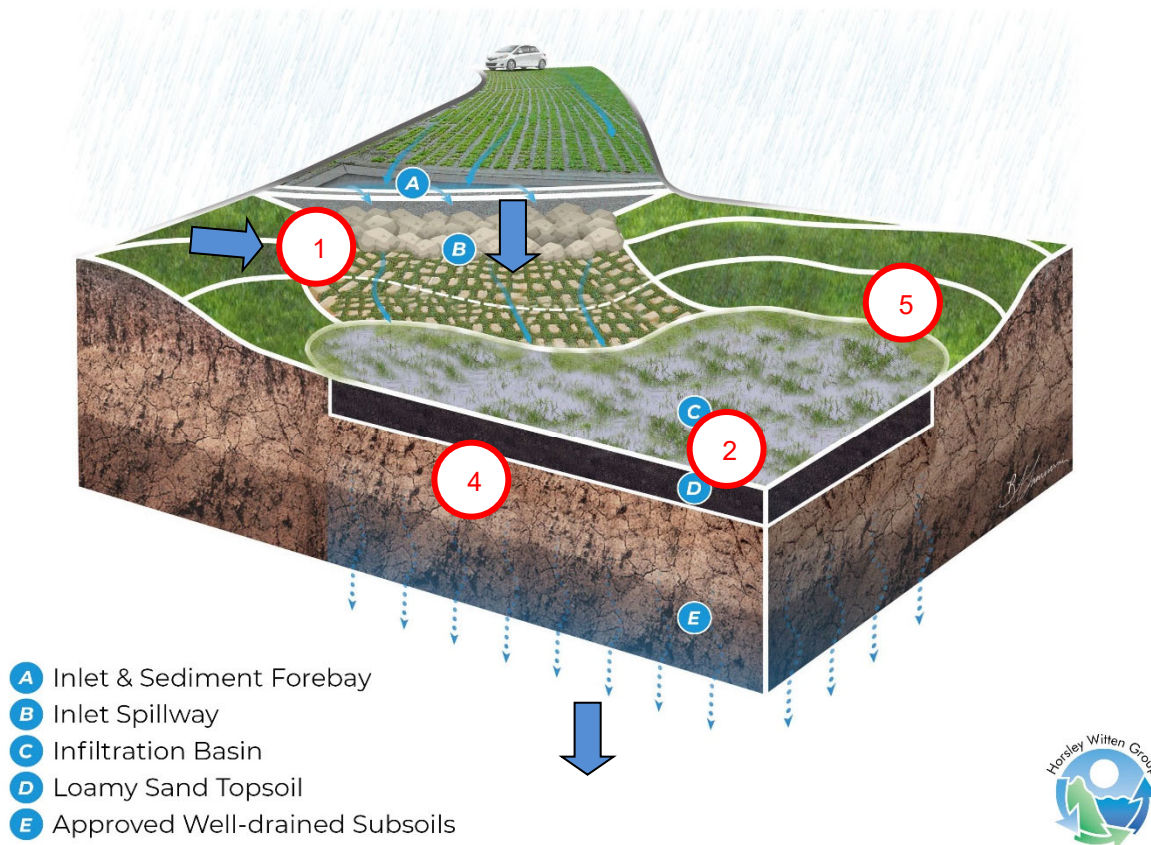
FUNCTION:

- 1. COLLECT** – Inlet flume
 - a. Stormwater runoff is collected at the inlet flume and diverted to the sediment forebay.
- 2. CAPTURE** – Sediment Forebay
 - a. Sediment, trash, and debris is captured and accumulates overtime in the sediment forebay.
- 3. MOVE** – The stormwater discharges directly to the bioretention area via a granite check dam weir.
- 4. TREAT AND MANAGE** – Bioretention Soil (filters)
 - a. Stormwater overtops the forebay granite check dam and flows through the planted bioretention area, which infiltrates or filters stormwater through the planted sandy soil matric and subsoils.
- 5. OVERFLOW STRUCTURE** (note, no underdrains are proposed)
 - a. During larger rain events, soils become saturated and the basin fills to the overflow structure. For extreme events, the water level will rise and overflow into the outlet structure.

SURROUNDING AREA - Parking lots, roadways, sidewalks, and open lawns

Problems such as unstabilized soils, erosion, invasive plants and over sanding of the parking lot can contribute to long-term maintenance problems (See Section 6.0).

