

# **Stormwater Management Operation and Maintenance Guide**

**Southern Tier Property  
Oak Bluffs, Massachusetts**

Prepared for:

**Affirmative Investments, Inc.**

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# Stormwater Operations & Maintenance Plan

## Southern Tier Property, Oak Bluffs, MA

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# 1. INTRODUCTION

This document provides a general description along with the operation and maintenance requirements for the Southern Tier site in Oak Bluffs, MA. The responsible parties are required to inspect and maintain all measures as outlined in this maintenance guide throughout the year. Site maintenance is divided into three categories as outlined below.

1. Green Stormwater Infrastructure
  - Structural Components
  - Structural Maintenance Schedule
  - Planting
  - Landscape Maintenance Schedule
  - Weed Guide
2. General Site Maintenance
  - Trash & Debris
  - Pet Waste
  - Pavement Sweeping
  - Contributing Drainage Areas
  - Snow Removal
  - De-icing
3. Long-Term Pollution Prevention Measures

## 2. RESPONSIBLE PARTIES

Affirmative Investments, Inc. is responsible for the financing and continuous operation, maintenance and required emergency repair for the stormwater management system and associated drainage network.

**Owner:**               **Affirmative Investments, Inc.**  
**Address:**           33 Union Street, 2<sup>nd</sup> Floor  
                              Boston, MA 02108

**Contact:**

Signed:\_\_\_\_\_

Date:\_\_\_\_\_

## 3. GREEN STORMWATER INFRASTRUCTURE

### 3.1. How Does Green Infrastructure Work?

Green Stormwater Infrastructure (GSI) is a 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 municipal drainage system or waterbodies.

GSI relies on the following basic steps to function properly. Structural components of the practices facilitate the functioning of the steps. If one of these steps, or components, does not work 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. The steps are:

1. **Collect** (Inlets)
2. **Move Water** (Conveyance) if needed, can come after capturing sediment
3. **Capture Sediment** (Pretreatment)
4. **Treat and Manage** (Filter, Infiltrate or Store)
5. **Overflow** (Structures and Spillways)

### 3.2. What is required for Maintenance?

As these are nature-based systems that rely on plant upkeep, the maintenance for GSI typically falls under landscape and general site maintenance services. Proper operation and maintenance (O&M) are vital to its long-term viability. Regularly scheduled maintenance can prevent system failures due to sediment build-up, damage, or deterioration. The maintenance requirements, outlined in this guide, are critical to ensure proper treatment, maintain storage capacity and preserve the visual integrity.

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, tress, plants, and vegetative cover as well as the removal of unwanted weeds and invasive species.

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 park 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 describe the general function and landscape maintenance of each practice on the site. Included in the appendices is a specific Inspection Report for each practice type (Appendix A) along with a plan showing the location of the items to be inspected and maintained (Appendix B).

### 3.3. What practices are used at this site?

The following practices are present at this site:

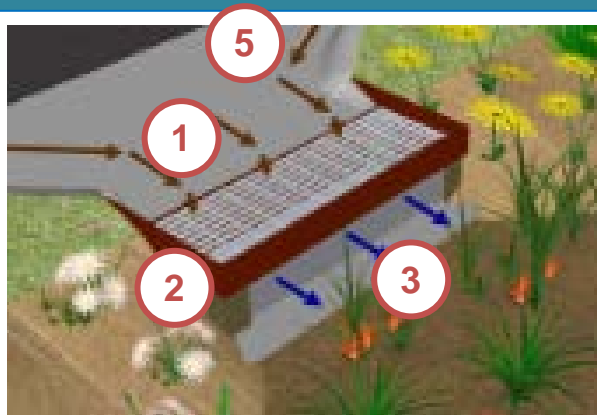
- a. Rain Guardian Fortress Inlets: Rain Guardian Fortress Inlets are a proprietary pretreatment device designed to remove trash, debris, and coarse sediment from runoff prior to entering surface green infrastructure. Debris and sediment accumulate in a shallow chamber within the structure.
- b. Sediment Forebay: A sediment forebay is a pretreatment feature intended to assist in the removal of sediment and debris from stormwater. The sediment forebays allow stormwater flow to slow before reaching the bioretention areas thus allowing sediment and debris to settle in the forebays gravel.
- c. Bioretention Areas: A bioretention area is a stormwater management practice to manage and treat stormwater runoff using a conditioned planting soil bed or “filter” media and plants to filter runoff captured in a shallow depression. The method combines physical filtering and adsorption with bio-geochemical processes to remove pollutants.
- d. Water Quality Structure: Water Quality Structures are proprietary pretreatment devices designed to filter out sediment and debris by reducing velocity and directing flow during a series of chambers. Debris and sediment accumulate within the structure.
- e. Underground Infiltration Chambers: Underground infiltration chambers consist of rigid plastic parabolic subsurface chambers surrounded by coarse aggregate stone. Stormwater is piped to these chambers and infiltrated into the existing soils below. A manhole with internal weir provides overflow during large storm events.

The maintenance for the green infrastructure is divided into two categories:

- a. The **Structural Components** that make up the basic steps of a functioning system.
- b. The **Plantings** that are the landscape and filtration element.

Each category is further described in the sections below.

## 4. STRUCTURAL COMPONENTS: RAIN GUARDIAN FORTRESS

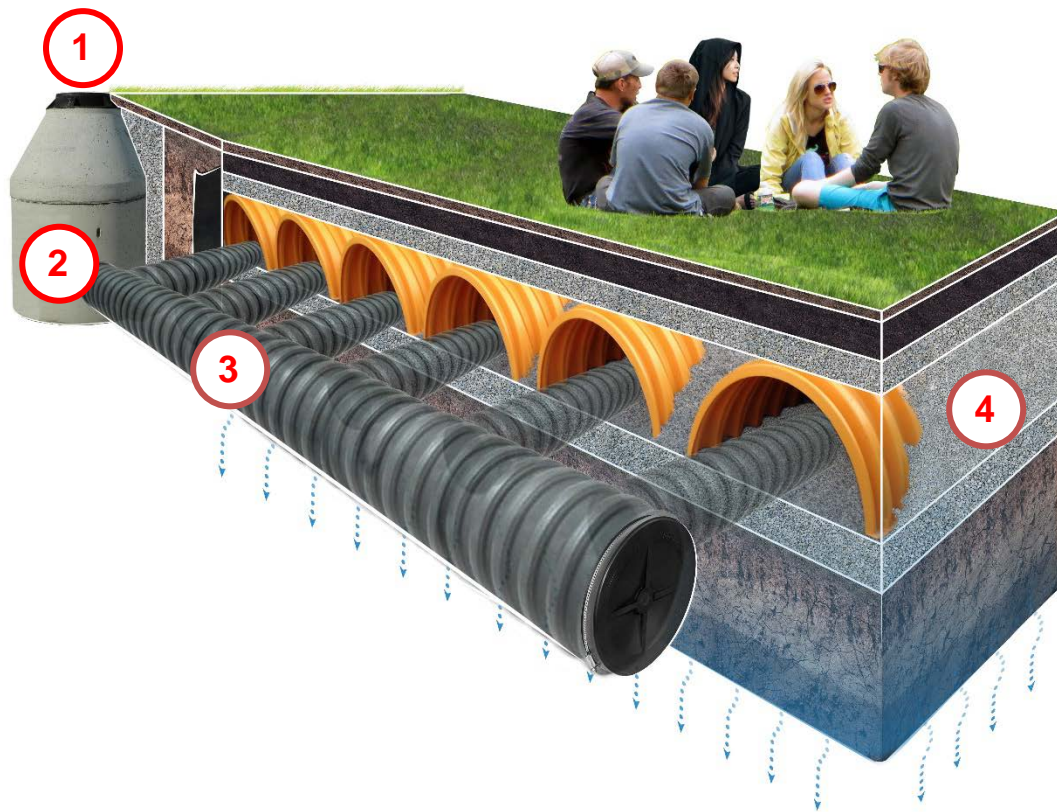


### Structural Components

1. COLLECT - Stormwater runoff is directed to grates.
2. CAPTURE SEDIMENT - The Fortress has a shallow chamber with screen to allow for settling and the separation of sediment, trash, and other debris.
3. MOVE WATER - The catch basins are piped directly into the existing stormwater system discharging to the underground detention system.
4. TREAT AND MANAGE - N/A
5. OVERFLOW - During extreme rain events, stormwater may pond at the grate. Any ponding will ultimately drain through the bioretention area.