See Appendix A for Maintenance Checklist



FUNCTION:

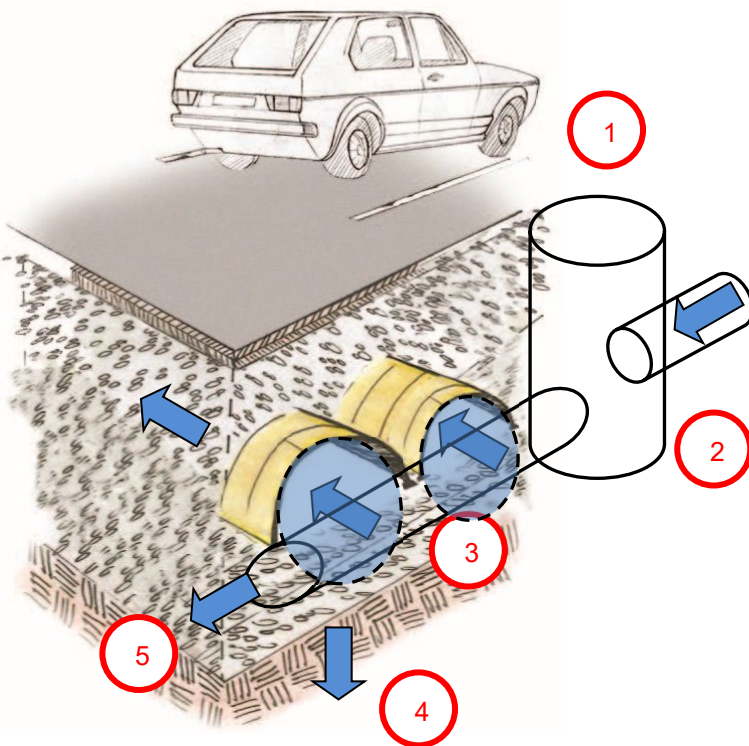
1. **COLLECT** Drainage Swale from backyards
 - a. Stormwater runoff is collected from roof drains by pipe and overland flow through to the inlet of the infiltration basin. No forebay is needed since no roadway or parking lot runoff is directed to the basin unless prior pretreatment by a bioretention system occurs.
2. **CAPTURE**–Infiltration Basin
 - a. Stormwater runoff is captured in the infiltration basin and stored during rain events.
3. **MOVE**– NA
4. **INFILTRATE** – Surface Basin into Subsoil
 - a. Runoff is infiltrated into the sub soils through the surface of the basin.
5. **OVERFLOW** –
 - a. The basin is sized to infiltration storms up to the 500-Year Storm event. No formal overflow is provided, but the houses are all raised above the 500-Year flow.

SURROUNDING AREA – Landscape Area

Problems such as unstabilized soils, erosion, and leaf litter can contribute to long-term maintenance problems (See Section 6.0).

See Appendix A for Maintenance Checklist

3.3 Underground Chambers



FUNCTION:

1. COLLECT – Paved inlet flumes and Bioretention (See Section 3.1)
 - a. Stormwater runoff is directed overland to the inlet(s) where stormwater enters the system.
2. CAPTURE –Manhole/Isolator Row/ Bioretention
 - a. Sediment, trash, and debris is captured and accumulates overtime in the bioretention area forebays, or chamber isolator row (see Appendix C)
3. MOVE - Pipes and Manifold
 - a. Runoff is directed to the isolator row and underground chambers via a closed pipe/manifold system.
4. STORE AND INFILTRATE- Underground Chambers (infiltrates and/or stores)
 - a. For recharge chambers, runoff from small rain events infiltrate into the subsurface soils beneath the chambers. Larger storm events are stored and slowly released.
5. OVERFLOW – Manhole with Weir

During larger rain events stored water from the chambers are discharged via an overflow structure.

SURROUNDING AREA – Parking Lot/Driveway

Problems such as unstabilized soils, erosion, invasive plants and over sanding can contribute to long-term maintenance problems (See Section 6.0).

See Appendix A for Maintenance Checklist

See Appendix C for additional manufacturer’s requirements.

3.4 Landscape Maintenance

By design, plants in the GIS practices are meant to help filter the stormwater and flourish throughout the growing season. The plants do not require fertilizers, watering and/or mowing. Remove and replace vegetation as necessary, using the appropriate species as shown on the recommended plant list below.