See Appendix A for Maintenance Checklist and Appendix B for Owner's Manual

## 5. STRUCTURAL COMPONENTS: UNDERGROUND RECHARGE CHAMBERS (URCs)



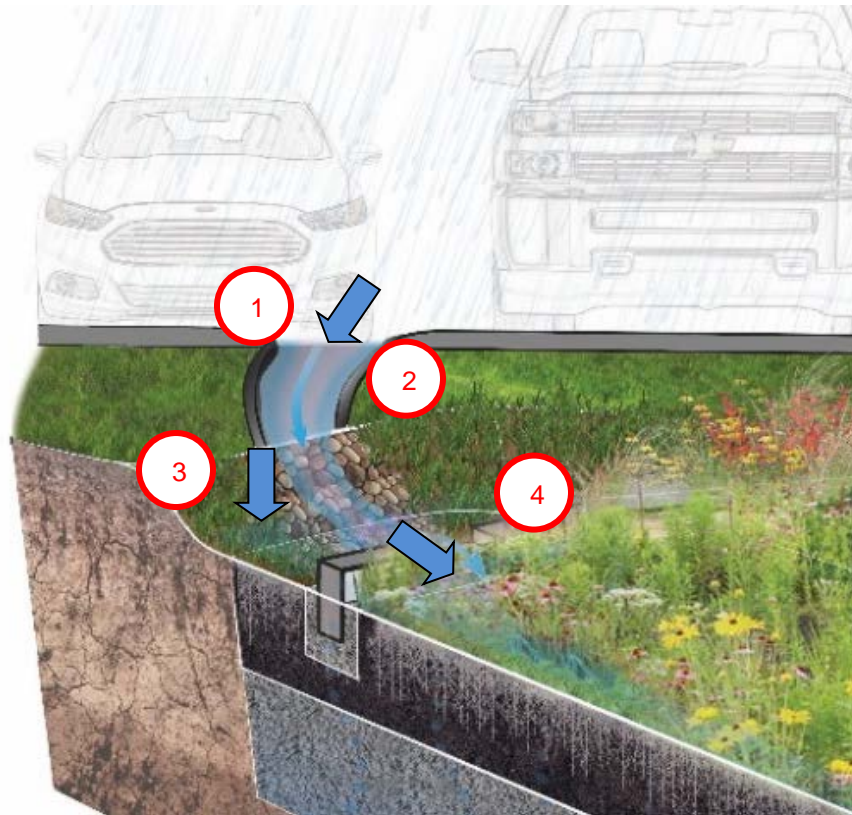
### Structural Components

1. **COLLECT** – Stormwater from adjacent rooftops and bioretention practices is collected in drainage piping and directed to a diversion manhole.
2. **CAPTURE SEDIMENT** - Sediment, trash, and debris is captured and accumulates overtime in the diversion manhole and isolator row within the practice (see Appendix A).
3. **MOVE** - Stormwater is directed to the underground chambers via a closed pipe/manifold system.
4. **STORE AND INFILTRATE** - Stormwater is stored in in the chambers and infiltrates into the subsurface soils. During larger storm events stormwater overflows from the outlet control manhole and connect to the existing sewer line on River Street. This is a combined sewer system
5. **OVERFLOW** - During larger rain events (25-yr storm or greater) when the chambers reach capacity the overflow structure will divert water from the chambers and discharge via overflow structure.

**SURROUNDING AREA** – Proposed parking lot  
Problems such as unstable soils, erosion, and over sanding during the winter can contribute to long-term maintenance problems. See Section 10.

**See Appendix A for Maintenance Checklist and Appendix B for Owner's Manual**

## 6. STRUCTURAL COMPONENTS: SEDIMENT FOREBAY



### **FUNCTION:**

1. **COLLECT** – Stormwater runoff is collected from roof drains by pipe and overland flow through the curb inlets.
2. **CAPTURE** – Stormwater runoff is captured in the sediment forebay. Gravel in the forebay slows the stormwaters flow and sediment, trash, and debris is captured in the sediment forebay.
3. **INFILTRATE** – Runoff if is infiltrated into the sub soils through the surrounding gravel.
4. **OVERFLOW** – When the capacity of the sediment forebay is exceeded stormwater will overflow to the adjacent bioretention area.

### **SURROUNDING AREA** – Landscape Area

Problems such as unstabilized soils, erosion, and leaf litter can contribute to long-term maintenance problems (See Section 8).

**See Appendix A for Maintenance Checklist**

## 7. STRUCTURAL COMPONENTS: BIORETENTION AREAS

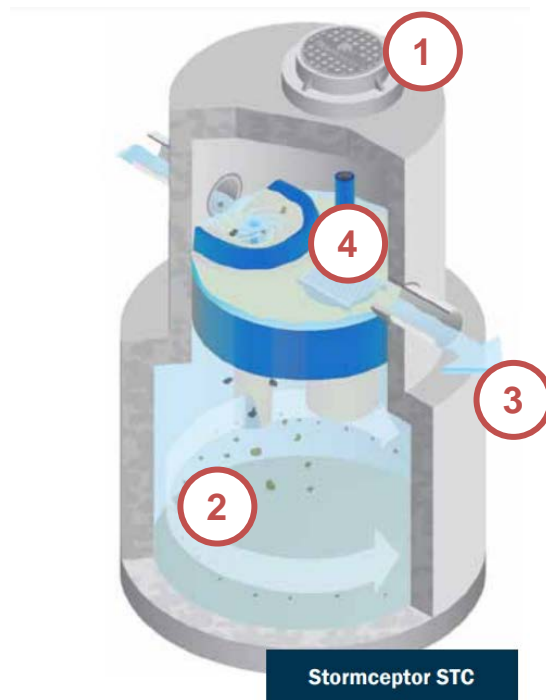


### Structural Components

1. **COLLECT** - Stormwater runoff is directed to inlets(s) or roof downspouts where stormwater enters the bioretention area.
2. **CAPTURE SEDIMENT** - For bioretention areas receiving runoff directly from paved areas sand and debris settle out within sediment forebays or Rain Guardian Fortress structures.
3. **MOVE WATER** - The stormwater discharges directly to the bioretention area via a granite check dam weir.
4. **TREAT AND MANAGE** - Stormwater overtops the forebay granite check dam or enters directly via Rain Guardian inlet and flows through the planted bioretention area. Plants slow the water down, and the soil media and plant roots filter the runoff, removing nitrogen and bacteria. The treated water then infiltrates into the soil below or overflows as described below.
5. **OVERFLOW** - During larger rain events, the water level will rise and overflow into the outlet structure during storm events greater than the Water Quality Volume.

**See Appendix A for Maintenance Checklist**

## 8. STRUCTURAL COMPONENTS: WATER QUALITY UNIT



### Structural Components



1. COLLECT - Stormwater runoff is directed to an inlet grate at the top of the structure or piped into the structure.
2. CAPTURE SEDIMENT – The Water Quality Unit is designed to allow sediment and debris to drop out into the bottom of the unit.
3. MOVE WATER – Once runoff has been treated, it is piped to chambers for infiltration.
4. OVERFLOW – During larger storms, the runoff utilizes the large storm overflow.

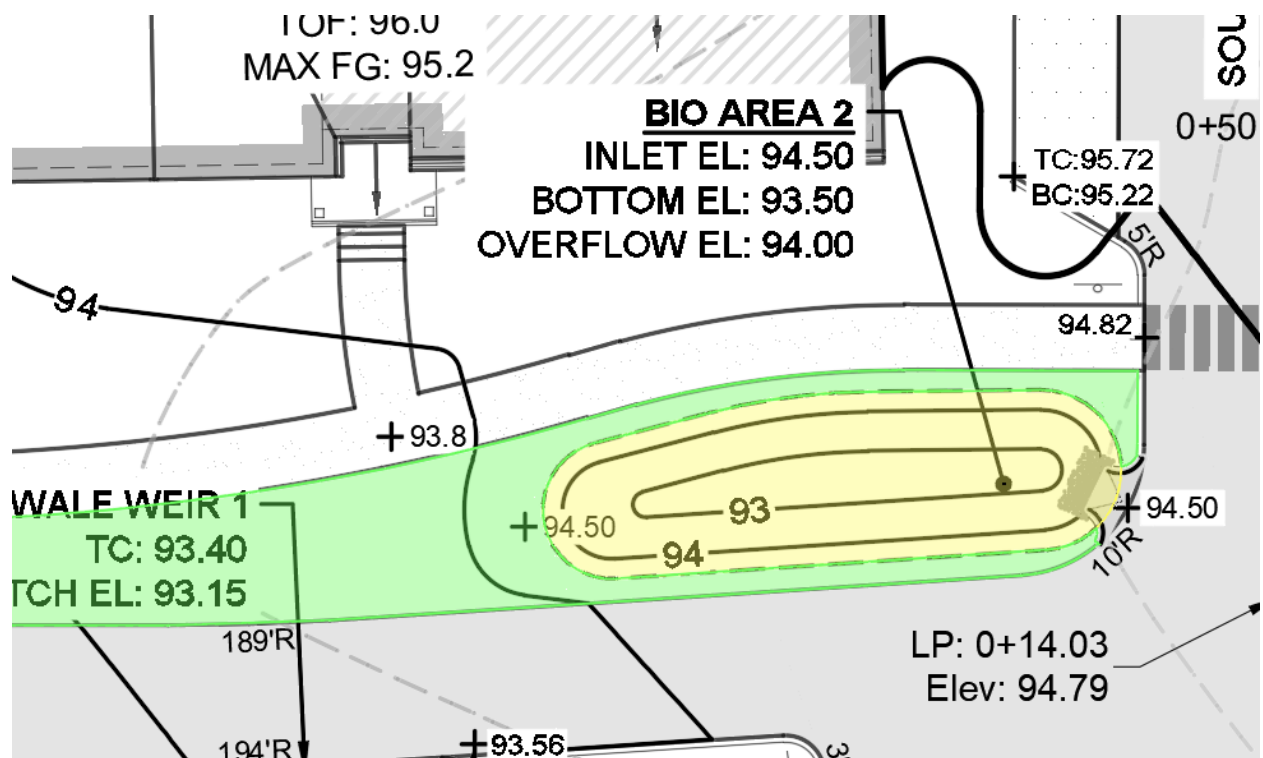
[See Appendix D for Maintenance Guide](#)

## 9. PLANTINGS

### 9.1. Plantings

The planting design for the site consists of three landscape maintenance areas. The “mow” area which consists of turf, the “no mow” areas that are Bioretention pockets and the naturalized site edge. A full planting plan is available in Appendix D.