Plants			
Task	Frequency	Requirement	Time of Year
Watering	First three months after planting or drought	<ul style="list-style-type: none"> • During establishment or drought conditions, plants should be watered a minimum of once every seven to ten days. 	<ul style="list-style-type: none"> • June-Sept.
Plant Cutting & Pruning	Annually	<ul style="list-style-type: none"> • Leave dry standing stalks during the dormant months and remove in the spring. • Cut back grasses, sedges, and rushes in the spring. • Prune trees to remove deadwood and low hanging branches. 	<ul style="list-style-type: none"> • Early Spring
Plant Thinning	Once every 3 years	<ul style="list-style-type: none"> • Separation of herbaceous vegetation rootstock should occur when over-crowding is observed 	<ul style="list-style-type: none"> • Early Spring or Late Fall
Plant Replacement	As required	<ul style="list-style-type: none"> • Replace/replant diseases, unhealthy or dead plans to maintain a healthy plant community 	<ul style="list-style-type: none"> • Early Spring or Fall
Mowing, Bioretention	NOT REQUIRED	<ul style="list-style-type: none"> • NONE, DO NOT MOW 	<ul style="list-style-type: none"> • NA
Fertilizing	NOT REQUIRED	<ul style="list-style-type: none"> • NONE 	<ul style="list-style-type: none"> • NA
Mulch	NOT REQUIRED	<ul style="list-style-type: none"> • NONE 	<ul style="list-style-type: none"> • NA

To reduce the level of effort, regular weeding should occur quarterly from April thru October.

Weeds			
Task	Frequency	Requirement	Time of Year
Weeding	Quarterly	<ul style="list-style-type: none"> Weeding should be limited to invasive and exotic species, which can overwhelm the desired plant community. Non-chemical methods including hand pulling and hoeing are recommended Chemical herbicides should be avoided. 	<ul style="list-style-type: none"> Early Spring Late Spring Late Summer Late Fall

RECOMMENDED PLANTS

Trees

Amelanchier x grandiflora
Betula nigra
Acer rubrum

Serviceberry
River Birch
Red Maple

Ornamental Grasses / Perennials

Asclepias tuberosa
Carex pensylvanica
Deschampsia cespitosa
Elymus virginicus
Eupatorium maculatum
Geranium maculatum
Iris versicolor
Juncus effusus
Liatris spicata
Monarda fistulosa
Muhlenbergia capillaris
Pycnanthemum muticum
Panicum virgatum
Schizachyrium scoparium
Sporobolus heterolepis

Butterflyweed
Pennsylvania Sedge
Tufted Hair Grass
Virginia Wild Rye
Joe-Pye Weed
Cranesbill
Blue Flag
Soft Rush
Blazing Star
Wild bergamot
Pink Muhly Grass
Big Leaf Mountain Mint
Switch grass
Little Bluestem
Prairie Dropseed

3.6 Weed Guide





4.0 ROUTINE MAINTENANCE

Other routine maintenance should include the following:

- Remove of trash and litter from paved and perimeter areas.
- Pavement Sweeping:
 - Minimum of once per year after the spring thaw.
- Check for erosions problems and sediment source(s) along the GSI practice sidewalls if excessive, frequent sediment accumulation occurs in practice area.
- Check for erosions problems and sediment source(s) in the contributing drainage area if excessive, frequent sediment accumulation occurs at inlet flume of sediment forebay.
- Contributing drainage pipes:
 - Inspect annually for proper operation.

5.0 SNOW REMOVAL

Snow removal from the practice is not necessary. Plowed or shoveled snow piles should not block the inlet flumes.

Excessive salting, sanding or other de-icing practices should be avoided. Use of large amounts of sand should also be avoided to avoid obstructing/clogging the conveyance system.

6.0 LONG-TERM POLLUTION PREVENTION PLAN

Long-term pollution prevention measures implemented throughout the development site will further reduce pollutants in stormwater discharges after construction.

6.1 Lawn/Landscaping Maintenance

Lawn and landscaping maintenance should be conducted with minimal use of fertilizers and pesticides to protect the nearby wetland and water resources. In particular, phosphate-based fertilizers are not to be used. Prior to applying fertilizers to the lawn and landscape, a soil analysis should be completed,

6.2 Pet Waste Management

Residents and visitors will be encouraged to pick up after their pets with signage along lawn areas.

6.3 Solid Waste Management

Enclosed dumpsters with lids will be provided on-site for solid waste management at the site.

6.4 Pavement Sweeping Schedules

The road and parking area will be, at a minimum, swept annually after spring snowmelt.

6.5 Illicit Discharges

No sewer pipes, floor drains or other new pipe connections will be connected to the drainage system. All wastewater will be connected to the municipal sewer.

6.6 Personnel Training

All staff/ personnel responsible for maintaining the practices will be given a copy of this Guide and will receive training in the applicable practices and implementation described in herein.

7.0 ESTIMATED OPERATION AND MAINTENANCE BUDGET

The estimated average annual operating and maintenance budget for the proposed system is shown below:

Bioretention (6):	\$ 3,000
<i>\$ 500 per practice</i>	
<i>Source: Center for Watershed Protection (CWP)</i>	
Infiltration Basins (2):	\$ 1,000
<i>\$500/structure</i>	
<i>Source: Massachusetts Highway Department</i>	
Underground Chamber (4):	\$ 8,000
	\$2,000/field
<i>Source: Manufacturer</i>	
Other Routine Maintenance:	\$ 1,000
<i>Removal of trash and litter</i>	
<i>Annual parking lot cleaning</i>	
<i>Drainage network inspections</i>	
<i>Source: Estimate</i>	
<hr/>	
Total:	\$ 13,500

It should be noted that the maintenance costs provided are estimates only.

APPENDIX A

Maintenance Checklists

Infiltration Basin - Maintenance Checklist
Littleton Drive, Wareham

Date:

Time:

Inspector:

Maintenance Item	Description	Maintenance Req'd (Y/N)
1. COLLECT		
Includes: Catch basin/Inlet Structure		
Frequency: Inspect four times per year during regular park maintenance and after major storm events (2" of rain or greater)		
When: March, June, September, November		
Inlet Grate	Remove all trash, leaf litter and inlet clogging. Remove sediment regularly or when accumulation impedes proper inflow and/or outflow.	
Actions to be taken:		
2. CAPTURE		
Includes: Deep Sump/Sediment Forebay		
Frequency: Inspect 4 times per year and after major storm events the first year; then annually and after major storm events (2" of rain or greater)		
When: March, June, September, November		
Deep Sump	Remove trash, sediment and debris from the structures and debris from the surface.	
Pipes	Check for clogged pipes and clean as necessary	
Debris Cleanout	Remove trash and debris	
Sediment/Organic Debris Removal	Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches or you cannot see stones.*	
Actions to be taken:		
3. MOVE		
Includes: Pipes and spillways		
Frequency: Inspect annually or if drainage problems are observed		
When: March		
Pipes	Check for clogging and clean if necessary	
Action to be Taken:		

Maintenance Item	Description	Maintenance Req'd (Y/N)
<p>4. STORE AND INFILTRATE</p>		
<p>Includes: Grass Bottom Area</p>		
<p>Frequency: Inspect four times per years during regular park maintenance and after major storm events (2" of rain or greater)</p>		
<p>When: March, June, September, November</p>		
Debris Cleanout	Remove any trash and debris from the surface.	
Side Slopes	Signs of erosion gullies, animal burrowing, overtopping, or slumping are observed. Repair, as necessary.	
Sediment/Organic Debris Removal	Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches or you cannot see stones.*	
Vegetation Maintenance Replacement	Area mowed regularly with routine park maintenance. Over seed bare or thin grass growth areas.	
Water Draining properly	If standing water is observed for more than 48 hours after a storm event, check cleanout of underdrain clogging. If necessary, rototill or aerate the bottom 6 inches to breakup any hard-packed sediment, and re-seed	
<p>Actions to be taken:</p>		
<p>5. OVERFLOW</p>		
<p>Includes: Outlet structures</p>		
<p>Frequency: Inspect bi-annually and after major storm events (2" of rain or greater)</p>		
<p>When: March and November</p>		
Overflow Structure	Check for sediment accumulation that impacts inflow. If sediment accumulation. Schedule cleaning. Check for clogging in the catch basin/diversion structure.	
<p>Actions to be taken:</p>		
<p>Other Routine Grounds Maintenance</p>		
<p>Includes: Surrounding landscape beyond the practice.</p>		
<p>Frequency: Inspect four times per year during regular park maintenance and after major storm events</p>		
<p>When: March, June, September, November</p>		
Debris Removal	Remove trash from perimeter areas.	
Pavement Sweeping	Sweep contributing paved surfaces minimum once a year after spring thaw.	
Surrounding Drainage Network	Ensure proper operation.	
Contributing drainage area	Check to ensure the surrounding area is stabilized. Look for erosion and other sediment sources	
<p>Actions to be taken:</p>		

*Sediment shall be disposed of offsite in a pre-approved location.