	“Mow” Areas
	No “Mow” Area (Bioretention and Edge)



## PLANTINGS: “MOW” AREAS MAINTENANCE

There is an area of the site that is allowed to be maintained as “mowed” lawn as necessary. Landscape maintenance of “mowed” lawn areas includes the following:

### Seeding

Loam and reseed bare spots with a seed mix that matches existing species.

### Mowing/Weed Whacking

Cut only 1/3 of vegetation. Do not mow during drought periods or when excessively wet. Depending on height of grasses and the time of year, grass cuttings/stalks may need to be raked and removed from site.

### Watering

Allowing the lawn areas to “brown” is desired. Water only during drought conditions or during reseeding establishment period.

### Fertilizing

No fertilizer shall be used.

### Weeding

Weeding should be limited to invasive and weedy species (see section 3.6 Weed Identification below and the Weed Guide at <https://web.uri.edu/riss/files/In-the-Weeds.pdf>). Non-chemical methods (hand pulling and hoeing) are required; chemical herbicides should be avoided. Properly remove and dispose of all invasive species off site as to prevent colonization elsewhere, this includes disposal on land beyond the project area.

### Monitoring

During the establishment period, walk the mow areas monthly during the first year to look for invasive species, bare spots and identify potential pest or disease problems. Properly remove and dispose all invasive species as to prevent colonization elsewhere, this includes disposal on land beyond the project area.

### Debris & Trash

Remove and properly dispose litter from all areas prior to mowing.

## **PLANTINGS: NO “MOW” AREA MAINTENANCE (BIORETENTION AREAS)**

By design, plants in bioretention areas and along the edge of the site are meant to flourish throughout the growing season leaving dry standing stalks during the dormant months. Plants do not require fertilizers and/or watering. This area is designated as “no mow.” Frequent mowing would eliminate selected meadow species, may promote the growth of undesirable plants, and require additional maintenance and watering. It is recommended this area be cut back no more than one time per year and only as necessary. Remove and replace vegetation as necessary, using the appropriate species as shown on the Planting Plan. The best time to plant is in early to mid-fall or early to mid-spring. Specific maintenance activities of the “no mow” area include:

### **Seeding**

Loam and reseed bare spots with the specified seed mix as shown on the Planting Plan.

### **Cutting Back**

Recommend cutting with shears a maximum of once a year in early spring. Otherwise, allow areas to grow to their natural heights (12” to 36”) to maintain a meadow appearance. Do NOT cut area lower than 6” – maintain sporadic wooden stakes on site at 6” height to provide visual cues during cutting. Depending on height of grasses and the time of year, grass cuttings/stalks may need to be raked and removed from site so as not to clog the bioretention. Use a leaf blower as needed to assist in clean-up.

### **Pruning**

Prune trees and shrubs to remove deadwood and low hanging branches.

### **Watering**

Water only during drought conditions or during reseeding establishment period.

### **Fertilizing**

No fertilizer shall be used.

### **Weeding**

Weeding should be limited to invasive and weedy species (see section on Weed Identification below and the Weed Guide at <https://web.uri.edu/riss/files/In-the-Weeds.pdf>). Non-chemical methods (hand pulling and hoeing) are required; chemical herbicides should be avoided. Properly remove and dispose off site all invasive species as to prevent colonization elsewhere; this includes disposal on land beyond the project area.

### **Monitoring**

During the establishment period, walk the “no mow” areas monthly without the intent to cut, but to look for invasive species, bare spots and identify potential pest or disease problems.

### **Debris & Trash**

Remove and properly dispose litter from all areas.

## PLANTINGS: REPLACEMENTS

The plants that thrive in bioretention areas are typically quite drought tolerant due to the filter profile having a top layer of planting soil and sandy soil media below. They need to be able to withstand periods of inundation after storm events; however, when it doesn't rain, there will be less water held naturally in the sand than in other soil types for the plants to use, so they need to tolerate dry periods as well.

Specifying plants native to the area increases the ecosystem benefits by helping to support native wildlife like pollinators.

If replacements are needed, use the planting plan as a guide (see Appendix C). However, if all the plants of a certain species have not done well in the bioretention area or other locations on the site, do not replace with that same species. Rather, replant with one or more of the other species that has thrived under the conditions or have a plant professional choose a different species based on current photos of the site.

Site specific considerations for plants in bioretention areas should be:

- Preferably native
- Drought tolerant
- Tolerant of inundation for 24 hours
- Size constraints:
  - taller perennials at the bottom of the bioretention
  - shorter perennials on the side slopes
- Sun and salt tolerant (bioretention)
- A mix of different types of plants that will create a resilient plant community: cold & warm season grasses, perennials, groundcovers in all areas.

## PLANTINGS: MAINTENANCE SCHEDULE

By design, plants in the bioretention area are meant to help filter the stormwater as it passes through and flourish throughout the growing season. The plants do not require fertilizers or mulch, and, after establishment, only need water during periods of drought. Remove and replace vegetation as necessary, using the appropriate species as discussed in the no-mow section above. Weeding should occur quarterly during the growing season as well as monitoring for invasive species. An annual spring “clean up” includes cutting last season’s growth of the perennials and pruning as needed. See the calendar below, the Plantings Maintenance Checklist in Appendix C, the Weed Identification section, and the Weed Identification Guide at <https://web.uri.edu/riss/files/In-the-Weeds.pdf> for more information.

Bioretention Landscape Maintenance Schedule												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Task	Frequency & Time of the Year											
Cutting				X								
Mowing				x	x	x	x	x				
Weeding				X	X	X	X					
Monitoring				X	X	X	X					
Watering						x	x	x	x			
Seeding				x	x		x	x				
Plant Replacement				x	x		x	x				

	“Mow” Areas
	No “Mow” Areas (Bioretention and Edge) & Planting Beds
	All areas

**X** required  
**x** as needed

- Trash and debris are removed during monthly structural component inspections but can also be completed during landscape maintenance visits for weeding and monitoring.

## PLANTINGS: WEED IDENTIFICATION



Yellow Toadflax (*Linaris vulgaris*)



Redroot Pigweed- (*Amaranthus retroflexus*)



Smartweed (*Polygonum lapathifolium*)



Dandelion (*Taraxacum officinale*)

## PLANTINGS: WEED IDENTIFICATION



Fireweed (*Erechtites hieracifolia*)



Spotted Spurge (*Euphorbia maculata*)



Crabgrass (*Digitaria ischaemum*)



Crabgrass with seedheads



Ragweed (*Ambrosia artemisiifolia*)



Japanese Knotweed (*Polygonum cuspidatum*)

## PLANTINGS: WEED IDENTIFICATION



Ragweed (*Ambrosia artemisiifolia*)



Oriental Bittersweet (*Celastrus orbiculatus*)



Green Foxtail (*Setaria viridis*)



Norway Maple Tree Seedling (*Acer platanoides*)

## PLANTINGS: WEED IDENTIFICATION



Catalpa Tree Seedling (*Catalpa speciosa*)



Purple Loosestrife (*Lythrum salicaria*)



Field Bindweed (*Convolvulus arvensis*)



Black Swallow-wort (*Cynanchum louisea*)

## 10. INVASIVE MANAGEMENT AND MAINTENANCE

Invasive plants are non-native species that have been introduced to areas outside of their native range, where they often thrive and out-compete/overtake endemic plant communities. These plants are characteristically aggressive, adapted to a wide variety of habitats and climatic conditions, are mostly free of known diseases, parasites and/or herbivorous predators native to the U.S. and tend to have very effective reproductive abilities. The state of Massachusetts has identified invasive species that are prohibited from sale in the state:

<https://www.mass.gov/service-details/massachusetts-prohibited-plant-list>

Japanese Honeysuckle (*Lonicera japonica*) and Bittersweet (*Celastrus orbiculatus*) has been identified on site and should be the focus of invasive species management.

### Overview of Management Techniques

Selected management techniques are generally based upon the extent of a given species within the vegetation community at a site and employ a strategy that best controls the invasive species, while minimizing the potential for adverse impacts to other desirable (i.e., native) species and the surrounding, integrated environment.

Methods for the management of invasive species fall into two categories:

- Physical/Mechanical (cutting, pulling, grubbing, covering, etc.), and
- Chemical (use of herbicides).

In general, mechanical controls, such as cutting or pulling, have the least adverse impacts on the adjacent, native communities; however, mechanical methods are often not as effective in the control of certain plant species. When warranted and appropriate, chemical controls (through the use of herbicides) are most effective through modest, precisely targeted applications of specific herbicides. Selective application of herbicides also functions to reduce adverse effects on desirable native species from herbicide use. Any application of herbicides should be completed by an applicator licensed in the state of Massachusetts.

Upon effective removal or control of invasive species, native plant species are then planted and/or promoted (via existing native populations and seed banks) in order to restore a native plant community, which provides a number of ecological benefits, and serves as the primary factor for limiting invasive plant establishment and spread in the future. With establishment of a robust and diverse native plant community, the system becomes more resilient to potential future invasions, and only minor ongoing invasive plant management efforts/interventions are required to maintain the long-term ecological integrity of the site.