Bioretention/Bioswale Maintenance Checklist
Littleton Drive, Wareham

Date:

Time:

Inspector:

Maintenance Item	Description	Maintenance (Y/N)
<p>1. COLLECT Includes: Catch basin/Inlet Structure Frequency: Inspect four times per years during regular park maintenance and after major storm events (2" of rain or greater) When: March, June, September, November</p>		
Surface Debris Cleaning	Remove all trash, leaf litter and inlet clogging.	
Inlets	Check for clogging and sediment accumulation that impacts inflow. If sediment/debris accumulation	
<p>Actions to be taken:</p>		
<p>2. CAPTURE Includes: Sediment Forebay Frequency: Inspect four times per year and after major storm events the first year; then annually and after major storm events (2" of rain or greater) When: March, June, September, November</p>		
Debris Cleanout	Remove all trash and debris.	
Side Slopes	Signs of erosion gullies, animal burrowing, overtopping, or slumping are observed. Repair, as necessary.	
Sediment/Organic Debris Removal	Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches or you cannot see stones.*	
<p>Actions to be taken:</p>		
<p>3 & 4. MOVES & FILTERS Includes: Planting bed Frequency: Inspect four times per years during regular park maintenance and after major storm events (2" of rain or greater) When: March, June, September, November</p>		
Debris Cleanout	Remove trash and debris from the surface.	
Sediment/Organic Debris Removal	Remove and properly disposed of when build-up is greater than or equal to 3 inches.*	

Maintenance Item	Description	Maintenance (Y/N)
Erosion	Check for areas of erosion/ gullies, particularly along the bottom. Repair/reseed as necessary	
Side Slopes	Signs of erosion gullies, animal burrowing, overtopping, or slumping are observed. Repair, as necessary.	
Vegetation Maintenance Replacement	Cut back twice per year minimum (12" grass height). Over seed bare or thin grass growth areas. See also Landscape Maintenance	
Water Draining properly	If standing water is observed for more than 48 hours after a storm event, check for standing water in cleanouts. If standing water observed flush underdrains. If still not draining, rototill or aerate the bottom 6 inches to breakup any hard-packed sediment	
Actions to be taken:		
5. OVERFLOW		
Includes: Outlet structures		
Frequency: Inspect bi-annually and after major storm events (2" of rain or greater)		
When: March and September		
Overflow Structure	Water level should below underdrain and outlet pipe inverts. Check for sediment accumulation that impacts outflow. If sediment accumulation. Schedule cleaning. Check for leaf litter, debris, and inlet clogging.	
Actions to be taken:		
Other Routine Grounds Maintenance		
Includes: Surrounding landscape beyond the practice.		
Frequency: Inspect four times per year during regular park maintenance and after major storm events		
When: March, June, September, November		
Debris Removal	Remove trash from perimeter areas.	
Contributing drainage area	Look for sediment sources from erosion in the surrounding area.	
Drainage Network	Ensure proper operation.	
Pavement Sweeping	Sweep parking lot minimum once a year after spring thaw.	
Actions to be taken:		

*Sediment shall be disposed of offsite in a pre-approved location.

Underground Chambers - Maintenance Checklist
Littleton Drive, Wareham

Date:

Time:

Inspector:

Maintenance Item	Description	Maintenance (Y/N)
1. COLLECT		
Includes: Catch basin/Inlet Structure - see also bioretention		
Frequency: Inspect four times per years during regular park maintenance and after major storm events (2" of rain or greater)		
When: March, June, September and November		
Inlet Grate	Remove all trash, leaf litter and inlet clogging. Remove sediment regularly or when accumulation impedes proper inflow and/or outflow.	
Surface Debris Cleaning	Remove all trash, leaf litter and inlet clogging. Check for clogging and sediment accumulation that impacts inflow.	
Actions to be taken:		
2. CAPTURE		
Includes: Deep Sump/Sediment Forebay/Isolator Row		
Frequency: Inspect four times per year and after major storm events the first year; then annually and after major storm events (2" of rain or greater)		
When: Mar March, June, September and November		
Debris Cleanout	Remove all trash and debris from the swale.	
Sediment/Organic Debris Removal	Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches or you cannot see stones.*	
Actions to be taken:		
3. MOVE		
Drain Manhole and manifold Cleanout	<ul style="list-style-type: none"> Remove trash and debris from the surface. 	
See Also Manufacturer's Requirements		
Actions to be taken:		

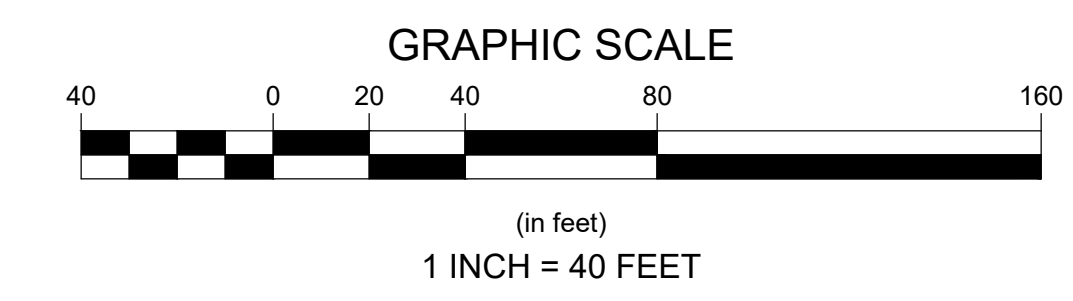
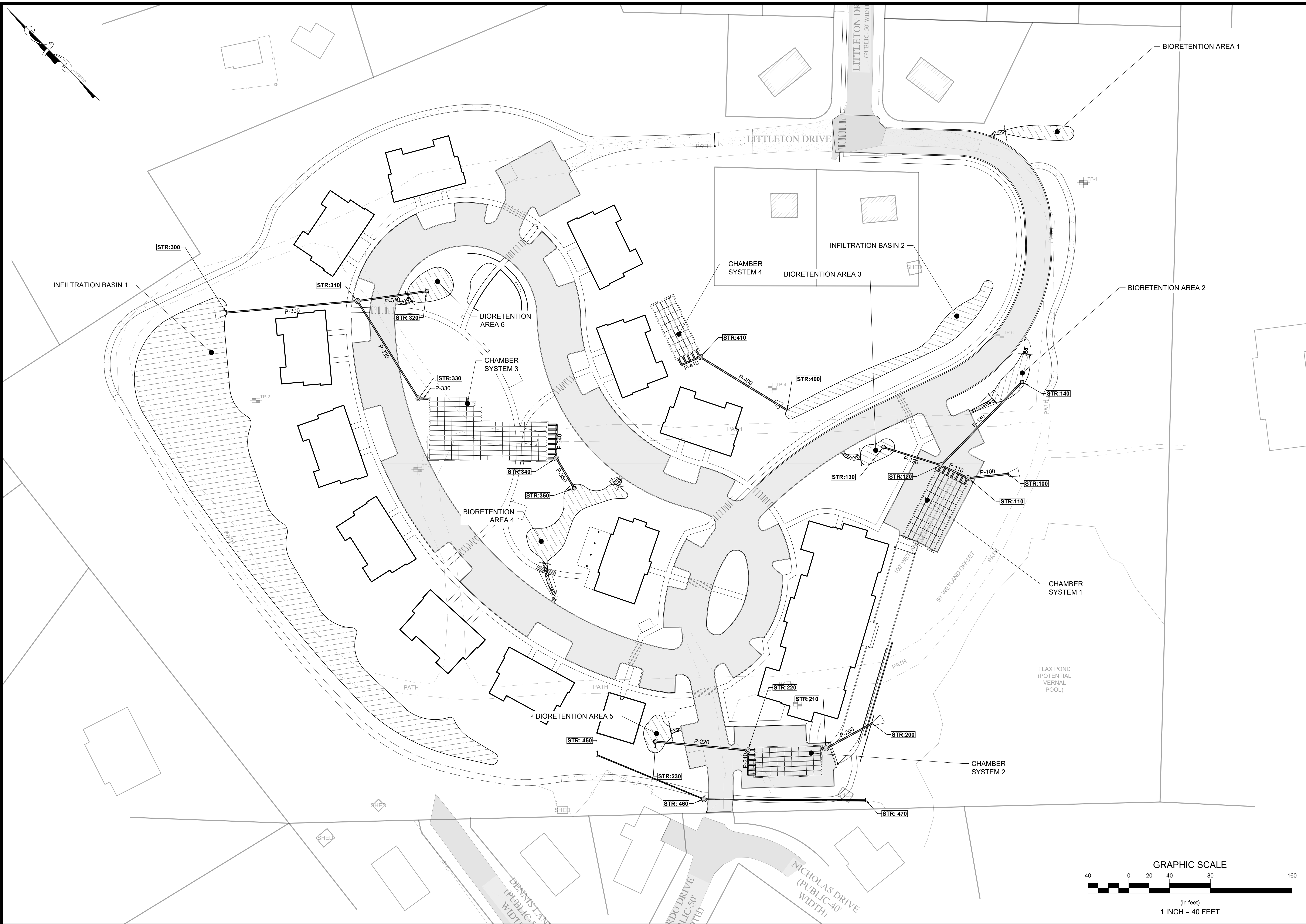
Maintenance Item	Description	Maintenance (Y/N)
4. STORE AND INFILTRATE		
Includes: Chambers		
Frequency: Inspect annually – see manufacturer’s requirements		
When: Spring		
Sediment/Organic Debris Removal	Use inspection ports to check chambers for sediment accumulation in isolator row.	
Water Draining properly	If standing water is observed for more than 48 hours after a storm event, jet vac chambers.	
5. OVERFLOW		
Includes: Drain manholes and weir walls		
Frequency: Inspect annually and after major storm events (2” of rain or greater)		
When: Spring		
Overflow Structure	Check for sediment accumulation that impacts inflow. If sediment accumulation. Schedule cleaning. Check for leaf litter, debris, and inlet clogging.	
Actions to be taken:		
Other Routine Grounds Maintenance		
Includes: Surrounding landscape beyond the practice.		
Frequency: Inspect four times per year during regular park maintenance and after major storm events		
When: March, June, September and November		
Debris Removal	Remove trash from perimeter areas.	
Contributing drainage area	Look for sediment sources from erosion in the surrounding area.	
Drainage Network	Ensure proper operation.	
Pavement Sweeping	Sweep parking lot minimum once a year after spring thaw.	
Actions to be taken:		