### Long Term Management

Initial implementation of invasive species management efforts will only address the immediate issues. Because of the invasive species ability to aggressively re-colonize through seeds and root fragments, long-term management and monitoring will be necessary. The control methods described above are likely to be successful in controlling many of these species for one to two years without additional action. However, invasive plants often begin to recover within a few years after treatment and will become re-established if follow-up monitoring and management efforts are not undertaken. Neighboring populations of invasive plants and existing dormant seeds within the soil often reintroduce a species. Annual maintenance is essential to the success of any management plan and should focus on the following:

- Prevention;
- Early detection/rapid response;
- Monitoring managed areas; and
- Preventing the spread of established populations.

### **Maintenance Plan**

Annual maintenance includes monitoring the area and applying recommended treatments as necessary to prevent re-growth. The recommended approaches provided above for the species identified at the site, generally apply to both the initial treatments and any follow-up/maintenance treatments. The recommended best practice for invasive plant maintenance, after initial treatments are completed, is to perform follow-up treatments at least two times per year (late-June & late-September are generally recommended) for three to five years after the initial treatments. The exact timing and number of each year's visits and number of years of follow-up maintenance needed to achieve adequate control of the invasive plants is subject to a number of site-specific variables (existing invasive seed bank, effectiveness of initial treatments, etc.) which can be difficult to predict in advance. For the best long-term results, the maintenance phase should be approached in an adaptive manner and utilize site condition feed-back from monitoring visits to inform and develop the scope and strategy for each year's maintenance work. Note that the maintenance phase should generally be viewed as an ongoing process, even after successful control has been achieved after a 3–5-year effort, but that the time and cost requirements typically follow a descending trajectory until a modest, minimum annual (or biannual) "bench/floor" level is reached.

### **Monitoring Plan**

Following the implementation of invasive species management and the introduction of native plant species, HW recommends that the site be monitored for a minimum of three growing seasons to ensure successful restoration. Monitoring should occur twice annually (approximately mid-June and mid-September) to assess the relative success of the restored areas. Semi-annual site inspections conducted during late spring and late summer will include an evaluation of the relative health and vigor of the planted vegetation, overall percent of vegetation cover, and extent of invasive species regrowth if any. Additional measures should be taken during construction and monitoring of the restoration area to discourage the invasion of exotic species within the newly disturbed soils.

## 11. GENERAL SITE MAINTENANCE

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General site maintenance includes the following requirements:

### **Trash & Debris**

Remove and properly dispose of all trash and debris.

### **Pet Waste**

Visitors to the site are encouraged to pick up after their pets. Remove and properly dispose of all pet waste left behind. Pet waste should be picked up and disposed of properly to reduce bacteria and nutrient levels in stormwater.

### **Pavement Sweeping**

Paved roadways should be mechanically swept, at a minimum of once per year in early spring, to remove accumulated sand and sediment debris.

### **Contributing Drainage Areas**

Check for sources of sediment in forebay from the contributing drainage area. Follow-up with landowner(s) as necessary.

### **Snow Removal**

Snow removal from the practice is not necessary. Plowed or shoveled snow piles should not block the catch basin grates or 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

## 12. LONG-TERM POLLUTION PREVENTION MEASURES

Long-term pollution prevention measures implemented at the site reduce pollutants in stormwater discharges. The following precautions will be employed on an on-going basis.

### Spill Prevention & Control Measures

To minimize the risk of spills or other accidental exposure of materials and substances to stormwater runoff, the following material management is to be used when working on site.

- Any materials stored on-site will be stored in a neat, orderly manner in their appropriate containers.
- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Manufacturers' recommendations for proper use and disposal will be followed.
- The contractor's supervisor will be issued this Guide to ensure proper use and disposal of materials.

Materials or substances listed below may be present on-site for maintenance and care should be taken to avoid spills:

- Petroleum Based Products

The following product-specific measures will be followed on-site:

- [Petroleum Products](#) - All on-site vehicles will be monitored for leaks and receive preventative maintenance to reduce the chance of leakage.
- [Grass Clipping, Leaf Litter and Plant Debris](#) – are to be removed from the property and not disposed on site.



## APPENDIX A

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### Maintenance Checklists

Bioretention

Underground Infiltration Chambers



## Bioretention/Bioswale and Pretreatment Maintenance Checklist Southern Tier

**Date:**

**Time:**

**Inspector:**

Maintenance Item	Description	Maintenance (Y/N)
<b>1. COLLECT</b> <b>Includes:</b> Catch basin/Inlet Structure/Piping <b>Frequency:</b> Inspect four times per years during regular park maintenance and after major storm events (2" of rain or greater) <b>When:</b> March, June, September, November		
Surface Debris Cleaning	Remove all trash, leaf litter and inlet clogging.	
Inlets	Check for clogging and sediment accumulation that impacts inflow. If there is sediment accumulation, schedule cleaning.	
<b>Actions to be taken:</b>		
<b>2. CAPTURE</b> <b>Includes:</b> Sediment Forebay, Rain Guardian Fortress <b>Frequency:</b> 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) <b>When:</b> March, June, September, November		
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.* Refer to Owner's Manual for Rain Guardian Fortress Specific Maintenance	
<b>Actions to be taken:</b>		
<b>3 &amp; 4. MOVES &amp; FILTERS</b> <b>Includes:</b> Planting bed <b>Frequency:</b> Inspect four times per years during regular park maintenance and after major storm events (2" of rain or greater) <b>When:</b> March, June, September, November		
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	
<b>Actions to be taken:</b>		
<b>5. OVERFLOW</b>		
<b>Includes:</b> Outlet structures		
<b>Frequency:</b> Inspect bi-annually and after major storm events (2" of rain or greater)		
<b>When:</b> March and September		
Overflow Structure	Water level should be below outlet pipe inverts. Check for sediment accumulation that impacts outflow. If there is sediment accumulation, schedule cleaning. Check for leaf litter, debris, and inlet clogging.	
<b>Actions to be taken:</b>		
<b>Other Routine Grounds Maintenance</b>		
<b>Includes:</b> Surrounding landscape beyond the practice.		
<b>Frequency:</b> Inspect four times per year during regular park maintenance and after major storm events		
<b>When:</b> 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.	
<b>Actions to be taken:</b>		

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

## Underground Chambers - Maintenance Checklist Southern Tier

**Date:**

**Time:**

**Inspector:**

Maintenance Item	Description	Maintenance (Y/N)
<b>1. COLLECT</b> <b>Includes:</b> Catch basin/Inlet Structure - see also bioretention <b>Frequency:</b> Inspect four times per years during regular park maintenance and after major storm events (2" of rain or greater) <b>When:</b> 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.	
<b>Actions to be taken:</b>		
<b>2. CAPTURE</b> <b>Includes:</b> Deep Sump/Sediment Forebay/Isolator Row <b>Frequency:</b> 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) <b>When:</b> 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.*	
<b>Actions to be taken:</b>		
<b>3. MOVE</b>		
Drain Manhole and manifold Cleanout	<ul style="list-style-type: none"> <li>Remove trash and debris from the surface.</li> </ul>	
See Also Manufacturer's Requirements		
<b>Actions to be taken:</b>		

Maintenance Item	Description	Maintenance (Y/N)
<b>4. STORE AND INFILTRATE</b>		
<b>Includes:</b> Chambers		
<b>Frequency:</b> Inspect annually – see manufacturer's requirements		
<b>When:</b> 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.	
<b>5. OVERFLOW</b>		
<b>Includes:</b> Drain manholes and weir walls		
<b>Frequency:</b> Inspect annually and after major storm events (2" of rain or greater)		
<b>When:</b> Spring		
Overflow Structure	Check for sediment accumulation that impacts inflow. If sediment accumulation. Schedule cleaning. Check for leaf litter, debris, and inlet clogging.	
<b>Actions to be taken:</b>		
<b>Other Routine Grounds Maintenance</b>		
<b>Includes:</b> Surrounding landscape beyond the practice.		
<b>Frequency:</b> Inspect four times per year during regular park maintenance and after major storm events		
<b>When:</b> 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.	
<b>Actions to be taken:</b>		

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

## APPENDIX B

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### Manufacturer Operations and Maintenance Materials

Rain Guardian Fortress Maintenance Guide

ADS StormTech Warranty and Isolator Row Operations and Maintenance Manual

Contech Stormceptor Operations and Maintenance Guide



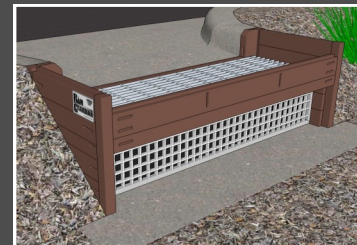


## PRETREATMENT FOR BIORETENTION

Rain Gardens • Swales • Filtration Basins • Infiltration Basins



COMMERCIAL/INDUSTRIAL

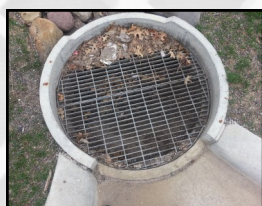


RESIDENTIAL

### Maintenance Guide

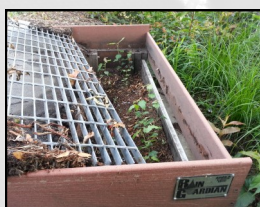
Rain Guardian pretreatment chambers simplify bioretention maintenance by collecting sand, leaves, grass clippings, and other debris in an easy to clean, confined location. Regularly maintaining the Rain Guardian sustains its functionality by maximizing storage and filtration capacities. Maintenance frequency is variable and depends on many factors such as rainfall frequency, drainage area size and land use type, and season of the year. The general cleaning process is identical for the Rain Guardian Turret and Rain Guardian Bunker.

Following rain events, inspect the pretreatment chamber for debris on the top grate, within the chamber, and on the vertical, drop-in filter wall. The maintenance steps described below should be completed if areas of the top grate are clogged, the chamber is >75% full, or the vertical filter wall is clogged. Maintenance should be completed when stormwater has completely drained from the bioretention practice. The filter wall allows the chamber to dry between rain events, which further simplifies maintenance by ensuring removed debris is largely dry. Ensure all debris collected during cleaning of the chamber is completely removed from the site and properly disposed of according to local environmental rules. Once cleaning is complete, reinstall the filter wall with filter fabric facing the inside of the chamber and replace the top grate.



#### Clear Debris from Top Grate

- Leaf litter and garbage commonly accumulate on the top grate
- Simply remove and dispose of debris by hand or with a shovel prior to removing top grate



#### Remove Debris from Inside Chamber

- Remove top grate and place on paved inlet to avoid damage to nearby plants
- Remove and dispose of accumulated debris within chamber using a shovel



#### Clean Filter Wall

- Remove drop-in filter by lifting vertically
- Clean filter wall with a stiff bristled broom or rinse clean with pressurized water



## 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<sup>®</sup> Row O&M Manual*



## THE ISOLATOR<sup>®</sup> 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.

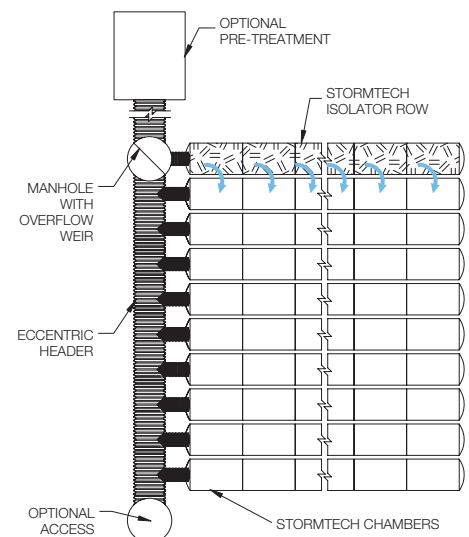
*Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.*



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.

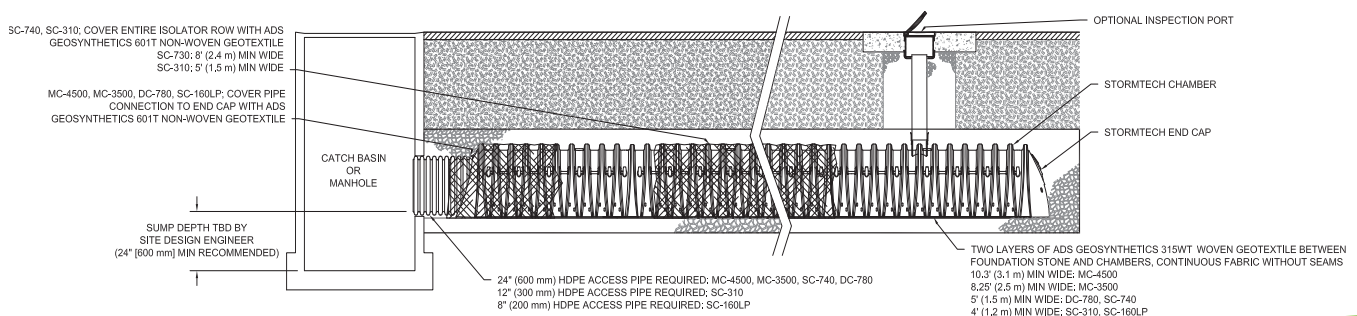
### MAINTENANCE

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.

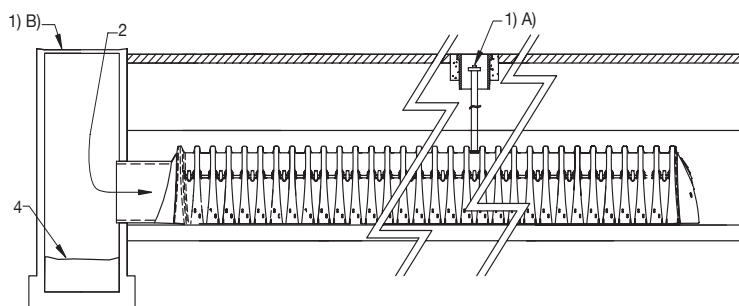
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

## STEP 3

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

## STEP 4

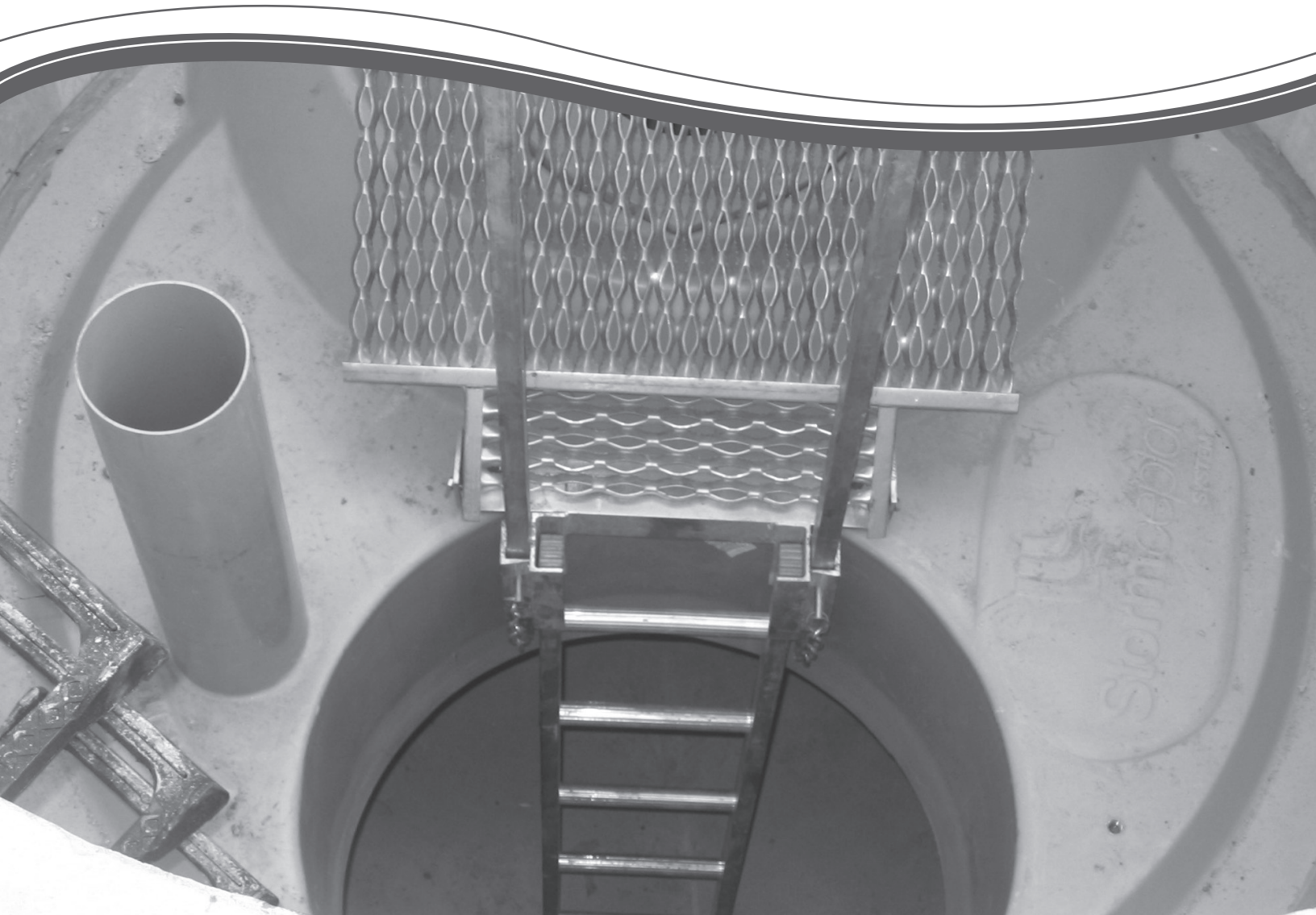
Inspect & clean catch basins and manholes upstream of the StormTech system.



## 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

## Stormceptor<sup>®</sup> STC Operation and Maintenance Guide



## Stormceptor Design Notes

- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.

### Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences			
Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in. (75 mm)	1 in. (25 mm)	3 in. (75 mm)
Multiple inlet pipes	3 in. (75 mm)	3 in. (75 mm)	Only one inlet pipe.

### Maximum inlet and outlet pipe diameters:

Inlet/Outlet Configuration	Inlet Unit STC 450i	In-Line Unit STC 900 to STC 7200	Series* STC 11000 to STC 16000
Straight Through	24 inch (600 mm)	42 inch (1050 mm)	60 inch (1500 mm)
Bend (90 degrees)	18 inch (450 mm)	33 inch (825 mm)	33 inch (825 mm)

- The inlet and in-line Stormceptor units can accommodate turns to a maximum of 90 degrees.
- Minimum distance from top of grade to crown is 2 feet (0.6 m)
- Submerged conditions. A unit is submerged when the standing water elevation at the proposed location of the Stormceptor unit is greater than the outlet invert elevation during zero flow conditions. In these cases, please contact your local Stormceptor representative and provide the following information:
  - Top of grade elevation
  - Stormceptor inlet and outlet pipe diameters and invert elevations
  - Standing water elevation
  - Stormceptor head loss,  $K = 1.3$  (for submerged condition,  $K = 4$ )



OPERATION AND MAINTENANCE GUIDE

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# 1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

## 1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 • 2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

# 2. Stormceptor Design Overview

## 2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

## 2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18" (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

## 2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.

## 3. Key Operation Features

### 3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

### 3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{sc} = \frac{H}{\theta_H} = \frac{Q}{A_s}$$

Where:

$v_{sc}$  = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$\theta_H$  = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft<sup>3</sup>/s (m<sup>3</sup>/s)

$A_s$  = surface area, ft<sup>2</sup> (m<sup>2</sup>)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

### 3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

## 4. Stormceptor Product Line

### 4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

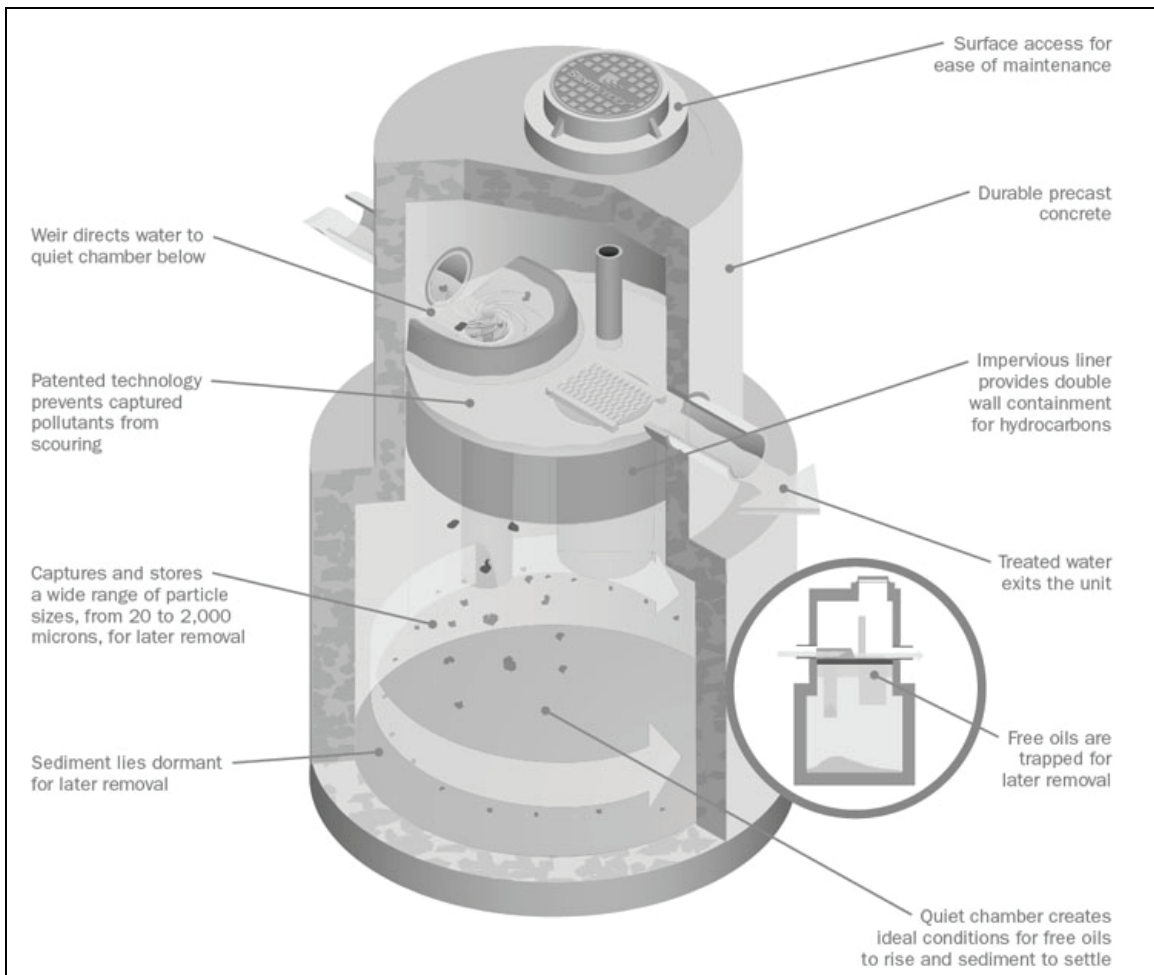
**Table 1. Stormceptor Models**

<b>Stormceptor Model</b>	<b>Total Storage Volume U.S. Gal (L)</b>	<b>Hydrocarbon Storage Capacity U.S. Gal (L)</b>	<b>Maximum Sediment Capacity ft<sup>3</sup> (L)</b>
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

**NOTE:** Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

### 4.2. Inline Stormceptor

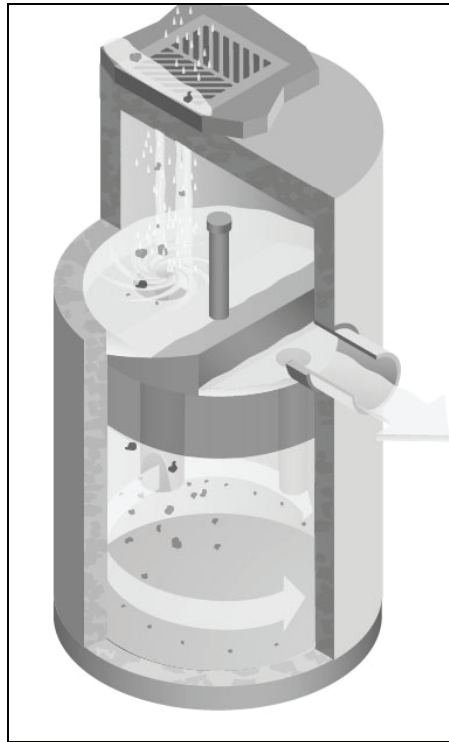
The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.



**Figure 1. Inline Stormceptor**

## Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.



**Figure 2. Inlet Stormceptor**

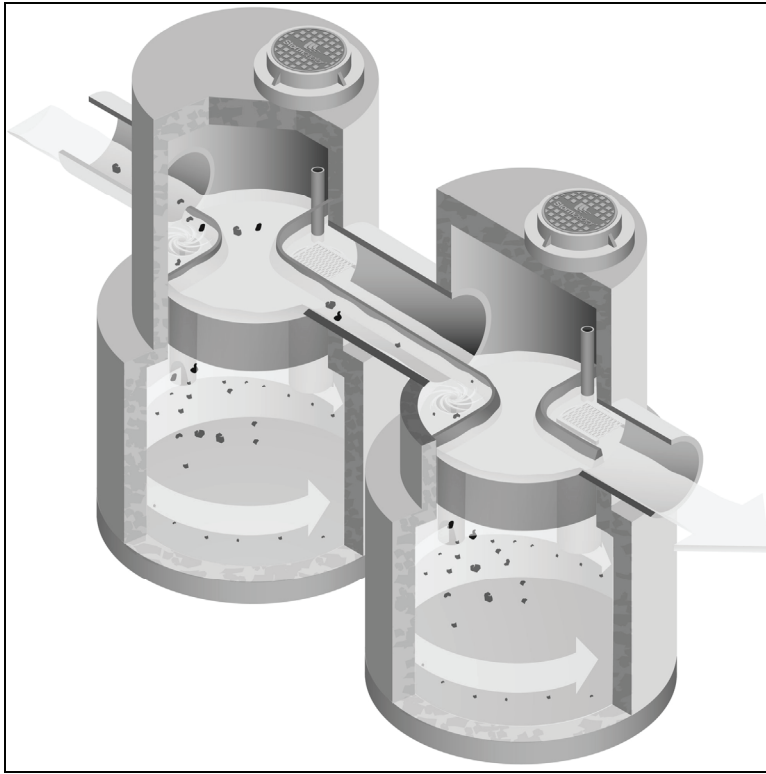
#### **4.3. Inlet Stormceptor**

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

#### **4.4. Series Stormceptor**

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.



**Figure 3. Series System**

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

## 5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

### STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

### STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

### STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

## STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

**Table 2. Fine Distribution**

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

## STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

## STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

## STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

## 5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
  - » The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
  - » The distribution of TSS with the hydrology is properly and accurately considered in the sizing
  - » Particle size distribution is properly considered in the sizing
  - » The sizing can be optimized for TSS removal
  - » The cost benefit of alternate TSS removal criteria can be easily assessed
  - » The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit [www.imbriumsystems.com](http://www.imbriumsystems.com) to download a free copy of the program.

## 5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site's typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

### Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit's performance. As an integral part of the product's design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered "stable" surfaces which have non – erodible surfaces.

### Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as "unstable". These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

## 6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

'Oil Removal' describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

'Spill Capture' describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

### 6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit's available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

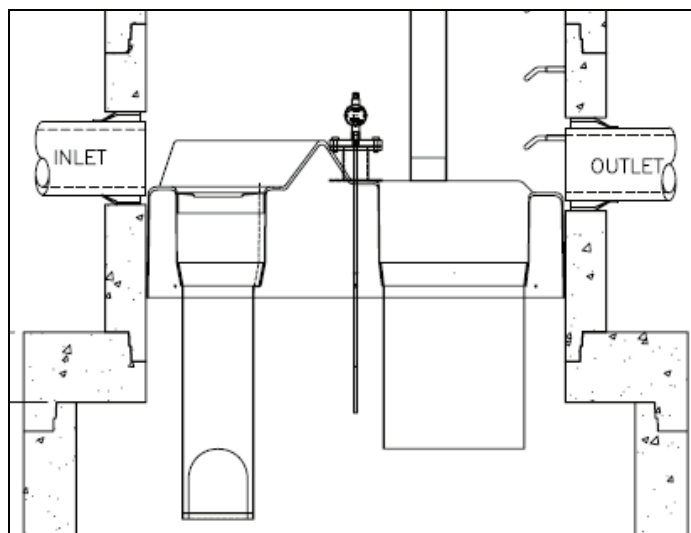


Figure 4. Oil level alarm

### 6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.

## 7. Stormceptor Options

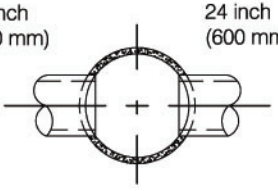
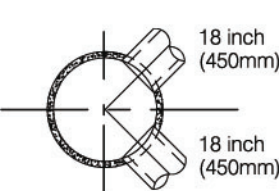
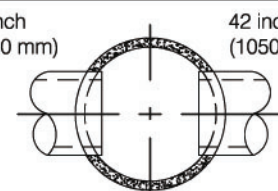
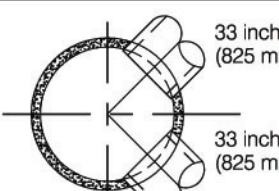
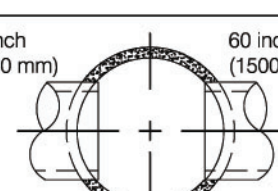
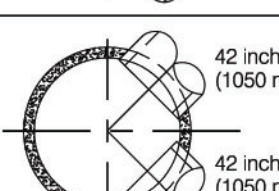
The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

### 7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

### 7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

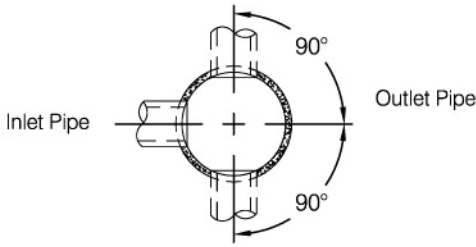
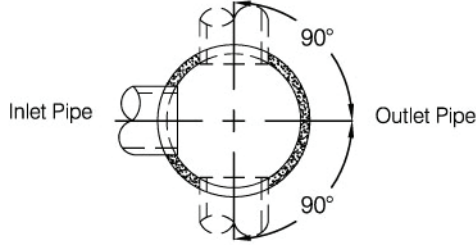
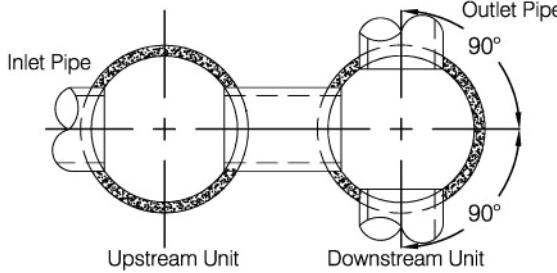
Upper Chamber Diameter	Maximum Pipe Diameters for Straight Through and 90° Bends (Based on Concrete Pipe)	
Inlet Stormceptor		
Inline Stormceptor		
Inline Stormceptor or Series Stormceptor		

**Figure 5. Maximum pipe diameters for straight through and bend applications**

\*The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

### 7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.

Stormceptor System	Maximum Bend Configurations
Inlet Stormceptor	
Inline Stormceptor	
Series Stormceptor	

**Figure 6. Maximum bend angles**

#### 7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

#### 7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

**Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts**

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

#### 7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

#### 7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

## 7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life-cycle maintenance cost.

## 7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss =  $k \cdot 1.3v^2/2g$ ).

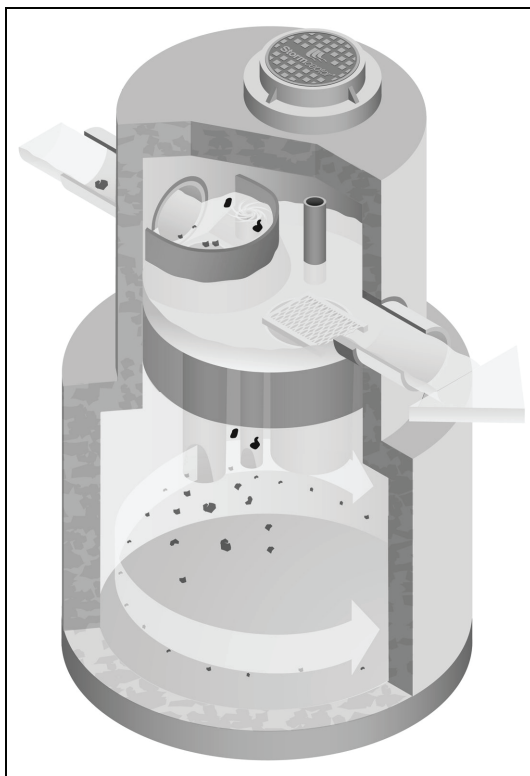
However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

## 7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation



**Figure 7. Submerged Stormceptor**

## 8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between “approved alternatives”. The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

### 8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

### 8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system’s performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product’s performance claims.

### 8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

### 8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system’s design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

## 9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

## 10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

### 10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

### 10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

## 11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate)
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

## 12. Maintenance

### 12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

### 12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

**Table 4. Sediment Depths Indicating Required Servicing\***

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit's total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

### 12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

### 12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

### 12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

### 12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations ( $<10$  mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.



## SUPPORT

Drawings and specifications are available at [www.ContechES.com](http://www.ContechES.com).

Site-specific design support is available from our engineers.

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## APPENDIX C

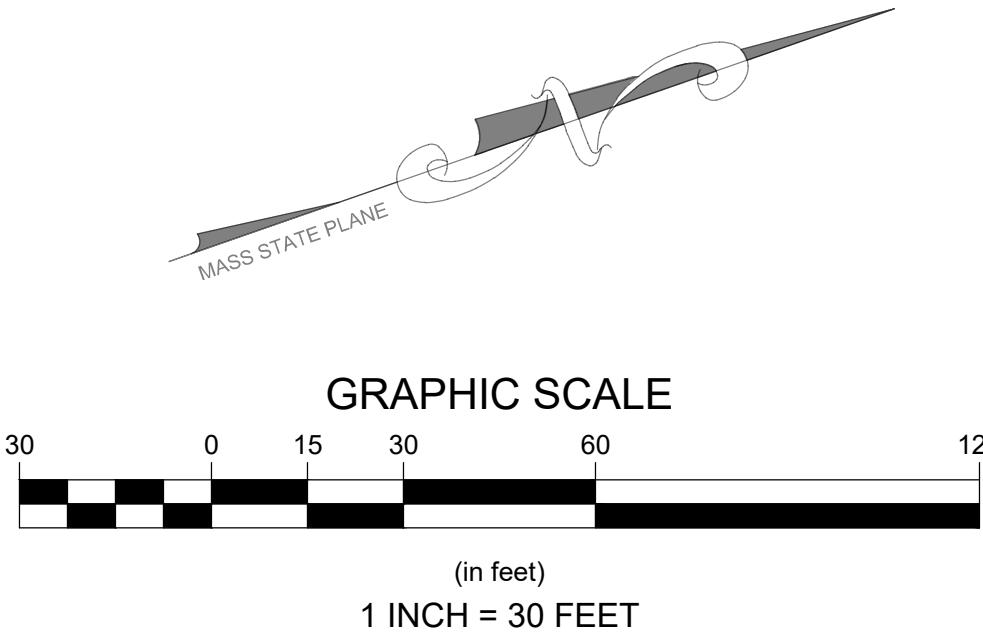
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### Operations and Maintenance Location Map





- LEGEND:
- BIORETENTION AREA
  - RAIN GARDEN FORTRESS INLET
  - SEDIMENT FOREBAY
  - UNDERGROUND INFILTRATION CHAMBERS



Project Number: <b>22008</b>	Sheet: 	Sheet Number: 	Registration: 	Survey Provided By: <b>Horsley Witten Group, Inc.</b> 90 Route 6A Sandwich, MA 02563 Phone: (508) 833-3150 Fax: (508) 833-3150 Dated: February 10, 2022	Prepared For: <b>Affirmative Investments, Inc.</b> 33 Union St. 2nd Floor Boston, MA 02108 Phone: --- Fax: ---	Plan Set: <b>SOUTHERN TIER PERMIT PLANS 85 EDGARTOWN-VINEYARD HAVEN ROAD OAK BLUFFS, MASSACHUSETTS</b>	<b>Horsley Witten Group, Inc.</b> <i>Sustainable Environmental Solutions</i> www.horsleywitten.com 90 Route 6A Sandwich, MA 02563 508-833-6600 voice 508-833-3150 fax		Revisions																																														
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## APPENDIX D

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### Planting Plans

Plant Schedule 1				
Key	Botanical Name	Common Name	Size	Spacing
<b>CANOPY TREES</b>				
AR	2 <i>Acer rubrum</i>	Red Maple	2.5" cal	As Shown
NS	4 <i>Nyssa sylvatica</i>	Tupelo	2.5" cal	As Shown
QA	5 <i>Quercus alba</i>	White Oak	2.5" cal	As Shown
QC	7 <i>Quercus coccinea</i>	Scarlet Oak	2.5" cal	As Shown
QI	4 <i>Quercus ilicifolia</i>	Bear Oak	1.5" cal	20' O.C.
QS	2 <i>Quercus stellata</i>	Post Oak	2.5" cal	As Shown
QV	6 <i>Quercus velutina</i>	Black Oak	2.5" cal.	As Shown
<b>UNDERSTORY TREES</b>				
AA	5 <i>Amelanchier arborea</i>	Serviceberry	1.5" cal	15' O.C.
SAS	2 <i>Sassafras albidum</i>	Sassafras	#2	20' O.C.
<b>EVERGREEN TREE</b>				
JV	3 <i>Juniperus virginiana</i>	Eastern Red Cedar	8" - 10' h.	As Shown
PR	12 <i>Pinus rigida</i>	Pitch Pine	7-8" B&B	As Shown



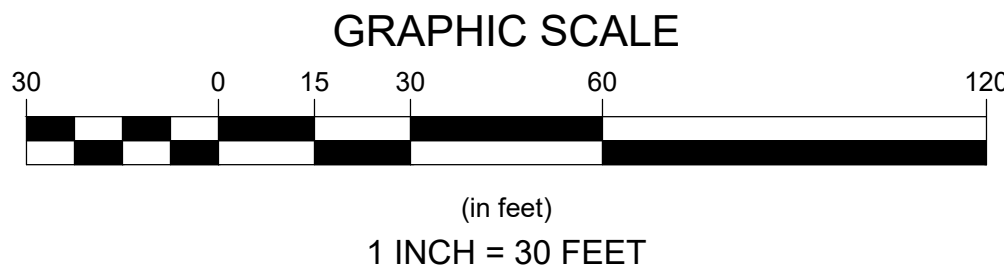
Suggested Plant List				
Key	Botanical Name	Common Name	Size	Spacing
<b>CANOPY TREES</b>				
AR	<i>Acer rubrum</i>	Red Maple	2.5" cal	As Shown
NS	<i>Nyssa sylvatica</i>	Tupelo	2.5" cal	As Shown
QA	<i>Quercus alba</i>	White Oak	2.5" cal	As Shown
QC	<i>Quercus coccinea</i>	Scarlet Oak	2.5" cal	As Shown
QI	<i>Quercus ilicifolia</i>	Bear Oak	1.5" cal	20' O.C.
QS	<i>Quercus stellata</i>	Post Oak	2.5" cal	As Shown
QV	<i>Quercus velutina</i>	Black Oak	2.5" cal.	As Shown
<b>UNDERSTORY TREES</b>				
AA	<i>Amelanchier arborea</i>	Serviceberry	1.5" cal	15' O.C.
SAS	<i>Sassafras albidum</i>	Sassafras	#2	20' O.C.
<b>EVERGREEN TREE</b>				
JV	<i>Juniperus virginiana</i>	Eastern Red Cedar	8" - 10' h.	As Shown
PR	<i>Pinus rigida</i>	Pitch Pine	7-8" B&B	As Shown
PS	<i>Pinus strobus</i>	Eastern White Pine	8-10' h	As Shown

LARGE SHRUBS				
HV	<i>Hamamelis virginiana</i>	Common Witchhazel	3/4" B&B	8' O.C.
IG	<i>Ilex glabra</i>	Inkberry	#5	5' O.C.
MC	<i>Morella carolinensis</i>	Bayberry	#5	6' O.C.
VC	<i>Vaccinium corymbosum</i>	Highbush Blueberry	3/4" B&B	6' O.C.
VD	<i>Viburnum dentatum</i>	Arrowwood Viburnum	#7	6' O.C.
<b>SMALL SHRUBS (Foundation Planting)</b>				
AM	<i>Aronia melanocarpa</i>	Black Chokeberry	#3	4' O.C.
AMM	<i>Aronia melanocarpa</i> 'Morton'	Morton Black Chokeberry	#3	4' O.C.
CPF	<i>Comptonia peregrina</i>	Sweet Fern	#2	4' O.C.
GB	<i>Gaylussacia bacata</i>	Black huckleberry	#2	4' O.C.
IG	<i>Ilex glabra</i>	Inkberry	#5	5' O.C.
IGS	<i>Ilex glabra</i> 'Shamrock'	Shamrock Inkberry	#5	4' O.C.
JH	<i>Juniperus horizontalis</i>	Creeping juniper	#3	3' O.C.
KA	<i>Kalmia angustifolia</i>	Sheep Laurel	#3	5' O.C.
RV	<i>Rosa virginiana</i>	Virginia Rose	#3	4' O.C.

MVC POLICY FOR SITE DESIGN AND LANDSCAPE:			
1 TREE / 8 PARKING SPACES:	REQUIRED	PROVIDED	WAIVER
TREE CALIPER	10	19	N/A
	2.5" - 4" MIN.	N/A	N/A

GRASS / PERENNIAL / GROUND COVER (Foundation Planting)			
AV	<i>Andropogon virginicus</i>	Broom Sedge	#1 18" O.C.
AUV	<i>Arctostaphylos uva-ursi</i>	Bearberry	4" av pot 12" O.C.
AS	<i>Asclepias purpurascens</i>	Purple Milkweed	Plugs 12" O.C.
ATW	<i>Asclepias tuberosa</i>	Butterfly Weed	Plugs 12" O.C.
CP	<i>Carex pensylvanica</i>	Pennsylvania Sedge	Plugs 12" O.C.
CR	<i>Chimaphila maculata</i>	Striped wintergreen	#2 30" O.C.
DP	<i>Dennstaedtia punctilobula</i>	Hay Scented Fern	#1 24" O.C.
ES	<i>Eragrostis spectabilis</i>	Purple Lovegrass	#1 18" O.C.
EDJ	<i>Eupatorium dubium</i> "Little Joe"	Little Joe Pye Weed	#1 18" O.C.
ED	<i>Eurybia divaricata</i>	White wood Aster	#1 18" O.C.
GP	<i>Gaultheria procumbens</i>	Tea Berry; Wintergreen	#1 12" O.C.
GM	<i>Geranium maculatum</i>	Wild Geranium	#1 18" O.C.
PV	<i>Panicum virgatum</i>	Switch Grass	#1 24" O.C.
PA	<i>Pteridium aquilinum</i>	Bracken Fern	#1 36" O.C.
PM	<i>Pycnanthemum muticum</i>	Short-toothed Mountain Mint	#1 18" O.C.
RH	<i>Rubus flagellaris</i>	Common dewberry	#1 18" O.C.
SS	<i>Schizachyrium scoparium</i>	Little Bluestem	Plugs 12" O.C.
SRF	<i>Solidago rugosa</i>	Wrinkle-leaved goldenrod	#1 24" O.C.
SJ	<i>Solidago juncea</i>	Early goldenrod	Plugs 12" O.C.
SNSB	<i>Sorghastrum nutans</i>	Indian Grass	#1 18" O.C.
<b>BIORETENTION/RAINGARDEN PLANTING</b>			
AS	<i>Asclepias purpurascens</i>	Purple Milkweed	Plugs 12" O.C.
BAM	<i>Baptisia tinctoria</i>	Wild indigo	#1 30" O.C.
CP	<i>Carex pensylvanica</i>	Pennsylvania Sedge	Plugs 12" O.C.
DM	<i>Deschampsia flexuosa</i>	Wavy hairgrass	Plugs 12" O.C.
EDJ	<i>Eupatorium dubium</i> "Little Joe"	Little Joe Pye Weed	#1 18" O.C.
GM	<i>Geranium maculatum</i>	Wild Geranium	#1 18" O.C.
PM	<i>Pycnanthemum muticum</i>	Short-toothed Mountain Mint	#1 18" O.C.
SS	<i>Schizachyrium scoparium</i>	Little Bluestem	#1 24" O.C.
SJ	<i>Solidago juncea</i>	Early goldenrod	Plugs 12" O.C.

- PLANTING LEGEND**
- PROPOSED CANOPY TREE
  - PROPOSED EVERGREEN TREE
  - PROPOSED UNDERSTORY TREE
  - PROPOSED LARGE DECIDUOUS SHRUB
  - PROPOSED SMALL SHRUB
  - BIORETENTION PLANTS MIX
  - GRASS/PERENNIAL/ GROUND COVER MIX
  - SEED MIX 1 - NO MOW  
NEW ENGLAND NATIVE WARM SEASON GRASS MIX
  - SEED MIX 2 - MOW AS NEEDED  
COLONIAL SEED - HARMONY MIX WITH CLOVER



PERMITTING SET ONLY  
NOT FOR CONSTRUCTION

Revisions

Rev	Date	By	Appr	Description
1				
2				
3				
4				
5				
6				

**Horsley Witten Group, Inc.**  
Sustainable Environmental Solutions  
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508-833-6600 voice  
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Created By: EEE

Drawn By: KJK

Designed By: KJK

Date: DECEMBER 8, 2022

Plan Set:  
**SOUTHERN TIER PERMIT PLANS**  
**85 EDGARTOWN-VINEYARD HAVEN ROAD**  
**OAK BLUFFS, MASSACHUSETTS**

Plan Title:  
**OVERALL LANDSCAPE PLAN**

Prepared For:  
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33 Union St. 2nd Floor  
Boston, MA 02108  
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Survey Provided By:  
**Horsley Witten Group, Inc.**  
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Phone: (508) 833-6600  
Fax: (508) 833-3150  
Dated: February 10, 2022

Registration:

Project Number: 22008  
Sheet: 16 of 18  
Sheet Number: L - 1