*Sediment shall be disposed of offsite in a pre-approved location.

APPENDIX B

Overall Stormwater BMP Locations

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<p>PREPARED FOR: Pennrose Properties, LLC 50 Milk Street, 16th Floor Boston, MA 02109 Phone: --- Fax: ---</p>	<p>PLANNED BY: Pennrose Properties, LLC</p>																																																							
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<p>APPENDIX C</p>																																																								

APPENDIX C

Underground Chambers Manufacturer's Requirements

17.0 Standard Limited Warranty



STANDARD LIMITED WARRANTY OF STORMTECH LLC ("STORMTECH"): PRODUCTS

- (A) This Limited Warranty applies solely to the StormTech chambers and end plates manufactured by StormTech and sold to the original purchaser (the "Purchaser"). The chambers and end plates are collectively referred to as the "Products."
- (B) The structural integrity of the Products, when installed strictly in accordance with StormTech's written installation instructions at the time of installation, are warranted to the Purchaser against defective materials and workmanship for one (1) year from the date of purchase. Should a defect appear in the Limited Warranty period, the Purchaser shall provide StormTech with written notice of the alleged defect at StormTech's corporate headquarters within ten (10) days of the discovery of the defect. The notice shall describe the alleged defect in reasonable detail. StormTech agrees to supply replacements for those Products determined by StormTech to be defective and covered by this Limited Warranty. The supply of replacement products is the sole remedy of the Purchaser for breaches of this Limited Warranty. StormTech's liability specifically excludes the cost of removal and/or installation of the Products.
- (C) THIS LIMITED WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.
- (D) This Limited Warranty only applies to the Products when the Products are installed in a single layer. UNDER NO CIRCUMSTANCES, SHALL THE PRODUCTS BE INSTALLED IN A MULTI-LAYER CONFIGURATION.
- (E) No representative of StormTech has the authority to change this Limited Warranty in any manner or to extend this Limited Warranty. This Limited Warranty does not apply to any person other than to the Purchaser.
- (F) Under no circumstances shall StormTech be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Products, or the cost of other goods or services related to the purchase and installation of the Products. For this Limited Warranty to apply, the Products must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and StormTech's written installation instructions.
- (G) THE LIMITED WARRANTY DOES NOT EXTEND TO INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES. STORMTECH SHALL NOT BE LIABLE FOR PENALTIES OR LIQUIDATED DAMAGES, INCLUDING LOSS OF PRODUCTION AND PROFITS; LABOR AND MATERIALS; OVERHEAD COSTS; OR OTHER LOSS OR EXPENSE INCURRED BY THE PURCHASER OR ANY THIRD PARTY. SPECIFICALLY EXCLUDED FROM LIMITED WARRANTY COVERAGE ARE DAMAGE TO THE PRODUCTS ARISING FROM ORDINARY WEAR AND TEAR; ALTERATION, ACCIDENT, MISUSE, ABUSE OR NEGLIGENCE; THE PRODUCTS BEING SUBJECTED TO VEHICLE TRAFFIC OR OTHER CONDITIONS WHICH ARE NOT PERMITTED BY STORMTECH'S WRITTEN SPECIFICATIONS OR INSTALLATION INSTRUCTIONS; FAILURE TO MAINTAIN THE MINIMUM GROUND COVERS SET FORTH IN THE INSTALLATION INSTRUCTIONS; THE PLACEMENT OF IMPROPER MATERIALS INTO THE PRODUCTS; FAILURE OF THE PRODUCTS DUE TO IMPROPER SITING OR IMPROPER SIZING; OR ANY OTHER EVENT NOT CAUSED BY STORMTECH. THIS LIMITED WARRANTY REPRESENTS STORMTECH'S SOLE LIABILITY TO THE PURCHASER FOR CLAIMS RELATED TO THE PRODUCTS, WHETHER THE CLAIM IS BASED UPON CONTRACT, TORT, OR OTHER LEGAL THEORY.



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Isolator[®] Row O&M Manual



THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) and Total Phosphorus (TP) removal with easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole provides access to the Isolator Row and typically includes a high flow weir. When flow rates or volumes exceed the Isolator Row weir capacity the water will flow over the weir and discharge through a manifold to the other chambers.

Another acceptable design uses one open grate inlet structure. Using a “high/low” design (low invert elevation on the Isolator Row and a higher invert elevation on the manifold) an open grate structure can provide the advantages of the Isolator Row by creating a differential between the Isolator Row and manifold thus allowing for settlement in the Isolator Row.

The Isolator Row may be part of a treatment train system. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

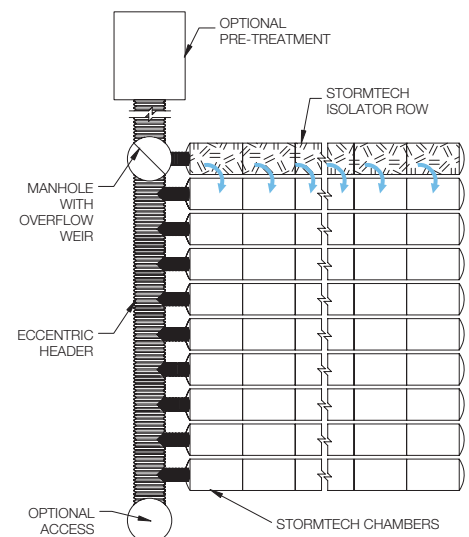
Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.



Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.



StormTech Isolator Row with Overflow Spillway (not to scale)





ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

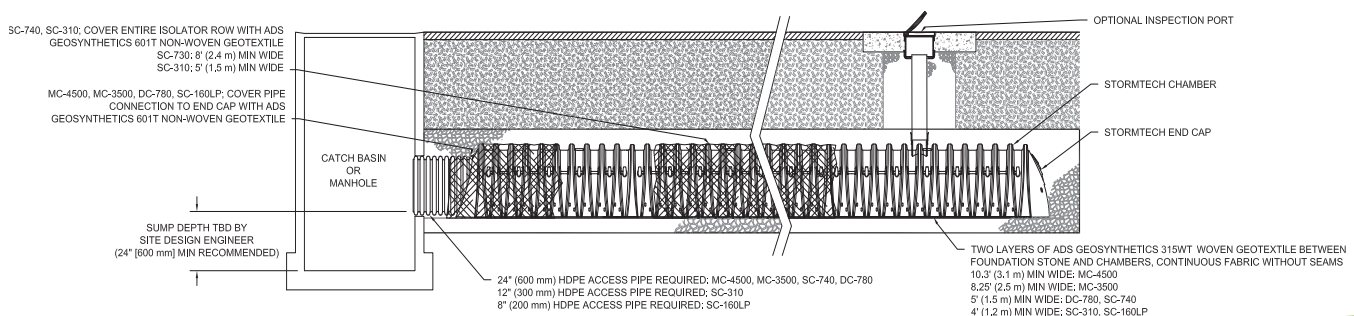
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1

Inspect Isolator Row for sediment.

- A) Inspection ports (if present)
 - i. Remove lid from floor box frame
 - ii. Remove cap from inspection riser
 - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
 - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
- B) All Isolator Rows
 - i. Remove cover from manhole at upstream end of Isolator Row
 - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
 - 1. Mirrors on poles or cameras may be used to avoid a confined space entry
 - 2. Follow OSHA regulations for confined space entry if entering manhole
 - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2

Clean out Isolator Row using the JetVac process.

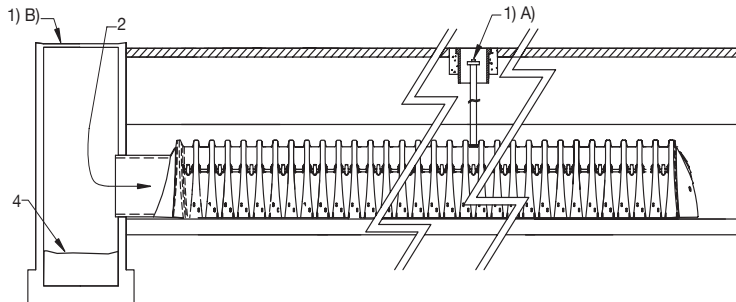
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

STEP 3

Replace all caps, lids and covers, record observations and actions.

STEP 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)-(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM