POST-CONSTRUCTION STRUCTURAL BEST MANAGEMENT PRACTICES OPERATION AND MAINTENANCE PLAN

ENVIRONMENTAL QUALITY MANAGEMENT
UNIVERSITY OF KENTUCKY
LEXINGTON, FAYETTE COUNTY, KENTUCKY

Prepared for:

Environmental Quality Management

Prepared by:

Strand Associates Inc.®
651 Perimeter Drive
Suite 220
Lexington, KY 40515

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1.0 INTRODUCTION

The University of Kentucky (University) main campus is located within the limits of the City of Lexington in Fayette County, Kentucky and is regulated as a Phase II Municipal Separate Storm Sewer System (MS4) by the Kentucky Division of Water (KDOW). As of 2021, the MS4 permit boundary encompasses approximately 824 acres of the main campus but does not include extended campus facilities, such as Coldstream Research Park or other research farms. The permitted area includes 386 acres of impervious areas and consists of classroom and administrative buildings, residence halls, all on-campus hospitals and health care facilities, athletic facilities, parking areas, research laboratories, an arboretum, and support facilities such as the Physical Plant's heating and cooling facilities. Although fully encompassed within the Lexington-Fayette Urban County Government's (LFUCG) Phase I MS4 boundary, the University is an independently regulated Phase II entity and is not included in the coverage of the LFUCG Permit. However, because both the University and LFUCG have a shared boundary, integrated coordination efforts are vital to the success of both programs.

The MS4 Phase II permit requires MS4 permittees to implement post-construction stormwater management controls within the permit boundary. Structural best management practices (BMPs) are used where appropriate to satisfy these requirements. Because of its location with LFUCG's MS4 boundary, the University's MS4 has committed to following the guidance provided in LFUCG's Stormwater Manual regarding acceptable Post-Construction BMPs. The following BMPs were identified as standard stormwater quality management measures for use on the University's campus.

a. Detention Basin and Retention Pond
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1.1 Purpose

The MS4 Phase II permit requires that post-construction stormwater quality management measures be perpetually maintained. This includes operation and maintenance (O&M) practices, routing field condition reviews, compliance inspection reporting, and additional documentation. The intent of this document is to provide guidance for completion of each permit element for the various departments at the University responsible for BMP O&M.

O&M plans are needed for each type of structural practice to describe the efforts required to maintain functionality of the structural controls. Routine inspections of the stormwater BMPs are necessary to identify which maintenance tasks, in addition to those defined in the preventative maintenance plan, are required to keep them working properly and efficiently. They also serve as a preventative measure by monitoring the condition and preventing significant problems from occurring. Routine inspections are to be completed by the staff responsible for operating and maintaining the BMP and issues noted should lead to prescribed maintenance activities or a request for a Compliance Inspection by qualified staff. Formal Compliance Inspections are necessary to meet the requirements of the MS4 Phase II permit and will be completed by Environmental Quality Management staff.

1.2 Scope

To meet the MS4 permit requirement for Post-Construction Stormwater Management, this BMP O&M Manual summarizes the University's protocols and procedures for the following items, as required by the permit:

a. Establishment of long-term maintenance practices.
b. Development of written procedures for BMP inspections.
c. Method for tracking and notifying the BMP operators of deficiencies.
d. Documentation of related activities.

This document includes O&M recommendations for structural BMPs standard stormwater quality management measures for use on the University's campus. Where applicable, the O&M plans are based on BMP information from the LFUCG Stormwater Manual. Manufacturer and designer recommendations are included for applicable structural controls. Additional O&M information was obtained from other references to supplement these resources and have been modified where applicable to adjust to the University's MS4 area and program. The recommendations in this manual and the associated preventative maintenance plan are not intended to replace any manufacturer or designer recommendations and should be considered supplemental guidance.

1.3 Administrative Regulation

Generally, municipalities develop ordinances as the regulatory mechanism that prohibits illicit discharges to the MS4. However, an ordinance is not applicable for other types of MS4 permittees, such as universities. Instead, the University uses "Administrative Regulations" (ARs) that provide interpretation and implementation of university-wide policies set forth by the Board of Trustees in the Governing Regulations and the Minutes of the Board of Trustees.

AR 6:3, effective August 24, 2016, and delegated to the Executive Vice President for Finance and Administration as the Responsible Office, specifically mandates compliance and assigns specific responsibilities associated with the implementation of the University's health, safety, and environmental protection programs. Through AR 6:3, the University has established broad, yet comprehensive, authority over its population of faculty, staff, and students regarding compliance with local, state and federal environmental regulations, including MS4 permit requirements. This environmental, health, and safety AR states the following:

> *The University of Kentucky (the University) endeavors to maintain a safe and healthy environment for its students, employees, and visitors through effective environmental health and safety programs. The University positions itself as a leader within the Commonwealth in environmental stewardship, health protection, and safety standards and expects all students, employees, and members of the community to comply with applicable environmental, health, and safety laws and regulations. This regulation mandates compliance and assigns specific responsibilities associated with implementation and maintenance of the University's environmental health and safety programs.*

1.4 BMP Design and Construction

Successful operations of each post-construction storm water quality BMP rely on preconstruction tasks such as a well-developed design and good construction practices. These tasks take place before the scope of this document but are critical to the successful operation of the BMPs. Good design includes implementation of design guidelines and thorough consideration of site-specific conditions. Poorly designed BMPs may not function or could become a nuisance rather than a water quality benefit. Good construction follows good design with components being translated into the field. If the construction does not follow the design, vegetation may not live, floatables may not be captured, and water quality treatment may not be provided.

Design guidance of stormwater control elements can be found in the University's Official Design Standards available through the Capital Project Management Division. This includes, by reference, the LFUCG Stormwater Manual requirements for water quality and quantity control and design guidance for a variety of BMPs.

1.5 BMP Maintenance and Inspection Responsibilities

The narrative within this manual provides general direction for the maintenance and inspection responsibilities for each type of BMP currently implemented or allowed on campus. The assignment of these responsibilities is provided in Appendix B–Preventative Maintenance Plan Matrix. In general, these responsibilities are assigned as follows; however, some systems have multiple responsible parties. By working together, departments can help to protect the significant investment that the University has made in these systems and prevent costly maintenance and repairs.

Grounds Department (Grounds)–Vegetated swales, bioretention, rain gardens, detention and retention ponds, green roofs, and permeable pavement

Utilities and Energy Management (Utilities)–Inlet control devices, pretreatment and inlet filter devices, underground detention, and sinkholes

Facilities–Water harvesting systems

Athletics Department–All BMPs associated with athletic facilities, unless other arrangements have been made.

Third-Parties–Entities who build and operate independent organizations on campus (e.g., Ronald McDonald House, EdR/Greystar, Shriners) are responsible for all BMPs associated with their facilities, unless other arrangements have been made.

1.6 Definitions

Best Management Practice (BMP)–BMPs are structural and nonstructural practices put in place in order to obtain permanent stormwater management. These BMPs can be designed to improve water quality and/or water quantity.

Compliance Inspection–For entities covered by a Phase II MS4 Permit, each stormwater management practice is required to be inspected at least once per permit term to verify they are operating correctly and are properly maintained.

Maintenance Inspection–Short-form inspections completed by trained personnel to proactively identify maintenance needs and identify conditions that may require additional review or a formal Compliance Inspection.

Municipal Separate Storm Sewer System (MS4)–An MS4 is a system of conveyances including roadway and site drainage systems that can include catch basins, curbs, gutters, ditches, and stormwater piping, among others.

Routine Screening Inspection–These informal inspections should be conducted by University staff while performing day-to-day operations. This routine screening evaluates general conditions associated with the BMP and can proactively identify conditions that may require additional review or a formal Maintenance or Compliance Inspection.

2.0 DETENTION BASIN AND RETENTION POND

Detention basins and retention ponds are traditional stormwater quantity control devices that are designed for peak discharge control and to provide some stormwater quality benefit. Detention basins are typically dry between rainfall events while retention ponds have a permanent pool. The following three types are discussed in this section: standard detention basins, extended detention basins, and retention ponds.

Detention Basin

Detention basins are designed to drain completely and are typically designed with an outlet control structure to detain runoff for a short duration to control peak discharges from specified storm events. Detention basins must be combined with other structural controls as a part of a treatment train to address stormwater quality treatment. Figure 2.1 shows a schematic of a detention basin.

Extended Detention Basin

Extended detention basins do not have a permanent pool; they are designed to drain completely between storm events and can be used for both stormwater quality treatment and stormwater quantity management. The side slopes, bottom, and forebay of extended detention basins are typically vegetated and equipped with an outlet control structure that provides extended detention time, typically between 24 and 48 hours, for a specific stormwater quality treatment volume along with shorter releases of controlled water quantity volume. The outlet control structure may also include some type of filtering device (i.e., gravel or sand envelope) to improve the removal of particulate pollutants.

Extended detention basins may also be modified to improve stormwater quality benefits. The pond may be modified to include a second stage that is a shallow marsh. In locations with continuous dry weather flow, this stage of the extended detention basins will tend to be continuously wet.

Pollutant removal in extended detention basins includes up to three mechanisms. The first mechanism is settling or sedimentation. For two-stage systems that include shallow marsh, pollutants may be removed by plant uptake and bacterial activity. Finally, some systems include limited infiltration.

There are multiple configurations and variations for extended detention basins. A plan view schematic of an extended detention basins is shown in Figure 2.2. Figures 2.3 and 2.4 show two different extended detention basins outlet configurations. Figure 2.7 contains a photograph of an example detention basin from the University's campus.

Figure 2.1–Detention Basin (from LFUCG, 2020)

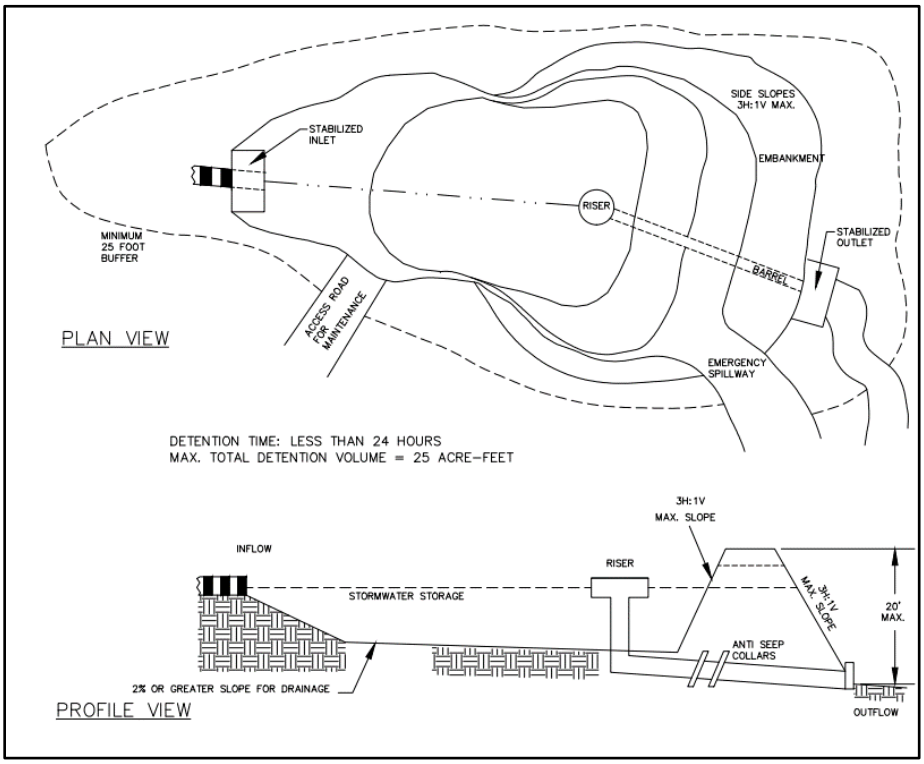


Figure 2.2–Extended Detention Basin (from LFUCG, 2020)

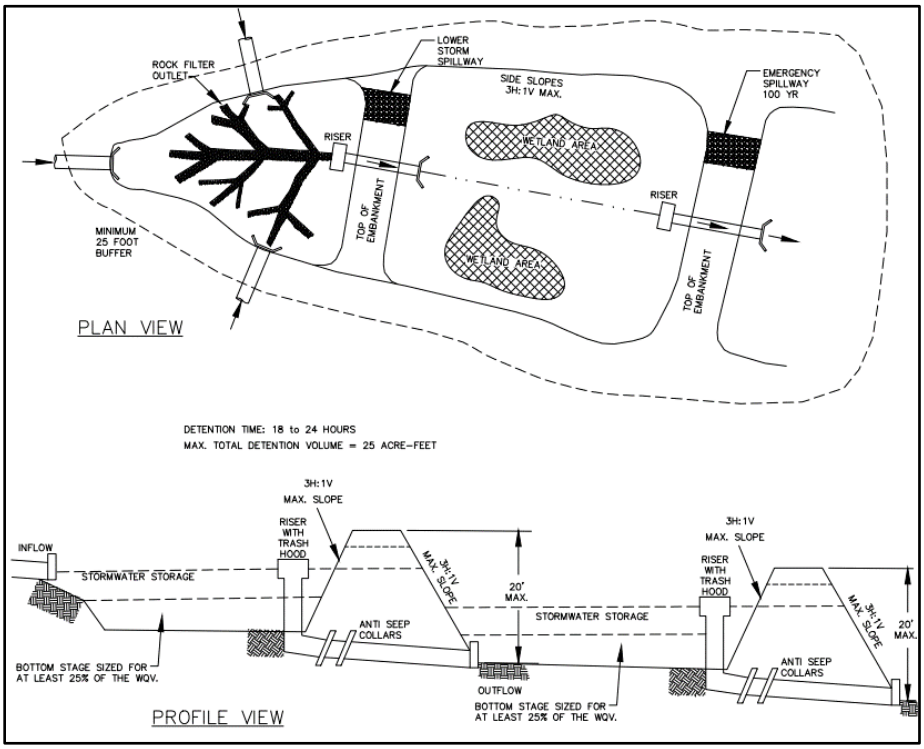


Figure 2.3–Extended Detention Basin Outlet (from LFUCG, 2020)

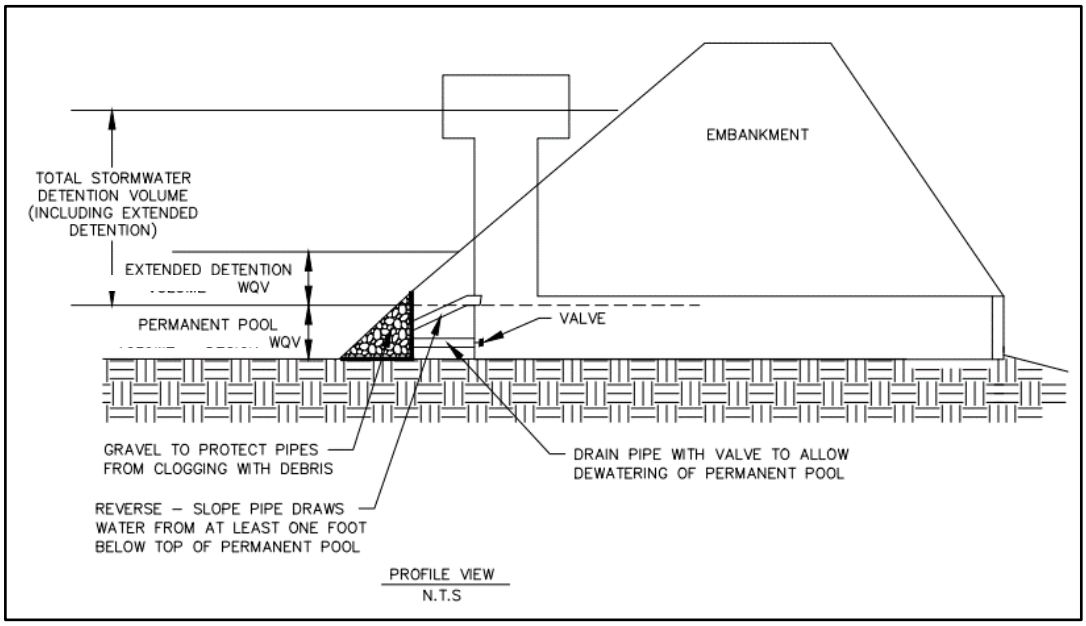
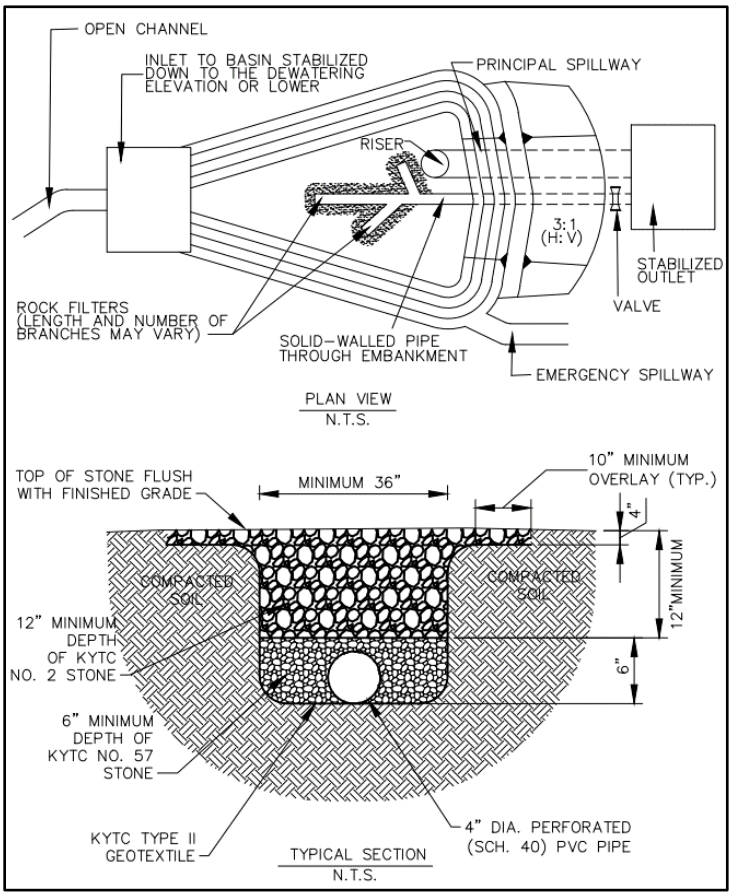


Figure 2.4–Extended Detention Basin Outlet and Rock Filter (from LFUCG, 2020)



Retention Ponds

Retention ponds are designed to have a permanent pool that does not completely drain between rainfall events. They typically require base flows to exceed or match water losses through evaporation and/or infiltration. Retention ponds can be designed for both stormwater quality and stormwater quantity management. The permanent pool is completely or partially displaced by incoming stormwater from the contributing drainage area. Water is temporarily stored before it is slowly released. A wet detention system is essentially a small lake with rooted wetland vegetation. Figure 2.5 shows a retention pond plan and profile view. Figure 2.6 contains a photograph of an example retention pond from the University's campus.

Multiple pollutant removal mechanisms are present in retention pond systems. The pollutant removal occurs mainly during the relatively long inactive period between storms. One mechanism is settling or sedimentation. Chemical flocculation also occurs when heavier sediment particles overtake and coalesce with smaller, lighter particles to form a still larger particle. Dissolved pollutants may also be reduced by biological processes such as filtering, adsorption onto bottom sediments, uptake by aquatic plants including algae, and metabolism by microorganisms inhabiting bottom sediments and aquatic plants.

Figure 2.5–Retention Pond (from LFUCG, 2020)

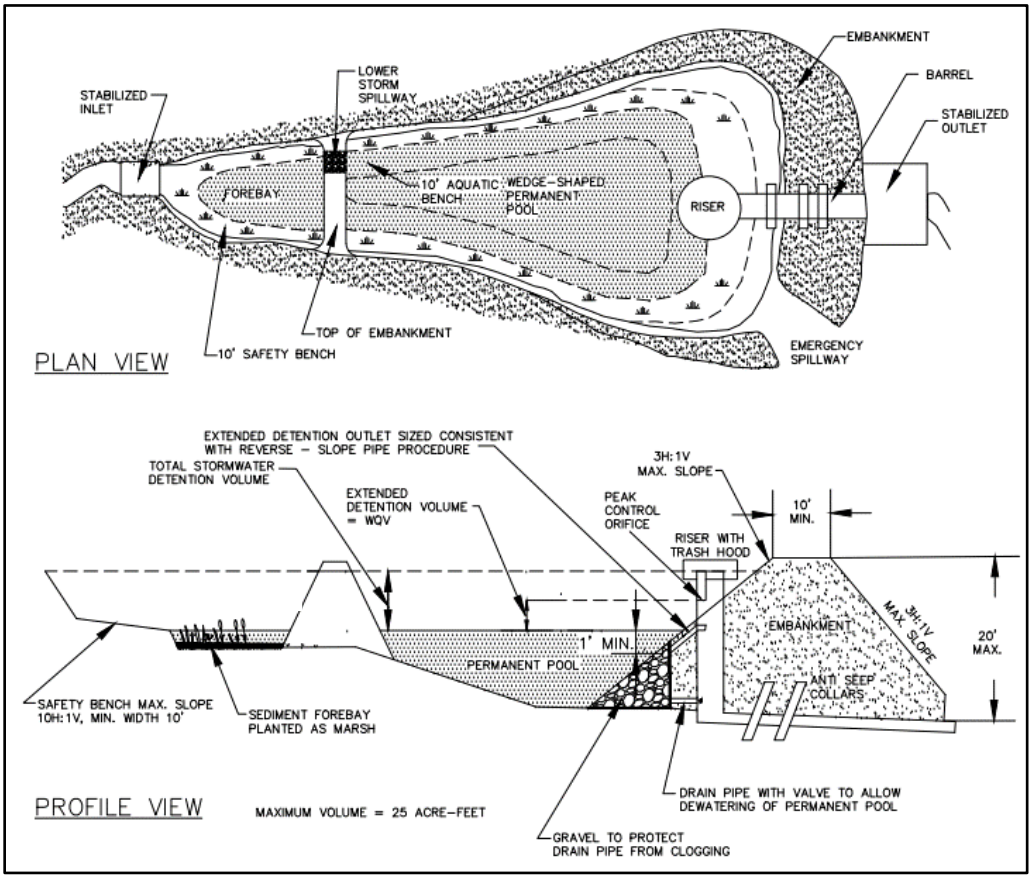


Figure 2.6–Gluck Retention Pond

Figure 2.7–KET/ACS Detention Basin

2.1 Operation

Successful detention basin and retention pond operation depends on the following items:

- Maintaining the Storage Volume–Build-up of sediment and debris can reduce the storage volume available for treatment.
- Maintaining the Discharge Rate–Decreased storage or a modified outlet structure can impact the discharge rate. Where the pond is designed for stormwater quantity control, any changes can lead to flooding or downstream erosion.
- Maintaining the System's Infiltration Capability–Where required as part of the designed operation, reduction in the infiltration rate because of clogging or other obstruction can lead to the pond storage volume being overwhelmed by the additional stored water, causing the facility to poorly manage water quantity or quality.
- Maintaining the Outlet Control Structure–The outlet control structure is an important component of the operation of the facility, as it controls discharge. Small outlet pipes have the potential to easily clog with debris and sediment.
- Maintaining Vegetation–For detention basins, vegetation of the embankments and basin bottom provides structural support for the underlying soil, reducing the likelihood of erosion. In retention ponds, the shoreline around the pond should be protected from erosion with plants that can withstand short-term inundation when the pond is full. In both cases, the vegetation associated with the facility provides additional water quality benefits.

2.2 Maintenance

Each facility type requires sediment removal to maintain proper function. For detention basins, the anticipated frequency for removing deposited sediment is at least once every 5 years. The anticipated frequency for removing deposited sediment from retention ponds will depend on multiple factors, including use of pretreatment BMPs or forebays, land cover and land use for the contributing drainage area, and sediment loading, among others. Generally, sediment should be removed from wet ponds when 10 to 20 percent of the system's storage volume has been lost, unless directed otherwise by the operating plan provided by the design engineer. Sediment levels should be measured every 3 years in retention ponds.

Maintenance tasks for retention ponds and detention basins are summarized in Table 2.2-1.

- Remove Trash and Debris–Trash tends to accumulate in the bottom of the detention basins and the upslope areas surrounding both detention basins and retention ponds.
- Mow Grass and Remove Clippings–On a regular basis, mow the bottom of the detention basins and upslope areas surrounding retention ponds. Collecting and disposing the clippings prevents clogging the control structure.

- Clean Sediment and Debris from Inlets and Outlets–Perform quarterly cleanings of inlet grates, inlet pipes, outlet pipes, and control structures to prevent clogging and subsequent underperformance of detention basins and retention ponds.

- Replant Vegetation–The vegetation surrounding retention ponds and detention basins provides benefits as described previously. Thin and transplant thriving plants. Replant shrubs, grasses, and woody plants that are in poor health to continue providing benefits to the facilities.

- Repair Erosion Channels–Heavy rains, animal burrowing, and human activity can cause rills and channels that erode soil and send sediment downstream, affecting the performance of the detention basins and retention ponds. In the spring and fall, fill in the erosion channels and stabilize with grass seed and erosion control blankets to prevent further erosion.

- Remove Excess Biomass–Each fall, trim, clip, and dispose excessive growth from the vegetation within and surrounding detention basins and retention ponds. Removal will prevent nutrients from leaching into the water and degrading downstream water quality.

- Complete Maintenance Inspection–Three times per year, qualified staff will thoroughly complete a maintenance inspection using WQ-FORM-201A. If further maintenance or repair work is necessary, staff will follow up with such work.

Table 2.2-1–Detention Basin and Retention Pond Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove Trash	X	X	X	X	X	X	X	X	X	X	X	X
Mow Grass and Remove Clippings				X	X	X	X	X	X	X		
Clean Sediment from Inlets and Outlets		X			X			X			X	
Replant Vegetation			X							X		
Repair Erosion Channels			X							X		
Remove Excess Biomass										X		
Measure Sediment Levels	~ ~ ~ Every 3 Years ~ ~ ~											
Complete Maintenance Inspection			X			X			X			

2.3 Inspection

Routine screening inspections should be conducted by Grounds staff while performing day to day operations. This routine screening should determine mowing and vegetation management needs. Considerations during routine screenings should include the following:

- Debris or trash obstructions at the inlet or outlet control devices
- Excessive erosion or sedimentation within or downstream of the facility
- Dam and embankment cracking, bulging, or settling
- Low spots in the bottom of an extended detention facility
- Pipe deterioration
- Emergency spillway erosion
- Stability of the side slopes
- Sparse or missing wetland vegetative growth for retention ponds
- Upstream and downstream channel conditions
- Signs of vandalism
- Evidence of animal burrows
- Corrosion in low-flow orifice, trash rack, weir trash rack, or riser

Maintenance inspections should be completed approximately three times per year, or as noted in the preventative maintenance plan. These inspections use a short-form inspection report targeted at maintenance issues specific to this BMP type. Identified maintenance issues should be addressed as soon as possible. Should serious concerns be identified during the maintenance inspection, a compliance inspection can be requested to be completed by EQM.

All aboveground detention and retention facilities must have formal compliance inspections at least once per 5 years. The inspections should be documented in writing on the inspection report at the end of this document. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible after the inspection where the need was noted.

3.0 Stream Restoration and Constructed Wetlands

Stream restorations and constructed wetlands are facilities constructed to treat and control stormwater that also incorporates some properties of natural waterways and wetlands, such as shallow flow through a dense and diverse assemblage of plants that can also serve as habitat for microorganisms.

Constructed wetlands can provide both water quality and water quantity management or water quality management only. The term “constructed wetland” can apply to a wetland constructed to mitigate impacts to a natural wetland, as required by a United States Army Corps of Engineers permit or a wetland, which is constructed as part of a water treatment system. For management of water quantity, a wetland would be constructed much like a retention pond with a 6- to 12-inch-deep permanent pool and varying water levels in other areas of the wetland. The key factor for determining whether a location is suitable for a constructed wetland is the existence of the required base flow to supply the permanent pool.

Figure 3.1–Farm Road CATchment (left) and Alumni Drive Stream Restoration (right)

Stream restorations and constructed wetlands can incorporate multiple pollutant removal mechanisms. One mechanism is settling or sedimentation. A second method is through pollutant adsorption of sediment, vegetation, or debris. Plants and algae may also provide filtration and uptake benefits. In addition, wetland microbes can remove stormwater pollutants through uptake or transformations. The extended detention in a constructed wetland allows pollutant removal during the relatively long inactive period between storms.

Figures 3.2 and 3.3 show examples of schematics for different elements of stream restoration projects from the Alumni Drive Stream Restoration Project.

Figure 3.2–Outer Bend Pool Detail from Alumni Drive Stream Restoration

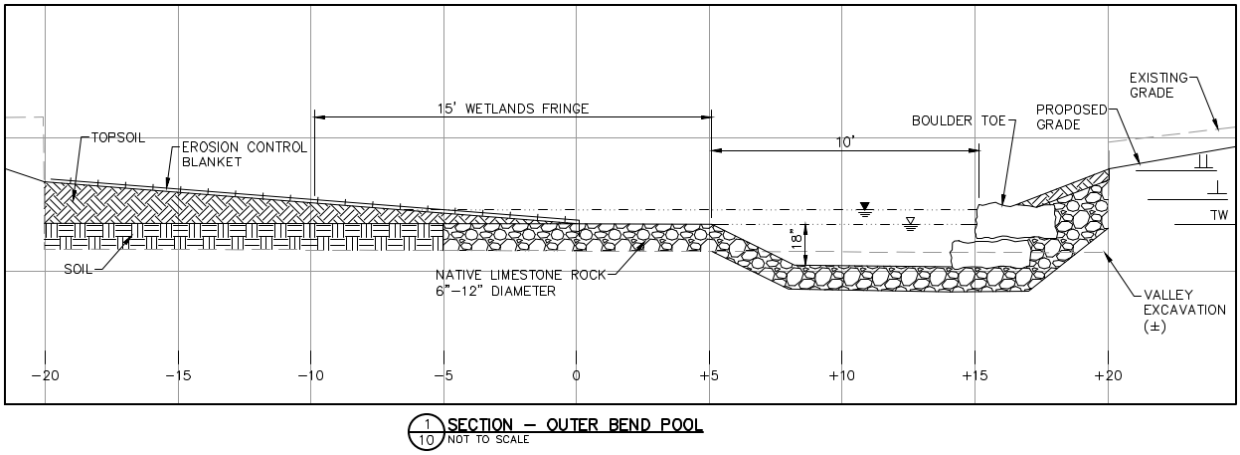
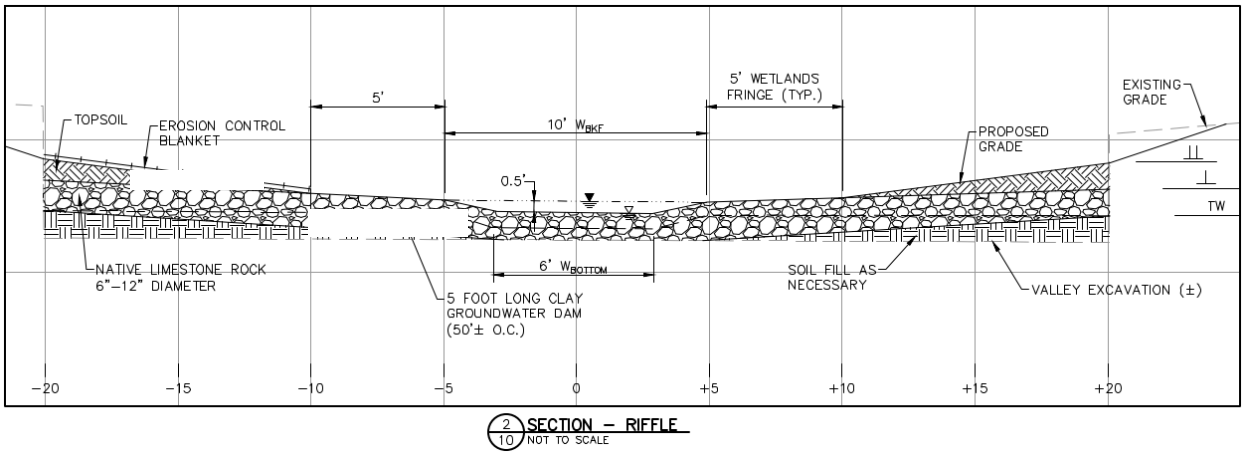


Figure 3.3–Riffle Detail from Alumni Drive Stream Restoration



3.1 O&M

Maintenance tasks for stream restorations and constructed wetlands are summarized in Table 3.2-1.

- Remove Trash–Trash tends to accumulate in the low-lying areas along stream restorations and constructed wetlands. This debris should be collected on a regular basis and ahead of any mowing activities.

- Mow Grass and Remove Clippings–On a regular basis, mow the upslope areas surrounding stream restorations and constructed wetlands. Collecting and disposing of the clippings prevents clogging of the control structure.

- Weed and Remove Invasives–It is important to periodically remove weeds and invasive species from stream restorations and constructed wetlands. Not only does this promote healthy vegetation, but it also helps prevent excess biomass from accumulating and leaching into downstream waterbodies.

- Remove Sediment from Inlets and Outlets–Perform quarterly cleanings of any inlet grates, inlet pipes, outlet pipes, and control structures to prevent clogging and subsequent underperformance. The anticipated frequency for removing deposited sediment will depend on multiple factors, including use of pretreatment BMPs or forebays, land cover and land use for the contributing drainage area and sediment loading. Generally, sediment should be removed when approximately 25 percent of the system's storage volume has been lost.

- Replant Vegetation–The vegetation surrounding stream restorations and constructed wetlands provides benefits as described previously. Replant shrubs, grasses, and woody plants that are in poor health to continue providing benefits to the facilities.

- Repair Erosion Channels–Heavy rains, animal burrowing, and human activity can cause rills and channels that erode soil and send sediment downstream, affecting the performance of these facilities. In the spring and fall, fill in the erosion channels and stabilize with grass seed and erosion control blankets to prevent further erosion.

- Remove Excess Biomass–Each fall, trim, clip, and dispose excessive growth from the vegetation within and surrounding the facilities. Removal will prevent nutrients from leaching into the water and degrading downstream water quality.

- Complete Maintenance Inspection–Three times per year, qualified staff will thoroughly complete a maintenance inspection using WQ-FORM-201B. If further maintenance or repair work is necessary, staff will follow up with such work.

Table 3.2-1–Stream Restoration and Constructed Wetland Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove Trash and Floatables	X	X	X	X	X	X	X	X	X	X	X	X
Mow Grass and Remove Clippings				X	X	X	X	X	X	X		
Weed and Remove Invasives				X		X	X			X		
Remove Sediment from Inlets and Outlets		X			X			X			X	
Replant Vegetation and Replace Rock			X							X		
Repair Erosion Channels			X							X		
Remove Excess Biomass										X		
Complete Maintenance Inspection			X			X			X			

3.2 Inspection

Routine screening inspections should be conducted by Grounds staff while performing day-to-day operations. The routine screening should help determine mowing and vegetation management needs. Additionally, it is recommended that a routine screening inspection be completed following rain events greater than 1 inch to verify operability and integrity of the system. Inspections should consider the following factors:

- Maintain water levels noted in the plans in the treatment area.
- Monitor erosion of side slopes or scouring of basin bottom.
- Monitor accumulations of trash, debris, and oil sheen. Sediment should be removed when 25 percent of the storage volume of the forebay has been lost.
- Mow grassed areas to maintain a good cover. Remove cut vegetation from the facility to prevent clogging the spillway or downstream infrastructure.
- Determine the health of the facility vegetation. Replant or replace vegetation when necessary.
- Monitor the plants both during the growing season and during the dry season to watch for healthy growth of desired plants.
- Remove exotic or nuisance species as soon as they appear to avoid having a monoculture.
- Thin or transplant plants from dense growth areas and use these plants to further establishment or growth in areas with less vigorous plant growth.

Maintenance Inspections should be completed approximately three times per year, or as noted in the preventative maintenance plan. These inspections use a short-form inspection report targeted at maintenance issues specific to this BMP type. Identified maintenance issues should be addressed as soon as possible. Should serious concerns be identified during the maintenance inspection, a compliance inspection can be requested to be completed by EQM.

All stream restoration and constructed wetland facilities must be formally inspected at least once per 5 years. These compliance inspections should be documented in writing on the inspection report at the end of this document. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible after the inspection where the need was noted.

4.0 VEGETATED SWALES

Swales are vegetated parabolic or trapezoidal channels with a large width to depth ratio that are used for conveying stormwater runoff. Vegetated swales tend to slow runoff rates and to allow for particle settling and stormwater infiltration. A biofiltration swale is a variation of a bioretention area without an underdrain system. Swales may be used with curb cuts for roadside drainage that replaces a traditional curb inlet and storm sewer system. Bermed swales use berms installed across the swale to impound shallow water for added particle settling and stormwater infiltration. Pollutant removal by vegetated swales can involve multiple mechanisms, including settling, infiltration, ion exchange, adsorption, microbial action, and vegetative filtration and uptake. Figures 4.1 and 4.2 show a biofiltration swale and a combination of curb cuts and vegetated swales, respectively. Figure 4.3 contains a photograph of an example vegetated swale from the University's campus.

Figure 4.1–Biofiltration Swale (from LFUCG Manual, 2020)

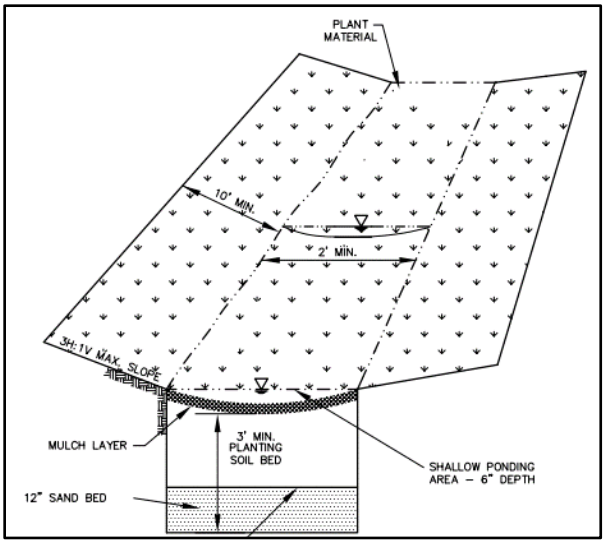


Figure 4.2–Baseball Stadium Vegetated Filter Strip

4.1 Maintenance

Some general maintenance considerations include the following points:

- The use of fertilizer should be minimized.
- If stagnant water persists, regrade, rototill, and replant swale, modify outlet structure, or install underdrain.
- If swale berms or blocks are used to promote infiltration or sedimentation, these blocks must be considered when performing maintenance. Sediments need to be carefully removed without damaging the swale block or its associated vegetation.
- If curb cuts are used as inflow diversions to a vegetated swale, sediments and vegetation should be removed from the curb cut when these items begin to interfere with the inflow to the swale.

Maintenance tasks for vegetated swales are summarized in Table 4.1-1.

- Remove Trash–Trash tends to accumulate in the bottom of vegetated swales and needs to be removed.
- Mow Grass and Remove Clippings–On a regular basis, mow the vegetated swales and collect clippings.
- Weed–It is important to periodically remove weeds. Not only does this promote healthy vegetation, but it also helps prevent excess biomass from accumulating and leaching into downstream waterbodies.
- Remove Leaves and Sediment–Because of the presence of vegetation in the swales, there is more organic matter that tends to collect and reduce performance. Throughout the year, rake out leaves, sediment, and other organic matter that collects.
- Replant Vegetation–Vegetation, when present in vegetated swales, provides many benefits. Replant shrubs, grasses, and woody plants that are in poor health to continue providing benefits to the facilities.
- Repair Erosion Channels–Heavy rains, animal burrowing, and human activity can cause rills and channels that erode soil and send sediment downstream, affecting the performance of the vegetated swales. In the spring and fall, fill in the erosion channels and stabilize with grass seed and erosion control blankets to prevent further erosion.
- Complete Maintenance Inspection–Three times per year, qualified staff will thoroughly complete a maintenance inspection using WQ-FORM-201C. If further maintenance or repair work is necessary, staff will follow up with such work.

Table 4.1-1–Vegetated Swale Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove Trash	X	X	X	X	X	X	X	X	X	X	X	X
Mow Grass and Remove Clippings				X	X	X	X	X	X	X		
Weed				X	X	X	X	X	X	X		
Remove Leaves and Sediment			X			X				X		
Replant Vegetation			X							X		
Repair Erosion Channels			X							X		
Complete Maintenance Inspection			X			X				X		

4.2 Inspection

Routine screening inspections should be conducted by Grounds staff while performing day-to-day operations. The routine screening should help determine maintenance needs. All inspections should consider the following:

- Remove trash, debris, sediment, landscape waste, or chemicals.
- Verify positive drainage; ponding water can kill vegetation.
- Inspect all components of the swale for evidence of erosion and stabilize these areas.
- Look for sediment deposits, if present they should be removed from the swale once identified
- Identify bare soil spots.
- Verify vegetation is receiving enough sunlight, report evidence of dead or dying vegetation, or when grass or weeds start to take over.

Maintenance inspections should be completed approximately three times per year, or as noted in the preventative maintenance plan. These inspections use a short form inspection report targeted at maintenance issues specific to this BMP type. Identified maintenance issues should be addressed as soon as possible. Should serious concerns be identified during the maintenance inspection, a compliance inspection can be requested to be completed by EQM.

All vegetated swales must be formally inspected at least once per 5 years. These compliance inspections should be documented in writing on the inspection report at the end of this document. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible after the inspection where the need was noted.

5.0 BIOFILTRATION PRACTICES

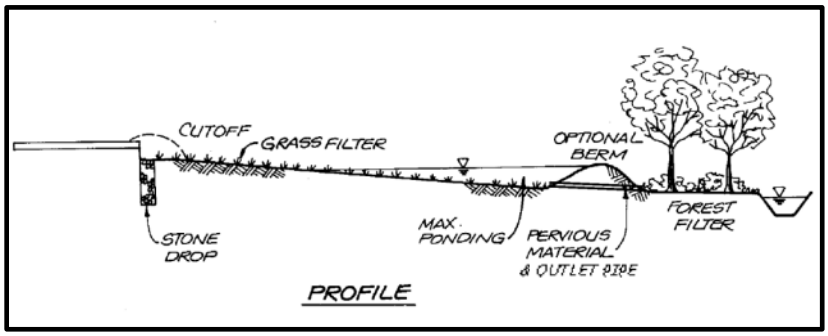
Biofiltration practices include multiple measures that use infiltration as a primary mechanism for addressing water quality. Examples of biofiltration practices include the following: filter strips, bioretention areas, and rain gardens. Each type of biofiltration practice provides pollutant removal using the following mechanisms: settling, infiltration, ion exchange, adsorption, microbial action and vegetative filtration, and uptake. Figure 5.1 contains a photograph of example biofiltration practices from the University's campus.

Figure 5.1–Wildcat Court Bioretention (left) and Arboretum Rain Garden (right)

Filter Strips

A vegetated filter strip relies on sheet flow through vegetation to filter out sediment and other pollutants from stormwater. These filters also provide an opportunity for stormwater infiltration. Vegetated filters are typically used for small subareas of a larger development such as the edge of a parking lot or other paved surface. To work properly, a filter strip should have sheet flow across the entire width of the vegetated area. The vegetation is typically grass or other ground covers that provide dense vegetation. Figure 5.2 shows a filter strip schematic.

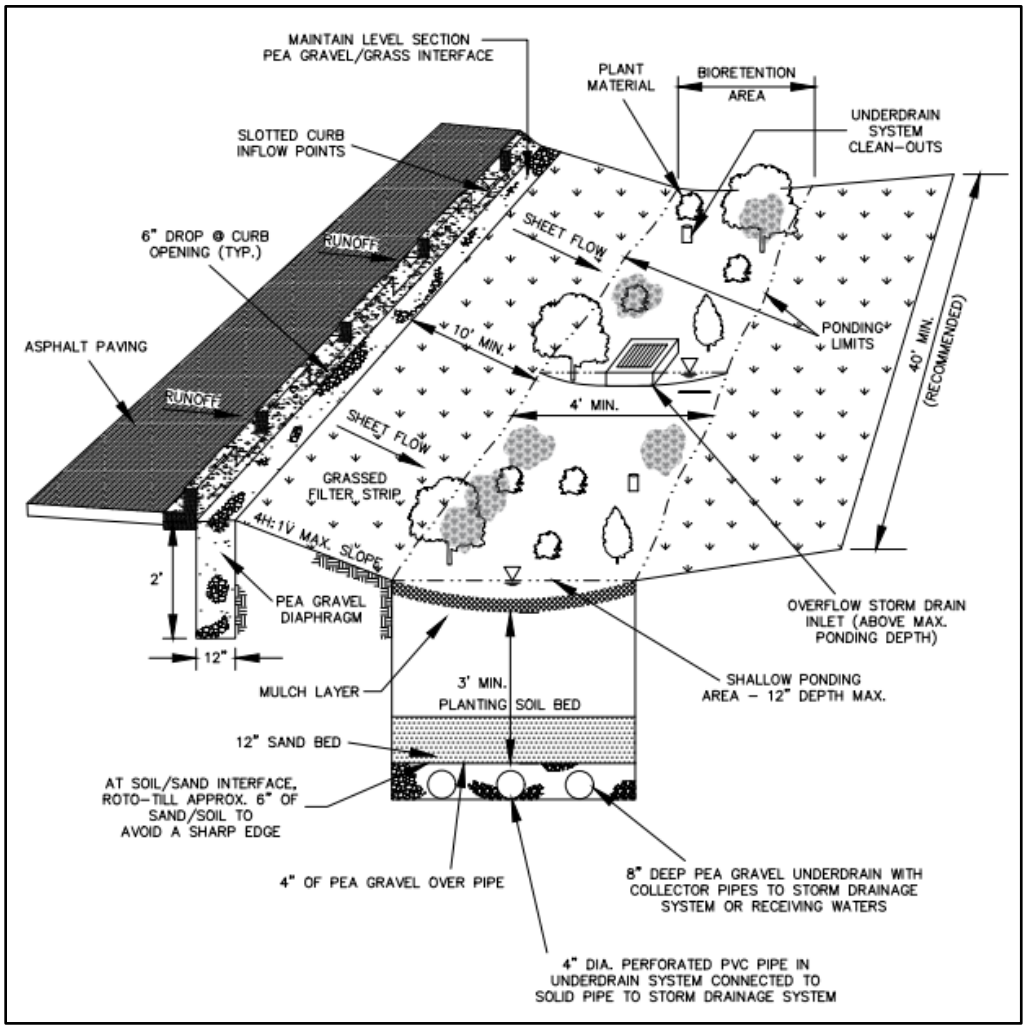
Figure 5.2–Filter Strip (from Atlanta Regional Commission, 2001)



Bioretention Areas

Bioretention areas treat stormwater runoff using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression. The practice combines physical filtering, adsorption, and biological processes to remove pollutants. The system consists of a structure to spread flow, a pretreatment filter strip or grass channel, a sand bed, pea gravel overflow curtain drain, a shallow ponding area, a surface organic layer of mulch, a planting soil bed, plant material, a gravel underdrain system, and an overflow system. Bioretention systems are particularly well suited for use in parking lot islands, roadside swales, and median strips. Figure 5.3 contains a schematic for a bioretention area.

Figure 5.3–Bioretention Area (from LFUCG Manual, 2020)



Rain Gardens

Rain gardens are depressed planting areas designed with shallow, level bottoms to help capture runoff before it reaches the drainage system. Rain gardens are often used to collect stormwater diverted from disconnected roof downspouts or from driveways or similar areas. The plants are typically native, drought tolerant, and non-invasive. Rain gardens use multiple mechanisms for removing pollutants, including settling, infiltration, ion exchange, adsorption, microbial action, and vegetative filtration and uptake. Reducing or avoiding erosion is a necessity in the treatment area or across the filter strip. Level

spreaders, dissipators, and other practices should be incorporated into the design and installed in the field to prevent erosion. Figures 5.4 and 5.5 depict typical rain garden layouts without and with underdrain systems, respectively.

Figure 5.4–Rain Garden without Underdrain System (LJCMSD, 2009)

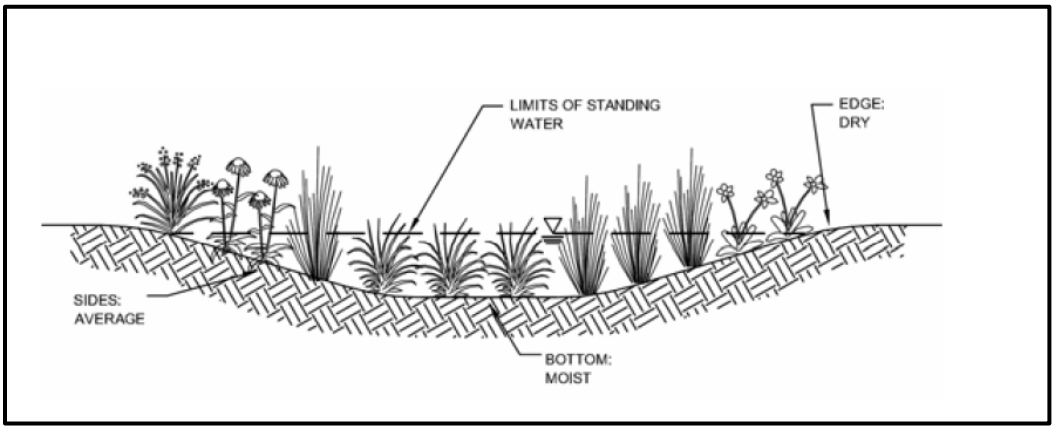
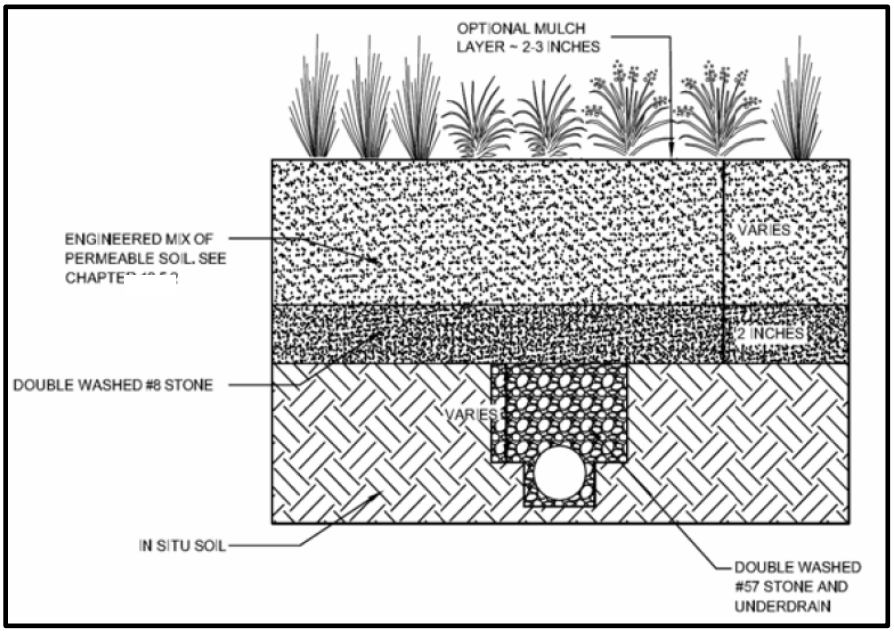


Figure 5.5–Rain Garden with Stone Filter Underdrain System (LJCMSD, 2009)



5.1 Maintenance

Some maintenance activities are common for all biofiltration practices, while other maintenance activities are specific to the biofiltration practice type. General maintenance considerations include the following items:

- The use of fertilizer should be minimized.

- Snow shall not be dumped directly onto the bioretention and rain garden.

- Filter strip turf grass height should be 2 to 6 inches.

- It is recommend to document maintenance and take photographs before and after major maintenance.

Maintenance tasks for biofiltration practices are summarized in Table 5.1-1.

- Remove Trash–Trash tends to accumulate in the vegetation within filter practices and needs to be removed.

- Mow Grass and Remove Clippings–On a regular basis, mow the filter practices and collect clippings. Disposing of clippings prevents decreased performance because of clogged pipes and reduced vegetation health.

- Weed–It is important to periodically remove weeds. Not only does this promote healthy vegetation, but it also helps prevent excess biomass from accumulating and leaching into downstream waterbodies.

- Mulching–Filter practices often include a layer of mulch at the surface. This mulch should be replaced each spring.

- Remove Leaves and Sediment–Because of the presence of vegetation in filter practices, there is more organic matter that tends to collect and reduce performance. Throughout the year, rake out leaves, sediment, and other organic matter that collects.

- Remove Excess Biomass–At the end of the growing season, trim and dispose of excess biomass in the filter practices. This action will prevent trash from collecting during the winter and will improve plant health.

- Replant Vegetation–Replant shrubs, grasses, and woody plants that are in poor health to continue providing benefits to the facilities.

- Repair Erosion Channels–Heavy rains, animal burrowing, and human activity can cause rills and channels that erode soil and send sediment downstream, affecting the performance of the filter practices. In the spring and fall, fill in the erosion channels and stabilize with grass seed and erosion control blankets to prevent further erosion.

- Clean Underdrain–If designed and constructed properly, the underdrain in filter practices should not easily clog. However, cleaning out the underdrain every 5 years with water jet blasting will support performance over the lifetime of the filter practices.

- Complete Maintenance Inspection–Three times per year, qualified staff will thoroughly complete a maintenance inspection using WQ-FORM-201D. If further maintenance or repair work is necessary, staff will follow up with such work.

Table 5.1-1–Biofiltration Practice Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove Trash	X	X	X	X	X	X	X	X	X	X	X	X
Mow Grass and Remove Clippings				X	X	X	X	X	X	X		
Weeding				X	X	X	X	X	X	X		
Mulching				X								
Remove Leaves and Sediment (Raking)			X			X		X		X		
Replant Vegetation			X							X		
Remove Excess Biomass										X		
Repair Erosion Channels			X							X		
Clean Underdrain	~ ~ ~ Every 5 Years ~ ~ ~											
Complete Maintenance Inspection			X			X				X		

5.2 Inspection

Routine screening inspections should be conducted by Grounds staff while performing day-to-day operations. The routine screening should help determine maintenance needs. The following items need to be inspected for all types of biofiltration practices:

- Verify the biofiltering practice drains correctly. Evidence that it is not correctly draining includes standing water, dead vegetation, or wetland vegetation.
- Inspect for sediment, trash, and debris buildup at inlets and outlets, which can cause scour an internal erosion.
- Check for signs of erosion occurring in the biofilter practice. Repair and revegetate eroding areas as soon as possible. Install level spreaders or dissipators to recreate sheet flow, where possible.

- Inspect the biofilter practice vegetation for sparse or missing vegetation. Verify the plants are healthy and weeds are not taking over.
- Inspect filter strips should also be inspected for erosion, which may indicate that flow is concentrating along the filter strip and may need further attention.
- Check bioretention areas, in addition to the general inspection items listed previously, to make sure that the treatment area drains within the designed drain time following rain event (i.e., no problems with the underdrain system).
- Inspect rain gardens to confirm that it dewaters within 24 hours and that the vegetation is healthy.

Maintenance inspections should be completed approximately three times per year, or as noted in the preventative maintenance plan. These inspections use a short-form inspection report targeted at maintenance issues specific to this BMP type. Identified maintenance issues should be addressed as soon as possible. Should serious concerns be identified during the maintenance inspection, a compliance inspection can be requested to be completed by EQM.

All biofiltration practices must be formally inspected at least once per 5 years. These compliance inspections should be documented in writing on the inspection report at the end of this document. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible after the inspection where the need was noted.

6.0 PREFABRICATED TREATMENT AND INLET FILTER DEVICES

For stormwater quality treatment, several manufacturers produce prefabricated devices that are effective in removing suspended solids and oils from stormwater runoff. These devices consist of flow-through concrete structures with a settling or separation unit and are typically well-suited for relatively small sites that have a high percentage of impervious cover. For prefabricated stormwater quality treatment devices in general, pollutant removal occurs mainly by swirl action, indirect filtration, or direct filtering with a settling or separation unit or filtering mechanism.

Prefabricated treatment devices may vary considerably in configuration and function. To date, the University has implemented baffle boxes, hydrodynamic separators, inlet filters, and other inlet control devices from various manufacturers. The designer must provide a schematic or drawing for any prefabricated device installed on campus and will be required to submit an O&M plan before handing over operation. Many treatment devices are not visible from the surface. Figure 6.1 contains photographs of example prefabricated treatment device locations from campus.

Figure 6.1–Coal Pile BMP HydroKleen© Inlet Filter (left) and Woodland Glenn FloGard© Vortex Separator (right)

6.1 Maintenance

Prefabricated devices should be operated and maintained as specified by the manufacturer. Maintenance tasks for prefabricated treatment devices are summarized in Table 6.1-1.

- Sweep Parking Lot and Roadway–During the growing season, it is important to regularly sweep paved surfaces surrounding prefabricated treatment devices to reduce pollutant loading from organic material and increase longevity of the devices. During the fall and winter, leaves and grit must also be swept from around prefabricated treatment devices to reduce pollutant loading. Trash and other debris should be swept year-round as they can pose the same threats.

- Remove Sediment and Debris from Inlet Filters–Inlet filters can accumulate heavy loads of pollutants. Like pretreatment devices, inlet filters can be cleaned via vacuum trucks. Alternatively, some can be cleaned by removing the inlet grate, removing the inlet filter by hand, dumping the contents into a waste container, and replacing the filter and grate.

- Vacuum Floatables and Sediment From Structure Sump–Many of the devices the University has installed collect sediment and trash, preventing these pollutants from entering the downstream waterbodies. Different products recommend different frequencies and methods to remove the accumulated sediment and trash, but most commonly a vacuum truck is recommended. General steps to performing such an action include the following:
    - Wait for dry weather.
    - Remove the covers and lids.
    - Insert the vacuum hose into the sump (each product has some variation) and remove the accumulated sediment.
    - If Oil is found, clean using either the vacuum hose or absorbent pads (if there is a chamber/area that holds oil and floatables), depending on the ability to dispose of the oil and water emulsion that might be created by vacuuming the oily layer.
    - Replace the lid, and the process is complete.

- Replace Media Filters–Some products (e.g., the Hydro Kleen Filtration System) have proprietary media filters that absorb pollutants such as oil or phosphorus from stormwater. Manufacturers advise replacing these filters twice per year for the first few years while also monitoring the inlet to determine the level of pollutant loading. Replacement frequency can be reduced to once per year after the initial monitoring period.

- Complete Maintenance Inspection–Twice per year, qualified staff will thoroughly complete a maintenance inspection using WQ-FORM-201E. If further maintenance or repair work is necessary, staff will follow up with such work.

Table 6.1-1–Prefabricated Treatment and Inlet Filter Device Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Parking Lot and Roadway Sweeping				X	X	X	X	X	X	X		
Remove Sediment and Debris from Inlet Filter Bags*				X						X		
Vacuum Sediment from Structure Sump	~ ~ ~ Every 3 Years ~ ~ ~											
Complete Maintenance Inspection				X						X		
Replace Media Filters*				X						X		

*For inlet filter only

6.2 Inspection

Routine screening inspections of the areas around these devices should be conducted by Grounds staff while performing day-to-day operations to help identify potential problems before they impact the system. While the Grounds staff may not be able to see inside the structure, the locations of the area inlets serving the device should be known allowing observations of the drainage area to inform potential maintenance needs. Utilities is responsible for routine screenings of the devices to help determine maintenance needs. By working together, both departments can help to protect the significant investment that the university has made in these devices and prevent costly maintenance and repairs. Elements to consider during routine screening inspections around manufactured treatment devices include:

- Accumulation of sediment and debris on top of or near inlet grates
- Significant erosion in the upstream area
- Damage or gaps opening in the areas around the structures
- Stored materials that are unprotected from rainfall

Maintenance inspections should be completed by Utilities approximately two times per year, or as noted in the preventative maintenance plan. These inspections use a short-form inspection report targeted at maintenance issues specific to this BMP type. Identified maintenance issues should be addressed as soon as possible. Should serious concerns be identified during the maintenance inspection, a compliance inspection can be requested to be completed by EQM.

All prefabricated treatment devices must be formally inspected at least once per 5 years. These compliance inspections should be documented in writing using an inspection report provided by the designer, or by the device's manufacturer. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible following the inspection where the need was noted.

7.0 PERVIOUS PAVEMENT AND PAVERS

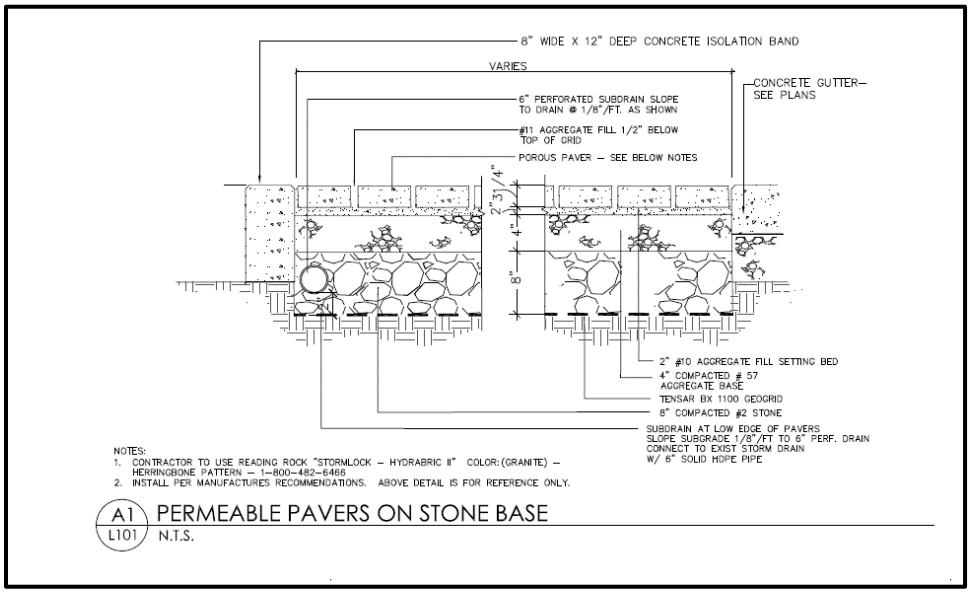
Pervious pavement is a green infrastructure practice that reduces the amount of impervious surface created through redevelopment and can be used to substitute standard impervious surfaces. It allows for infiltration of rainwater reducing the amount of surface runoff that must be managed by other stormwater control devices. This practice will likely not function as the sole water quality infiltration and treatment device but can provide significant reduction of the amount of runoff that must be detained and treated. Two types of pervious pavements are approved for use at the University. These measures are pervious pavers and pervious concrete.

Pervious Pavers

Pervious pavers are a type of modular pavement consisting of strong structural materials, typically concrete, having regularly scattered void spaces that are filled with pervious materials such as sand, gravel, or sod. These pavements can be used to construct driveways or overflow parking lots where less frequent parking is intended.

Modular pavement uses two main methods for pollutant removal. The first is percolation of rainfall and runoff through the voids into the permeable base and soil. This is the standard method for pollutant removal that is implemented on campus. In special circumstances, a second method is filtration of rainfall and runoff by the vegetation that can grow in the voids. It is important to understand each installation to know whether vegetation is intentional or needs to be removed. Figure 7.1 show a schematic for pervious a paver installation with an underdrain system.

Figure 7.1–Pervious Pavers with an Underdrain System (Shriner's Hospital)



Pervious Concrete

Pervious concrete is another example of a porous pavement system for increasing infiltration and decreasing surface runoff volume. This application requires using concrete with a higher void ratio than typical concrete. The pervious concrete is designed to reduce runoff volumes by allowing stormwater to infiltrate through the pavement to an aggregate reservoir system below. Runoff eventually infiltrates into

the ground or may be collected by an underdrain collection system. One key consideration in the design is the infiltration rate of the underlying soils. Pervious concrete should be limited to light traffic conditions without heavy truck use, such as overflow parking lots. Pervious concrete may have multiple configurations, depending on whether an underdrain system is used. Figures 7.2 shows a typical configuration for pervious concrete systems. Figure 7.3 contains photographs of example pervious pavement and pavers from the University's campus.

Figure 7.2–Pervious Concrete with Underdrain System and Bioretention Area Outlet (from LJCMSD, 2009)

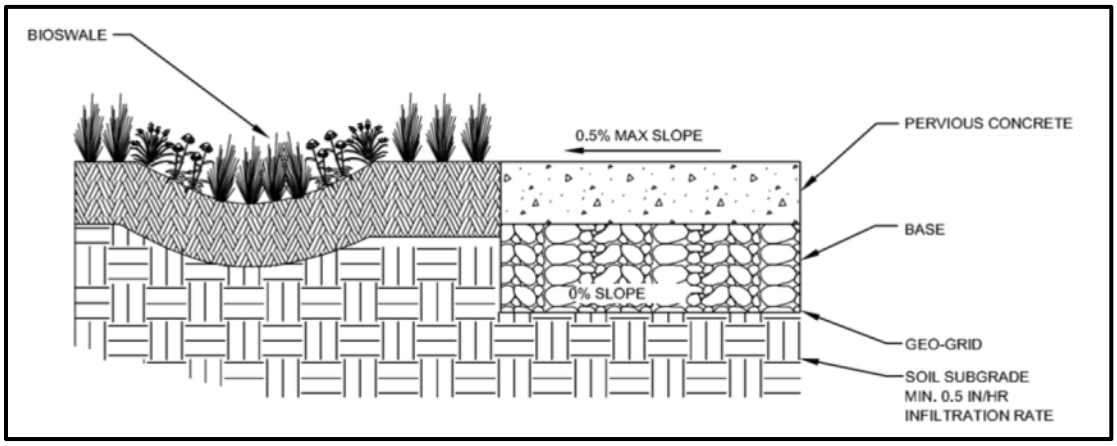


Figure 7.3–Garrigus Plaza Permeable Pavers (right) and Cancer Facility for Women Pervious Concrete (left)

7.1 Maintenance

General maintenance considerations to prolong the useful lifetime of pervious pavement and pavers includes the following items:

- "Good housekeeping" practices should be used to minimize the production and transport of sediment onto the modular pavement. Areas draining onto pervious pavers or pavement should be stabilized. The void spaces within the pavers or pavement can easily be filled with soil, greatly reducing the infiltration capacity of the practice.

- For installations with turf, normal turf maintenance is required. However, mowing is seldom required in areas of frequent traffic, and fertilizers and pesticides should be used sparingly because these materials may adversely affect concrete products and groundwater.

- For winter conditions: Sand and other fine-graded material should not be used, as it can fill the voids or clog the open-graded based, preventing water infiltration. Also, the methodology for snow removal should be considered. For example, broom removal may be considered for pervious concrete, but this approach may not be appropriate for pavers as it can remove the aggregate joint filler material. Snowplows may be used; however, plow blade shoes should be used to protect the paver surface.

Maintenance tasks for pervious pavement are summarized in Table 7.1-1.

- Remove Trash–Trash needs to be removed.

- Sweep or Vacuum to Remove Leaves and Debris–Street sweeping is crucial to maintaining the effectiveness of pervious pavement. Sweeping also enhances the aesthetics of pervious pavement. Sweeping should be done at least once per year, preferably during the summer while students are not on campus.

- Manage Upstream Vegetation–As discussed, sediment is the main reason pervious pavement has its performance reduced. Upstream landscaping can be a source of such sediment, and thus managing the vegetation in that upstream landscaping helps reduce the likelihood of erosion subsequently affecting the pervious pavement.

- Remove Vegetation in Pavers–In most cases currently on campus, vegetation should be prevented from growing between pavers through installation of geotextile fabrics during construction. Sometimes vegetation breaks through regardless and reduces the ability of the pavers to infiltrate stormwater. Vegetation needs to be removed to restore the performance of the pavers. However, it is important that those completing maintenance on these systems understand whether the vegetation in the paver area needs to be removed or if it was designed to provide additional pollutant removal benefits.

- Replenish the Top Layer of Stone between Joints–Each time that pervious pavers are swept, they need to be refilled with stone between the joints. Otherwise, the lack of stone presents a tripping hazard, particularly to people wearing high heels. The stone should match the pervious paver manufacturer's recommendations.

- Complete Maintenance Inspection–Three times per year, qualified staff will thoroughly complete a maintenance inspection using WQ-FORM-201F. If further maintenance or repair work is necessary, staff will follow up with such work.

Table 7.1-1–Permeable Pavement Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trash Removal	X	X	X	X	X	X	X	X	X	X	X	X
Sweep and Vacuum to Remove Leaves and Debris						X						
Manage Upstream Vegetation			X									
Remove Vegetation in Pavers (unless it is designed to be vegetated)				X		X		X				
Replenish Top Layer of Stone Between Joints						X						
Complete Maintenance Inspection			X			X				X		

7.2 Inspection

The inspection frequencies for both pervious pavers and pervious concrete should include more frequent inspections during the first few months following installation to check for proper operation. These initial inspections should be conducted after storms to check for long duration surface ponding that may indicate local or widespread clogging or presence of a spring. After the initial few months of checking for proper installation and operation, the inspection frequency can be decreased. Routine screening inspections should also be conducted by Grounds staff while performing day to day operations. The routine screening should help determine maintenance needs. Inspections for both BMP types should consider the following items:

- Watch for proper drainage.
- Monitor sediment and debris accumulation.
- Inspect the pavement surface by looking for noticeable gaps between pavers, vegetation growing in/on the pavement, cracks, depressions, or crumbling.
- Determine whether excessive ponding time above the modular or pervious pavement may indicate clogging.
- Monitor the contributing drainage areas for erosion and stabilize these areas to prevent clogging the pervious pavers or pavement.

Maintenance inspections should be completed approximately three times per year, or as noted in the preventative maintenance plan. These inspections use a short-form inspection report targeted at maintenance issues specific to this BMP type. Identified maintenance issues should be addressed as soon as possible. Should serious concerns be identified during the maintenance inspection, a compliance inspection can be requested to be completed by EQM.

All pervious pavement and paver facilities must be formally inspected at least once per 5 years. These compliance inspections should be documented in writing on the inspection report at the end of this document. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible after the inspection where the need was noted.

8.0 GREEN ROOFS

Green roofs are roofs of buildings that are covered by planted material generally in trays or other containers that hold vegetation including plants, shrubs, or trees. This practice is typically used in urban areas to capture and absorb rainwater, resulting in decreased stormwater runoff. All buildings must have the structural capacity to hold a green roof. In general, green roofs include the following basic layers: a deck layer (roof support), a waterproofing layer, an insulation layer, a root barrier, a drainage system and drainage layer, a growing media layer, and a plant cover layer. Green roofs use multiple mechanisms for removing pollutants, including vegetative filtration and uptake; infiltration; ion exchange; adsorption; and microbial action.

There are two major types of green roofs–extensive and intensive. An extensive green roof has a shallow growing media depth (2 to 6 inches). An intensive green roof has a much thicker growing media depth (6 inches to 4 feet) and can support a wider variety of plants including trees. Vegetation must also be carefully selected considering factors such as rooting depth, maintenance, and drought tolerance. Extensive green roofs are lighter than intensive green roofs, but intensive green roofs can provide additional stormwater runoff treatment. Figure 8.1 shows a cross-sectional view of a green roof. Figure 8.2 contains photographs of example green roofs from the University's campus.

Figure 8.1–Typical Green Roof Cross Section (LJCMSD, 2009)

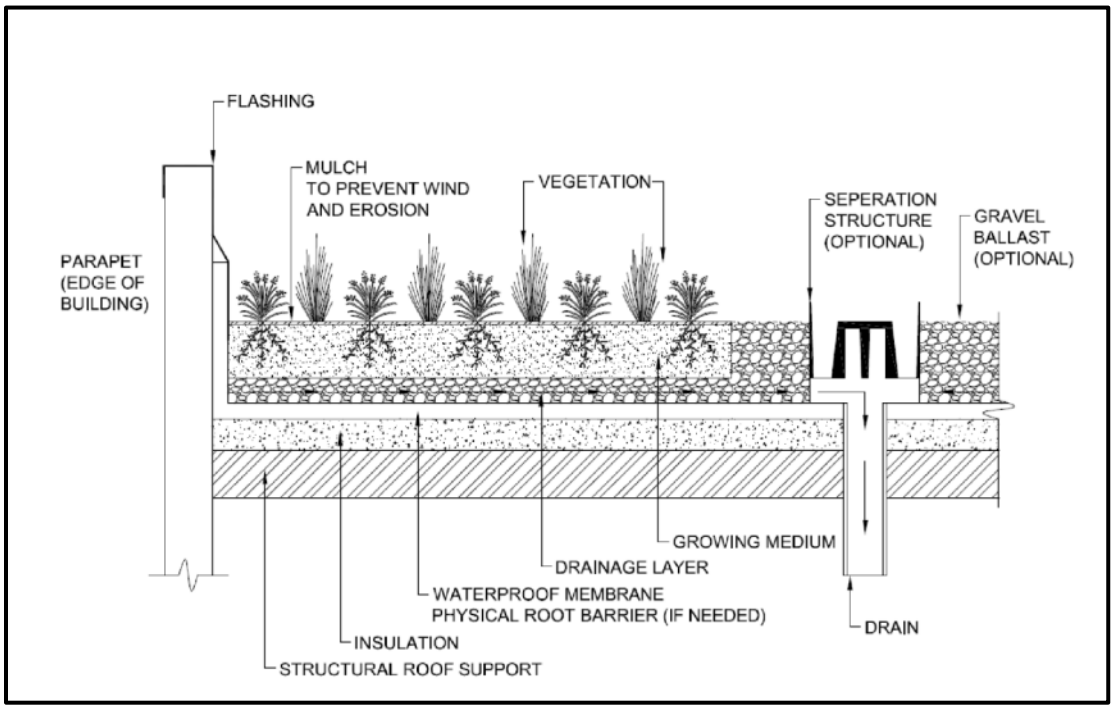


Figure 8.2–Rosenberg Law Building (left) and Patient Care Facility South Green Roof (right)


8.1 Maintenance

Maintenance tasks for green roofs are summarized in Table 8.1-1.

- Weed and Remove Invasives–Like other BMPs, it is important to periodically remove weeds and invasive species from green roofs. Not only does this promote healthy vegetation, but it also helps prevent excess biomass from accumulating and affecting the structural capacity of the roof itself.

- Remove Trash from Discharge Points–To prevent clogging and oversaturation of green roofs, it is important to remove trash from the discharge points. Removing trash also prevents possible damage to the structural integrity of the roof caused by excess water weight.

- Water–Healthy plants in green roofs support infiltration and proper function throughout the growing season. Some systems will include irrigation to support growth during dry seasons. Supplemental watering may be required.

- Manage Vegetation–Some plants may die during the initial period after installation or due to changing climate conditions. Plants should be replaced either by replacing whole trays of the green roof system or replanting of new vegetation. Repeated replanting in the same areas of the roof could point to issues with plant selection and require consultation with a landscape professional.

- Mulch–Filter practices often include a layer of mulch at the surface. This mulch should be replaced each spring in accordance with the project specifications.

- Complete Maintenance Inspection–Two times per year, qualified staff will thoroughly complete a maintenance inspection using WQ-FORM-201G. If further maintenance or repair work is necessary, staff will follow up with such work.

Table 8.1-1–Green Roof Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Weed and Remove Invasives				X		X		X		X		
Remove Trash from Discharge Points				X	X	X	X	X	X	X		
Water				X	X	X	X	X	X	X		
Manage Vegetation				X								
Mulch				X								
Maintenance Inspection				X						X		

8.2 Inspection

Frequent inspections are needed during vegetation establishment and after major rain events. Routine screening inspections should also be conducted by Grounds staff while performing day to day operations. The routine screening should help determine maintenance needs. Inspections should consider the following items:

- Watch for excessive ponding and improper drainage.
- Check for debris and trash accumulation, especially where vegetation growth or drainage may be affected.
- Replace dead or diseased vegetation and remove overgrown vegetation to manage vegetation.
- Check roof layers underneath vegetation for cracks and signs of leakage.

Maintenance inspections should be completed approximately two times per year, or as noted in the preventative maintenance plan. These inspections use a short-form inspection report targeted at maintenance issues specific to this BMP type. Identified maintenance issues should be addressed as soon as possible. Should serious concerns be identified during the maintenance inspection, a compliance inspection can be requested to be completed by EQM.

All green roof facilities must be formally inspected at least once per 5 years. These compliance inspections should be documented in writing on the inspection report at the end of this document. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible after the inspection where the need was noted.

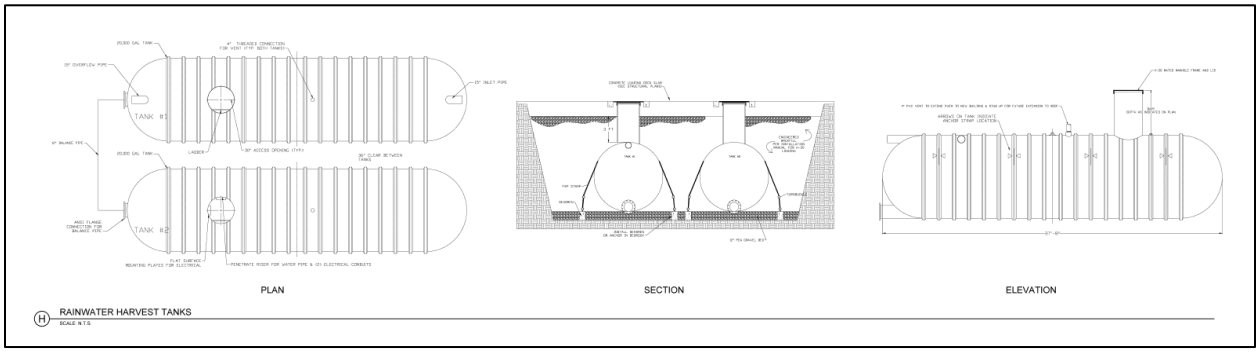
9.0 WATER HARVESTING SYSTEMS

Water harvesting systems are permanent structures that are used for rainwater harvesting and temporarily storing rainwater. Typically, these systems are limited to rainwater runoff from roofs or other impervious areas. The harvested rainwater may be used for watering nearby landscaping, washing vehicles or for heating, ventilation, and air conditioning (HVAC) or boiler makeup water. Rainwater harvesting reduces stormwater runoff volumes and the associated pollutants through collection and beneficial reuse of the collected water. Ideally, the harvested rainwater needs to be used before the next rain event to allow for continued harvesting, especially when these controls are used to address stormwater quantity.

Water harvesting systems may be installed either above or below ground. Typically, the aboveground systems are simple rain barrels that store small quantities of rainwater. Larger engineered systems typically include an underground tank with a pump and disinfection system installed in a separate location. All systems should be equipped with an overflow port or mechanism to allow excess rainfall from larger storm events to be diverted to another stabilized location or storm sewer. The system should also include mechanisms for moving water from the tank to the reuse location. If it is below ground, a pump will be required to move the water from the storage tank to the reuse location. Ultraviolet (UV) lamps or other systems may also be equipped to provide disinfection before reuse.

Figure 9.1–Ronald McDonald House Rain Barrel

Figure 9.2–Healthy Kentucky Research Building Water Harvesting Tank Schematic



9.1 Maintenance

General maintenance considerations to support the capacity and performance of harvesting systems includes the following items. Full-year operation is expected for stormwater controls meeting the water quality treatment requirements. Winter operations should be considered during design to minimize potential shutdowns. General guidance for water harvesting systems is included in the following. However, engineered systems have specific maintenance and operation requirements that should be followed. The system specific requirements that were submitted by the designer during project closeout are included in the appendix to this document. Maintenance requirements may vary based on manufacturer's specifications or designer provided guidance and should be followed in place of the guidance following.

Maintenance tasks for water harvesting systems are summarized in Table 9.1-1.

Pretreatment:

- Remove Leaves and Clean Debris Screens–Proper drainage to the storage tank is maintained through regularly disposing of debris and leaves in the upstream areas and the storage tank's debris screens. Filters are required to filter larger debris and grit from entering the tank. A screen filter, as well as a first flush diverter can be used to prevent this. This is applicable for both simple and engineered systems.

Tank O&M:

- Inspect Water in Storage Tank and Check for Leaks–The water in the storage tank itself should be inspected at regular intervals, and any debris should be swept out. Any leaks should also be noted and repaired. This is applicable for both simple and engineered systems.

- Change UV Lamp–For engineered systems, to continue using the water collected in the storage tank, it is necessary to annually replace the UV lamp that provides treatment of the stormwater.

- Reconnect Roof Downspouts–In the spring when the threat of freezing temperatures is low, reconnect roof connections to the storage tank. This may be applicable for both simple and engineered systems.

Overflow:

- Occasionally Allow Storage Tank Overflow–Rainwater tank overflow is a beneficial process as it helps move water which creates oxygenation and helps to prevent stagnation. Once the storage tank is full, design shall account for safe bypass of conveyed water into a storm drainage receiving system.

Winterization:

- Disconnect Roof Downspouts and Drain the Storage Tank
    - In late fall, roof downspouts should be disconnected from simple systems, and the storage tank should be drained before the first significant freeze, unless required by design.
    - Disconnected downspout drainage (fall and winter) should go to a stabilized, pervious area.
    - In the early spring, the roof downspouts should be reconnected to the storage tank.
    - Storage tanks should be drained and removed or kept at half capacity with the spigot open during the winter months to prevent ice damage, unless directed otherwise by the manufacturer.

Record Keeping:

- Complete Maintenance Inspection–Two times per year, qualified staff will thoroughly complete a maintenance inspection using WQ-FORM-201H. If further maintenance or repair work is necessary, staff will follow up with such work.

- Complete the required operations log of system use, including water usage and shutdowns.

Table 9.1-1–Storage Tank and Water Harvesting Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove Leaves and Clean Debris Screens			X	X	X	X	X	X	X	X	X	
Inspect Water in Storage tank and Check for Leaks			X			X					X	
Change UV Lamp			X									
Reconnect Roof Downspouts			X									
Disconnect Roof Downspouts, Drain Storage Tank											X	
Complete Maintenance Inspection			X								X	

9.2 Inspection

Routine screening inspections should be conducted by Grounds staff while performing day-to-day operations. The routine screening should help determine maintenance needs. Water harvesting system screening inspections should evaluate the following items:

- Verify the storage tank is properly connected or disconnected based on the season
- Confirm drainage to the reuse site is working properly
- Check the condition of the storage tank including trash, debris, algae growth
- Inspect the vegetation receiving the water should be inspected for health and signs of stress, and replace if necessary
- Check for cracking, rusting, or leaking
- Identify noticeable odors

Maintenance inspections should be completed approximately two times per year or as noted in the preventative maintenance plan. These inspections use a short-form inspection report targeted at maintenance issues specific to this BMP type. Identified maintenance issues should be addressed as soon as possible. Should serious concerns be identified during the maintenance inspection, a compliance inspection can be requested to be completed by EQM. If inspections are not completed correctly, it may result in system shutdown. Extended periods of system shutdown may result in noncompliance for systems used to meet water quality requirements.

All rainwater harvesting facilities must be formally inspected at least once per 5 years. These compliance inspections should be documented in writing on the inspection report at the end of this document. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible after the inspection where the need was noted.

10.0 UNDERGROUND DETENTION SYSTEMS

Underground detention basins or underground vaults provide water quantity control through temporary storage of stormwater runoff. Some systems also include integrated water quality treatment though isolation chambers (i.e., Advanced Drainage System [ADS] Isolator Rows) and filter mechanisms. They are typically constructed of plastic or concrete. They are generally more expensive than aboveground facilities and are primarily used in areas where the usable value of the land is high and very little pervious space exists. One disadvantage of underground detention basins is that some maintenance requires specialized training and equipment.

Most underground detention systems on campus are either oversized piping, constructed vaults with a flow control orifice, or ADS StormTech Chambers. Figure 10.1 shows the schematic for the underground vault at John Smith Hall. Figure 10.2 shows a schematic for the Advanced Drainage Systems StormTech Chambers at College Way. Figure 10.3 contains photographs of the same underground detention systems to show what is visible from the surface.

Figure 10.1–John Smith Hall Underground Detention System Schematic

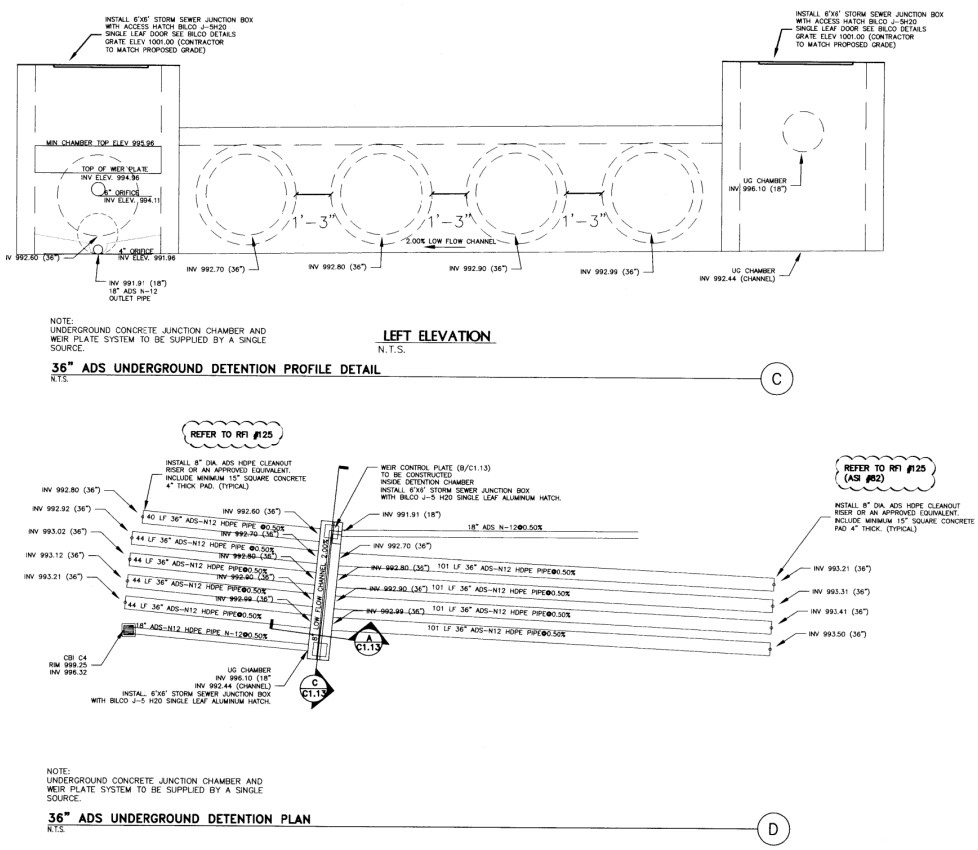


Figure 10.2–College Way Parking Lot Underground Detention Schematic

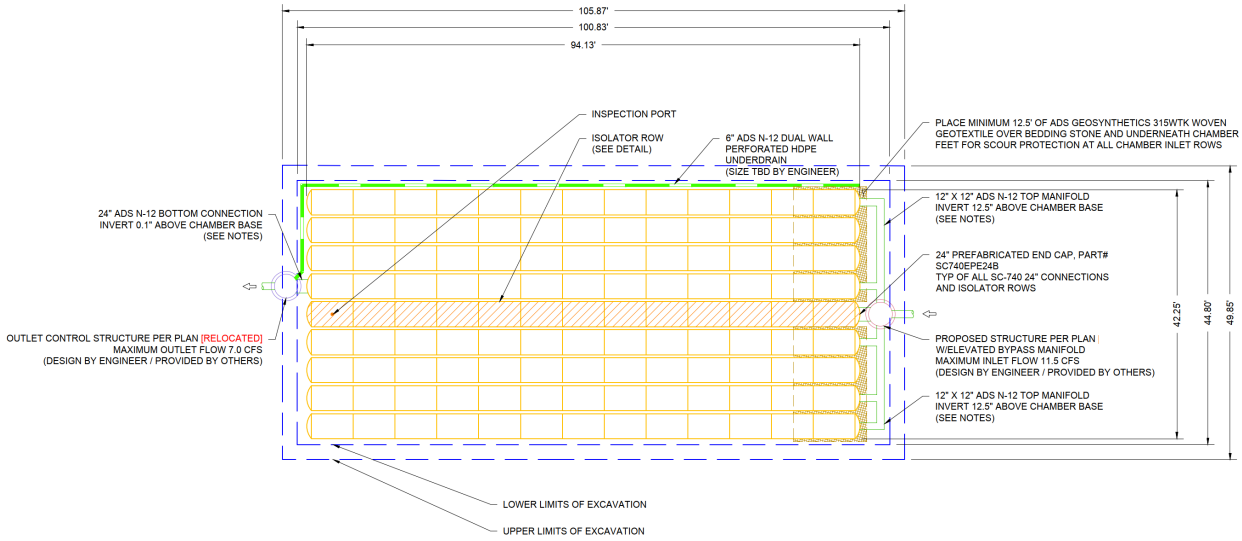


Figure 10.3–John Smith Hall (left) and College Way (right) Underground Detention Systems

10.1 Maintenance

Underground detention basins should be operated and maintained as specified by the manufacturer. General maintenance tasks for underground detention basins are summarized in Table 10.1-1. It is important to note that there are typically pretreatment devices associated with these systems. Completing maintenance on both the underground detention system and the pretreatment devices at the same time using the same equipment can increase the efficiency can decrease the cost.

- Remove Trash and Debris in Upstream Areas–Regularly dispose of trash in aboveground areas that drain to the underground detention basins.

- Clean Out Manhole and Weir Structures–Many underground detention basins include a manhole downstream of the system that contains a weir to control flow leaving the system. Cleaning of the manhole prevents backups and trash accumulation downstream. In ADS systems, remove

floatables from the sump in the catch basin upstream of the underground detention and check the sediment accumulation depth.

- Remove Sediment Accumulation–Using a vacuum truck, remove the sediment and debris buildup from the inlet and manifold structure and storage vaults and tanks. This should be checked during routine inspections and completed when sediment depth within the sump is within 12 inches of the outlet pipes or the storage vault sediment depth exceeds 3 inches.

- Water Jet Isolator Row–In the various ADS underground detention basins, water jet out accumulated sediment in the isolator row when sediment levels reach 3 inches deep. For information on how to complete this task, refer to the maintenance information provided by the manufacturer.

- Complete Compliance Inspection–Once per year, qualified staff will thoroughly complete a compliance inspection using WQ-FORM-301A. If further maintenance or repair work is necessary, staff will follow up with such work.

Table 10.1-1–Underground Detention Basin Preventive Maintenance Schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove Trash and Debris in Upstream Areas	X	X	X	X	X	X	X	X	X	X	X	X
Clean Out Manhole and Weir Structure											X	
Remove Sediment Accumulation	~ ~ ~ Every 3 Years ~ ~ ~											
Water Jet Isolator Row	~ ~ ~ Every 6 Years ~ ~ ~											
Complete Compliance Inspection				X								

10.2 Inspection

Routine screening inspections of the areas around underground detention basins should be conducted by Grounds staff while performing day-to-day operations to help identify potential problems before they impact the system. While the Grounds staff may not be able to see inside the structure, the locations of the area inlets serving the device should be known allowing observations of the drainage area to inform potential maintenance needs. Utilities is responsible for monthly routine screenings of the surrounding area and underground system while they are checking and cleaning the manhole structures, to help

determine maintenance needs. By working together, both departments can help to protect the significant investment that the University has made in these systems and prevent costly maintenance and repairs.

It is also recommended that underground detention systems and their associated elements have screening inspections completed following major rainfall events greater than 1 inch to verify operability and integrity of the system.

Inspections should consider the following factors:

- Excessive trash, debris, sediment, landscape waste, or yard clippings in adjacent areas
- Evidence of chemicals or automotive fluids
- Excessive erosion or sedimentation
- Soil particles entering the basin
- Standing water or wet spots
- Odors
- Outlet and inlet free of debris
- Cover damage, spalling, cracking, or deteriorating

All underground detention facilities must have compliance inspections performed annually by a registered engineer. These compliance inspections should be documented in writing on the inspection report at the end of this document. Required maintenance items or activities will be clearly documented on the inspection report and communicated to the BMP owner to be completed as soon as possible after the inspection where the need was noted.

11.0 REFERENCES

Lexington-Fayette Urban County Government Stormwater Manual. Lexington-Fayette Urban County Government (LFUCG), 2020.

Metropolitan Sewer District Design Manual, LJCMSD, 2009.

Georgia Stormwater Management Manual. Volume 2: Technical Handbook. First Edition, Atlanta Regional Commission, 2001.

Appendices Table of Contents

APPENDIX A
PROCEDURES, WORK INSTRUCTIONS, AND FORMS

Post-Construction Structural BMP Operations & Maintenance Plan Controlled Document Master List

Number	Title	Revision No.	Revision Date	Director Approval
WQ-PROC-100	Routine BMP Screening Inspections			
WQ-WI-101	Performing Routine BMP Screening			
WQ-PROC-100	BMP Inspections			
WQ-WI-201	Performing Maintenance BMP Inspections			
WQ-FORM-201A	Maintenance and Compliance BMP Inspection Form: Detention Basin or Retention Pond			
WQ-FORM-201B	Maintenance and Compliance BMP Inspection Form: Stream Restoration or Constructed Wetland			
WQ-FORM-201C	Maintenance and Compliance BMP Inspection Form: Vegetated Swale			
WQ-FORM-201D	Maintenance and Compliance BMP Inspection Form: Biofiltration Practice			
WQ-FORM-201E	Maintenance and Compliance BMP Inspection Form: Prefabricated Treatment and Inlet Filter Device			
WQ-FORM-201F	Maintenance and Compliance BMP Inspection Form: Pervious Pavement or Pavers			
WQ-FORM-201G	Maintenance and Compliance BMP Inspection Form: Green Roof			

POST-CONSTRUCTION STRUCTURAL BMP OPERATIONS & MAINTENANCE PLAN CONTROLLED DOCUMENT MASTER LIST

Number	Title	Revision No.	Revision Date	Director Approval
WQ-FORM-201H	Maintenance and Compliance BMP Inspection Form: Water Harvesting System			
WQ-WI-202	Performing Compliance BMP Inspections			
WQ-FORM-202A	Maintenance and Compliance BMP Inspection Form: Underground Detention System			

PROCEDURE
ROUTINE BMP SCREENINGS

Purpose:	The purpose of the routine screening is to evaluate the condition of the BMP while staff are performing day-to-day operations. Detailed knowledge of how each BMP works is not required, but a general understand of each BMP is helpful. Routine inspections also act as preventative measures by monitoring the conditions of the BMPs and preventing major problems from occurring.
Scope:	This procedure applies to field personnel performing day-to-day tasks in the vicinity of stormwater BMPs.
Responsible Personnel:	EMD Director, Stormwater Quality Manager, Ground, Facilities, Athletics, Contractors
PPE Required:	Whatever is required for personnel to complete their day-to-day tasks.
Regulatory Reference:	N/A
Supporting Documents:	N/A
Procedure:	Field personnel will identify mowing and vegetation management concerns, other frequent maintenance concerns, and evidence of potential failures so that issues can be reported, and proactive corrective action steps can be taken.
Work Instructions:	WQ-WI-101

WORK INSTRUCTIONS
PERFORMING ROUTINE BMP SCREENINGS

Reference Procedure:	WQ-PROC-100
Purpose:	The purpose is to provide guidance for field personnel to follow when performing routine screenings of stormwater BMPs.
Scope:	This procedure applies to field personnel performing day-to-day tasks in the vicinity of stormwater BMPs.
Responsible Personnel:	EMD Director, Stormwater Quality Manager, Ground, Facilities, Athletics, Contractors
Minimum PPE Required:	Whatever is required for personnel to complete their day-to-day tasks.
Supporting Documents:	General Stormwater Training Module, Illicit Discharge Detection and Elimination Plan
Work Instructions:	All personnel should review and understand observation and reporting procedures before beginning field activities.

1. Supervisors will identify the types of BMPs in the vicinity of day-to-day tasks and will train assigned staff on general considerations for each type of BMP. Detailed knowledge of how each BMP works is not required, but a general understand of each BMP is helpful. Also, training on the identification of Illicit Discharges and response procedure is required.

2. Field personnel will make general observations on the condition of vegetation, frequent maintenance concerns, and evidence of potential failures and make a verbal report to their supervisor or the proper authorities. This should include, but is not limited to, the following.

    a. Vegetation Condition–Overgrown vegetation, dead or dying vegetation resulting in unstabilized soil, significant weed or invasive species growth, need for additional mulching, lack of vegetation maintenance.

    b. Debris and Sediment–Build-up of trash and debris in and around the BMP, excessive sediment from unstabilized soil due to erosion or adjacent construction activities, sediment or debris accumulation in inlet or outlet pipes, standing water where it was designed to drain.

    c. Structural Failures–Evidence of ground sliding or sinking, development of sinkholes, significant soil erosion, cracked or spalled concrete, broken or displaced grates, leaking or broken piping.

d. Unknown Spills/Illicit Discharges–Oil slicks or other chemical spills, improper handling or disposal of cleaning or cooking liquids, leaking storage tanks, stored materials that are unprotected from rain. Illicit discharges can be reported from a mobile device by visiting https://www.uky.edu/env/stormwater and clicking on the "Report an Illicit Discharge" button.

3. Supervisors or authorities will act on unknown spills or illicit discharges as outlined in the University's standard response procedures and regulatory requirements.

4. Supervisors will review reports from field personnel and follow up with appropriate maintenance actions or schedule a maintenance BMP inspection to be completed in accordance with WQ-PROC-200. Supervisors can also contact the Stormwater Quality Manager for additional support and information.

PROCEDURE
BMP INSPECTIONS

Purpose:	To identify the type of inspection being completed and then perform the field review to ensure that the stormwater BMPs are in good working condition and adequately maintained. Maintenance inspections act as preventative measures by monitoring the conditions of the BMPs and preventing major problems from occurring. Compliance inspections meet the requirements of the Kentucky Pollutant Discharge Elimination System Permit KYG200000 Section 2.2.5-7, *Post-Construction Stormwater Management in New Development and Redevelopment*.
Scope:	This procedure applies to personnel supervising or conducting stormwater BMP inspections.
Responsible Personnel:	EMD Director, Stormwater Quality Manager, Grounds, Utilities, Athletics, Contractors
PPE Required:	Slip-resistant steel-toe shoes, waders or rubber boots, hardhat, reflective safety vest, gloves (if necessary)
Regulatory Reference:	Kentucky Pollutant Discharge Elimination System Permit KYG200000 Section 2.2.5-7
Supporting Documents:	WQ-FORM-201A, WQ-FORM-201B, WQ-FORM-201C, WQ-FORM-201D, WQ-FORM-201E, WQ-FORM-201F, WQ-FORM-201G, WQ-FORM-201H, WQ-FORM-202A, Preventative Maintenance Plan Matrix
Procedure:	Maintenance inspections are to be completed by the entity responsible for maintaining the BMP at set intervals defined in the Preventative Maintenance Plan Matrix and should be completed as outlined in WQ-WI-201. Compliance inspections are to be completed assigned staff or contractor at a minimum interval of once every five years, as required by the KYG200000 permit and as outlined in WQ-WI-202.
Work Instructions:	WQ-WI-201, WQ-WI-202

WORK INSTRUCTIONS
PERFORMING MAINTENANCE BMP INSPECTIONS

Reference Procedure:	WQ-PROC-200
Purpose:	The purpose is to provide instructions for personnel to follow when performing maintenance inspections of stormwater BMPs.
Scope:	This procedure applies to personnel supervising or conducting stormwater BMP inspections.
Responsible Personnel:	EMD Director, Stormwater Quality Manager, Grounds, Utilities, Athletics, Contractors
Minimum PPE Required:	Slip-resistant steel-toe shoes, waders or rubber boots, hardhat, reflective safety vest, gloves (if necessary)
Supporting Documents:	WQ-FORM-201A, WQ-FORM-201B, WQ-FORM-201C, WQ-FORM-201D, WQ-FORM-201E, WQ-FORM-201F, WQ-FORM-201G, WQ-FORM-201H, Preventative Maintenance Plan Matrix
Work Instructions:	All personnel should review and understand procedures before beginning field activities:

1. Identify the type of BMP to be inspected and gather all necessary equipment and the associated field inspection form specific to the type of BMP being inspected.

2. Prior to the inspection, review the associated section for the type of BMP in the Operation and Maintenance Plan. Field personnel should be familiar with how the BMP functions, standard maintenance tasks, and the guidance provided in the inspection section for the BMP.

3. Review the Preventative Maintenance Plan matrix to confirm the maintenance tasks scheduled to be completed prior to the next schedule maintenance inspection.

4. Complete the “Structure” section of the inspection form and review the previous inspection.

5. Perform the inspection. Review the overall condition of the areas upstream of the BMP by inspecting each part of the structure and respond to the questions on the inspection form. Take photographs of any noted defects and the general condition of the structure. Provide any comments on the condition of the BMP, maintenance tasks recommendations, or necessary structural repairs.

6. Submit the inspection form to your immediate supervisor and/or the stormwater quality manager. Report any defects needing immediate attention such as major structural defects, severe erosion, excessively clogged pipes, or any other condition that impacts the ability of the BMP to perform as designed.

MAINTENANCE AND COMPLIANCE BMP INSPECTION FORM
DETENTION BASIN OR RETENTION POND

Reference Work Instruction: WQ-WI-201, WQ-WI-202

Scope: This form documents the condition of a detention basin or retention pond with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In:	Time Out:	Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.):	Precipitation Last 24 Hours (in):	Precipitation Last 72 Hours (in):	
EMBANKMENT/EMERGENCY SPILLWAY	Adequate vegetation and ground cover?	□ Yes □ No □ NA	Bare soil exposed?	□ Yes □ No □ NA
	Evidence of erosion?	□ Yes □ No □ NA	Evidence of animal burrows?	□ Yes □ No □ NA
	Evidence of dam cracking, bulging, or sliding?	□ Yes □ No □ NA	Evidence of seeps or leaks in the downstream face?	□ Yes □ No □ NA
	Evidence of slope erosion or riprap failures?	□ Yes □ No □ NA	Obstruction or debris in the emergency spillway?	□ Yes □ No □ NA
	Embankment/Emergency Spillway Comments:			
OUTLET CONTROL STRUCTURE/ PRINCIPAL SPILLWAY	Type of Spillway □ Reinforced Concrete □ Corrugated Pipe □ Masonry □ Other			
	Evidence of obstruction or debris in low flow orifice, low flow trash rack, weir trash rack, and/or riser?	□ Yes □ No □ NA	Evidence of corrosion in low flow orifice, low flow trash rack, weir trash rack, and/or riser?	□ Yes □ No □ NA
	Evidence of cracks, displacement, spalling, or joint failures in the structure's walls, frame, or top slab?	□ Yes □ No □ NA	Is the control valve operational and exercised? Chained and locked?	□ Yes □ No □ NA
	Is the pond drain valve operational and exercised? Chained and locked?	□ Yes □ No □ NA	Evidence of outfall channel impediment or erosion?	□ Yes □ No □ NA
	Outlet Control Structure/Principal Spillway Comments:			

PERMANENT POOL (WET)	Undesirable vegetative growth in or around ponded area?	□ Yes □ No □ NA	Evidence of floating or floatable trash/debris?	□ Yes □ No □ NA
	Visible evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA	Evidence of sedimentation resulting in loss of pond volume?	□ Yes □ No □ NA
	Permanent Pool Comments:			
SEDIMENT FOREBAY	Evidence of sedimentation resulting in loss of forebay volume?	□ Yes □ No □ NA	Evidence of trash or floatable debris?	□ Yes □ No □ NA
	Sediment Forebays Comments:			
DRY POND AREAS	Sufficient vegetation and ground cover?	□ Yes □ No □ NA	Undesirable vegetative growth?	□ Yes □ No □ NA
	Evidence of low flow channel impediment?	□ Yes □ No □ NA	Evidence of standing water or wet spots?	□ Yes □ No □ NA
	Evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA	Sedimentation resulting in loss of pond volume?	□ Yes □ No □ NA
	Dry Pond Area Comments:			
OUTFALL INTO POND	Slope erosion or riprap failures?	□ Yes □ No □ NA	Deterioration of storm pipes?	□ Yes □ No □ NA
	Deterioration of endwalls/headwalls?	□ Yes □ No □ NA	Evidence of outfall pipe sedimentation or blockage?	□ Yes □ No □ NA
	Outfalls into Pond Comments:			

Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed. □ Excellent: Well maintained, no action required.

General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

MAINTENANCE AND COMPLIANCE BMP INSPECTION FORM
STREAM RESTORATION OR CONSTRUCTED WETLAND

Reference Work Instruction: WQ-WI-201

Scope: This form documents the condition of a stream restoration or constructed wetland with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In:	Time Out:	Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.):	Precipitation Last 24 Hours (in):	Precipitation Last 72 Hours (in):	
CONTRIBUTING DRAINAGE AREA	Excessive trash, debris, sediment, landscape waste, or yard clippings in adjacent area?	□ Yes □ No □ NA	Bare soil exposed?	□ Yes □ No □ NA
	Evidence of erosion?	□ Yes □ No □ NA	Visible evidence of chemicals and/or automotive fluids?	□ Yes □ No □ NA
	Contributing Drainage Area Comments:			
VEGETATION	Are at least 50% of the wetland plants alive?	□ Yes □ No □ NA	Does vegetation appear healthy?	□ Yes □ No □ NA
	Undesirable vegetative growth?	□ Yes □ No □ NA	Evidence of erosion or sedimentation?	□ Yes □ No □ NA
	Vegetation Comments:			
WETLAND POOL AREA	Evidence of low flow orifice or pipe impediment?	□ Yes □ No □ NA	Evidence of floating or floatable trash/debris?	□ Yes □ No □ NA
	Visible evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA	Evidence of shoreline erosion?	□ Yes □ No □ NA
	Evidence of sedimentation resulting in loss of pool volume?	□ Yes □ No □ NA		□ Yes □ No □ NA
	Wetland Pool Area Comments:			

DRAINAGE/ SPILLWAYS	Evidence of obstruction or debris in the riser, barrel, or embankment?	□ Yes □ No □ NA	Evidence of corrosion, cracks, displacement, spalling, or joint failures in the riser, barrel, or pipes?	□ Yes □ No □ NA
	Evidence of sedimentation?	□ Yes □ No □ NA	Approximate depth (in.) of sedimentation?	
	Drainage/Spillways Comments:			

Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed. □ Excellent: Well maintained, no action required.

General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

MAINTENANCE AND COMPLIANCE BMP INSPECTION FORM
VEGETATED SWALE

Reference Work Instruction: WQ-WI-201

Scope: This form documents the condition of a vegetated swale with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In: / Time Out:		Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.): / Precipitation Last 24 Hours (in): / Precipitation Last 72 Hours (in):			
CONTRIBUTING DRAINAGE AREA	Excessive trash, debris, sediment, landscape waste, or yard clippings in adjacent areas?	□ Yes □ No □ NA	Bare soil exposed?	□ Yes □ No □ NA
	Evidence of erosion?	□ Yes □ No □ NA	Visible evidence of chemicals and/or automotive fluids?	□ Yes □ No □ NA
	Contributing Drainage Area Comments:			
VEGETATION	Approximate level of sedimentation, if any? (in.)	_____	Approximate grass height? (in.)	_____
	Does vegetation appear healthy?	□ Yes □ No □ NA	Is there bare soil exposed?	□ Yes □ No □ NA
	Is there evidence of erosion?	□ Yes □ No □ NA	Evidence of standing water or wet spots	□ Yes □ No □ NA
	Vegetation Comments:			
DRAINAGE/SPILLWAY	Evidence of flow bypassing check dams or energy dissipators?	□ Yes □ No □ NA	Evidence of erosion at downstream toe?	□ Yes □ No □ NA
	Evidence of outlet or overflow spillway impediment?	□ Yes □ No □ NA	Deterioration of outlet or overflow spillway?	□ Yes □ No □ NA
	Evidence of slope erosion?	□ Yes □ No □ NA	Visible evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA
	Drainage/Spillways Comments:			

Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed. □ Excellent: Well maintained, no action required.		
General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

MAINTENANCE AND COMPLIANCE BMP INSPECTION FORM
BIOFILTRATION PRACTICE

Reference Work Instruction: WQ-WI-201, WQ-WI-202

Scope: This form documents the condition of a biofiltration practice with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In:	Time Out:	Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.):	Precipitation Last 24 Hours (in):	Precipitation Last 72 Hours (in):	
CONTRIBUTING DRAINAGE AREA	Excessive trash, debris, sediment, landscape waste, or yard clippings in adjacent areas?	□ Yes □ No □ NA	Bare soil exposed?	□ Yes □ No □ NA
	Evidence of erosion?	□ Yes □ No □ NA	Visible evidence of chemicals and/or automotive fluids?	□ Yes □ No □ NA
	Contributing Drainage Area Comments:			
VEGETATION/SEDIMENTATION	Excessive trash, debris, or sediment in filter practice and inlet/outlet?	□ Yes □ No □ NA	Evidence of erosion or sedimentation?	□ Yes □ No □ NA
	Approximate level of sedimentation? (in.)	_____	Approximate grass height? (in.)	_____
	Is there bare soil exposed?	□ Yes □ No □ NA	Undesirable vegetative growth?	□ Yes □ No □ NA
	Does vegetation appear healthy?	□ Yes □ No □ NA	Evidence of dead or dying vegetation that needs to be removed or replaced?	□ Yes □ No □ NA
	Is mulch in place and in good condition to prevent weed growth?	□ Yes □ No □ NA	Evidence of standing water or wet spots?	□ Yes □ No □ NA
	Vegetation/Sedimentation Comments:			

FILTER STRIPS	Indication of concentrated flow (i.e., erosion or bare spots)?	□ Yes □ No □ NA
	Filter Strips Comments:	

Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed. □ Excellent: Well maintained, no action required.		
General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

MAINTENANCE AND COMPLIANCE BMP INSPECTION FORM
PREFABRICATED TREATMENT AND INLET FILTER DEVICE

Reference Work Instruction: WQ-WI-201, WQ-WI-202

Scope: This form documents the condition of a prefabricated treatment and inlet filter device with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In:	Time Out:	Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.):	Precipitation Last 24 Hours (in):	Precipitation Last 72 Hours (in):	
CONTRIBUTING DRAINAGE AREA	Excessive trash, debris, sediment, landscape waste, or yard clippings in adjacent area?	□ Yes □ No □ NA	Bare soil exposed?	□ Yes □ No □ NA
	Evidence of erosion?	□ Yes □ No □ NA	Visible evidence of chemicals and/or automotive fluids?	□ Yes □ No □ NA
	Contributing Drainage Area Comments:			
PREFABRICATED STRUCTURE	Evidence of cracks, displacement, spalling, or joint failures in the structure's wall, frame, or top slab?	□ Yes □ No □ NA	Evidence of cracks greater than 1/2 inch, allowing soil particles to enter?	□ Yes □ No □ NA
	Evidence of baffles corroding, cracking, warping, or showing other signs of failure?	□ Yes □ No □ NA	Visible evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA
	Approximate depth (in.) of floatable debris within structure?	_____	Approximate depth (in.) of sediment in vault:	_____
	Evidence of sediment in drain pipes or cleanouts?	□ Yes □ No □ NA	Approximate depth (in.) of sediment in pipes or cleanouts?	_____
	Is the cover damaged?	□ Yes □ No □ NA	Can one person remove the cover?	□ Yes □ No □ NA
	Structure Comments:			
Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed.			

	□ Excellent: Well maintained, no action required.		
General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

MAINTENANCE COMPLIANCE BMP INSPECTION FORM
PERVIOUS PAVEMENT OR PAVERS

Reference Work Instruction: WQ-WI-201, WQ-WI-202

Scope: This form documents the condition of pervious pavement or pavers with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In:	Time Out:	Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.):	Precipitation Last 24 Hours (in):	Precipitation Last 72 Hours (in):	
CONTRIBUTING DRAINAGE AREA	Excessive trash, debris, sediment, landscape waste, or yard clippings in adjacent areas?	□ Yes □ No □ NA	Bare soil exposed?	□ Yes □ No □ NA
	Evidence of erosion?	□ Yes □ No □ NA	Visible evidence of chemicals and/or automotive fluids?	□ Yes □ No □ NA
	Drainage/Spillways Comments:			
PERVIOUS PAVEMENT SURFACE	Excessive trash, debris, sediment, landscape waste, or yard clippings on pavement surface?	□ Yes □ No □ NA	Visible evidence of chemicals and/or automotive fluids on surface?	□ Yes □ No □ NA
	Evidence of standing water?	□ Yes □ No □ NA	Visible evidence of sediment accumulation or clogging?	□ Yes □ No □ NA
	Visible evidence of pavement deterioration or failure (including rutting, rippling, cracking, chipping, etc.)?	□ Yes □ No □ NA		
	Permeable Pavement Surface Comments:			
UNDERDRAIN AND OUTLET	Evidence of underdrain flow impediment?	□ Yes □ No □ NA	Evidence of outlet flow impediment?	□ Yes □ No □ NA
	Excessive trash, debris, or sediment accumulation at outlet(s)?	□ Yes □ No □ NA	Evidence of erosion at/around outlet(s)?	□ Yes □ No □ NA
	Underdrain and Outlet Comments:			

Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed. □ Excellent: Well maintained, no action required.		
General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

MAINTENANCE AND COMPLIANCE BMP INSPECTION FORM
GREEN ROOF

Reference Work: WQ-WI-201, WQ-WI-202

Scope: This form documents the condition of a green roof with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In:	Time Out:	Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.):	Precipitation Last 24 Hours (in):	Precipitation Last 72 Hours (in):	
VEGETATION	Does vegetation appear healthy?	□ Yes □ No □ NA	Evidence of sparse or missing vegetation at any location?	□ Yes □ No □ NA
	Evidence of dead or dying vegetation that needs to be removed or replaced?	□ Yes □ No □ NA	Undesirable vegetative growth?	□ Yes □ No □ NA
	Does vegetation look maintained?	□ Yes □ No □ NA	Evidence of erosion or sedimentation?	□ Yes □ No □ NA
	Vegetation Comments:			
DRAINAGE	Evidence of standing water or wet spots?	□ Yes □ No □ NA	Evidence of leaks or cracks in waterproof membrane?	□ Yes □ No □ NA
	Is mulch in place and in good condition to prevent weed growth?	□ Yes □ No □ NA	Evidence of roof drain, gutter, or drainage system impediment?	□ Yes □ No □ NA
	Roof layers underneath vegetation show signs of leakage or damage?	□ Yes □ No □ NA		
	Drainage Comments:			
ROOF SYSTEM	The roof system appears to be structurally sound.	□ Yes □ No □ NA		
	Roof System Comments:			

Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed. □ Excellent: Well maintained, no action required.		
General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

MAINTENANCE AND COMPLIANCE BMP INSPECTION FORM
WATER HARVESTING SYSTEM

Reference Work Instruction: WQ-WI-201, WQ-WI-202

Scope: This form documents the condition of a water harvesting system with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In: / Time Out:		Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.): / Precipitation Last 24 Hours (in): / Precipitation Last 72 Hours (in):			
CONTRIBUTING DRAINAGE AREA	Excessive trash, debris, sediment, landscape waste, or yard clippings in adjacent areas?	□ Yes □ No □ NA	Bare soil exposed?	□ Yes □ No □ NA
	Evidence of erosion?	□ Yes □ No □ NA	Visible evidence of chemicals and/or automotive fluids?	□ Yes □ No □ NA
	Contributing Drainage Area Comments:			
PRETREATMENT DEVICE	Evidence of cracks, displacement, spalling, or joint failures in the structure's walls, frame, or top slab?	□ Yes □ No □ NA	Evidence of cracks greater than 1/2 inch, allowing soil particles to enter?	□ Yes □ No □ NA
	Evidence of baffles corroding, cracking, warping, or showing other signs of failure?	□ Yes □ No □ NA	Visible evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA
	Approximate depth (in.) of floatable debris within structure?	_____	Approximate depth (in.) of sediment in vault? :	_____
	Evidence of sediment in drain pipes or cleanouts?	□ Yes □ No □ NA	Approximate depth (in.) of sediment in pipes or cleanouts?	_____
	Is the cover damaged?	□ Yes □ No □ NA	Can one person remove the cover?	□ Yes □ No □ NA
	Pretreatment Device Comments:			
DRAINAGE/ SPILLWAY	Evidence of flow bypassing check dams or energy dissipators?	□ Yes □ No □ NA	Evidence of erosion at downstream toe?	□ Yes □ No □ NA
	Evidence of outlet or overflow spillway impediment?	□ Yes □ No	Deterioration of outlet or overflow spillway?	□ Yes □ No

		□ NA		□ NA
	Evidence of slope erosion?	□ Yes □ No □ NA	Visible evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA
	Drainage/Spillways Comments:			
CISTERN/TANK	Evidence of flow bypassing check dams or energy dissipators?	□ Yes □ No □ NA	Evidence of cracking, wear, or rust on access ports, fittings, and/or pipes?	□ Yes □ No □ NA
	Is water able to freely enter the cistern?	□ Yes □ No □ NA	Evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA
	Is there a leaking or damaged component?	□ Yes □ No □ NA	Evidence or noticeable odors, presence of algae, or floating aquatic vegetation?	□ Yes □ No □ NA
	Cistern/Tank Comments:			
OUTLET/OVERFLOW STRUCTURE	Evidence of flow bypassing check dams or energy dissipators?	□ Yes □ No □ NA	Visible evidence of erosion?	□ Yes □ No □ NA
	Outlet/Overflow Structure Comments:			
SYSTEM OPERATION AND MAINTENANCE	Evidence of flow bypassing check dams or energy dissipators?	□ Yes □ No □ NA	Are operating procedures posted or available at the system control panel?	□ Yes □ No □ NA
	Are maintenance procedures posted or available at the system control panel?	□ Yes □ No □ NA	Is a system maintenance log available?	□ Yes □ No □ NA
	Is data on system performance being collected?	□ Yes □ No □ NA		□ Yes □ No □ NA
	System Operation and Maintenance Comments:			

Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed. □ Excellent: Well maintained, no action required.		
General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

WORK INSTRUCTIONS
PERFORMING COMPLIANCE BMP INSPECTIONS

Reference Procedure:	WQ-PROC-200
Purpose:	The purpose is to provide instructions for personnel to follow when performing compliance inspections of stormwater BMPs.
Scope:	These instructions apply to EMD personnel conducting or supervising the regulatory compliance BMP inspections.
Responsible Personnel:	EMD Director, Stormwater Quality Manager, Grounds, Utilities, Athletics, Contractors
Minimum PPE Required:	Slip-resistant steel-toe shoes, waders or rubber boots, hardhat, reflective safety vest, gloves (if necessary)
Supporting Documents:	WQ-FORM-201A, WQ-FORM-201B, WQ-FORM-201C, WQ-FORM-201D, WQ-FORM-201E, WQ-FORM-201F, WQ-FORM-201G, WQ-FORM-201H, WQ-FORM-202A
Work Instructions:	All personnel should review and understand procedures before beginning field activities:

1. Identify the type of BMP to be inspected and gather all necessary equipment and the associated field inspection form specific to the type of BMP being inspected.

2. Prior to the inspection, review the associated section for the type of BMP in the Operation and Maintenance Plan. Field personnel should be familiar with how the BMP functions, standard maintenance tasks, and the guidance provided in the inspection section for the BMP.

3. Review the previous maintenance inspection forms submitted by the entity responsible for maintaining the BMP and any reported maintenance activities.

4. Using a field capable device, log on to stormwater.ms4web.com and review the previous compliance inspection.

5. Perform the inspection. Review the overall condition of the areas upstream of the BMP by inspecting each part of the structure and respond to the questions on the inspection form. Take photographs of any noted defects and the general condition of the structure. Provide any comments on the condition of the BMP, maintenance tasks recommendations, or necessary structural repairs.

6. Export the inspection form as a PDF and provide a copy to the Stormwater Quality Manager and the entity responsible for maintaining the BMP. Report any defects needing immediate attention such as major structural defects, severe erosion, excessively clogged pipes, or any other condition that impacts the ability of the BMP to perform as designed.

MAINTENANCE AND COMPLIANCE BMP INSPECTION FORM
UNDERGROUND DETENTION SYSTEM

Reference Work Instruction: WQ-WI-202

Scope: This form documents the condition of as underground detention system with recommendations for maintenance and repair tasks.

STRUCTURE	Name:		Compliance:	
	Added:		Last Inspected:	
	Site Physical Address:			
	Inspector:		Inspector ID:	
INSPECTION	Inspection Type:		Inspection Date:	
	Scheduled Inspection Date:		Compliance Status:	
	Time In:	Time Out:	Follow-up Inspection Date:	
	Weather Condition:		Temperature (F):	
	Precipitation (in.):	Precipitation Last 24 Hours (in):	Precipitation Last 72 Hours (in):	
CONTRIBUTING DRAINAGE AREA	Excessive trash, debris, sediment, landscape waste, or yard clippings in adjacent areas?	□ Yes □ No □ NA	Bare soil exposed?	□ Yes □ No □ NA
	Evidence of erosion?	□ Yes □ No □ NA	Visible evidence of chemicals and/or automotive fluids?	□ Yes □ No □ NA
	Contributing Drainage Area Comments:			
SYSTEM INLET	Is system inlet in the same structure as the pretreatment device?	□ Yes □ No □ NA	Evidence of cracks, displacement, spalling, or joint failures in the structure's walls, frame, or top slab?	□ Yes □ No □ NA
	Evidence of cracks greater than 1/2 inch, allowing soil particles to enter?	□ Yes □ No □ NA	Visible evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA
	Approximate depth (in.) of debris/sediment in structure?	_____	Approximate depth (in.) of sediment in pipes or cleanouts?	_____
	Evidence of sediment in inlet pipes?	□ Yes □ No □ NA	Is the cover damaged?	□ Yes □ No □ NA
	Can one person remove the cover?	□ Yes □ No □ NA		
	System Inlet Comments:			

ISOLATOR ROW	Number of isolator rows in the system	_____	Do one or more of the isolator rows have visible sediment?	□ Yes □ No □ NA
	Evidence of standing water or wet spots?	□ Yes □ No □ NA	Evidence of cracking, wear, or rust on access ports, fittings, and or pipes?	□ Yes □ No □ NA
	Evidence of damage to the chambers?	□ Yes □ No □ NA	Evidence of base erosion or filter fabric damage?	□ Yes □ No □ NA
	Describe location and amount of sediment			
	Isolator Row Comments:			
BASIN/CHAMBER/TANK	Evidence of cracks, displacement, spalling, or joint failures in the structure?	□ Yes □ No □ NA	Visible evidence of cracks greater than 1/2 inch, allowing soil particles to enter?	□ Yes □ No □ NA
	Accumulation of sediment or debris in structure?	□ Yes □ No □ NA	Approximate depth of sediment in basin?	_____
	Evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA	Evidence or noticeable odors, presence of algae, or floating aquatic vegetation?	□ Yes □ No □ NA
	Visible evidence of standing water or wet spots?	□ Yes □ No □ NA	Evidence of flow impediment within structure?	□ Yes □ No □ NA
	Basin/Chamber/Tank Comments:			
SYSTEM OUTLET	Visible evidence of cracks, displacement, spalling, or joint failures in the structure's walls, frame, or top slab?	□ Yes □ No □ NA	Is there evidence of cracks greater than 1/2 inch, allowing soil particles to enter?	□ Yes □ No □ NA
	Is there evidence of oil, gasoline, contaminants, or other pollutants?	□ Yes □ No □ NA	Does the system contain an outlet control device?	□ Yes □ No □ NA
	Does the outlet control appear to be free from impediments?	□ Yes □ No □ NA	Approximate depth of debris/sediment in structure?	_____
	Evidence of sediment in outlet pipes?	□ Yes □ No □ NA	Is any debris at the outlet indicative of structural or performance failures within the system?	□ Yes □ No □ NA
	Approximate depth of sediment in pipes or cleanouts?	_____	Is the cover damaged or broken?	□ Yes □ No □ NA
	Can the cover be removed by one person?	□ Yes □ No □ NA		
	System Outlet Comments:			
SYSTEM COMPONENTS	Visible evidence of cracks, displacement, spalling, or joint failures in the structure's walls, frame, or top slab?	□ Yes □ No □ NA	Number of Access Points?	_____
	Are special tools required for accessing the system or completing inspection?	□ Yes □ No □ NA	Number of Inspection Ports?	_____
	System Components Comments:			

Overall Condition of Facility:	□ Poor: Immediate need for repair or replacement. □ Fair: Poorly maintained, routine maintenance and repair needed. □ Good: Adequately maintained, routine maintenance needed. □ Excellent: Well maintained, no action required.		
General Notes, Maintenance Tasks, Repairs		Repair Completion Date:	□ Immediate □ 30 days □ 90 days □ 1 year

APPENDIX B
PREVENTATIVE MAINTENANCE PLAN MATRIX

UK Preventative Maintenance Program
Type: Detention Basin and Retention Pond

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Remove Trash & Debris	Mow Grass and Remove Grass Clippings	Clean Sediment and Debris from Inlets and Outlets	Replant Vegetation	Repair Erosion Channels	Remove Excess Biomass	Maintenance Inspection Form: WQ-FORM-101	Compliance Inspection Form: WQ-FORM-201
Arboretum - North Detention at Greg Page	Behind Greg Page Apartments buildings 18-21 along Commonwealth Street	STWR102577	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Arboretum - South Detention	South end of Arboretum off trail at bridge	STWH200255	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
BCTC - Detention	Front of BCTC at along Cooper Drive	STWRS02103	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Bio Pharm @ 179 Leader Detention	East of E27 surface parking lot (Press Avenue and Leader Avenue), behind Bio Pharm	STWRS02109	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Central Utility Plant / Press Ave Detention	North of surface parking lot at end of Transcript Avenue next to railroad tracks	STWRS02102	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Cooper Dr Detention Behind Boone/WR-3	Along north side of Cooper Drive adjacent to cross walk, south of Tennis Courts	STWRS02104	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Alumni Dr S at WH1 - Detention	Along south side of Alumni Drive, behind UK stone gate	STWH100068	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Detention at B&E	Corner of Limestione and Administration Drive across from Guardhouse	STTBR01343	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Softball Stadium - Detention	Between Alumni Drive and Softball Field	STWH100069	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
FEMA Project - Area 3 Lower Detention Basin	Below FEMA Area 3 Upper Basin, Between Alumni Drive and Reg Services Building	STWR102582	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
FEMA Project - Area 3 Upper Detention Basin	Below FEMA Area 4 Basin, Adjacent to Alumni Drive and Child Development Center	STWR102578	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
FEMA Project - Area 4 Detention Basin	At Corner of Alumni Drive and Commonwealth Drive below Child Development Center	STWR102583	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Gluck Detention South	Opposite Rain Garden, surrounded by parking lot	STWR202204	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years

UK Preventative Maintenance Program
Type: Detention Basin and Retention Pond

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Remove Trash & Debris	Mow Grass and Remove Grass Clippings	Clean Sediment and Debris from Inlets and Outlets	Replant Vegetation	Repair Erosion Channels	Remove Excess Biomass	Maintenance Inspection Form: WQ-FORM-101	Compliance Inspection Form: WQ-FORM-201
KET/ACS - Detention Pond	Sports Center Drive behind KET	STWRS02105	McDonald Det	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Library Sinkhole East	East Side of Library, Center of Circle	STTBR01339	UK Grounds/ Utilities	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Library Sinkhole West	West Side of Library, Center of Oval	STTBR01340	UK Grounds/ Utilities	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Linden Walk East Detention	Corner of Linden Walk and Rose Lane between building and parking lot	STTBR01341	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Linden Walk West Detention	Corner of Linden Walk and Rose Lane between street and sidewalk	STTBR01342	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Parking Structure 8 Detention	Behind parking structure along Conn Terrace, across from Patient Care	STWRS02101	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Press Ave/BBSRB Parking Detention	South west corner of parking lot across from Press Avenue Garage	STWRS02108	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Roach Cancer Center - Detention Basin	Between Rose Street and Hospital Drive	STWRS02110	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Shawneetown Rd - Detention Pond	Below FEMA Area 3 Lower Basin, near the intersection of Alumni Drive and Nicholasville Road	STWR102723	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
University Inn Detention Basin	Located at rear of property, corner of South Limestone and University Avenue	STWRS02133	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years
Gluck Wet Pond	In front of Gluck Equine building along Nicholasville Road	STWR202205	UK Grounds	Monthly	Every 2 weeks April through October	February May August November	March October	March October	October	March June September	Every 5 Years

UK Preventative Maintenance Program
Type: Stream Restoration and Constructed Wetland

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Mow Grass and Remove Grass Clippings	Remove Trash	Weeding	Remove Leaves and Sediment	Replant Vegetation	Repair Erosion Channels	Maintenance Inspection Form: WQ-FORM-103	Compliance Inspection Form: WQ-FORM-203
Arboretum - Arboretum Drive Bioswale	Along Arboretum Drive below parking lot along curve to trail crosswalk	STWH100079	UK Grounds	Every 2 weeks April through October	Every month	Every month April through October	March June October	March October	March October	March June October	Every 5 Years
Ronald McDonald - Bioswale	Sports Center, Between KET and RMH parking	STWRS02266	RMHC	Every 2 weeks April through October	Every month	Every month April through October	March June October	March October	March October	March June October	Every 5 Years

UK Preventative Maintenance Program
Type: Vegetated Swale

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Mow Grass and Remove Grass Clippings	Remove Trash	Weeding	Remove Leaves and Sediment	Replant Vegetation	Repair Erosion Channels	Maintenance Inspection Form: WQ-FORM-103	Compliance Inspection Form: WQ-FORM-203
New Baseball Stadium - Vegetative Swale #3	Along north side of Wildcat Court from College Way to softball parking	STWH100078	UK Athletics/ Grounds	Every 2 weeks April through October	Every month	Every month April through October	March June October	March October	March October	March June October	Every 5 Years
New Baseball Stadium - Vegetative Swale #1	At corner of Alumni and College Way near round about, below baseball field sign	STWR102588	UK Athletics/ Grounds	Every 2 weeks April through October	Every month	Every month April through October	March June October	March October	March October	March June October	Every 5 Years
New Baseball Stadium - Vegetative Swale #2	Along north side of Alumni Drive between baseball field and soccer field	STWH100072	UK Athletics/ Grounds	Every 2 weeks April through October	Every month	Every month April through October	March June October	March October	March October	March June October	Every 5 Years

UK Preventative Maintenance Program
Type: Biofiltration Practices

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Remove Trash	Weeding	Mulching	Mow Grass and Remove Grass Clippings	Remove Sediment and Leaves (via Raking)	Remove Excess Biomass	Replant Vegetation and Repair Erosion Channels	Clean Underdrain	Maintenance Inspection Form: WQ-FORM-104	Compliance Inspection Form: WQ-FORM-204
Alumni Dr N at WH1 - Bioswale	Along north side of Alumni Drive, west of church parking lot that is at the intersection of Alumni Drive and Tates Creek Road	STWH100067	UK Grounds	Every month	Every month April through October	April	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
Alumni Stream Restoration Bioswale	In median along north side of Alumni Drive across from the softball stadium		UK Grounds	Every month	Every month April through October	April	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
Arboretum - Wet Meadow Demonstration Area	Outside the restroom adjacent to the Children's Garden Entrance	STWH100076	UK Grounds	Every month	Every month April through October	April	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
New Baseball Stadium - Vegetative Filter Strip #1	Adjacent to sidewalk along northern outfield area	STWH100073	UK Athletics/Grounds	Every month	Every month April through October	N/A	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
New Baseball Stadium - Vegetative Filter Strip #2	Adjacent to pavement under large park display board along southern outfield area	STWH100074	UK Athletics/Grounds	Every month	Every month April through October	N/A	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
New Baseball Stadium - Vegetative Filter Strip #3	Mid site, adjacent to stadium between north side of Alumni Drive and walking path	STWH100075	UK Athletics/Grounds	Every month	Every month April through October	N/A	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
New Baseball Stadium - Vegetative Filter Strip #4	Mid site, corner between walking path leading down hill to walking path and off of south side of entrance pavement	STWR102589	UK Athletics/Grounds	Every month	Every month April through October	N/A	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
Arboretum - Rain Garden	Arboretum, behind visitor center	STWH200256	UK Grounds	Every month	Every month April through October	April	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
Gluck Rain Garden	Northeast of Gluck Equine parking lot, off Farm Road	STWR202203	UK Grounds	Every month	Every month April through October	April	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years
Kentucky Clinic Parking Lot Rain Garden	Located in center of parking lot behind Kentucky Clinic Parking Garage and between MDS and Agronomy Head House on corner of Rose Street and Huguelet Drive	STTBR01454	UK Grounds	Every month	Every month April through October	April	N/A	March June August October	October	March October	Every 5 years	March June October	Every 5 years
Marksbury Rain Garden	Rose Street before East Maxwell on left	STTBR01335	UK Grounds	Every month	Every month April through October	April	N/A	March June August October	October	March October	Every 5 years	March June October	Every 5 years
McDonald Rain Garden	Sports Center Drive behind KET	STWRS02106	RMHC	Every month	Every month April through October	April	Every 2 weeks April through October	March June August October	October	March October	Every 5 years	March June October	Every 5 years

UK Preventative Maintenance Program
Type: Prefabricated Treatment and Inlet Filter Devices

Post Construction BMP Control Name	Manufacturer Name/Type	Location/Comments	Tracking ID	Owner	Parking Lot and/or Street Sweeping	Remove Sediments, Debris, and Trash from Filter Bags	Vacuum Sediment from Structure Sump	Replace Media Filters	Maintenance Inspection Form: WQ-FORM-106	Compliance Inspection Form: WQ-FORM-206
Student Ctr - Contech CDS Hydrodynamic Separator A	CDS2015 4-Foot Diameter	Between NW Corner of Alumni gym, Avenue of Champions, and steps (in raised planter, vegetation in summer covers manhole)	STTBR01364	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Student Ctr - Contech CDS Hydrodynamic Separator D	CDS2015 4-Foot Diameter	East of Frazee Hall, between New Student Center and Barker Hall, on Patterson Drive side of box culvert	STTBR01365	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Student Ctr - Oil Water Separator	Zurn Z1188 Large Capacity Oil Interceptor (300 GPM)	Large metal lid near the base of the ramp at the Student Center loading dock	STTBR02187	UEM/UK Facilities	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
ASB - Contech CDS Hydrodynamic Separator	ADS/Hydro International stormwater/FD-6 First Defense	Interior courtyard adjacent to stone detention basin (on right side facing building)	STTBR01361	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Academic Science Building - VortSentry #1	ADS/Hydro International stormwater/FD-6 First Defense	Along Rose Street across from Morgan Building	STTBR01359	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Academic Science Building - VortSentry #2	ADS/Hydro International stormwater/FD-6 First Defense	Equidistant between parking structure entrance, ASB entrance, and Haggin Hall (near corner as hilltop enters garage), in triangle grass area	STTBR01360	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
AGR Water Quality Unit	Hydro International First Defense High Capacity	Southwest corner of Phi Mu parking lot right off of the pavement into the grass	STTBR01457	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Johnson Hall - Hydro Dynamic Separator	Hydro International Downstream Defender	In front of entrance to Johnson Hall along Hilltop Avenue	STTBR01338	Greystar (EDR)	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Jewell Hall - Manufactured WQ Device	Contech CDS	In front of Jewell Hall between Avenue of Champions and building, almost in center	STTBR01356	Greystar (EDR)	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
College Way Parking Lot Pretreatment Device #1	Nyloplast/EnviroHood	East most Pretreatment Device of Phase I - Both inlets in rear corner of parking lot immediately prior to underground detention, back face of parking lot	STWRS02680	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
College Way Parking Lot Pretreatment Device #2	Nyloplast/EnviroHood	Northeast Pretreatment Device of Phase I - Both inlets in rear corner of parking lot immediately prior to underground detention, north face of parking lot	STWRS02679	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
College Way Parking Lot Pretreatment Device #3	Nyloplast/EnviroHood	Southmost Pretreatment Device of Phase II - Both inlets immediately upstream of underground detention (across street in front corner of parking lot)	STWRS02682	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years

UK Preventative Maintenance Program
Type: Prefabricated Treatment and Inlet Filter Devices

Post Construction BMP Control Name	Manufacturer Name/Type	Location/Comments	Tracking ID	Owner	Parking Lot and/or Street Sweeping	Remove Sediments, Debris, and Trash from Filter Bags	Vacuum Sediment from Structure Sump	Replace Media Filters	Maintenance Inspection Form: WQ-FORM-106	Compliance Inspection Form: WQ-FORM-206
College Way Parking Lot Pretreatment Device #4	Nyloplast/EnviroHood	Westmost Pretreatment Device of Phase II - Both inlets immediately upstream of underground detention (across street in front corner of parking lot)	STWRS02681	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Commonwealth Stadium - Baffle Box	?	South side of stadium, near loading dock	STWR102581	UEM/Athletics	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
B&E, Hydro International First Defense Vortex Unit	ADS/Hydro International stormwater/FD-6 First Defense	Corner of courtyard along Administration Drive closest to intersection of Administration Drive and South Limestone Street	STTBR01351	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Haggin Hall - Manufactured WQ Device	Crystalstream - Crystalclean Water Quality Vault Model 646	In sidewalk, east corner of Building Adjacent to hilltop traffic circle/cul de sac	STTBR01357	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Lewis Hall - Downstream Defender	Hydro International/Downstream Defender	Front of building along University Drive, just past raise crosswalk toward library	STTBR01372	Greystar (EDR)	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Law Building - Water Quality Unit	Hydro International Downstream Defender	Adjacent to Limestone Street, beside tree at northeast corner of Law Building	STTBR01444	UEM	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Holmes Hall - Hydrodynamic Separator	Hydro International First Defense	Sidewalk along Avenue of Champions at corner of building closest to Roselle Hall, at corner of drive up to Patterson Hall	STTBR01369	Greystar (EDR)	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
New Baseball Stadium - Hydrodynamic Separator #1	Aquashield - Aquaswirl	Off west corner of parking lot at College Way and Alumni Drive	STWR102587	UEM/Athletics	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
New Baseball Stadium - Hydrodynamic Separator #2	Aquashield - Aquaswirl	Rear corner of site next to Wildcat Court near soccer field, at driveway to back of baseball field	STWH100070	UEM/Athletics	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
New Baseball Stadium - Hydrodynamic Separator #3	Aquashield - Aquaswirl	Rear of site at back center (directly across from home plate) near center of soccer field	STWH100071	UEM/Athletics	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
New Baseball Stadium - Hydrodynamic Separator #4	Aquashield - Aquaswirl	Along College Way halfway between Alumni and Wildcat Court	STWR102591	UEM/Athletics	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years

UK Preventative Maintenance Program
Type: Prefabricated Treatment and Inlet Filter Devices

Post Construction BMP Control Name	Manufacturer Name/Type	Location/Comments	Tracking ID	Owner	Parking Lot and/or Street Sweeping	Remove Sediments, Debris, and Trash from Filter Bags	Vacuum Sediment from Structure Sump	Replace Media Filters	Maintenance Inspection Form: WQ-FORM-106	Compliance Inspection Form: WQ-FORM-206
Parking Structure 8 - North Snout	Best Management Products/Snout Insert	Along Transcript Avenue, behind parking structure	STWRS02320	UEM	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Parking Structure 8 - South Snout	Best Management Products/Snout Insert	Along Conn Terrace, behind parking structure, across from Patient Care	STWRS02113	UEM	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Research Bldg 2 - Oil/Water Separator	Hydro International/Oldcastle Precast 4-foot by 6-foot oil/water separator	Near BBSRB Loading Dock/Mid College of Pharmacy Building, adjacent to harvesting tanks	STWRS02125	UEM/MC PPD	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Research Bldg 2, Hydro International First Defense	Old Castle/Hydro International FD-6HC	Located between RB2 and harvesting tanks at loading dock area, Oldcastle lids	STWRS02124	UEM/MC PPD	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Roselle Hall Underground Storage Outlet Snout	Best Management Products/Snout Insert	In front of Roselle Hall along AOC	STTBR02725	UEM	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Shriners Hospital - Hydro First Defense Water Quality Unit	Hydro International FD-4HC	In grass area adjacent to traffic circle exit onto Conn Terrace, between street sidewalk and entrance portico	STWRS02132	Shriners	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
The 90 - Hydrodynamic Separator	Hydro International First Defense	Front corner of building along hilltop near loading dock	STTBR01358	UEM	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Track and Field - Baffle Box	CrystalStream Technologies - Stormwater Treatment Device	Located adjacent to north side of track in grass field, near center	STTBR01345	UEM/Athletics	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Track and Field - Hydrodynamic Separator	Contech CDS	Along Sports Center Drive near track and field, at curb between entrance to parking and fieldhouse, between curb inlet and light post	STSHC02722	UEM/Athletics	Every 2 weeks April through October	NA	3 Years	NA	April October	Every 5 years
University Flats - Downstream Defender #1	Hydro International Downstream Defender	Northern portion of site between building and University Drive	STWRS02121	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
University Flats - Downstream Defender #2	Hydro International Downstream Defender	Adjacent to entry drive at southern corner of building between building and University Drive	STWRS02122	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
University Flats - Downstream Defender #3	Hydro International Downstream Defender	Southern oortion of site at corner of University and Complex Drives	STWRS02123	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
University Flats Field C Pretreatment Device (Snout) #2*	Best Management Products/Snout Insert	Southern portion of site, northwest of University Flats Snout C, between building and Blanding III	STWRS02734	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
University Flats Snout A*	Best Management Products/Snout Insert	Northeastern portion of site between building and Blanding I	STWRS02731	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
University Flats Snout B*	Best Management Products/Snout Insert	Eastern portion of site between building and Blanding II	STWRS02732	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
University Flats Snout C*	Best Management Products/Snout Insert	Southern portion of site between building and Blanding III	STWRS02733	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years

UK Preventative Maintenance Program
Type: Prefabricated Treatment and Inlet Filter Devices

Post Construction BMP Control Name	Manufacturer Name/Type	Location/Comments	Tracking ID	Owner	Parking Lot and/or Street Sweeping	Remove Sediments, Debris, and Trash from Filter Bags	Vacuum Sediment from Structure Sump	Replace Media Filters	Maintenance Inspection Form: WQ-FORM-106	Compliance Inspection Form: WQ-FORM-206
Woodland Glenn - FloGard Dual Vortex Separator #1	FloGard Dual Vortex Separator	Between WG 3 and 5 (facing and closest to WG 2), northmost	STSHC00245	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Woodland Glenn - FloGard Dual Vortex Separator #2	FloGard Dual Vortex Separator	Between WG 4 and 5, closest to grass terraces, westmost	STSHC00246	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Woodland Glen - FloGard Dual Vortex Separator #3	FloGard Dual Vortex Separator	Between WG 3 and 4, closest to dumpsters and Sport Center Drive, southmost	STSHC00247	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Woodland Glenn I - Baffle Box	CrystalStream - Crystalclean Water Quality Vault Model 1266	Courtyard of Woodland Glenn Complex, Behind WG 1 on the right (facing courtyard)	STSHC00244	Greystar (EDR)	Every 4 weeks April through October	NA	3 Years	NA	April October	Every 5 years
Coal Med Inlet Control 1*	Hydro Kleen Filtration System	Between Patient Care Facility and VA	STWRS02729	UEM	Every 2 weeks April through October	April October	NA	April October	April October	Every 5 Years
Coal Med Inlet Control 2*	Hydro Kleen Filtration System	Between Patient Care Facility and VA	STWRS02730	UEM	Every 2 weeks April through October	April October	NA	April October	April October	Every 5 Years
Coal Pile BMP Chandler Med	Straw Bales	Between Patient Care Facility and VA, south of Medical Center heating and cooling plant	STWRS02098	UEM	Every 2 weeks April through October	April October	NA	N/A	April October	Every 5 Years
Coal Pile BMP PPD	Hydro Kleen Filtration System	Limestone, left on Scott Avenue, right on Dickey, pile on left	STTBR01336	UEM	Every 2 weeks April through October	April October	NA	April October	April October	Every 5 Years
Coal Pile BMP @ PPD 2*	Hydro Kleen Filtration System	Limestone, left on Scott Avenue, right on Dickey Hall, pile on left		UEM	Every 2 weeks April through October	April October	NA	April October	April October	Every 5 Years
Peterson Storm Drain Filter 2	Flo-Gard Plus Catch Basin Insert Filter	Inlet in parking area between South Upper Street and Peterson Service Building	STTBR01443	UEM	Every 2 weeks April through October	April October	NA	N/A	April October	Every 5 Years
Coal Drop-Off Area BMP - Peterson Service Bldg	Siltsack Sediment Capture Device	Limestone, left on Scott Avenue, right on Dickey Hall, pile on left	STTBR01337	UEM	Every 2 weeks April through October	April October	NA	N/A	Every 3 weeks Entire Year	Every 5 Years
Peterson Storm Drain Filter 1	Flo-Gard Plus Catch Basin Insert Filter	Inlet in parking area between South Upper Street and Peterson Service Building	STTBR01442	UEM	Every 2 weeks April through October	April October	NA	N/A	April October	Every 5 Years
Scott St Parking Lot - ADS Flex Storm Inlet Filter	Inlet & Pipe Protection, Inc./ADS Flexstorm Inlet Filter	Inlet in area B-1 (near center of lot) adjacent to Scott Street, corner parking spot	STTBR01346	UEM	Every 2 weeks April through October	April October	NA	N/A	April October	Every 5 Years
South Coal Pile BMP	Proprietary system consisting of pre-screening, limestone filtration (pH adjustment), sedimentation pit, bioinfiltration, and additional pH adjustment	College Way to Wildcat Court, across from soccer practice field, south of BIRP Building	STWH100066	UEM	Every 2 weeks April through October	April October	NA	April October	April October	Every 5 Years

UK Preventative Maintenance Program
Type: Pervious Pavement and Pavers

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Trash Removal	Sweep/Vacuum out Sediment & Leaves	Manage Upstream Vegetated Areas	Remove Vegetation in Permeable Pavers	Replentish Top Layer of Stone Between Joints	Maintenance Inspection Form: WQ-FORM-107	Compliance Inspection Form: WQ-FORM-207
Student Ctr - Parking Permeable Pavers	Lower end of Phase II parking lot accessed via the dropoff loop from Avenue of Champions (southeast corner of site)	STTBR01368	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Student Ctr - Plaza Permeable Pavers	Plaza located between Frazee, Barker, and Student Center (area around Harvesting Tank D)	STTBR01367	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Academic Science Building - Permeable Pavers	Interior courtyard at rear of building on Haggin Hall side	STTBR01441	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Arboretum Restrooms Pervious Pavement	ADA access patio entrance to the restroom adjacent to the Children's Garden	STWH100077	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
AXO Patio - Pervious Pavers	Back patio of AXO house facing Alice Loyd College	STTBR01455	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Blue Lot Permeable Concrete	Corner of University and Alumni beneath tree at bottom of parking lot	STWR102590	UK Athletics/Grounds	Monthly	June	March	N/A	N/A	March June October	Every 5 Years
Cornerstone (PS#5) Pervious Pavers (PS5/Winslow Permeable Pavers)	Along the northeast and southeast faces of the new portion of Parking Structure No. 5.	STTBR02252	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Garrigus Plaza - Pervious Pavers	Garrigus Building courtyard south of Ag North	STWRS02114	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Greek Park Phase II - Permeable Concrete Pavement	Concrete walk of Amphitheater near Farmhouse Frat	STTBR01354	UK Grounds	Monthly	June	March	N/A	N/A	March June October	Every 5 Years
Lewis Hall - Pervious Pavement	Interior courtyard area located in building center by enterance, near back corner of The 90	STTBR01373	Greystar (EDR)	Monthly	June	March	April June August	June	March June October	Every 5 Years
Holmes Hall Pervious Pavers #1*	Entryway along AOC at center of Limestone I Building (at steps).	STTBR01374	Greystar (EDR)	Monthly	June	March	April June August	June	March June October	Every 5 Years
Holmes Hall Pervious Pavers #2	Plaza at corner of South Limestone and AOC.	STTBR01370	Greystar (EDR)	Monthly	June	March	April June August	June	March June October	Every 5 Years
New Baseball Permeable Pavers - Left	Left field terrace (5538 sq ft)	STWH100107	UK Athletics/Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
New Baseball Permeable Pavers - Right	Right field terrace (5538 sq ft)	STWH100108	UK Athletics/Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Phi Kappa Tau Permeable Pavement	Rear patio behing Phi Kappa Tau house on Pennsylvania Court	STTBR02228	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Phi Mu Pervious Concrete	Corner of Woodland Avenue and Rose Street, at rear of parking lot	STTBR01350	Phi Mu/UK Grounds	Monthly	June	March	N/A	N/A	March June October	Every 5 Years
Research Facility #1 - Pervious Concrete Sidewalk	Between Mathews Garden and Research Facility #1, connects Washington Avenue to parking area	STTBR01445	UK Grounds	Monthly	June	March	N/A	N/A	March June October	Every 5 Years

UK Preventative Maintenance Program
Type: Pervious Pavement and Pavers

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Trash Removal	Sweep/Vacuum out Sediment & Leaves	Manage Upstream Vegetated Areas	Remove Vegetation in Permeable Pavers	Replentish Top Layer of Stone Between Joints	Maintenance Inspection Form: WQ-FORM-107	Compliance Inspection Form: WQ-FORM-207
Ronald McDonald Pervious Pavers	Pavers located off Sports Center Drive, driveway to Ronald McDonald House	STWRS02728	RMHC	Monthly	June	March	April June August	June	March June October	Every 5 Years
Ronald McDonald Porous Pavement	Ronald McDonald House parking lot pavement	STWRS02265	RMHC	Monthly	June	March	N/A	N/A	March June October	Every 5 Years
SAE House Porous Pavers	Parking lot off Rose Lane between SAE and Newman Center, on Newman Center side of parking lot	STTBR01333	UK Grounds	Monthly	June	March	April June August	June	March June October	Every 5 Years
Shriners Hospital - Pervious Pavement	Rear parking area accessed via first turn off traffic circle	STWRS02131	Shriners	Monthly	June	March	April June August	June	March June October	Every 5 Years
Track and Field - Permeable Pavers	South side of track and field stadium	STTBR01331	UK Athletics	Monthly	June	March	April June August	June	March June October	Every 5 Years
University Flats - Permeable Pavers #1	Arched concrete area along Complex Drive	STWRS02120	Greystar (EDR)	Monthly	June	March	N/A	N/A	March June October	Every 5 Years
University Flats - Permeable Pavers #2	Front area of concrete between building and University Drive (entire length of building) - Augmented to be permeable paver strips feeding permeable concrete and base below asphalt	STWRS02130	Greystar (EDR)	Monthly	June	March	April June August	June	March June October	Every 5 Years
Women's Cancer Center Pervious Sidewalk	Sidewalk between parking and grass area of Cancer Facility for Women	STWRS02116	UK Grounds	Monthly	June	March	N/A	N/A	March June October	Every 5 Years
Roach Brachytherapy Permeable Pavers	Sidewalk southeast of Roach Cancer Center between Chandler Medical Center			Monthly	June	March	April June August	June	March June October	Every 5 Years

UK Preventative Maintenance Program
Type: Green Roofs

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Weeding and Remove Invasives	Remove Trash from Discharge Points	Water Vegetation	Mulching	Maintenance Inspection Form: WQ-FORM-108	Compliance Inspection Form: WQ-FORM-208
Arboretum Green Roof	On the south side of the tool shed located near the vegetable garden	STWH200257	UK Grounds	April June August October	Every month April through October	Every 2 weeks April through October	April	April October	Every 5 Years
Euclid & Linden Walk Bus Shelter Green Roof	Corner of Linden Walk and East Euclid Avenue	STTBR01334	UK Grounds	April June August October	Every month April through October	Every 2 weeks April through October	April	April October	Every 5 Years
Patient Care Facility Green Roof South	Behind Ag North, Patient Care Facility, Corner of Hospital Drive and Limestone (approximately 60,000 sq ft, including addition - see #89)	STWRS02107	UK Grounds	April June August October	Every month April through October	Every 2 weeks April through October	April	April October	Every 5 Years
Garrigus Plaza - Green Roof	Planting Beds in Courtyard of Garrigus Building	STWRS02115	UK Grounds	April June August October	Every month April through October	Every 2 weeks April through October	April	April October	Every 5 Years
Patient Care Facility Green Roof North	Approximately 27,000 sq ft (6500 trays) added to the overhang area of patient pickup/dropoff	STWRS02129	UK Grounds	April June August October	Every month April through October	Every 2 weeks April through October	April	April October	Every 5 Years
Research Building 2 - Green Roof	Roof Plaza located between BBSRB and Healthy KY Research Building	STWRS02127	UK Grounds	April June August October	Every month April through October	Every 2 weeks April through October	April	April October	Every 5 Years

UK Preventative Maintenance Program
Type: Water Harvesting Systems

Post Construction BMP Control Name	Location/Comments	Tracking ID	Owner	Remove Leaves and Clean Debris Screens	Inspect Water in Cistern and Check for Leaks	Change UV Lamp	Reconnect Roof Downspouts	Disconnect Roof Downspouts, Drain Cistern	Maintenance Inspection Form: WQ-FORM-109	Compliance Inspection Form: WQ-FORM-209
ASB - Water Harvesting (2-20,000 gal)	Center courtyard of building facing Haggin, at base of center interior wall	STTBR01363	UK PPD/ Grounds/UEM	Once monthly March through November	March June November	March	March	November	March November	Every 5 Years
Student Ctr - Water Harvesting (Tank D-20,000 gal)	East of Frazee Hall, adjacent to Separator D, on Patterson Drive side of box culvert	STTBR01366	UK PPD/ Grounds/UEM	Once monthly March through November	March June November	March	March	November	March November	Every 5 Years
Research Bldg 2 - Water Harvesting (2-20,000 gal)	Left side of loading dock area across from middle of College of Pharmacy Building	STWRS02392	UK PPD/ Grounds/UEM	Once monthly March through November	March June November	March	March	November	March November	Every 5 Years

UK Preventative Maintenance Program
Type: Underground Detention Systems

Post Construction BMP Control Name	Manufacturer Name/Type or Description	Location/Comments	Tracking ID	Owner	Remove Trash & Debris in Upstream Areas	Clean out Manhole and Weir Structure	Remove Sediment Accumulation	Water Jet Isolator Row	Compliance Inspection Form: WQ-FORM-210
Alpha Tau Omega Underground Detention	Inline pipe detention	Corner of Pennsylvania Avenue and Pennsylvania Court	STTBR01347	UEM	Monthly	Monthly	April	N/A	Every Year
Central Hall Underground Detention	Inline pipe detention	Corner of University and Hilltop Avenue closer to Veterans	STTBR01348	Greystar (EDR)	Monthly	Monthly	April	N/A	Every Year
College Way Parking Lot Underground Detention Phase I	ADS/StormTech/SC-740 chamber with one isolator row	Located in left rear corner of parking lot when entering from College Way (east parking lot from College Way)	STWRS02134	UEM	Monthly	Monthly	April	April	Every Year
College Way Parking Lot Underground Detention Phase II	ADS/StormTech/SC-740 chamber with one isolator row	At entrance of lower College Way parking lot (west parking lot from College Way)	STWRS02272	UEM	Monthly	Monthly	April	April	Every Year
FEMA Project - Area 5 ADS Stormtech Greg Page Underground Detention	ADS/StormTech/MC-4500	Greg Page Apartments, behind laundromat and Apt. # 8	STWR102584	UEM	Monthly	Monthly	April	April	Every Year
FEMA Project - Area 5 - Part 1	ADS/StormTech/MC-4500	Greg Page Apartments, South of FEMA Project - Area 5 ADS Stormtech Units with isolator rows	STWR102584	UEM	Monthly	Monthly	April	April	Every Year
Greek Park Phase II - Underground Detention	Inline pipe detention	Corner of Farmhouse Fraternity closest to Amphitheater	STTBR01355	UEM/Farmhouse	Monthly	Monthly	April	N/A	Every Year
John Smith Hall - Underground Detention	36-inch ADS HDPE underground detention with 6-foot by 6-foot concrete junction chamber and weir plate system	Sports Center Drive between Smith & Kirwan, across from Cooperstown	STWRS02111	UEM	Monthly	Monthly	April	N/A	Every Year
Law/Memorial Lawn Underground Detention	ADS Stormtech MC 3500	Located equidistant between Law and Memorial, the sidewalk along Limestone Street and the front of Memorial	STTBR01456	UEM	Monthly	Monthly	April	April	Every Year
Orange Lot - ADS Stormtech Unit w/ Isolator Row #1	ADS/StormTech/MC 3500 chamber with one isolator row	In center of parking lot located at the corner of University and Alumni Drive	STWR102579	UEM	Monthly	Monthly	April	April	Every Year
Orange Lot - ADS Stormtech Unit w/ Isolator Row #2	ADS/StormTech/MC 3500 chamber with one isolator row	Located in northwest corner of Orange Lot across from rear corner of building and adjacent to parking lot extension	STWR202207	UEM	Monthly	Monthly	April	April	Every Year
Orange Lot Expansion ADS Underground Detention	ADS/StormTech/MC 3500 chamber with one isolator row	Between existing underground detention and Alumni Drive at rear of parking lot	STWR102611	UEM	Monthly	Monthly	April	April	Every Year
Ronald McDonald House - Underground Detention	ADS/StormTech/SC-740 chamber with one isolator row	Sports Center Drive behind KET, west side of parking lot to mid parking lot	STWRS02267	RMHC	Monthly	Monthly	April	April	Every Year
Roselle Hall - Underground Detention	BMP INC, underground vault with snout	Limestone Street, right on Avenue of Champions, left at MLK Boulevard	STTBR02724	UEM	Monthly	Monthly	April	N/A	Every Year

UK Preventative Maintenance Program
Type: Underground Detention Systems

Post Construction BMP Control Name	Manufacturer Name/Type or Description	Location/Comments	Tracking ID	Owner	Remove Trash & Debris in Upstream Areas	Clean out Manhole and Weir Structure	Remove Sediment Accumulation	Water Jet Isolator Row	Compliance Inspection Form: WQ-FORM-210
Orange Lot, ADS Stormtech Unit w/ Isolator Row - A	ADS/StormTech/SC-740 chamber with one isolator row	Corner of south parking lot, adjacent to Gluck Building	STWR202206	UEM	Monthly	Monthly	April	April	Every Year
Orange Lot, ADS Stormtech Unit w/ Isolator Row - B	ADS/StormTech/SC-310 chamber with one isolator row	Corner of south parking lot near Senior Center, at Junction with Orange lot	STWR102580	UEM	Monthly	Monthly	April	April	Every Year
Track and Field - Underground Detention	8 runs of 60-fett RCP at 5 percent slope with 4-foot by 6-foot box culvert at inlet and outlet	At track off Sports Center Drive	STTBR01332	UEM/Athletics	Monthly	Monthly	April	April	Every Year
University Flats - ADS Stormtech Unit w/ Isolator Row A	ADS/StormTech/MC-3500 chamber with three isolator rows	Upper end of site between Blanding II and Volleyball Court	STWRS02373 / STWRS02117	Greystar (EDR)	Monthly	Monthly	April	April	Every Year
University Flats - ADS Stormtech Unit w/ Isolator Row B	ADS/StormTech/MC-3500 chamber three isolator rows	Directly below Unit A, between flats and Blanding II	STWRS02118	Greystar (EDR)	Monthly	Monthly	April	April	Every Year
University Flats - ADS Stormtech Unit w/ Isolator Row C	ADS/StormTech/MC-3500 chamber with three isolator rows	Rear of flats In lower interior corner of building across from Blanding III	STWRS02119	Greystar (EDR)	Monthly	Monthly	April	April	Every Year

UK Preventative Maintenance Program
Type: Class V Injection Well

Post Construction BMP Control Name	Control Type	Location/Comments	Tracking ID	Owner	*To be inspected as detention basin or pretreatment device (WQ-FORM-101)
Library Sinkhole East**	Detention Pond	East side of Library, center of circle	STTBR01339	UK Grounds/UEM	March June September December
Library Sinkhole West**	Detention Pond	West side of Library, center of oval	STTBR01340	UK Grounds/UEM	March June September December
Woodland Glen - Sinkhole North*	Class V Injection Well	Adjacent to Woodland Glenn I	STSHC00243	UEM	March June September December
Woodland Glen - Sinkhole South*	Class V Injection Well	Centered Between Woodland Glenn 3, 4, and 5	STSHC00242	UEM	March June September December
*The two Woodland Glen Sinkholes are inspected with their pretreatment devices.					
*The two Library Sinkholes are located at the outlet of each detention basin. See the Library East Detention and the Library West Detention information on each.					

APPENDIX C
INLET CONTROL O&M MANUALS

Appendix C-1
ADS BaySaver Barracuda

Maintenance Guide

BaySaver Barracuda™

July 2017

One of the advantages of the BaySaver Barracuda is the ease of maintenance. Like any system that collects pollutants, the BaySaver Barracuda must be maintained for continued effectiveness. Maintenance is a simple procedure performed using a vacuum truck or similar equipment. The systems were designed to minimize the volume of water removed during routine maintenance, reducing disposal costs.

Contractors can access the pollutants stored in the manhole through the manhole cover. This allows them to gain vacuum hose access to the bottom of the manhole to remove sediment and trash. There is no confined space entry necessary for inspection or maintenance.

The entire maintenance procedure typically takes from 2 to 4 hours, depending on the size of the system, the captured material, and the capacity of the vacuum truck.

Local regulations may apply to the maintenance procedure. Safe and legal disposal of pollutants is the responsibility of the maintenance contractor. Maintenance should be performed only by a qualified contractor.

Inspection and Cleaning Cycle

Periodic inspection is needed to determine the need for and frequency of maintenance. You should begin inspecting as soon as construction is complete and thereafter on an annual basis. Typically, the system needs to be cleaned every 1-3 years.

Excessive oils, fuels or sediments may reduce the maintenance cycle. Periodic inspection is important.

Determining When to Clean

To determine the sediment depth, the maintenance contractor should lower a stadia rod into the manhole until it contacts the top of the captured sediment and mark that spot on the rod. Then push the probe through to the bottom of the sump and mark that spot to determine sediment depth.

Maintenance should occur when the sediment has reached the levels indicated in the Storage Capacity Chart.

BaySaver Barracuda Storage Capacities

Model	Manhole Diameter	Treatment Chamber Capacity	Standard Sediment Capacity (20" depth)	NJDEP Sediment Capacity (50% of standard depth)
S3	36"	212 gallons	0.44 cubic yards	0.22 cubic yards
S4	48"	564 gallons	0.78 cubic yards	0.39 cubic yards
S5	60"	881 gallons	1.21 cubic yards	0.61 cubic yards
S6	72"	1269 gallons	1.75 cubic yards	0.88 cubic yards
S8	96"	3835 gallons	3.10 cubic yards	1.55 cubic yards
S10	120"	7496 gallons	4.85 cubic yards	2.43 cubic yards

Maintenance Instructions

1. Remove the manhole cover to provide access to the pollutant storage. Pollutants are stored in the sump, below the bowl assembly visible from the surface. You'll access this area through the 10" diameter access cylinder.

2. Use a vacuum truck or other similar equipment to remove all water, debris, oils and sediment. See figure 1.
3. Use a high pressure hose to clean the manhole of all the remaining sediment and debris. Then, use the vacuum truck to remove the water.
4. Fill the cleaned manhole with water until the level reaches the invert of the outlet pipe.
5. Replace the manhole cover.
6. Dispose of the polluted water, oils, sediment and trash at an approved facility.
   - Local regulations prohibit the discharge of solid material into the sanitary system. Check with the local sewer authority for authority to discharge the liquid.
   - Some localities treat the pollutants as leachate. Check with local regulators about disposal requirements.
   - Additional local regulations may apply to the maintenance procedure.

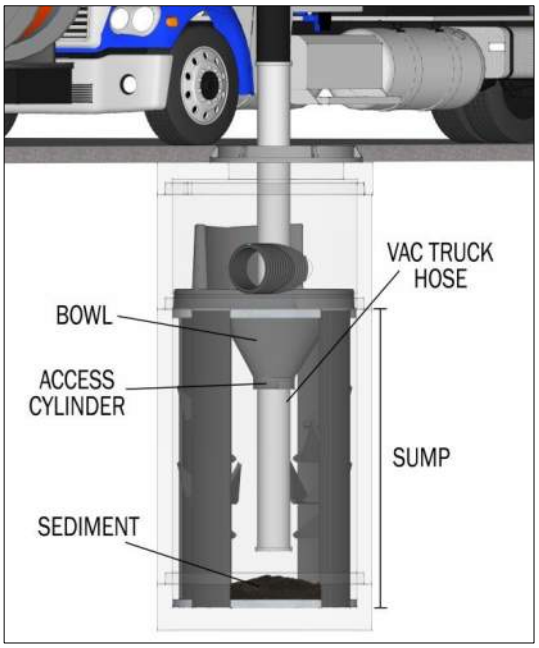


Figure 1

Appendix C-2
ADS Flexstorm Inlet Filter

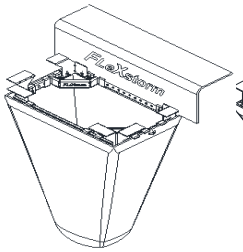
The Most Advanced Name in Water Management Solutions

Tennessee

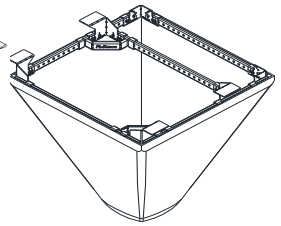
Product selection for FLEXSTORM CATCH-IT Filters (Temporary Inlet Protection)

TDOT Standard	JR HOE Catalog	JBS Catalog #	Inlet Type	Grate Size	Opening Size	Bag Cap. (ft^3)	FX Flow Ratings (CFS)	ADS P/N
TDOT std. #12, #10, #25, #41		3123	Curb Box (CB)	36.25 x 21.75	32.0 x 17.75	3.4	2.0	62LCBFX
TDOT std. #18		3061	Square/Rect (SQ)	24.875 x 26.25 (x2)	48 x 24	6.2	3.8	62XLSQFX
	HOE 518	4254	Square/Rect (SQ)	24 x 36	22 x 34	3.5	2.4	62LSQ2436FX
	HOE 525	3080	Curb Box (CB)	35.5 x 17.5	33.0 x 16.0	3.8	2.2	62LCBEXTFX
Nashville, TN std. CB		3300	Curb Box (CB)	31.375 x 21.375	29.5 x 19.0	3.3	2.0	62LCBFX
	HOE 280	4075	Square/Rect (SQ)	24 x 24	22 x 22	2.2	1.8	62MS22QFX
Memphis TN std. #10	HOE 320	4190	Square/Rect (SQ)	25.75 x 25.75	23.75 x 23.75	3.1	1.9	62MSQFX
		4220/4330	Square/Rect (SQ)	27.75 x 27.75	26 x 26	5.0	2.3	62LSQFX
Metro Nashville std.	HOE 568	4300/4310/4315	Square/Rect (SQ)	31.5 x 31.5	30.0 x 30.0	5.4	2.5	62XLSQFX
TDOT std. #42	HOE 595	4200/4260	Square/Rect (SQ)	35.5 x 35.5	33.25 X 33.25	6.1	2.6	62XLSQFX

FLEXSTORM INLET FILTERS CATCH IT



62LCBFX with Curb Flap to cover curb hood opening.

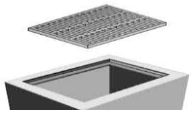


62LCBEXTFX with Extended Back Fits under the curb hood.

Square/Rectangular (SQ)

Rolled Curb (RC)

Curb Box (CB)



Square/Rect on Concrete Box (HD)

Round (RD)

Product selection for FLEXSTORM PURE Filters (Permanent Inlet Protection)

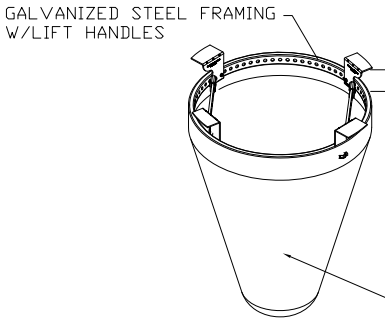
TDOT Standard	JR HOE Catalog	JBS Catalog #	Inlet Type	Grate Size	Opening Size	Bag Cap. (ft^3)	Flow Ratings (CFS)			ADS P/N			
							FX/FX+	PC/PC+	Bypass	FX	FX+	PC	PC+
TDOT std. #12, #10, #25, #41		3123	Curb Box (CB)	36.25 x 21.75	32.0 x 17.75	3.4	2.0	1.7	5.1	62LHDCBFX	62LHDCBFXP	62LHDCBPC	62LHDCBPCP
TDOT std. #18		3061	Square/Rect (SQ)	24.875 x 26.25 (x2)	48 x 24	6.2	3.8	3.2	8.0	62XLHDFX	62XLHDFXP	62XLHDPC	62XLHDPCP
	HOE 518	4254	Square/Rect (SQ)	24 x 36	22 x 34	3.5	2.4	2.0	5.4	62LHD2436FX	62LHD2436FXP	62LHD2436PC	62LHD2436PCP
	HOE 525	3080	Curb Box (CB)	35.5 x 17.5	33.0 x 16.0	3.8	2.2	1.9	5.9	62LHDEXTCBFX	62LHDEXTCBFX	62LHDEXTCBFX	62LHDEXTCBFX
Nashville, TN std. CB		3300/3300-V	Curb Box (CB)	31.375 x 21.375	29.5 x 19.0	3.3	2.0	1.7	5.1	62LHDFX	62LHDFXP	62LHDPC	62LHDPCP
	HOE 280	4075	Square/Rect (SQ)	24 x 24	22 x 22	2.4	1.9	1.4	4.4	62MHD22FX	62MHD22FXP	62MHD22FX	62MHD22PCP
Memphis TN std. #10	HOE 320	4190	Square/Rect (SQ)	25.75 x 25.75	23.75 x 23.75	3.1	1.9	1.6	4.7	62MHDFX	62MHDFXP	62MHDPC	62MHDPCP
		4220/4330	Square/Rect (SQ)	27.75 x 27.75	26 x 26	3.4	2.2	1.9	5.4	62LHDFX	62LHDFXP	62LHDPC	62LHDPCP
Metro Nashville std.	HOE 568	4300/4310/4315	Square/Rect (SQ)	31.5 x 31.5	30.0 x 30.0	5.4	2.5	2.1	6.3	62LHDFX	62LHDFXP	62LHDPC	62LHDPCP
TDOT std. #42	HOE 595	4200/4260	Square/Rect (SQ)	35.5 x 35.5	33.25 X 33.25	6.5	2.7	2.4	6.9	62XLHDFX	62XLHDFXP	62XLHDPC	62XLHDPCP

*Once bypass flow rates are reached water bypasses over top back of filter, this results in unlimited bypass capacity in Wall Mounted Units

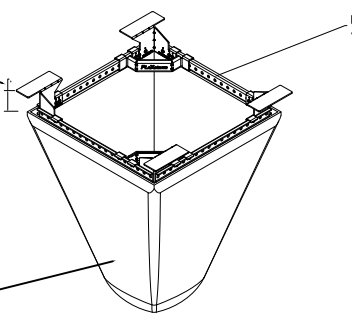
Flexstorm Accessories	
62CTSB	Included with every FX+ and PC+ bag, this pouch skims hydrocarbons from the storm water.
62UMT	Flexstorm's Patented 2 man Flexstorm Matintenance and Grate removal tool. Remove 400 lb grates and service full Flexstorm filters without the use of a machine.

FLEXSTORM CATCH-IT FILTERS FOR TEMPORARY INLET PROTECTION
PRODUCT SELECTION AND SPECIFICATION DRAWING

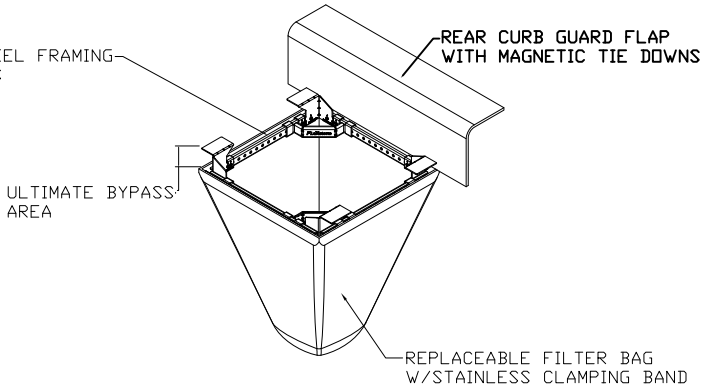
TENNESSEE



FLEXSTORM CATCH-IT INLET FILTERS
FOR ROUND OPENINGS



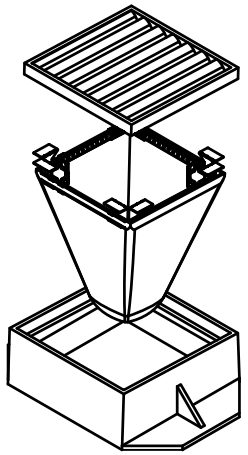
FLEXSTORM CATCH-IT INLET FITLERS FOR
SQUARE/RECTANGULAR OPENINGS



FLEXSTORM CATCH-IT INLET FITLERS FOR
CURB BOX OPENINGS (MAGNETIC CURB FLAP)

Product selection for FLEXSTORM CATCH-IT Filters (Temporary Inlet Protection)

TDOT Standard	JR HOE Catalog	JBS Catalog #	Inlet Type	Grate Size	Opening Size	Bag Cap. (ft^3)	FX Flow Ratings (CFS)	ADS P/N
TDOT std. #12, #10, #25, #41		3123	Curb Box (CB)	36.25 x 21.75	32.0 x 17.75	3.4	2.0	62LCBFX
TDOT std. #18		3061	Square/Rect (SQ)	24.875 x 26.25 (x2)	48 x 24	6.2	3.8	62XLSQFX
	HOE 518	4254	Square/Rect (SQ)	24 x 36	22 x 34	3.5	2.4	62LSQ2436FX
	HOE 525	3080	Curb Box (CB)	35.5 x 17.5	33.0 x 16.0	3.8	2.2	62LCBEXTFX
Nashville, TN std. CB		3300	Curb Box (CB)	31.375 x 21.375	29.5 x 19.0	3.3	2.0	62LCBFX
	HOE 280	4075	Square/Rect (SQ)	24 x 24	22 x 22	2.2	1.8	62MS22QFX
Memphis TN std. #10	HOE 320	4190	Square/Rect (SQ)	25.75 x 25.75	23.75 x 23.75	3.1	1.9	62MSQFX
		4220/4330	Square/Rect (SQ)	27.75 x 27.75	26 x 26	5.0	2.3	62LSQFX
Metro Nashville std.	HOE 568	4300/4310/4315	Square/Rect (SQ)	31.5 x 31.5	30.0 x 30.0	5.4	2.5	62XLSQFX
TDOT std. #42	HOE 595	4200/4260	Square/Rect (SQ)	35.5 x 35.5	33.25 X 33.25	6.1	2.6	62XLSQFX



*FLOW RATINGS SHOWN ARE 50% MAXIMIUM

NOTES:

1. ALL FRAMING IS CONSTRUCTED OF CORROSION RESISTANT STEEL FRAMING FOR PROLONGED PRODUCT LIFE.
2. TOTAL BYPASS CAPACITY WILL VARY WITH EACH SIZED DRAINAGE STRUCTURE. FLEXSTORM DESIGNS FRAMING BYPASS TO MEET OR EXCEED THE DESIGN FLOW OF THE PARTICULAR DRAINAGE STRUCTURE. CONCRETE STRUCUTRES MAY REQUIRE ADDITIONAL REVIEW.
3. UPON ORDERING THE ADS P/N CONFIRMATION OF THE DOT CALLOUT, FLEXSTORM ITEM CODE, CASTING MAKE AND MODEL, OR DETAILED DIMENSIONAL FORMS MUST BE PROVIDED.
4. FOR WRITTEN SPECIFICATIONS AND MAINTENANCE GUIDELINES VISIT WWW.INLETFILTERS.COM

INSTALLATION:

1. REMOVE GRATE
2. DROP FLEXSTORM INLET FILTER ONTO LOAD BEARING LIP OF CASTING OR CONCRETE STRUCTURE
3. REPLACE GRATE

FLEXSTORM® INLET FILTERS
CATCH-IT®

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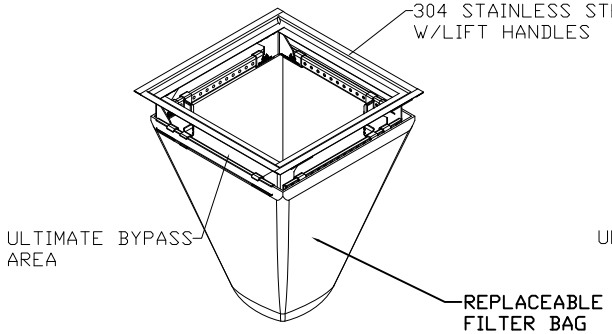
BY INLET & PIPE PROTECTION, INC
A DIVISION OF ADS, INC.
WWW.INLETFILTERS.COM
(866) 287-8655 PH
(630) 355-3477 FX
INFO@INLETFILTERS.COM

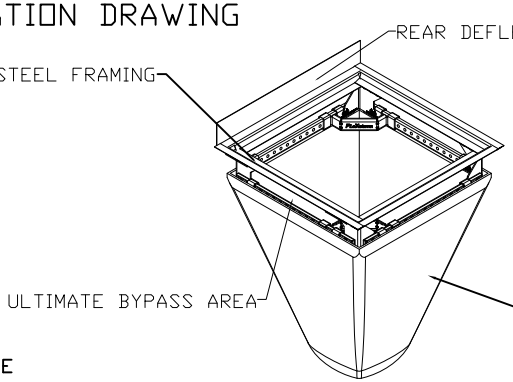
SIZE		DWG NO	REV
C		C-TN-SUBMIT	A
SCALE		SHEET 1 OF 1	

FLEXSTORM PURE FILTERS FOR PERMANENT INLET PROTECTION
PRODUCT SELECTION AND SPECIFICATION DRAWING

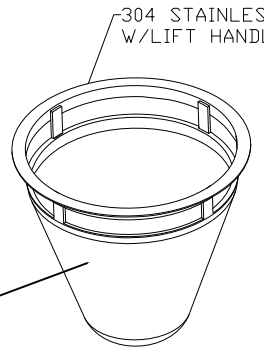
TENNESSEE



FLEXSTORM PURE INLET FILTERS FOR RECTANGULAR OPENINGS WITH GRATES



FLEXSTORM PURE INLET FILTERS FOR CURB INLETS



FLEXSTORM PURE INLET FILTERS FOR ROUND OPENINGS

Product selection for FLEXSTORM PURE Filters (Permanent Inlet Protection)

TDOT Standard	JR HOE Catalog	JBS Catalog #	Inlet Type	Grate Size	Opening Size	Bag Cap. (ft^3)	Flow Ratings (CFS)			ADS P/N			
							FX/FX+	PC/PC+	Bypass	FX	FX+	PC	PC+
TDOT std. #12, #10, #25, #41		3123	Curb Box (CB)	36.25 x 21.75	32.0 x 17.75	3.4	2.0	1.7	5.1	62LHDCBFX	62LHDCBFXP	62LHDCBPC	62LHDCBPCP
TDOT std. #18		3061	Square/Rect (SQ)	24.875 x 26.25 (x2)	48 x 24	6.2	3.8	3.2	8.0	62XLHDFX	62XLHDFXP	62XLHDPC	62XLHDPCP
	HOE 518	4254	Square/Rect (SQ)	24 x 36	22 x 34	3.5	2.4	2.0	5.4	62LHD2436FX	62LHD2436FXP	62LHD2436PC	62LHD2436PCP
	HOE 525	3080	Curb Box (CB)	35.5 x 17.5	33.0 x 16.0	3.8	2.2	1.9	5.9	62LHDEXTCBFX	62LHDEXTCBFX	62LHDEXTCBFX	62LHDEXTCBFX
Nashville, TN std. CB		3300/3300-V	Curb Box (CB)	31.375 x 21.375	29.5 x 19.0	3.3	2.0	1.7	5.1	62LHDFX	62LHDFXP	62LHDPC	62LHDPCP
	HOE 280	4075	Square/Rect (SQ)	24 x 24	22 x 22	2.4	1.9	1.4	4.4	62MHD22FX	62MHD22FXP	62MHD22FX	62MHD22PCP
Memphis TN std. #10	HOE 320	4190	Square/Rect (SQ)	25.75 x 25.75	23.75 x 23.75	3.1	1.9	1.6	4.7	62MHDFX	62MHDFXP	62MHDPC	62MHDPCP
		4220/4330	Square/Rect (SQ)	27.75 x 27.75	26 x 26	3.4	2.2	1.9	5.4	62LHDFX	62LHDFXP	62LHDPC	62LHDPCP
Metro Nashville std.	HOE 568	4300/4310/4315	Square/Rect (SQ)	31.5 x 31.5	30.0 x 30.0	5.4	2.5	2.1	6.3	62LHDFX	62LHDFXP	62LHDPC	62LHDPCP
TDOT std. #42	HOE 595	4200/4260	Square/Rect (SQ)	35.5 x 35.5	33.25 X 33.25	6.5	2.7	2.4	6.9	62XLHDFX	62XLHDFXP	62XLHDPC	62XLHDPCP

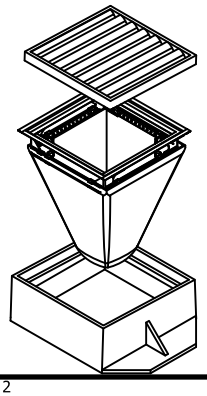
*FLOW RATINGS SHOWN ARE 50% MAXIMIUM

NOTES:

1. ALL FRAMING IS CONSTRUCTED OF 304 STAINLESS STEEL FOR 25 YEAR SERVICE LIFE RATING
2. TOTAL BYPASS CAPACITY WILL VARY WITH EACH SIZED DRAINAGE STRUCTURE. FLEXSTORM DESIGNS FRAMING BYPASS TO MEET OR EXCEED THE DESIGN FLOW OF THE PARTICULAR DRAINAGE STRUCTURE.
3. UPON ORDERING ADS P/N CONFIRMATION OF THE DOT CALLOUT, FLEXSTORM ITEM CODE, CASTING MAKE AND MODEL, OR DETAILED DIMENSIONAL FORMS MUST BE PROVIDED.
4. FOR WRITTEN SPECIFICATIONS AND MAINTENANCE GUIDELINES VISIT WWW.INLETFILTERS.COM

INSTALLATION:

1. REMOVE GRATE
2. DROP FLEXSTORM INLET FILTER ONTO LOAD BEARING LIP OF CASTING OR CONCRETE STRUCTURE
3. REPLACE GRATE



FLEXSTORM INLET FILTERS PURE

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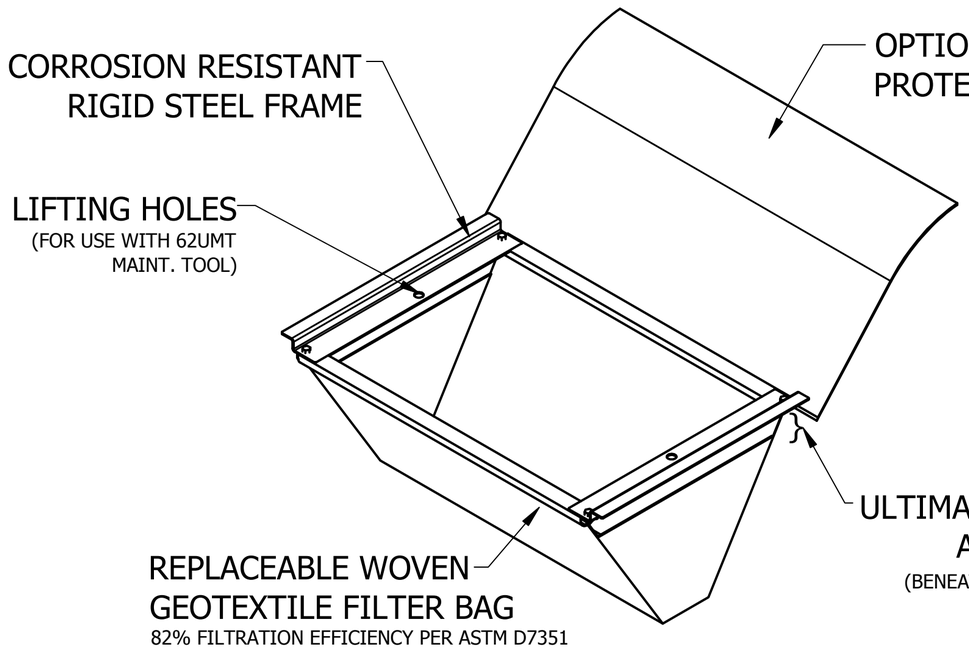
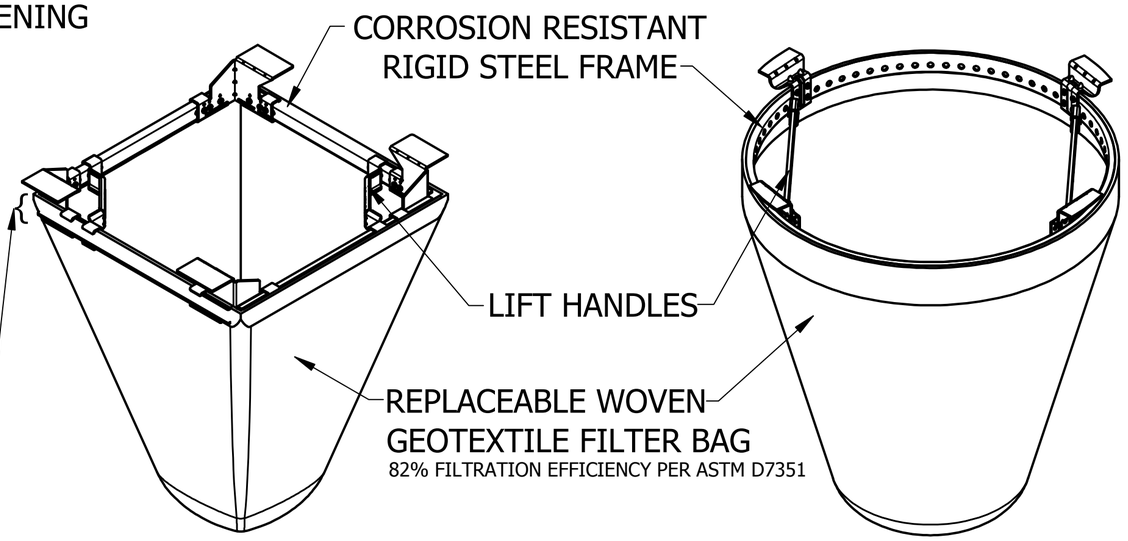
SIZE		DWG NO	REV
C		P-TN-SUBMIT	A
SCALE		SHEET 1 OF 1	

FLEXSTORM Specification Drawing
ASTM D8057 Standard Specification for Inlet Filters with a Rigid Frame



FLEXSTORM CATCH-IT LITE
(SHOWN WITH OPTIONAL CURB FLAP)



FLEXSTORM CATCH-IT SQUARE
(TYPICAL SETUP)

FLEXSTORM CATCH-IT ROUND
(TYPICAL SETUP)

ASTM D8057 Requirements

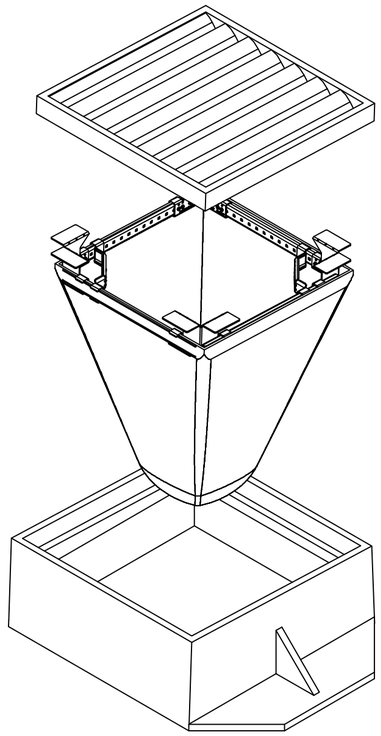
-> Filter system consists of rigid frame and removable geosynthetic bag
-> Filter bag sized to meet treatment flow rate of the drainage location
-> Bag maintains shape to be extracted when completely filled with sediment
-> Rigid frame capable of supporting full load of sediment with grate removed
-> Frame does not interfere or elevate grate by more than 1/8"
-> Bypass flow exceeds design flow of drainage location
-> Filter bag achieves >80% filtration efficiency per ASTM D7351

Installation Instructions:

1. Remove grate from the drainage structure
2. Clean stone and dirt from ledge (lip) of drainage structure
3. Drop the FLEXSTORM inlet filter through the clear opening such that the hangers rest firmly on the lip of the structure
4. Replace the grate and confirm it is not elevated more than 1/8"

Maintenance Guidelines:

1. Empty the sediment bag if more than half filled with sediment and debris
2. Remove the grate, engage the lifting points, and lift filter from the drainage structure
3. Dispose of sediment and debris as directed by the Engineer or Maintenance Contract
4. Alternatively, an industrial vacuum can be used to collect sediment from filter bag



For more information contact
APM@inletfilters.com

Inletfilters.com 630-355-3288

FLEXSTORM ASTM D8057 SPECIFICATION DRAWING

FLEXSTORM™ Inlet Filter Specifications and Work Instructions

Product: **FLEXSTORM Inlet Filters**

Manufacturer: **Inlet & Pipe Protection, Inc** www.inletfilters.com

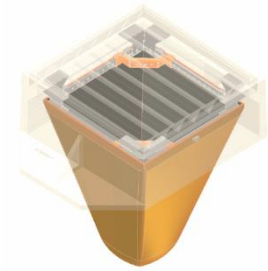
A subsidiary of **Advanced Drainage Systems (ADS)** www.ads-pipe.com

1.0 Description of Work:

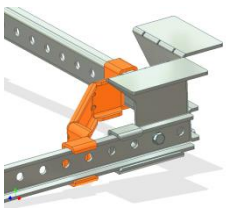
1.1 The work covered shall consist of supplying, installing, and maintaining/cleaning of the FLEXSTORM Inlet Filter assembly. The purpose of the FLEXSTORM Inlet Filter system is to collect silt and sediment from surface storm water runoff at drainage locations shown on the plans or as directed by the Engineer. FLEXSTORM PURE, permanent filters, are capable of removing small particles, hydrocarbons, and other contaminants from drainage "hot spots".

2.0 Material:

2.1 The FLEXSTORM Inlet Filter system is comprised of a corrosion resistant steel frame and a replaceable geotextile sediment bag attached to the frame with a stainless steel locking band. The sediment bag hangs suspended from the rigid frame at a distance below the grate that shall allow full water flow into the drainage structure if the bag is completely filled with sediment.

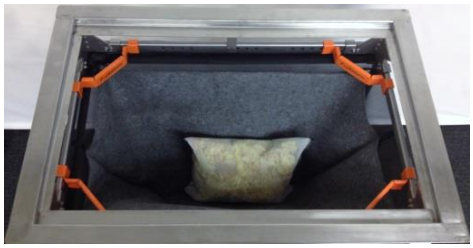



2.2 The FLEXSTORM Inlet Filter frame includes lifting handles in addition to the standard overflow feature. A FLEXSTORM Removal Tool engages the lifting bars or handles to allow manual removal of the assembly without machine assistance. The frame suspension system on most rectangular designs is adjustable in ½" increments up to 5" per side should the casting or drainage structure have imperfections.


2.3 **FLEXSTORM CATCH-IT** Inlet Filters for temporary inlet protection: The FLEXSTORM CATCH-IT framing is galvanized or zinc plated for corrosion resistance. The **"FX"** Woven Polypropylene filter bag is the design standard, although the **"IL"** Nonwoven geotextile is also available if preferred by the engineer. These products are typically used for temporary inlet protection lasting 3 months (short term road work) to 5 years (residential developments).

2.4 **FLEXSTORM PURE** Inlet Filters for permanent inlet protection: The FLEXSTORM PURE framing is comprised of 304 stainless steel with a 25 year life rating. Multiple filter bags are available: **FX, FX+, PC, PC+, LL** and others. The Post Construction **"PC+"** is the design standard consisting of the **"FX"** Woven Polypropylene sediment bag lined with Adsorb-it filter fabric, which is made from recycled polyester fibers. The **"PC+"** includes a replaceable hydrocarbon skimmer pouch strapped to the bottom of the bag for advanced TPH removal.



3.0 Filter Bag Specifications and Capabilities:

3.1 Material Properties (taken from manufacturers average roll value):

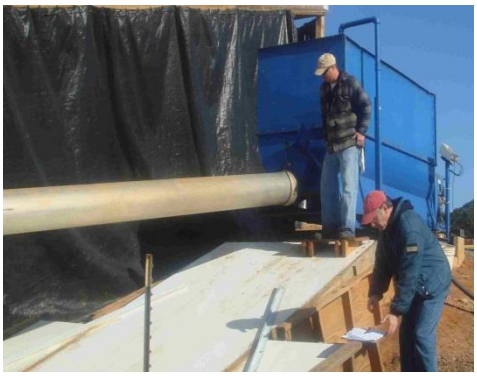
FLEXSTORM FILTER BAGS	(22" depth) STD Bag P/N	(12" depth) Short Bag P/N	Clean Water Flow Rate (GPM/SqFt)	Min A.O.S. (US Sieve)
FX: Standard Woven Bag	FX	FX-S	200	40
FX+: Woven w/ Oil Skimmer	FXP	FXP-S	200	40
FXO: Woven w/ Oil Boom	FXO	FXO-S	200	40
PC: Post Construction Bag	PC	PC-S	137	140
PC+: PC w/ Oil Skimmer	PCP	PCP-S	137	140
LL: Litter and Leaf Bag	LL	LL-S	High	3.5
IL: IDOT Non-Woven Bag	IL	IL-S	145	70

3.2 Standard Bag Sizes and Capabilities: Bag Sizes are determined by clear opening dimensions of the drainage structure. Once frame design size is confirmed, Small - XL bag ratings can be confirmed to meet design criteria. Ratings below are for standard 22" deep bags.

Standard Bag Size§	Solids Storage Capacity (CuFt)	Filtered Flow Rate at 50% Max (CFS)			Oil Retention (Oz)	
		FX	PC	IL	PC*	PCP**
Small	1.6	1.2	0.8	0.9	66	155
Medium	2.1	1.8	1.2	1.3	96	185
Large	3.8	2.2	1.5	1.6	120	209
XL	4.2	3.6	2.4	2.6	192	370

4.0 Tested Filtration Efficiency and Removal Rates: Filtration Efficiency, TSS, and TPH testing performed under large scale, real world conditions at accredited third party erosion and sediment control testing laboratory. (See Full Test Reports at www.inletfilters.com)

Inside View of Hopper Agitator



Hopper With Outlet Pipe Leading To Area Inlet

Area Inlet Simulated Showing Influent Discharge From Pipe

4.1 **FLEXSTORM "FX" Filtration Efficiency Test Results:** All testing performed in general accordance with the ASTM D 7351, *Standard Test Method For Determination of Sediment Retention Device Effectiveness in Sheet Flow Application,* with flow diverted into an area inlet. Test Soil used as sediment had the following characteristics with a nominal 7% sediment to water concentration mix. This is representative of a heavy sediment load running off of a construction site.

Soil Characteristics	Test Method	Value		Filtration Efficiency of "FX" FLEXSTORM Bag
% Gravel	ASTM D 422	2		**82%**
% Sand		60		
% Silt		24		
% Clay		14		
Liquid Limit, %	ASTM D 4318	34		
Plasticity Index, %		9		
Soil Classification	USDA	Sandy Loam		
Soil Classification	USCS	Silty Sand (SM)		

4.2 **FLEXSTORM "PC" and "PC+" Test Results:** TSS measured on effluent samples in accordance with SM 2540D and TPH in accordance with EPA 1664A.

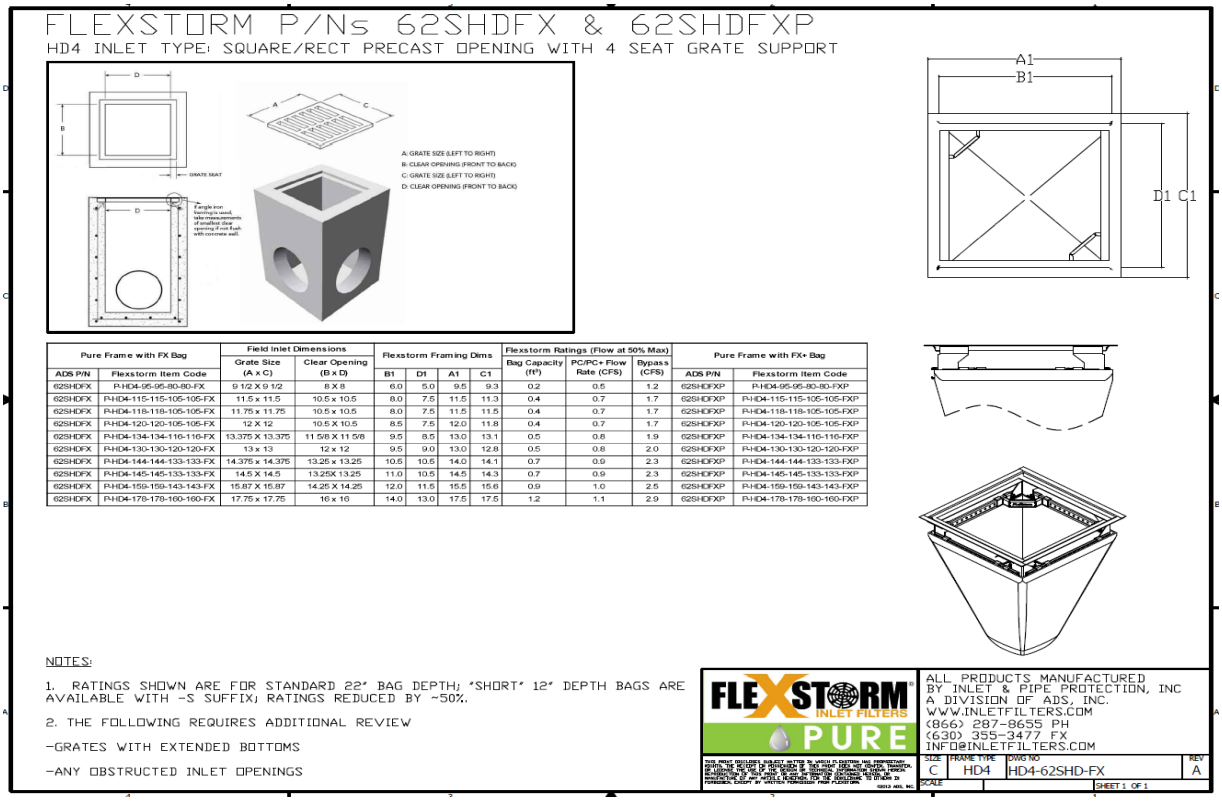
Product Tested	110 micron Sediment Load	Ave Flow Rate GPM	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	1750 mg/L using OK-110 Silica Sand and Clean Water	23	**99.28%**	98.96%
		48	**99.32%**	99.25%
		70	**98.89%**	98.80%

Product Tested	Street Sweep Sediment Load	Particle Size of Sediment Load	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	2.5% = 100 lbs Sed / 4000 lbs water	.001 mm – 10.0 mm (median 200 micron)	**99.68%**	95.61%

Product Tested	Hydrocarbon Load	Ave Flow Rate GPM	% TPH Removal	Oil Retention Efficiency
FLEXSTORM PC+	243 mg/L using 750 mL (1.45 lb) used motor oil + lube oil and clean water	19	**99.04%**	97.22%
FLEXSTORM PC		20	**97.67%**	91.61%
FLEXSTORM PC+		92	**96.88%**	99.11%

5.0 Identification of Drainage Structures to Determine FLEXSTORM Item Codes:

5.1 The Installer (Contactor) shall inspect the plans and/or worksite to determine the quantity of each drainage structure casting type. The foundry casting number or the exact grate size and clear opening size will provide the information necessary to identify the required FLEXSTORM Inlet Filter part number. Inlet Filters are supplied to the field pre-configured to fit the specified drainage structure. Item Codes can be built using the FLEXSTORM Product Configurator at www.inletfilters.com. Detailed Submittal / Specification drawings are linked to each Item Code and available for download by engineers and contractors to include on plans and/or verify field inlet requirements. An example of a typical drawing is shown below.



Pure Frame with FX Bag		Field Inlet Dimensions		Flexstorm Framing Dims				Flexstorm Ratings (Flow at 50% Max)			Pure Frame with FX+ Bag	
		Grate Size (A x C)	Clear Opening (B x D)					Bag Capacity (ft³)	PC/PC+ Flow Rate (CFS)	Bypass (CFS)		
ADS P/N	Flexstorm Item Code			B1	D1	A1	C1				ADS P/N	Flexstorm Item Code
62SHDFX	P-HD4-95-95-80-80-FX	9 1/2 X 9 1/2	8 X 8	6.0	5.0	9.5	9.3	0.2	0.5	1.2	62SHDFXP	P-HD4-95-95-80-80-FXP
62SHDFX	P-HD4-115-115-105-105-FX	11.5 x 11.5	10.5 x 10.5	8.0	7.5	11.5	11.3	0.4	0.7	1.7	62SHDFXP	P-HD4-115-115-105-105-FXP
62SHDFX	P-HD4-118-118-105-105-FX	11.75 x 11.75	10.5 x 10.5	8.0	7.5	11.5	11.5	0.4	0.7	1.7	62SHDFXP	P-HD4-118-118-105-105-FXP
62SHDFX	P-HD4-120-120-105-105-FX	12 X 12	10.5 X 10.5	8.5	7.5	12.0	11.8	0.4	0.7	1.7	62SHDFXP	P-HD4-120-120-105-105-FXP
62SHDFX	P-HD4-134-134-116-116-FX	13.375 X 13.375	11 5/8 X 11 5/8	9.5	8.5	13.0	13.1	0.5	0.8	1.9	62SHDFXP	P-HD4-134-134-116-116-FXP
62SHDFX	P-HD4-130-130-120-120-FX	13 x 13	12 x 12	9.5	9.0	13.0	12.8	0.5	0.8	2.0	62SHDFXP	P-HD4-130-130-120-120-FXP
62SHDFX	P-HD4-144-144-133-133-FX	14.375 x 14.375	13.25 x 13.25	10.5	10.5	14.0	14.1	0.7	0.9	2.3	62SHDFXP	P-HD4-144-144-133-133-FXP
62SHDFX	P-HD4-145-145-133-133-FX	14.5 X 14.5	13.25X 13.25	11.0	10.5	14.5	14.3	0.7	0.9	2.3	62SHDFXP	P-HD4-145-145-133-133-FXP
62SHDFX	P-HD4-159-159-143-143-FX	15.87 X 15.87	14.25 X 14.25	12.0	11.5	15.5	15.6	0.9	1.0	2.5	62SHDFXP	P-HD4-159-159-143-143-FXP
62SHDFX	P-HD4-178-178-160-160-FX	17.75 x 17.75	16 x 16	14.0	13.0	17.5	17.5	1.2	1.1	2.9	62SHDFXP	P-HD4-178-178-160-160-FXP

6.0 Installation Into Standard Grated Drainage Structures:

6.1 Remove the grate from the casting or concrete drainage structure. Clean the ledge (lip) of the casting frame or drainage structure to ensure it is free of stone and dirt. Drop in the FLEXSTORM Inlet Filter through the clear opening and be sure the suspension hangers rest firmly on the inside ledge (lip) of the casting. Replace the grate and confirm it is elevated no more than 1/8", which is the thickness of the steel hangers. For Curb Box Inlet Filters: Insert FLEXSTORM CATCH IT Inlet Filter as described above, pull the rear curb guard flap up and over the open curb box until tight, align magnets to ensure firm attachment to the top portion of the curb box casting. If the curb back opening is not magnetic, slide a typical rock sack or 2 x 4 through the 2-ply rear curb box flap to create a dam which will direct runoff into the sediment bag.




7.0 Maintenance Guidelines: The frequency of maintenance will vary depending on the application (during construction, post construction, or industrial use), the area of installation (relative to grade and runoff exposure), and the time of year relative to the geographic location (infrequent rain, year round rain, rain and snow conditions). The FLEXSTORM Operation & Maintenance Plan (as shown in 7.5) or other maintenance log should be kept on file.

7.1 Frequency of Inspections: Construction site inspection should occur following each ½" or more rain event. Post Construction inspections should occur three times per year (every four months) in areas with year round rainfall and three times per year (every three months) in areas with rainy seasons before and after snowfall season. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than three times per year.

7.2 General Maintenance for standard sediment bags: Upon inspection, the FLEXSTORM Inlet Filter should be emptied if the sediment bag is more than half filled with sediment and debris, or as directed by the Engineer. Remove the grate, engage the lifting bars or handles with the FLEXSTORM Removal Tool, and lift the FLEXSTORM Inlet Filter from the drainage structure. Machine assistance is not required. Dispose of the sediment or debris as directed by the Engineer. As an alternative, an industrial vacuum may be used to collect the accumulated sediment if available. Remove any caked on silt from the sediment bag and reverse flush the bag for optimal filtration. Replace the bag if the geotextile is torn or punctured to ½" diameter or greater on the lower half of the bag. If properly maintained, the Woven sediment bag will last a minimum of 4 years in the field.

7.3 Inspection and Handling of the FLEXSTORM PC / PC+ post construction sediment bag: The PC+ sediment bags will collect oil until saturated. Both the Adsorb-it filter liner and the skimmer pouch will retain oil. The volume of oils retained will depend on sediment bag size. Unlike other passive oil sorbent products, Adsorb-it filter fabric has the ability to remove hydrocarbons at high flow rates while retaining 10- 20 times its weight in oil (weight of fabric is 12.8 oz / sq yd). The average 2' x 2' PC Bag contains approx .8 sq yds, or 10 oz of fabric. At 50% saturation, the average Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil. Once the bag has become saturated with oils, it can be centrifuged or passed through a wringer to recover the oils, and the fabric reused with 85% to 90% efficacy. If it is determined, per Maintenance Contracts or Engineering Instructions, that the saturated PC sediment bags will be completely replaced, it is the responsibility of the service technician to place the filter medium and associated debris in an approved container and dispose of in accordance with EPA regulations. Spent Adsorb-it can be recycled for its fuel value through waste to energy incineration with a higher BTU per pound value than coal. The oil skimmers start white in color and will gradually turn brown/black as they become saturated, indicating time for replacement. The average skimmer pouch will absorb approximately 62 oz (4 lbs) of oil before requiring replacement. To remove the pouch simply unclip it from the swivel strap sewn to the bottom of the bag. Dispose of all oil contaminated products in accordance to EPA guidelines. The ClearTec Rubberizer media used in the pouch, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

7.4 Sediment Bag Replacement: When replacing a Sediment Bag, remove the bag by loosening or cutting off the clamping band. Take the new sediment bag, which is equipped with a stainless steel worm drive clamping band, and use a drill or screw driver to tighten the bag around the frame channel. Ensure the bag is secure and that there is no slack around the perimeter of the band. For Oil absorbent boom bags, simply replace the oil boom or pouch when saturated by sliding it through the mesh support sleeve.

FLEXSTORM OPERATION AND MAINTENANCE PLAN

OPERATION & MAINTENANCE PLAN

Installation Instructions:

1. Remove grate from the drainage structure
2. Clean stone and dirt from ledge (lip) of drainage structure
3. Drop the FLEXSTORM inlet filter through the clear opening such that the hangers rest firmly on the lip of the structure.
4. Replace the grate and confirm it is not elevated more than 1/8", the thickness of the steel hangers.

Frequency of Inspections:

1. Inspection should occur following any rain event >½".
2. Post construction inspections should occur 4 times per year. In snowfall affected regions additional inspections should take place before and after snowfall season.
3. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than 3 times/year.

Maintenance Guidelines:

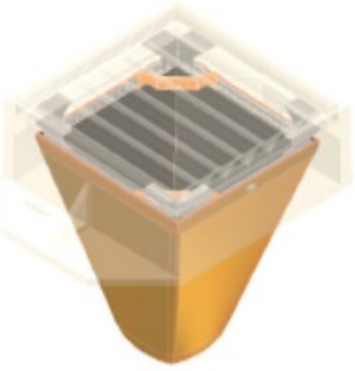
1. Empty the sediment bag if more than half filled with sediment and debris, or as directed.
2. Remove the grate, engage the lifting bars with the FLEXSTORM Removal Tool, and lift from drainage structure.
3. Dispose of sediment or debris as directed by the Engineer or Maintenance contract.
4. An industrial vacuum can be used to collect sediment.
5. Remove caked on silt from sediment bag and flush with Medium spray with optimal filtration.
6. Replace bag if torn or punctured to >½" diameter on lower half of bag.

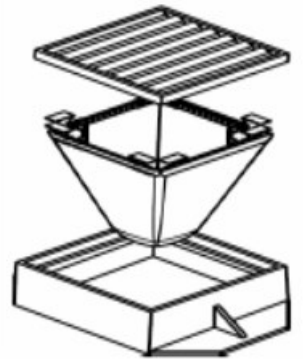
Post Construction PC Bag Maintenance:

1. At 50% saturation the average 2'x2' Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil and should be serviced. To recover the oils the filter can be centrifuged or passed through a wringer.
2. Oil skimmer pouches start to turn black when saturated, indicating time for replacement. Each ClearTec Rubberizer pouch will absorb ~62oz (4 lbs) of oil before needing replacement.
3. Dispose of all oil contaminated products in accordance with EPA guidelines. ClearTec Rubberizer, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

Sediment Bag Replacement:

1. Remove the bag by loosening or cutting off clamping bag.
2. Take new sediment bag and secure worm drive clamping band to the frame channel.
3. Ensure Bag is secure and there is no slack around perimeter.





STRUCTURE ID#/LOCATION:

DATE	TASK PERFORMED	INSPECTOR

Appendix C-3
Oldcastle Flogard Plus Catch Basin Insert Filter

Oldcastle Infrastructure™
A CRH COMPANY

FLOGARD+PLUS®
CATCH BASIN INSERT FILTER

Inspection and Maintenance Guide

DRAINAGE PROTECTION SYSTEMS
DPS
A division of
Oldcastle Infrastructure

Water

SCOPE:

Federal, State and Local Clean Water Act regulations and those of insurance carriers require that stormwater filtration systems be maintained and serviced on a recurring basis. The intent of the regulations is to ensure that the systems, on a continuing basis, efficiently remove pollutants from stormwater runoff thereby preventing pollution of the nation's water resources. These specifications apply to the FloGard+Plus® Catch Basin Insert Filter.

RECOMMENDED FREQUENCY OF SERVICE:

Drainage Protection Systems (DPS) recommends that installed FloGard+Plus Catch Basin Insert Filters be serviced on a recurring basis. Ultimately, the frequency depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, cans, paper, etc.); however, it is recommended that each installation be serviced a minimum of three times per year, with a change of filter medium once per year. DPS technicians are available to do an on-site evaluation, upon request.

RECOMMENDED TIMING OF SERVICE:

DPS guidelines for the timing of service are as follows:

1. For areas with a definite rainy season: Prior to, during and following the rainy season.
2. For areas subject to year-round rainfall: On a recurring basis (at least three times per year).
3. For areas with winter snow and summer rain: Prior to and just after the snow season and during the summer rain season.
4. For installed devices not subject to the elements (wash racks, parking garages, etc.): On a recurring basis (no less than three times per year).

SERVICE PROCEDURES:

1. The catch basin grate shall be removed and set to one side. The catch basin shall be visually inspected for defects and possible illegal dumping. If illegal dumping has occurred, the proper authorities and property owner representative shall be notified as soon as practicable.
2. Using an industrial vacuum, the collected materials shall be removed from the liner. (Note: DPS uses a truck-mounted vacuum for servicing FloGard+Plus catch basin inserts).
3. When all of the collected materials have been removed, the filter medium pouches shall be removed by unsnapping the tether from the D-ring and set to one side. The filter liner, gaskets, stainless steel frame and mounting brackets, etc., shall be inspected for continued serviceability. Minor damage or defects found shall be corrected on-the-spot and a notation made on the Maintenance Record. More extensive deficiencies that affect the efficiency of the filter (torn liner, etc.), if approved by the customer representative, will be corrected and an invoice submitted to the representative along with the Maintenance Record.
4. The filter medium pouches shall be inspected for defects and continued serviceability and replaced as necessary, and the pouch tethers re-attached to the liner's D-ring.
5. The grate shall be replaced.

REPLACEMENT AND DISPOSAL OF EXPOSED FILTER MEDIUM AND COLLECTED DEBRIS

The frequency of filter medium exchange will be in accordance with the existing DPS-Customer Maintenance Contract. DPS recommends that the medium be changed at least once per year. During the appropriate service, or if so determined by the service technician during a non-scheduled service, the filter medium will be replaced with new material. Once the exposed pouches and debris have been removed, DPS has possession and must dispose of it in accordance with local, state and federal agency requirements.

DPS also has the capability of servicing all manner of storm drain filters, catch basin inserts and catch basins without inserts, underground oil/water separators, stormwater interceptors and other such devices. All DPS personnel are highly qualified technicians and are confined-space trained and certified. Call us at (888) 950-8826 for further information and assistance.

FLOGARD+PLUS®
CATCH BASIN INSERT FILTER

OUR MARKETS

BUILDING STRUCTURES

COMMUNICATIONS

WATER

ENERGY

TRANSPORTATION

Appendix C-4
Terrafix SILTSACK Brochure

terrafix®
geosynthetics inc.

Construction Sequence

To install the SILTSACK® in the catch basin, remove the grate and place the sack in the opening. Hold approximately six inches of the sack outside the frame. This is the area of the lifting straps. Replace the grate to hold the sack in place.

The SILTSACK® is full and should be emptied when the restraint cord is no longer visible.

To remove the SILTSACK®, take two pieces of 1" diameter rebar and place through the lifting loops on each side of the sack to facilitate the lifting of the SILTSACK®.

To empty the SILTSACK®, place it where the contents will be collected. Place the rebar through the lift straps (connected to the bottom of the sack) and lift. This will turn the SILTSACK® inside out and empty the contents. Clean out and rinse. Return the SILTSACK® to its original shape and place back in the basin.

The SILTSACK® is reusable. Once the construction cycle is complete, remove the SILTSACK® from the basin and clean. The SILTSACK® should be stored out of the sunlight until needed on another project.

SILTSACK® Specifications

Control of Sediment Entering Catch Basins for Storm Water Management

The SILTSACK® will be manufactured from a woven polypropylene geotextile and sewn by a double needle machine, using a high strength nylon thread.

The SILTSACK® seams have a certified average wide width strength per ASTM D-4884 standards as follows:

SILTSACK® Style	Test Method	Minimum Values
Regular Flow	ASTM D-4884	165.0 lbs./in

The SILTSACK® will be manufactured to fit the opening of the catch basin or drop inlet. The SILTSACK® will have the following features: two dump straps attached at the bottom to facilitate the emptying of the SILTSACK®; the SILTSACK® will also have lifting loops as an integral part of the system to be used to lift the SILTSACK® from the basin. The SILTSACK® will have a restraint cord approximately halfway up the sack to keep the sides away from the catch basin walls, this yellow cord is also a visual means of indicating when the sack should be emptied. Once the strap is covered with sediment, the SILTSACK® should be emptied, cleaned, and placed back into the basin.

The geotextile fabric will be woven polypropylene fabric with the following properties:

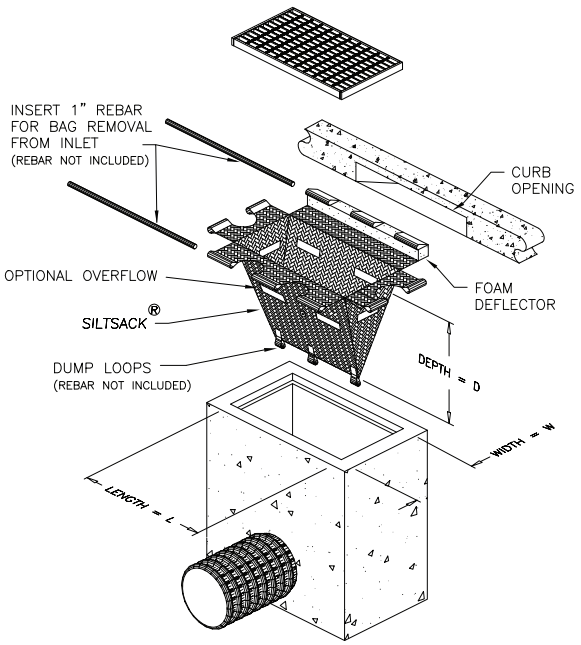
SILTSACK® Regular Flow

Property	Test Method	Minimum Value
Grab Tensile	ASTM D-4632	300 lbs.
Grab Elongation	ASTM D-4632	20%
Puncture	ASTM D-4633	120 lbs.
Mullen Burst	ASTM D-3786	800 psi
Trapezoid Tear	ASTM D-4533	120 lbs.
UV Resistance	ASTM D-4355	80%
Apparent Opening	ASTM D-4751	40 US Sieve
Flow Rate	ASTM D-4491	40 Gal/Min/Ft^2
Permittivity	ASTM D-4491	0.55 sec^{-1}

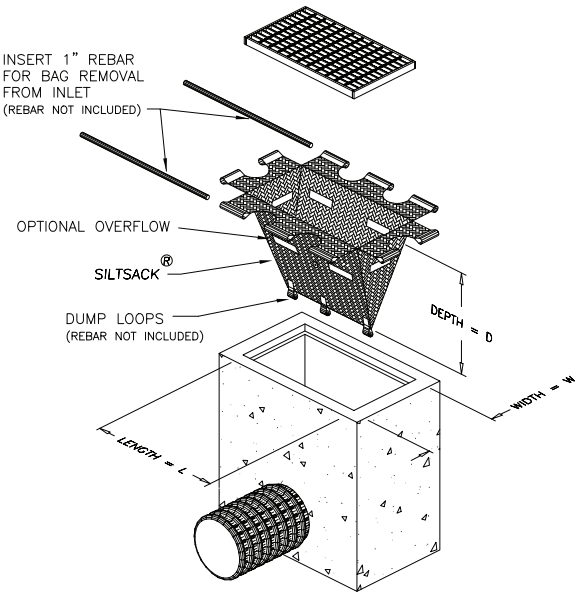
All properties are minimum average roll values

Catch Basin Sediment Capture Device

Typical Siltsack® Construction - Type A



Typical Siltsack® Construction - Type B



Catch Basin Sediment Capture Device

SILTSACK® Catch Basin

SILTSACK® is a simple and cost-effective solution to prevent clogging of catch basins.

SILTSACK® is a sediment control device used to prevent silt and sediment from entering your drainage system. SILTSACK® traps the silt / sediment but allows water to pass through into the sewer. SILTSACK® can be used as a primary or secondary sediment control device to prevent failure of drainage system due to clogging with silt / sedimentation. Maintenance of the SILTSACK® on a regular basis will ensure that the SILTSACK® will function properly.

Available in two styles:

- Regular flow
- High flow

Basic Installation Instructions

- Remove drain gate
- Insert SILTSACK®
- Replace grate to hold SILTSACK® in position

Benefits

- SILTSACK® traps silt & sediment
- Saves money and time

Routine Inspection of the SILTSACK®'s collected sediment level is important to prevent over-flow of silt and sediment.

SILTSACK® should be inspected every 2-3 weeks and after every major storm.

The yellow restraint cord should be visible at all times. If the cord is covered with sediment, the SILTSACK® should be emptied.

DISTRIBUTED BY

terrafix® geosynthetics inc.

455 Horner Avenue
Toronto, Ontario • M8W 4W9

Telephone (416) 674-0363
Fax (416) 674-1159

December 2009 • 1435

Appendix C-5
Ultratech HydroKleen

ULTRATECH INTERNATIONAL, INC

Ultra-HydroKleen®

Maintenance and Care Instructions

1. Inspect the Ultra-HydroKleen every three months or after significant rainfall events.
   - If the sediment chamber is full (the level or sediment and debris is within 1” of the flow holes located around the perimeter of the chamber), remove the catch basin grate and extract the sediment and debris located in the sediment chamber.
   - Dispose of the extracted contents according to state and local regulations.
   - In many cases the extracted sediment and debris may be sent for landfill disposal.

2. At a minimum, the Ultra-HydroKleen needs to have the filters removed, disposed of and replaced every six months.
   - Dispose of the filters according to state and local regulations.
   - If the HydroKleen is a Sampling Model, the end user should monitor the effluent from the HydroKleen and change out the filters based on the data obtained from the samples using their own guidelines or local and state requirements.
   - By using sampling data for filter change-out decisions the six month minimum may not apply.
   - If very little pollution is entering the HydroKleen, then the filters may not need to be changed out until one year or more.

UltraTech International, Inc. · 11542 Davis Creek Court, Jacksonville, Florida 32256 USA
(800) 353-1611 · 1-904-292-1611 · stormwaterproducts.com

APPENDIX D
PRETREATMENT DEVICES O&M MANUALS

Appendix D-1
AquaSield AquaSwirl

Stormwater Treatment System Inspection and Maintenance Manual

AquaShield™, Inc.
2733 Kanasita Drive
Suite 111
Chattanooga, TN 37343
Toll free (888) 344-9044
Phone: (423) 870-8888
Fax: (423) 826-2112
Email: info@aquashieldinc.com
www.aquashieldinc.com

October 2017

Aqua-Swirl® Stormwater Treatment System

The Aqua-Swirl® Stormwater Treatment System (Aqua-Swirl®) is a vortex-type hydrodynamic separator designed and supplied by AquaShield™, Inc. (AquaShield™). Aqua-Swirl® technology removes pollutants including suspended solids, trash, floatables and free-floating oil from stormwater runoff. Both treatment and storage are accomplished in the single swirl chamber without the use of multiple or hidden, blind access chambers.

Floatable debris in the Aqua-Swirl®

Aqua-Swirl® System Maintenance

The long term performance of any stormwater treatment structure, including manufactured or land based systems, depends on a consistent maintenance plan. Inspection and maintenance functions are simple and easy for the Aqua-Swirl® allowing all inspections to be performed from the surface.

It is important that a routine inspection and maintenance program be established for each unit based on: (a) the volume or load of the contaminants of concern, (b) the frequency of releases of contaminants at the facility or location, and (c) the nature of the area being drained.

Example of Aqua-Swirl® manhole cover

Inspection

The Aqua-Swirl® can be inspected from the surface thereby eliminating the need to enter the system to determine when cleanout should be performed. AquaShield™ recommends in most cases that a quarterly inspection take place for the first year of operation to develop an appropriate schedule of maintenance. Based on experience of the system's first year in operation, we recommend that the inspection schedule be revised to reflect the site-specific conditions encountered. The typical inspection schedule for subsequent years is reduced to semi-annual inspection events. **Table 1** below lists the available Aqua-Swirl® models as well their inner diameters, oil/debris storage capacities and the sediment storage capacities.

Table 1. Aqua-Swirl® Storage Capacities

Aqua-Swirl® Model	Inner Diameter (ft)	Oil/Debris Storage Capacity (gal)	Sediment Storage Capacity (ft^3)
AS-2	2.5	37	6
AS-3	3.5	110	11
AS-4	4.5	190	19
AS-5	5.0	270	23
AS-6	6.0	390	33
AS-7	7.0	540	45
AS-8	8.0	710	58
AS-9	9.0	910	74
AS-10	10.0	1,130	91
AS-11	11.0	1,422	110
AS-12	12.0	1,698	131
AS-13	13.0	1,986	154
AS-XX	Custom*		

* Custom designs to meet site-specific criteria, can include multiple (twin) units for increased flow and materials storage capacity.

Maintenance

The Aqua-Swirl® has been designed to minimize and simplify the inspection and maintenance process. The single chamber of the system can be inspected and maintained entirely from the surface thereby eliminating the need for confined space entry. There are no areas of the structure that are blocked from visual inspection or periodic cleaning. Inspection of any free-floating oil and floatable trash can be directly observed and maintained through the manhole access provided directly over the swirl chamber. If so equipped, the trash screen can be exposed once the water is removed from the unit and inspected.

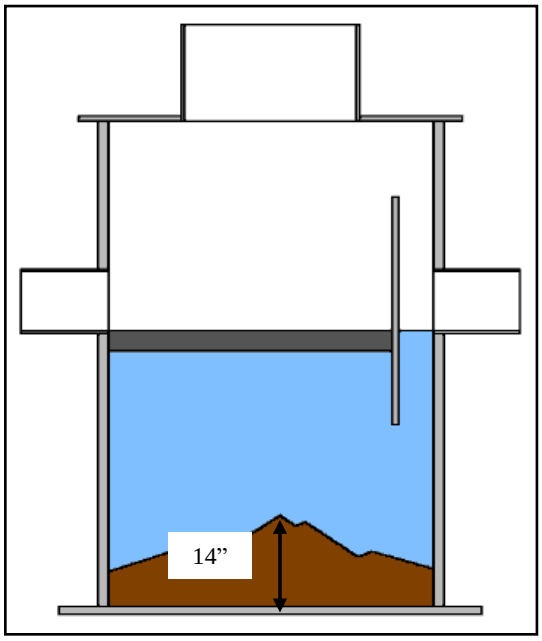
Aqua-Swirl® Inspection Procedure

To inspect the Aqua-Swirl®, a hook is typically needed to remove the manhole cover. AquaShield™ provides a customized manhole cover with our distinctive logo to make it easy for maintenance crews to locate the system in the field. We also provide a permanent metal information plate affixed inside the access riser which provides our contact information, the Aqua-Swirl® model size, and serial number.

The only tools needed to inspect the Aqua-Swirl® system are a flashlight and a measuring device such as a stadia rod or pole. Given the easy and direct accessibility provided, floating oil and debris can be observed directly from the surface. Sediment depths can easily be determined by lowering a measuring device to the top of the sediment pile and to the surface of the water.

It should be noted that in order to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the *top* of the sediment pile. Keep in mind that the finer sediment at the top of the pile may offer less resistance to the measuring device than the larger particles which typically occur deeper within the sediment pile. The Aqua-Swirl® design allows for the captured sediment to accumulate in a semi-conical fashion as illustrated below. That is, the depth to sediment as measured below the water surface may be less in the center of the swirl chamber; and likewise, may be greater at the edges of the swirl chamber.

Sediment inspection using a stadia rod



Maximum recommended sediment depth prior to cleanout
is 14 inches for all Aqua-Swirl® models (not to scale)

Aqua-Swirl® Cleanout Procedure

Cleaning the Aqua-Swirl® is simple and quick. Free-floating oil and floatable trash can be observed and removed directly through the 30-inch service access riser provided. A vacuum truck is typically used to remove the accumulated sediment and debris. An advantage of the Aqua-Swirl® design is that the entire sediment storage area can be reached with a vacuum hose from the surface reaching all the sides. Since there are no multiple or limited (blind) access chambers in the Aqua-Swirl®, there are no restrictions to impede on-site maintenance tasks. If applicable, the trash screen can be reached from the surface and cleaned with a vacuum hose.

Disposal of Recovered Materials

AquaShield™ recommends that all maintenance activities be performed in accordance with appropriate health and safety practices for the tasks and equipment being used. AquaShield™ also recommends that all materials removed from the Aqua-Swirl® and any external bypass structures (divergent and convergent) be handled and disposed of in full accordance with any applicable local and state requirements.

Vacuum (vactor) truck quickly cleans the single open access swirl chamber

Aqua-Swirl®
Inspection and Maintenance Work Sheets
on following pages

Aqua-Swirl®
Inspection and Maintenance Work Sheets

SITE and OWNER INFORMATION

Site Name: _____

Site Location: _____

Date: _____ Time: _____

Inspector Name: _____

Inspector Company: _____ Phone #: _____

Owner Name: _____

Owner Address: _____

Owner Phone #: _____ Emergency Phone #: _____

INSPECTIONS

I. Floatable Trash/Debris and Oil

1. Remove manhole lid to expose liquid surface of the Aqua-Swirl®.
2. Remove floatable trash/debris with basket or net if any present.
3. If oil is present, measure its depth. Clean liquids from system if one half (½) inch or more of oil and/or trash is present.
4. If applicable, clean trash screen surface with vacuum hose.

Note: Water in Aqua-Swirl® can appear black and similar to oil due to the dark body of the surrounding structure. Oil may appear darker than water in the system and is usually accompanied by oil stained debris (e.g. Styrofoam, etc.). The depth of oil can be measured with an oil/water interface probe, a stadia rod with water finding paste, a coliwasa, or collect a representative sample with a jar attached to a rod.

II. Sediment Accumulation

1. Lower measuring device (e.g. stadia rod) into swirl chamber through service access provided until top of sediment pile is reached.
2. Record distance to top of sediment pile from top of standing water: _____ inches.
3. Maximum recommended sediment depth prior to cleanout is 14 inches for all models. Consult system shop drawing for treatment chamber depth as measured from the inlet pipe invert to base of the unit.

III. Diversion Structures (External Bypass Features)

If a diversion (external bypass) configuration is present, it should be inspected as follows:

1. Inspect weir or other bypass feature for structural decay or damage. Weirs are more susceptible to damage than off-set piping and should be checked to confirm that they are not crumbling (concrete or brick) or decaying (steel).
2. Inspect diversion structure and bypass piping for signs of structural damage or blockage from debris or sediment accumulation.
3. When feasible, measure elevations on diversion weir or piping to ensure it is consistent with site plan designs.
4. Inspect downstream (convergence) structure(s) for sign of blockage or structural failure as noted above.

CLEANING

Schedule cleaning with local vactor company to remove sediment, trash, oil and other floatable pollutants. The captured material generally does not require special treatment or handling for disposal. Site-specific conditions or the presence of known contaminants may necessitate that appropriate actions be taken to clean and dispose of materials captured and retained by the Aqua-Swirl®. All cleaning activities should be performed in accordance with property health and safety procedures.

AquaShield™ always recommends that all materials removed from the Aqua-Swirl® during the maintenance process be handled and disposed in accordance with local and state environmental or other regulatory requirements.

MAINTENANCE SCHEDULE

I. During Construction

Inspect the Aqua-Swirl® full capture device every three (3) months and clean the system as needed. The Aqua-Swirl® should be inspected and cleaned at the end of construction regardless of whether it has reached its maintenance trigger.

II. First Year Post-Construction

Inspect the Aqua-Swirl® every three (3) months and clean the system as needed.

Inspect and clean the system once annually regardless of whether it has reached its sediment, trash or floatable pollutant storage capacity.

III. Second and Subsequent Years Post-Construction

If the Aqua-Swirl® did not reach full sediment or floatable trash capacity in the First Year Post-Construction period, the system can be inspected and cleaned once annually.

If the Aqua-Swirl® reached full sediment, trash or floatable pollutant capacity in less than 12 months in the First Year Post-Construction period, the system should be inspected once every six (6) months and cleaned as needed.

The Aqua-Swirl® should be cleaned annually regardless of whether it reaches its sediment, trash or floatable pollutant capacity.

IV. Bypass Structures

Bypass structures should be inspected whenever the Aqua-Swirl® is inspected. Maintenance should be performed on bypass structures as needed.

MAINTENANCE COMPANY INFORMATION

Company Name: _____

Street Address: _____

City: _____ State/Prov.:_____ Zip/Postal Code: _____

Contact: _____ Title: _____

Office Phone: _____ Cell Phone: _____

ACTIVITY LOG

Date of Cleaning: _____ (Next inspection should be 3 months from this data for first year).

Time of Cleaning: Start: _____ End: _____

Date of Next Inspection: _____

Floatable debris present: Yes No

Notes: _____

_____

_____

Oil present: Yes No Oil depth (inches): _____

Measurement method and notes: _____

_____

_____

STRUCTURAL CONDITIONS and OBSERVATIONS

Structural damage: Yes No Where: _____

Structural wear: Yes No Where: _____

Odors present: Yes No Describe: _____

Clogging: Yes No Describe: _____

Other Observations: _____

_____

_____

NOTES

Additional Comments and/or Actions To Be Taken	Time Frame

ATTACHMENTS

- Attach site plan showing Aqua-Swirl® location.
- Attach detail drawing showing Aqua-Swirl® dimensions and model number.
- If a diversion configuration is used, attach details showing basic design and elevations (where feasible).

Aqua-Swirl®

TABULAR MAINTENANCE SCHEDULE

Date Construction Started: _____

Date Construction Ended: _____

During Construction

	Month											
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Inspect and Clean as needed			X			X			X			X
Inspect Bypass and maintain as needed			X			X			X			X
Clean System*												X*

* The Aqua-Swirl® should be cleaned **once a year** regardless of whether it has reached full pollutant storage capacity. In addition, the system should be cleaned at the **end of construction** regardless of whether it has reach full pollutant storage capacity.

First Year Post-Construction

	Month											
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Inspect and Clean as needed			X			X			X			X
Inspect Bypass and maintain as needed			X			X			X			X
Clean System*												X*

* The Aqua-Swirl® should be cleaned **once a year** regardless of whether it has reached full pollutant storage capacity.

Second and Subsequent Years Post-Construction

	Month											
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Inspect and Clean as needed												X*
Inspect Bypass, maintain as needed												X*
Clean System*												X*

* If the Aqua-Swirl® did **not** reach full sediment or floatable pollutant capacity in the First Year Post-Construction period, the system can be inspected and cleaned once annually.

If the Aqua-Swirl® **reached** full sediment, trash or floatable pollutant capacity in less than 12 months in the First Year Post-Construction period, the system should be inspected once every six (6) months or more frequently if past history warrants, and cleaned as needed. The Aqua-Swirl® should be cleaned annually regardless of whether it reaches its full sediment, trash or floatable pollutant capacity.

Appendix D-2
BMP, Inc. Snout Stormwater Quality Systems

Design and Maintenance Considerations for SNOUT® Stormwater Quality Systems

Background:

The SNOUT system from Best Management Products, Inc. (BMP, Inc.) is based on a vented hood that can reduce floatable trash and debris, free oils, and other solids from stormwater discharges. In its most basic application, a SNOUT hood is installed over the outlet pipe of a catch basin or other stormwater quality structure with a deep sump (see Installation Drawing). The SNOUT forms a baffle that traps floatable debris and free oils on the surface, while permitting heavier solids to sink to the bottom of the sump. The clarified intermediate layer is forced out of the structure through the open bottom of the SNOUT by displacement from incoming flow. The resultant discharge contains considerably less unsightly trash and other gross pollutants, and can also offer reductions of free-oils and finer solids.

As with any structural stormwater quality design, maintenance considerations will have a dramatic impact on SNOUT system performance over the life of the facility. The most important factor to consider when designing structures with a SNOUT is the depth of the sump. Sump is defined as the depth from the invert of the outlet pipe to the bottom of the structure. *Simply put, the deeper the sump, the more effective the unit will be both in terms of pollutant removals and reducing frequency of maintenance.* More volume in a structure means more quiescence, thus allowing the pollutants a better chance to separate out. Secondly, more volume means fewer cycles between maintenance, because the structure has a greater capacity. Of equal importance to good performance is putting SNOUTs in multiple structures. The closer one captures pollution to where it enters the infrastructure (e.g. at the inlet), the less mixing of runoff there is, and the easier it will be to separate out pollutants. Putting SNOUTs and deep sumps in all inlets that can be easily maintained develops a powerful structural treatment train with a great deal of effective storage volume, where even finer particles may have chance to settle out.

Design Notes:

- The SNOUT size is ALWAYS greater than the nominal pipe size. The SNOUT should cover the pipe OD and optimally the grouted area around the pipe (e.g. for a 12” pipe, an 18” SNOUT is the correct choice).
- As a rule of thumb, BMP, Inc. recommends *minimum* sump depths based on outlet pipe inside diameters of 2.5 to 3 times the outlet pipe size.
- For best performance, the inlet pipe and outlet pipe should have inverts close to the same elevation (a six inch or less deviation is optimal).
- Special note for smaller pipes: A minimum sump depth of 36 inches for all

pipe sizes 12 inches ID or less, and 48 inches for pipe 15-18 inches ID is required if collection of finer solids is desired.

- The plan dimension of the structure should be up to 6 to 7 times the flow area of the outlet pipe. Increasing area beyond that has a minimal impact on performance. However, the structure wall where the SNOUT is mounted must accommodate the size of the SNOUT (either the correct diameter or enough width).
- To optimize pollutant removals establish a "treatment train" with SNOUTs placed in as many inlets where it is feasible to do so (this protocol applies to most commercial, institutional or municipal applications and any application with direct discharge to surface waters).
- At a minimum, SNOUTs should be used in every third structure for less critical applications (less critical areas might include flow over grassy surfaces, very low traffic areas in private, non-commercial or non-institutional settings, single family residential sites).
- Use Bio-Skirts® for increased hydrocarbon reduction. Bio-Skirts are highly recommended for fueling or vehicle service stations, convenience stores, restaurants, loading docks, marinas, beaches, schools or high traffic applications. Each Bio-Skirt can retain about one gallon of oils.
- Use the Stainless TrashScreen for "Full Trash Capture" requirements.
- The "R" series SNOUTs (12R, 18R, 24R, 30R, 30R/96, 42RTB/60, 52RTB/72, 52RTB/84 and 72RTB/96) are available for round manhole type structures of up to 96" ID; the "F" series SNOUTs (LP318F, 12F, 18F, 24F, 30F, 36F, 48F, 72F and 96F) are available for flat walled structures; the "NP" series SNOUTs (NP1218R, NP1524R, NP1830R, and NP2430R) are available for smaller diameter structures up to 30" ID.

Example Structure Sizing Calculation:

A SNOUT equipped structure with a 15 inch ID outlet pipe (1.23 sqft. flow area) will offer best performance with a minimum plan area of 7.4 sqft. and 48 inch sump. Thus, a readily available 48 inch diameter manhole-type structure, or a rectangular structure of 2 feet x 4 feet will offer sufficient size when combined with a sump depth of 48 inches or greater.

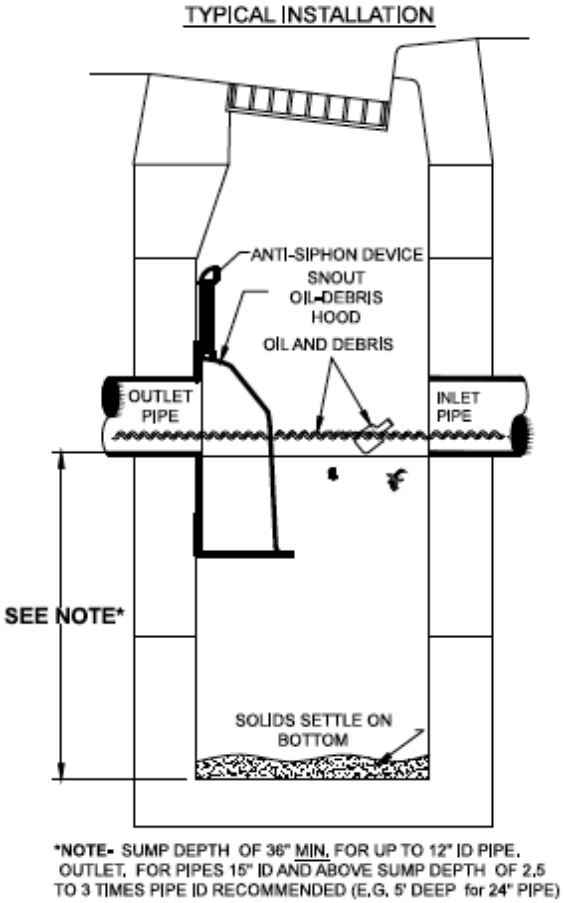
Maintenance Recommendations:

- Monthly monitoring for the first year of a new installation after the site has been stabilized is a recommended practice.
- Measurements should be taken after each rain event of .5 inches or more, or monthly, as determined by local weather conditions.
- Checking sediment depth and noting the surface pollutants in the structure will be helpful in planning maintenance.
- The pollutants collected in SNOUT equipped structures will consist of floatable debris and oils on the surface of the captured water, and grit and sediment on the bottom of the structure.
- It is best to schedule maintenance based on the solids collected in the sump.
- Optimally, the structure should be cleaned when the sump is half full (e.g. when 2 feet of material collects in a 4 foot sump, clean it out).
- Structures should also be cleaned if a spill or other incident causes a larger than normal accumulation of pollutants in a structure.

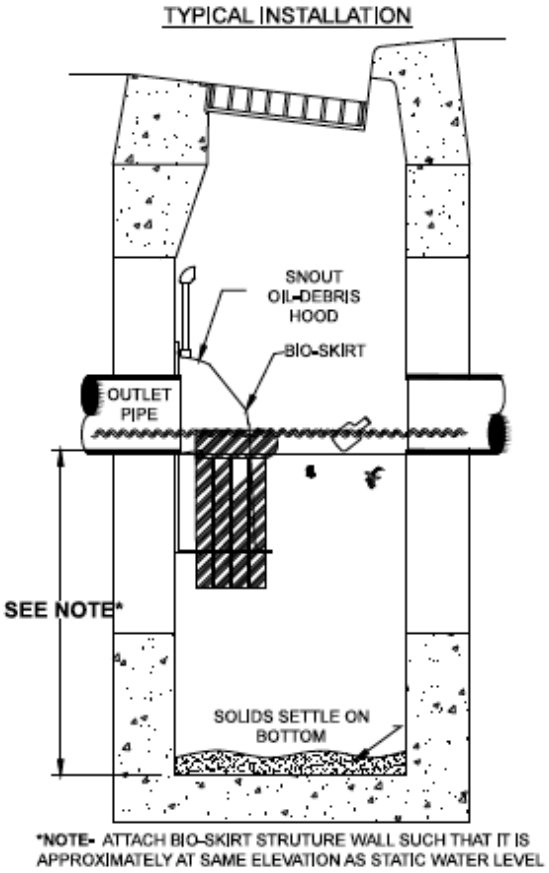
- Maintenance is best done with a vacuum truck.
- If Bio-Skirts are being used in the structure to enhance hydrocarbon capture, they should be checked on a monthly basis for the first year, and serviced or replaced when more than 2/3 of the boom is submerged, indicating a nearly saturated state. Assuming a typical pollutant-loading environment exists, Bio-Skirts should be serviced* annually or replaced as necessary.
- In the case of an oil spill, the structure should be checked and serviced and Bio-Skirts (if present) replaced or serviced immediately.
- All collected wastes must be handled and disposed of according to local environmental requirements.
- To maintain the SNOUT hoods, an annual inspection of the anti-siphon vent and access hatch are recommended. A simple flushing of the vent, or a gentle rodding with a flexible wire are all that's typically needed to maintain the anti-siphon properties. Opening and closing the access hatch once a year ensures a lifetime of trouble-free service.

*To extend the service life of a Bio-Skirt, the unit may be "wrung out" to remove oils and washed in an industrial washing machine with warm water. The Bio-Skirt may then be re-deployed if the material maintains it's structural integrity. A maintained Bio-Skirt can last for several years. Each Bio-Skirt can hold about on gallon of oils.

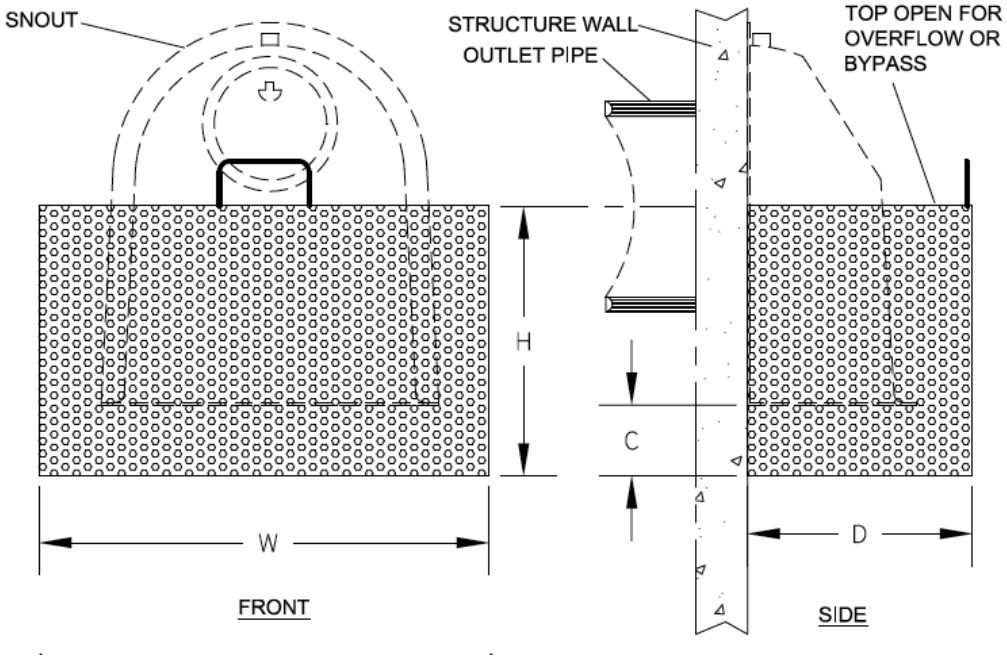
SNOUT INSTALLATION:



BIO-SKIRT INSTALLATION:



STAINLESS TRASHSCREEN INSTALLATION:



Contact Information:

Please contact us if we can offer further assistance. Technical Assistance: T. J. Mullen at 800-504-8008, tjm@bmpinc.com or Matt White at 888-434-0277, mwhite@bmpinc.com.

Website: www.bmpinc.com

The SNOUT, Bio-Skirt and TrashScreen are protected by US Patents 6126817, 7857966, 7951294 and 8512556

More US patents are pending and BMP holds Canadian patents for much of the technology patented in the US. Canadian Patents numbers include 2285146, 2688012, 2690156, 2740678

The SNOUT®, Bio-Skirt® and Stainless TrashScreen™ are trademarks of Best Management Products,

The SAFL® Baffle is a patented and trademarked by Upstream Technologies, an Original Equipment Manufacturer for BMP, Inc.

Appendix D-3
CDS Hydrodynamic Separator

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

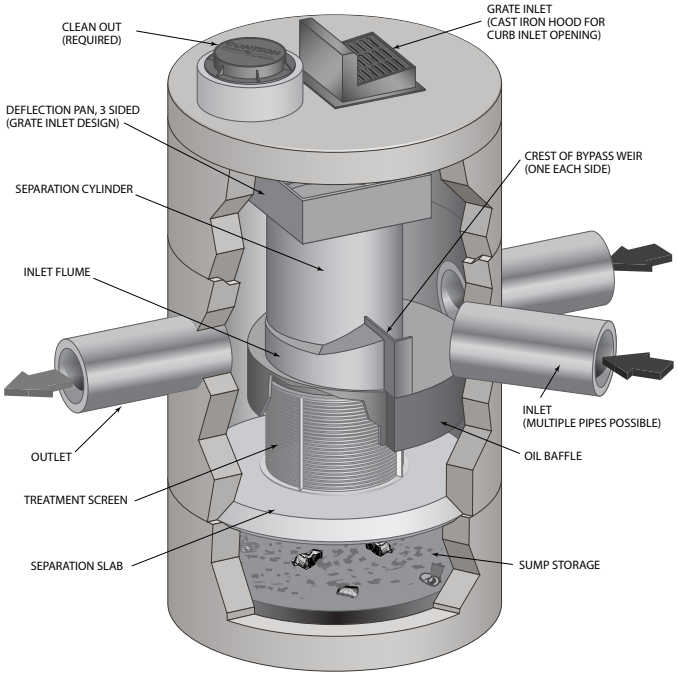
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

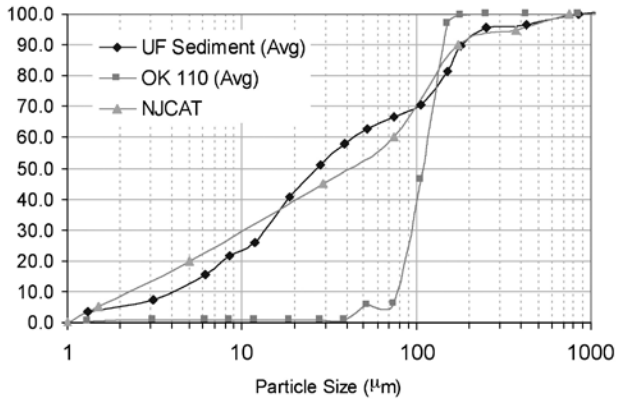


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

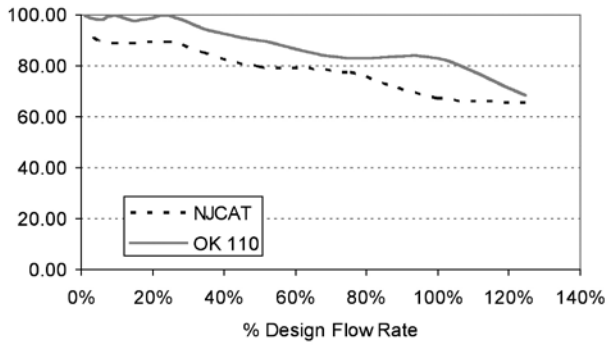


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

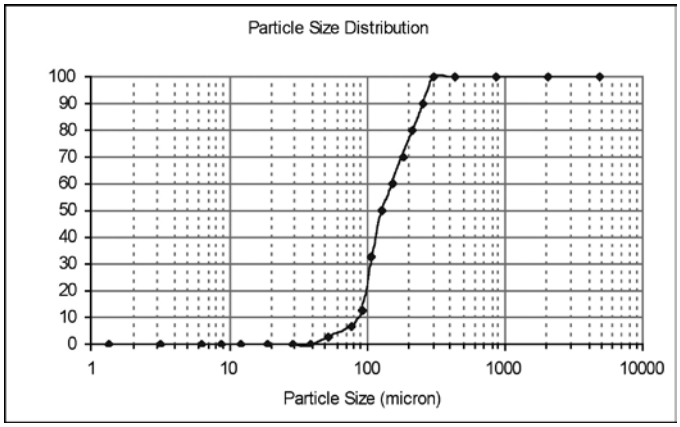


Figure 3. WASDOE PSD

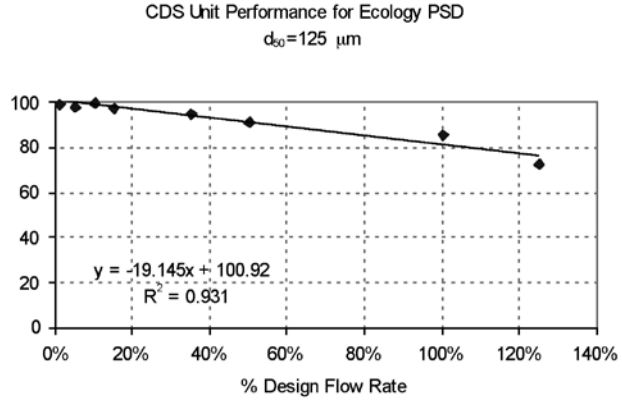


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

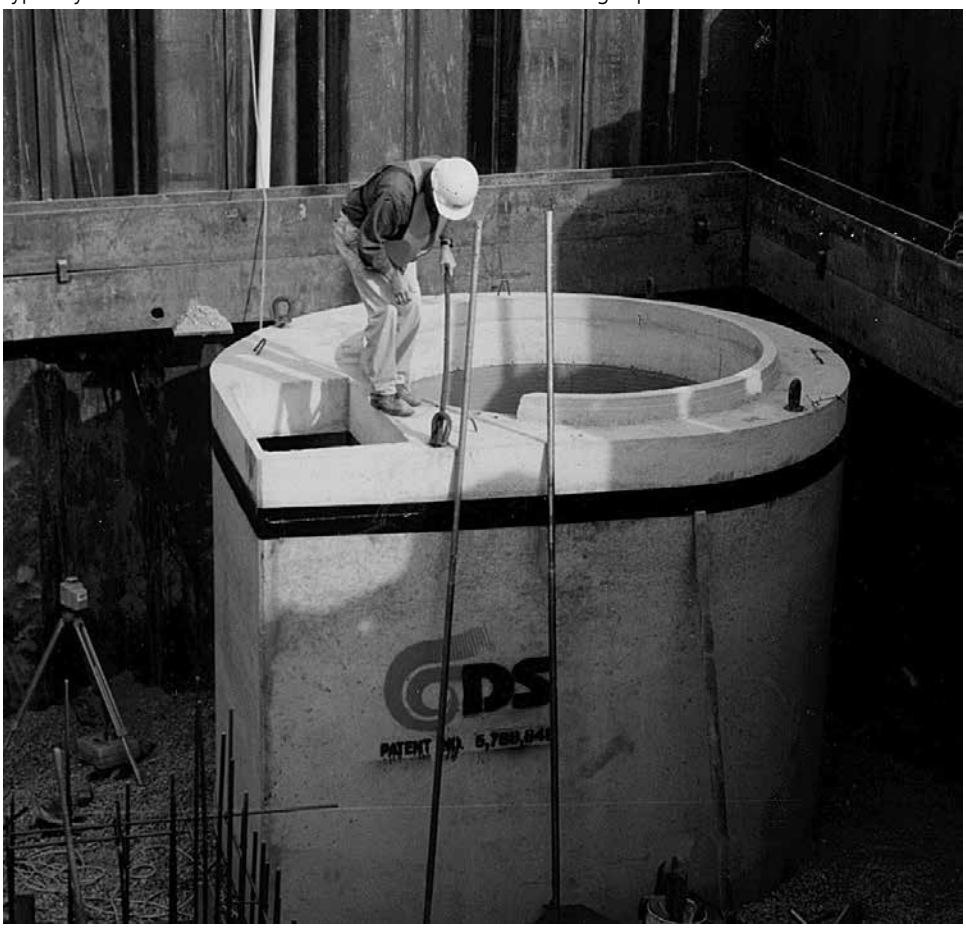
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

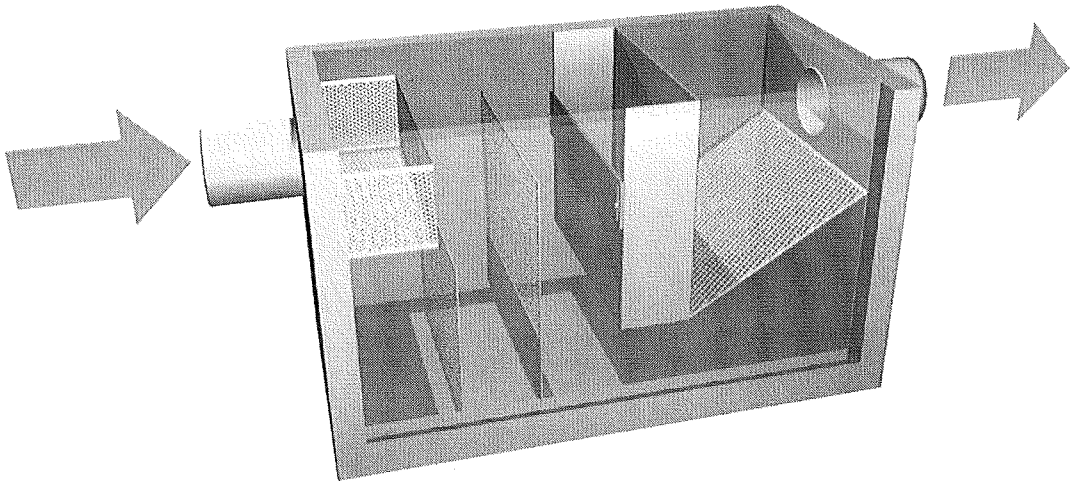
cds_manual 3/17 PDF

Appendix D-4
CrystalStream Technologies Stormwater Treatment Device

Installation, Operation, Inspection, Maintenance and Cleaning Manual

(Models 646, 946, 956, 1056, 1266, 1856, 2056, & 2466)

CrystalStream™ Technologies
Stormwater Treatment Device



CrystalStream Technologies

CrystalStream Technologies 2090 Sugarloaf Parkway. Suite 135 Lawrenceville, GA 30045

READ THE FOLLOWING INFORMATION, INSTRUCTIONS AND WARNINGS CAREFULLY BEFORE INSPECTING, PERFORMING MAINTENANCE OR CLEANING THIS DEVICE

This manual is intended to explain the specifics of our system, and to review the common aspects of the existing regulations and safety procedures. It is the responsibility of all personnel to familiarize themselves with, understand, and comply with all applicable local, state and federal laws, before attempting to inspect, maintain, or clean the CrystalStream unit.

Table of Contents

All precautions and procedures in this manual are current at the time of printing and are subject to change based on new processes and procedures. CrystalStream Technologies takes no responsibility and will be held harmless for any injuries, fines, penalties or other losses that occur involving any procedures in this manual or other non-addressed actions. The unit's performance is based on the procedures being followed and lack of performance due to non-compliance with these measures will be the responsibility of the owner.

1.1 General Purpose

The CrystalStream storm water treatment device is designed to treat the gross pollutants found in urban storm water run-off and protect downstream waterways from these pollutants. Additionally the CrystalStream unit provides spill protection for oil and other hydrocarbon products.

1.2 Unit Description

The base unit is a pre-cast concrete rectangular structure constructed in various dimensions based on the model purchased. The base unit is poured with walls of 6'' reinforced concrete tested to 4,000 psi. A riser of the same construction is used if needed to bring the top of the unit to grade. The internal components will vary based on the application and pollutants targeted. At most the unit will have components consisting of a trash basket, mesh lining, baffles, oil & hydrocarbon reservoir, adjustable weir plate and fiber mesh screen. All of these components are constructed out of aluminum. The fiber mesh screen itself is ¾" coconut fiber. The internal placement of the components will vary based on the individual nature of the site and hydrology but the basic configuration is shown on the cover of this manual. This is also a standard cut sheet drawing included in Appendix 1. The top of the unit can be either a tread plate double access lid or aluminum hatch in non-traffic applications or a standard grate and frame/ring and cover in traffic areas.

1.3 Unit Operation

The unit is installed with all components in place to operate and based on proper installation; the owner has no responsibilities to make the unit operational. Due to the nature of construction THE UNIT MUST BE INSPECTED WHEN THE SITE IS TURNED OVER TO THE OWNER/END-USER. (See Section 3.1 through Section 3.3 for inspections) IF IT IS NOT CLEAN AT THAT TIME, IT MUST BE CLEANED AND LEFT UNDAMAGED AND READY TO OPERATE. (See Section 4.1 for cleaning.) Please read this entire manual before any inspection or cleaning operations. Your personal safety is important. **Call CrystalStream at 1-800-748-6945 if you are unsure about any procedure.**

Prior to the site being turned over to the owner, CrystalStream Technologies recommends that the pipe system leading to the unit be flushed and jetted, to make certain that any residual sediment is cleaned from the pipes. When sediment is allowed to accumulate in the pipes, it slowly moves to the unit during rainfall events. The larger the rainfall event, the more sediment is moved. The CrystalStream storm water treatment device is extremely effective at trapping sediment. When sediment is left in the pipes and moves to the unit, it can necessitate a shorter than average cleaning schedule which translates into higher cleaning costs for the owner. Cleaning and jetting the pipes assures the owner that the unit he receives is in proper working order, and free of sediment. If the site is under a maintenance agreement with CST, CST personnel will inspect the unit and the pipe system prior to the unit being transferred to the owner.

1.4 Installation

The unit is installed during the construction phase with the excavation, pipe attachment, and backfill completed by the contractor on site. A stable roadway must be provided for delivery of the CrystalStream unit. CrystalStream Technologies (CST) will provide the contractor with the measurements he will need to excavate the hole. A 6" depth of crushed stone should be placed under the unit to assist in leveling and to provide uniform base support. CST will have the unit delivered to the site and placed in the hole with our equipment in most cases. After placement, the contractor will backfill the device as necessary and attach the pipes. Proper construction methods during the backfill and pipe attachment are essential to the operation and cleaning of the CrystalStream unit.

Contractors Please Note:

Call CrystalStream at 1-800-748-6945 if you are unsure about any procedure.

- The pipes must be placed at the correct invert for the unit to achieve the proper removal rates.
- The pipes must be installed flush with the interior walls of the unit to provide for proper cleaning access.
- The pipes must be mudded in on both the inlet and outlet connections. Failure to properly mud the pipes can result in the water undermining the soil surrounding the unit.
- When a tread Plate lid is used on the Model 646, CST also provides a set of hooks to be used to hold the lids open during maintenance and cleaning procedures except in traffic areas. These hooks should also be turned over to the property owner when all construction has been completed.
- A stable roadway must be maintained to facilitate inspection and cleaning of this unit. This roadway must be, at a minimum, constructed of gravel or crushed stone on a stable base, and must be capable of supporting a cleaning truck weight of approximately 15,000 pounds.

2.1 Safety Overview

The CrystalStream unit is designed to be cleaned and maintained in an efficient safe manner by qualified professionals trained to service in-ground vaults and to handle the equipment necessary for removing the pollutants targeted.

The CrystalStream unit can be cleaned using common equipment and methods including cleaning from the surface using a vacuum truck and trash netting system. Although this method will be addressed, in our experience with these types of devices, a confined space entry cleaning yields a quicker, more thorough and less cost intensive result.

This manual is intended to explain the specifics of our system, and to review the common aspects of the existing regulations and safety procedures. It is the responsibility of all personnel to familiarize themselves with, understand, and comply with all applicable local, state and federal laws, before attempting to inspect, maintain, or clean the CrystalStream unit.

ALWAYS FOLLOW ALL OSHA REQUIREMENTS WHEN ENTERING A CONFINED SPACE. CRYSTALSTREAM TECHNOLOGIES RECOMMENDS THAT CLEANING BE ACCOMPLISHED BY A "BUDDY SYSTEM" AND THAT BOTH WORKMEN BE CONFINED SPACE ENTRY RESCUE AND CONFINED SPACE AWARENESS TRAINED.

CAUTION! Any inspection or maintenance work performed in a traffic area must meet the DOT guidelines for roadway work and additional safety procedure will be necessary.

2.2 OSHA Requirements

Definition of A Confined space

A confined space has limited or restricted means of entry or exit. It is large enough for an employee to enter and perform assigned work. The confined space is not designed for continuous occupancy. Confined space openings are limited primarily by size or location. The atmosphere in a confined space may be hazardous due to low oxygen levels, flammable or explosive concentrations of gases, vapors or dusts, or toxic levels of gases and vapors.

NOTE: Never enter a CrystalStream unit when there has been an obvious gasoline spill or other flammable/hazardous material. This manual is for routine cleaning of storm water debris and any unusual occurrences should be left to properly trained and equipped individuals.

Entry without permit/attendant

Confined spaces may be entered without the need for a written permit or attendant provided that the space can be maintained in a safe condition for entry by mechanical ventilation alone. All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter an enclosed/confined space shall have successfully completed, as a minimum, the training as required.

Testing the Atmosphere

Before entering a confined space, testing should be completed for oxygen, then for flammable or combustible gases and vapors and finally for toxic gases and vapors. Some gases and vapors are heavier than air and will settle to the bottom of a confined space. Other gases are lighter than air and will be found around the top of the confined space. Testing should be done in all areas (top, middle, bottom) with testing instruments that are calibrated in accordance with the manufacturer's recommendations to determine what atmospheric conditions are present.

NOTE: The test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable reading in an oxygen deficient atmosphere. Testing for combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening than exposure to toxic gases and vapors. If testing reveals oxygen deficiency or the presence of toxic gases or vapors, the space must be ventilated and retested before the worker may enter.

Detector tubes, alarm only gas monitors and explosion meters are examples of monitoring equipment that may be used. If there are no non-atmospheric hazards present and if the pre-entry tests show there are no dangerous air contamination and/or oxygen deficiency within the space and there is no reason to believe that any is likely to develop, entry into and work within may proceed.

Ventilation

Ventilation by a blower or fan may be necessary to remove harmful gases and vapors from a confined space. We recommend that a ventilating hose run to the bottom of the unit to blow out all harmful gases or vapors. The air intake should be place in an area that will draw in fresh air only. Ventilation should be continuous where possible because in many confined spaces the hazardous atmosphere will accumulate again when the flow of air is stopped. Periodic testing must be conducted to ensure that the atmosphere inside the confined space is safe.

Respirators

Respirators are devices that protect workers from breathing unsafe levels of toxic particles, gases and vapors. Two basic types of respirators are air purifying, which filter dangerous substances from the air and air –supplying which deliver a supply of safe breathing air from a tank or an uncontaminated area nearby.

Manholes

CrystalStream devices located in traffic areas use a manhole as the point of entry into the unit. Manholes may present a variety of hazards if proper care is not taken. When covers are removed manholes can become a trap into which workers can fall. It can also become a hazard to others if the manhole cover is not replaced when the work has been completed

2.3 Inspection Safety

Always place cones around the CrystalStream unit and the vehicle to keep people out of the working zone.

In traffic areas, follow all DOT regulations for roadwork.

Follow all OSHA requirements if entering the unit.

The tread plate lids can be very heavy. Follow appropriate safety measures when lifting the lid to avoid back injury.

Remember, snakes and other creatures like dark, cool spaces. Use appropriate caution to remove creatures from the unit.

Always lock all non-traffic lids, using the locking bar and locks provided.

Always replace the manhole cover and the metal grating when completing the inspection.

Follow all procedures outlined in Section 3.2.

2.4 Cleaning & Maintenance Safety

Always place cones around the CrystalStream unit and the vehicle to keep people out of the working zone.

In traffic areas, follow all DOT regulations for roadwork.

Follow all OSHA requirements if entering the unit.

The tread plate lids can be very heavy. Follow appropriate safety measures when lifting the lid to avoid back injury.

Always lock all non-traffic lids, using the locking bar and locks provided.

Always replace the manhole cover and the metal grating when completing the inspection.

Remember, snakes and other creatures like dark, cool spaces. Use appropriate caution to remove creatures from the unit.

Follow all procedures outlined in Section 3.3.

2.5 Public Safety

Before inspecting or cleaning the unit, clear the zone of unnecessary personnel. Put up cones and warning tape to keep people out of the working area. Use of physical barriers is important to protect both the workers and the public from injury.

Follow all Department of Transportation requirements when working in traffic areas. Consult your local DOT guidelines to determine what precautions are required.

Always replace the manhole cover when inspection or maintenance is performed on the CrystalStream unit with a traffic lid.

3.1 Inspection Overview

The unit is designed and specified in most applications to comply with the non-point source mandates of the Clean Water Act and the NPDES regulations. These regulations state that any BMP (Best Management Practice) needs to be inspected every 90 days and cleaned and maintained as needed. Many local regulations have similar requirements and all federal, state and local requirements must be met. CrystalStream Technologies recommends visual inspection on a 30-day cycle as well as sediment depth inspection, during the construction phase. The unit inspection is done to determine the operational status of the unit and determine if a cleaning cycle is necessary as well as to meet any jurisdictional ordinance requirements. All inspections must be documented (Appendix 2). When construction has been completed and the site has stabilized, the CST unit should be inspected every 90 days and cleaned when there is 1" of sediment in front of the oil reservoir.

3.2 Inspection Procedures

As per the following:

3.2.1 The unit should be visually inspected from the surface to determine the integrity of access points. Look for broken hinges or broken or missing handles. A qualified welder should repair any broken hinges immediately. Inspect bolts on lid angle iron and look for loose red heads on angle iron. Replace red heads as needed. Re-paint the lid, with a rust resistant paint as necessary.

3.2.2 The access should be opened and secured properly.

3.2.3 A visual inspection should be made of the trash basket at the front of the unit to determine capacity and type of material trapped.

3.2.4 A visual inspection should be made of the water surface in the front of the unit to determine oil sheen or blanket.

3.2.5 A visual inspection should be made of the oil and hydrocarbon reservoir to determine amount of oil/water trapped and the historical high-water level in the unit.

3.2.6 A visual inspection of the water surface in the rear of the unit should be made and any pollutants noted.

3.2.7 Inspect the aluminum mesh in the trash basket. Replace as needed.

3.2.8 Inspect the basket frame for cracks or damage. Repair as needed.
A visual inspection should be made of the pipe connections to the unit and any material decay or improper installation noted. Pipes should be cut flush with the interior wall of the unit and properly mudded in. **If upon inspection it is noted that the pipes are not cut flush, or are not mudded in, contact the contractor and require that he correct this immediately**.

3.2.9 Inspect baffles to ensure that they are properly seated into the brackets. Also note if there is any damage to baffles (bowing). Reseat baffles if necessary.

3.2.10 Inspect oil reservoir for cracks or damage. Check the welds around the oil reservoir for wear or damage and note any repair work necessary. A qualified welder must perform all repair work to the welds on the oil reservoir during the routine cleaning.

3.2.11 Inspect the riser for cracks in the concrete walls. Repair as required during the routine cleaning.

3.2.12 A silt gauge should be used to determine sediment depth as shown in Appendix 1. Check the silt/sediment level behind the trash basket and in front of the oil reservoir

3.2.13 The access for cleaning should be evaluated and documented. The truck cleaning these units requires a stable roadway capable of withstanding 15,000 pounds.

3.2.14 Any changes in the area tributary that are evident should be noted.

3.2.15 Replace the access point covers carefully.

3.2.16 Note the condition of the area surrounding the unit on the inspection report. (Example: grass, dirt, rocks, sink holes) Report any hazardous conditions to the appropriate supervisor.

3.2.17 An inspection report should be completed, with a copy staying on site and a copy being sent to the local jurisdiction.

The inspection procedures for the traffic units are similar to those for the non- traffic units with the exception of the sediment depth evaluations as shown in Appendix 1 and an inspection of the grate and Frame and Ring and Cover. Also proper precautions should be taken in Traffic situations as specified in the Safety section of this manual.

NOTE: When there has been an obvious gasoline spill or other flammable/hazardous material in the unit, immediate notification should be given to the owner and jurisdictional authorities. This manual is for routine cleaning of storm water debris and any unusual occurrences should be left to properly trained and equipped individuals.

4.1 Cleaning Overview

The cleaning of the unit is the essential element to the operational success of the CrystalStream Device. The pollutant removal capacity of the device will eventually cause the equipment to fail without proper maintenance and additionally not achieve the goals of the installation. The cleaning cycle is dependant on a number of factors including pollutant load, rainfall, time of year, basin changes, upstream mitigation tactics and installation. Based on the variety of factors, a cleaning schedule can be consistent or vary widely on the same device. This highlights the importance of the inspection process in the overall maintenance and integrity of the unit. The cleaning is generally done with a two-person crew and a vacuum pump system. The duration of the maintenance will depend on a number of factors but can typically be done in about 2.5 hours with properly trained individuals.

4.2 Cleaning Procedures – Surface Cleaning

If the cleaning of the unit is to be preformed from the surface, the operator should expect a longer cleaning time and the potential for additional disposal charges. The front chamber of the unit will contain the trash and debris in the trash basket, any floating hydrocarbons that have not been skimmed into the oil/hydrocarbon reservoir and accumulated sediment on the bottom of the unit.

Cleaning procedures are as per the following:

4.2.1 The unit should be visually inspected from the surface to determine the integrity of the tread plate lid, Aluminum Hatch or other access.

4.2.2 A visual inspection of the unit should be done to evaluate structural integrity and determine if any impacted material is present in the device. If there has been a hazardous spill see Section 4.6

NOTE: When there has been an obvious gasoline spill or other flammable/hazardous material in the unit, immediate notification should be given to the owner and jurisdictional authorities. This manual is for routine cleaning of storm water debris and any unusual occurrences should be left to properly trained and equipped individuals.

4.2.3 The Trash Basket should be cleaned by either using a trash netting system or vacuum truck. If cleaning using a netting system, this material can be disposed of in trash bags in the normal manner.

4.2.4 The surface oil/hydrocarbon separation zone in the front chamber should be removed either with sorbants or with a vacuum truck.

4.2.5 The stormwater contained in the area between the surface water and the sediment accumulation can be decanted to minimize the amount of disposal required. Any downstream discharge needs to be after the surface cleaning and only down to the level of the bottom of the oil/hydrocarbon reservoir or the top of the sediment accumulation. Any pollutants discharged downstream are the responsibility of the cleaning operator.

4.2.6 The oil/hydrocarbon reservoir needs to be evacuated by the vacuum equipment.

4.2.7 The sediment accumulated in the front and rear chamber can be removed by the vacuum equipment.

4.2.8 The unit should be pressure washed down to remove any pollution attached to the baffles, walls or hydrocarbon reservoir.

4.2.9 All parts should be inspected for wear and tear and documented.

4.2.10 A maintenance report (Appendix 3) should be completed, with a copy staying on site and a copy being sent to the local jurisdiction.

4.3 Cleaning Procedures – Confined Space Entry

The cleaning procedures are similar for confined space entries except that the OSHA guideline apply and need to be followed. The confined space entry allows the crew to do a better job of cleaning the unit and allows for the time needed and disposal cost to be reduced.

CAUTION! Any inspection done in a traffic area must meet the DOT guidelines for roadway work and additional safety procedure will be necessary.

CAUTION ! All OSHA confined space requirements should be met while cleaning this unit.

4.3.1 The unit should be visually inspected from the surface to determine the integrity of the tread plate lid.

4.3.2 A visual inspection of the unit should be done to evaluate structural integrity and determine if any impacted material is present in the device. If there has been a hazardous spill see section 4.6

NOTE: When there has been an obvious gasoline spill or other flammable/hazardous material in the unit, immediate notification should be given to the owner and jurisdictional authorities. This manual is for routine cleaning of storm water debris and any unusual occurrences should be left to properly trained and equipped individuals.

4.3.3 A ladder should be inserted on the front side of the unit between the baffles and a sorbant blanket laid on the surface of the water to collect any free oil floating on the surface.

4.3.4 In most units, the trash basket and baffles can be removed to allow easier access to the bottom of the unit.

4.3.5 Inspect the aluminum mesh in the trash basket. Replace as needed.

4.3.6 The Trash Basket should be cleaned and directly disposed of in garbage bags.

4.3.7 The stormwater contained in the area between the surface water and the sediment accumulation can be decanted to minimize the amount of disposal required. Any downstream discharge needs to be after the surface cleaning and only down to the level of the bottom of the oil/hydrocarbon reservoir or the top of the sediment accumulation. Any pollutants discharged downstream are the responsibility of the cleaning operator.

4.3.8 The unit should be pressure washed down to remove any pollution attached to the baffles, walls or hydrocarbon reservoir.

4.3.9 The ladder can be used to get on to the unit floor and remove the rest of the water and sediment from the bottom of the unit.

4.3.10 The walls should be wiped down in the front with a sorbant blanket

4.3.11 The fresh coconut fiber mesh should be replaced in the frame and the frame assembly returned to the unit.

4.3.12 All parts should be inspected for wear and tear and documented.

4.3.13 Remove all equipment from the unit. Replace the manhole cover and the grate in the concrete lid.

4.3.14 A maintenance report (Appendix 3) should be completed, with a copy staying on site and a copy being sent to the local jurisdiction.

Cleaning Equipment

The equipment needed to clean the CrystalStream unit is:

- Vacuum truck 750 gallon
- Pressure Washer
- Submersible Pump
- Generator
- Sorbant Pads (Mycelx™)
- 16-25 Ft. Ladder
- Gloves
- Coconut Fiber Mesh (Rolanka Industries)
- Trash Bags
- CrystalStream Lid Hooks

- Sediment/Silt Gauge
- Rubber boots
- Testing equipment to meet OSHA confined space entry requirements
- Cones
- Barricades
- Caution Tape
- Hardhat
- Waterproof silicon caulk
- Aluminum mesh (for trash basket)
- Flat shovel
- 20' electrical cord
- 5 gallon bucket w/rope
- First Aid kit containing eye wash
- Tripod safety harness recovery apparatus

Call CrystalStream at 1-800-748-6945 if you need supplies or parts.

Documentation and Disposal

The cleaning of the unit should be documented and the contents of the unit estimated and recorded in a log for inspections. This documentation should meet Federal, State and Local Guidelines.

The disposal of the trash, debris, water and sediment should be done at an approved facility and the proper permits should be obtained to transport the material. Sediment and water should be disposed of in accordance with all applicable state and local regulations. Sediment should be removed to a landfill and liquids to a decanting facility.

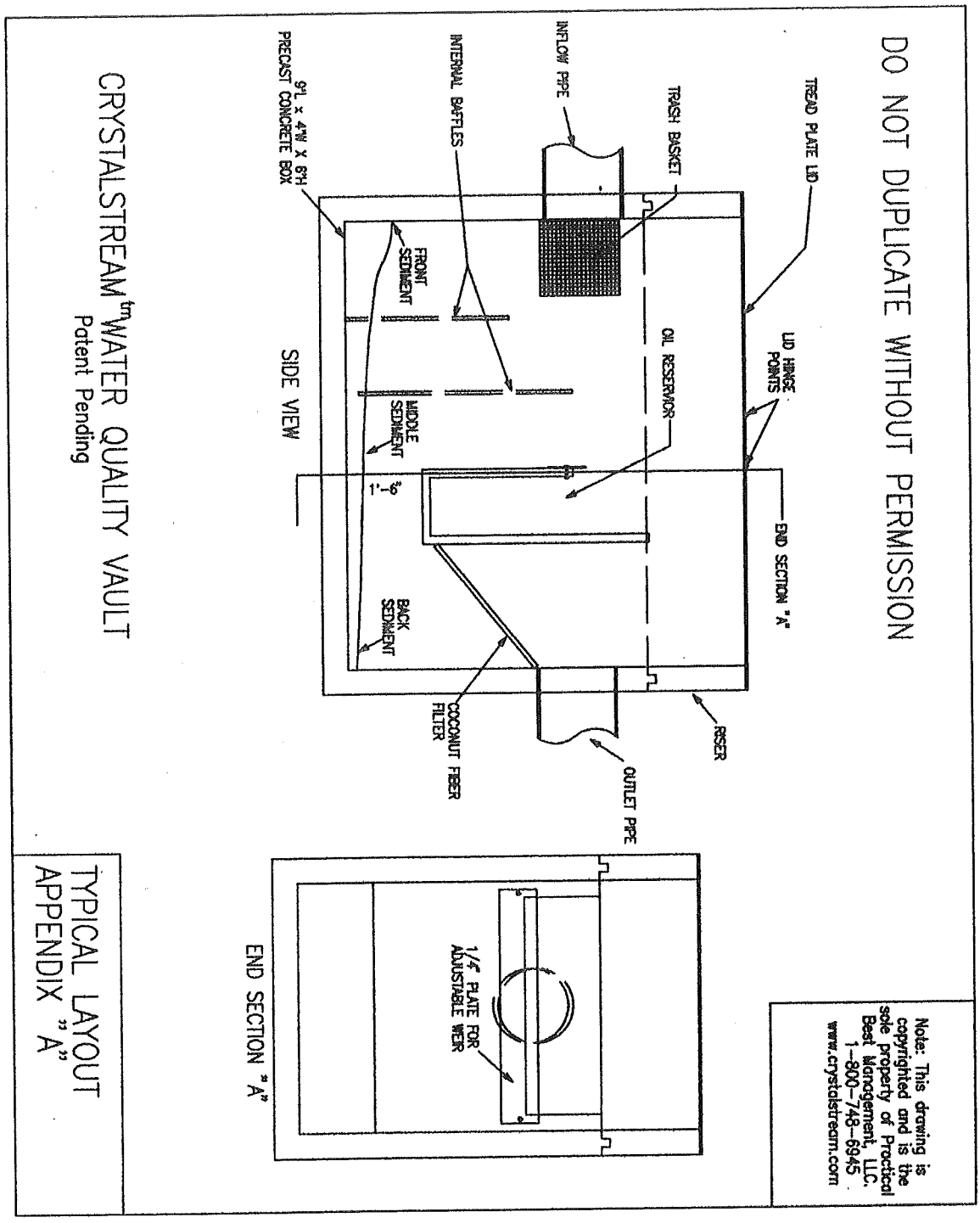
Hazardous Waste Procedure

The presence of any hazardous material inside the unit should prompt an immediate call to the jurisdiction and an appropriate hazardous response team. This material is not part of the standard cleaning of the device and should be treated with the proper care afforded such spills as per Federal, State and Local guidelines.

5.1 Maintenance Overview

All of the components in the unit should be inspected at every cleaning to determine wear or damage. If any components are damaged, please contact CrystalStream Technologies for an evaluation of the damage and a maintenance estimate.

APPENDIX 1


DO NOT DUPLICATE WITHOUT PERMISSION
CRYSTALSTREAM™ WATER QUALITY VAULT
Patent Pending
TYPICAL LAYOUT
APPENDIX "A"
SIDE VIEW
END SECTION "A"
TREAD PLATE LID
INFLOW PIPE
TRASH BASKET
INTERNAL BAFFLES
9'L x 4'W X 6'H PRECAST CONCRETE BOX
FRONT SEDIMENT
MIDDLE SEDIMENT
BACK SEDIMENT
OIL RESERVOIR
LID HINGE POINTS
END SECTION "A"
COCONUT FIBER FILTER
OUTLET PIPE
RISER
1/4" PLATE FOR ADJUSTABLE WEIR
Note: This drawing is copyrighted and is the sole property of Practical Best Management, LLC.
1-800-748-6945
www.crystalstream.com

APPENDIX 2

CrystalStream Technologies

Inspection Date _____ Job Number _____ Traffic ☐
Job Name _____ Hatch ☐
Job Address _____ Size _____
_____
Inspector's Name _____

Operations Inspections Checklist

Water Level	Oil Bucket Level	Sediment Level	Trash Conditions
☐ low ☐ normal ☐ above outlet	☐ low ☐ typical ☐ high	☐ little ☐ typical ☐ excessive	☐ minimal ☐ typical ☐ unacceptably high
Recommendations: This unit appears to need maintenance on a shorter / longer / unchanged schedule.			

This report is a complete and accurate description of conditions found at the time of inspection and all work performed on this device.

Inspector's Signature:	**Date:**

Inspection Data

Sediment: inlet side	Inches
Sediment: outlet side	Inches

Water in unit at inspection	Inches
Fluid in bucket at inspection	Inches

Items Inspected	Comments
Lid: inspect bolts, eyehooks, hinges	
Trash Rack: inspect aluminum mesh	
Baffle Plates: inspect for damage	
Oil Bucket: Leaks / Sheen	
Surroundings: check grass/plantings	
Invert – pipes mudded	
Construction Phase	

Additional Comments

APPENDIX 3

STORM SYSTEM SERVICES
A DIVISION OF CRYSTALSTREAM TECHNOLOGIES

Inspection Date _____ Job Number _____

Job Name _____

Job Address _____

_____

Inspector's Name _____

Traffic ☐
Hatch ☐
Steel Lid ☐
Size _____
Time _____
Disposal Fee _____
Volume (Gal) _____

Maintenance Inspections Checklist

Water Level	Oil Bucket Level	Sediment Level	Trash Conditions
☐ low ☐ normal ☐ above outlet	☐ low ☐ typical ☐ high	☐ little ☐ typical ☐ excessive	☐ minimal ☐ typical ☐ unacceptably high
Recommendations: This unit appears to need maintenance on a ☐shorter ☐ longer ☐ unchanged schedule.			

This report is a complete and accurate description of conditions found at the time of inspection and all work performed on this device

Inspector's Signature: **Date:**

Inspection Data

Sediment: inlet side	Inches
Sediment: outlet side	Inches

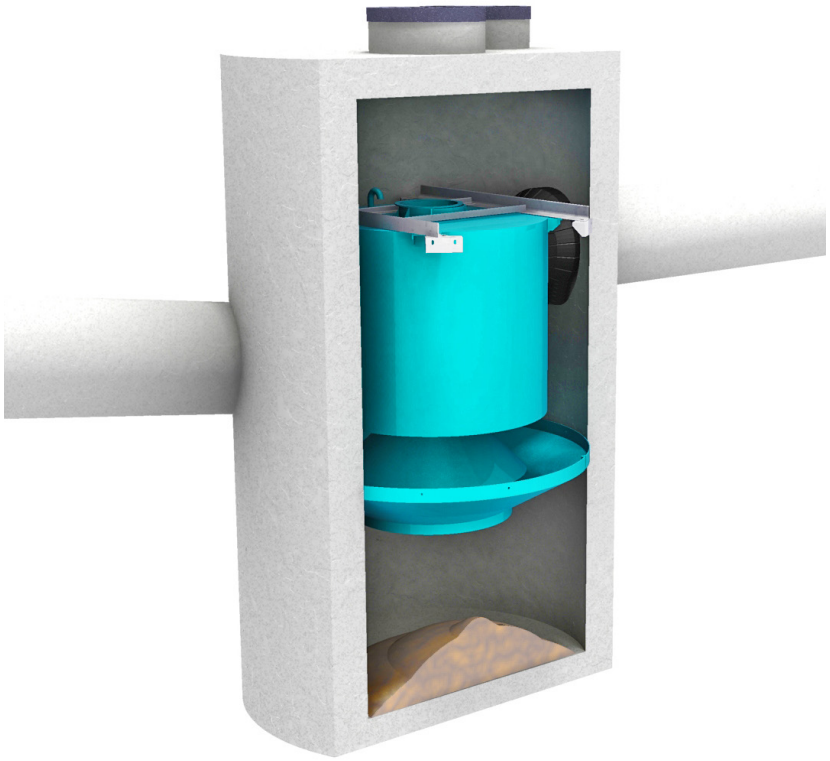
Water in unit at inspection	Inches
Fluid in bucket at inspection	Inches

Items Maintained	Comments
Lid: inspect bolts, eyehooks, hinges	
Trash Rack: inspect aluminum mesh	
Baffle Plates: inspect for damage	
Oil Bucket: Leaks / Sheen	
Surroundings: check grass/plantings	
Coconut Fiber / Flapper	

Additional Comments

Appendix D-5
Hydro International Downstream Defender

Hydro International®



Operation and Maintenance Manual

Downstream Defender®

Vortex Separator for Stormwater Treatment

Turning Water Around ...®

Table of Contents

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Downstream Defender® by Hydro International

The Downstream Defender® is an advanced Hydrodynamic Vortex Separator designed to provide high removal efficiencies of settleable solids and their associated pollutants, oil, and floatables over a wide range of flow rates.

The Downstream Defender® has unique, flow-modifying internal components developed from extensive full-scale testing, CFD modeling and over thirty years of hydrodynamic separation experience in wastewater, combined sewer and stormwater applications. These internal components distinguish the Downstream Defender® from simple swirl-type devices and conventional oil/grit separators by minimizing turbulence and headlosses, enhancing separation, and preventing washout of previously stored pollutants.

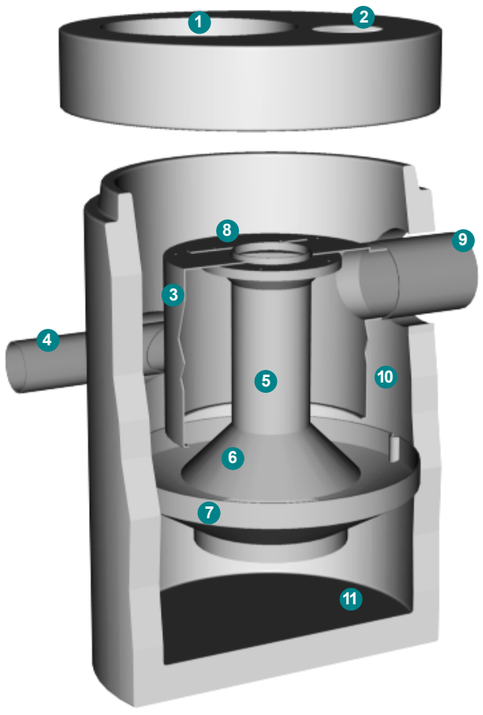
The high removal efficiencies and inherent low headlosses of the Downstream Defender® allow for a small footprint making it a compact and economical solution for the treatment of non-point source pollution.

Benefits of the Downstream Defender®

- Removes sediment, floatables, oil and grease
- No pollutant washouts
- Small footprint
- No loss of treatment capacity between clean-outs
- Low headloss
- Efficient over a wide ranges of flows
- Easy to install
- Low maintenance

Applications

- New developments and retrofits
- Utility yards
- Streets and roadways
- Parking lots
- Pre-treatment for filters, infiltration and storage
- Industrial and commercial facilities
- Wetlands protection



Downstream Defender® Components

1. Central Access Port
2. Floatables Access Port (6-ft., 8-ft. and 10-ft. models only)
3. Dip Plate
4. Tangential Inlet
5. Center Shaft
6. Center Cone
7. Benching Skirt
8. Floatables Lid
9. Outlet Pipe
10. Floatables Storage
11. Isolated Sediment Storage Zone

Hydro Maintenance Services

Hydro International has been engineering stormwater treatment systems for over 30 years. We understand the mechanics of removing pollutants from stormwater and how to keep systems running at an optimal level.

Nobody Knows our Systems Better than we do

Avoid Service Negligence

Sanitation services providers not intimately familiar with stormwater treatment systems are at risk of the following:

- Inadvertently breaking parts or failing to clean/replace system components appropriately.
- Charging you for more frequent maintenance because they lacked the tools to service your system properly in the first place.
- Billing you for replacement parts that might have been covered under your Hydro warranty plan
- Charging for maintenance that may not yet have been required.

Leave the Dirty Work to us

Trash, sediment and polluted water is stored inside treatment systems until they are removed by our team with a vactor truck. Sometimes teams must physically enter the system chambers in order to prepare the system for maintenance and install any replacement parts. Services include but are not limited to:

- Solids removal
- Removal of liquid pollutants
- Replacement media installation (when applicable)

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Downstream Defender® Operation and Maintenance Manual

Better Tools, Better Results

Not all vactor trucks are created equal. Appropriate tools and suction power are needed to service stormwater systems appropriately. Companies who don't specialize in stormwater treatment won't have the tools to properly clean systems or install new parts.

Service Warranty

Make sure you're not paying for service that is covered under your warranty plan. Only Hydro International's service teams can identify tune-ups that should be on us, not you.

Treatment Systems Serviced by Hydro:

- Stormwwater filters
- Stormwater separators
- Baffle boxes
- Biofilters/biorention systems
- Storage structures
- Catch basins
- Stormwater ponds
- Permeable pavement

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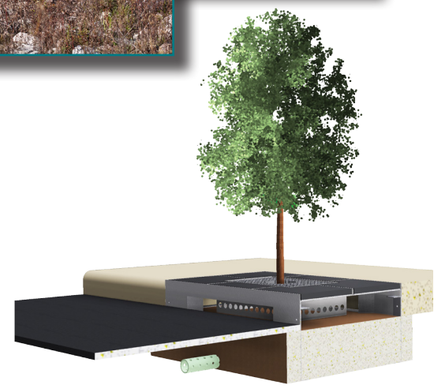

Operation

Introduction

The Downstream Defender® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The Downstream Defender® has been designed to allow for easy and safe access for inspection/monitoring and clean-out procedures. Entry into the unit or removal of the internal components is not necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention

The internal components of the Downstream Defender® have been designed to protect the oil, floatables and sediment storage volumes so that separator performance is not reduced as pollutants accumulate between clean-outs. Additionally, the Downstream Defender® is designed and installed into the storm drain system so that the vessel remains wet between storm events. Oil and floatables are stored on the water surface in the outer annulus separate from the sediment storage volume in the sump of the unit providing the option for separate oil disposal, and accessories such as adsorbant pads. Since the oil/floatables and sediment storage volumes are isolated from the active separation region, the potential for re-suspension and washout of stored pollutants between clean-outs is minimized.

Wet Sump

The sump of the Downstream Defender® retains a standing water level between storm events. The water in the sump prevents stored sediment from solidifying in the base of the unit. The clean-out procedure becomes more difficult and labor intensive if the system allows fine sediment to dry-out and consolidate. Dried sediment must be manually removed by maintenance crews. This is a labor intensive operation in a hazardous environment.

Blockage Protection

The Downstream Defender® has large clear openings and no internal restrictions or weirs, minimizing the risk of blockage and hydraulic losses. In addition to increasing the system headloss, orifices and internal weirs can increase the risk of blockage within the unit.

Maintenance

Overview

The Downstream Defender® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the Downstream Defender®. The Downstream Defender® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the Downstream Defender® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

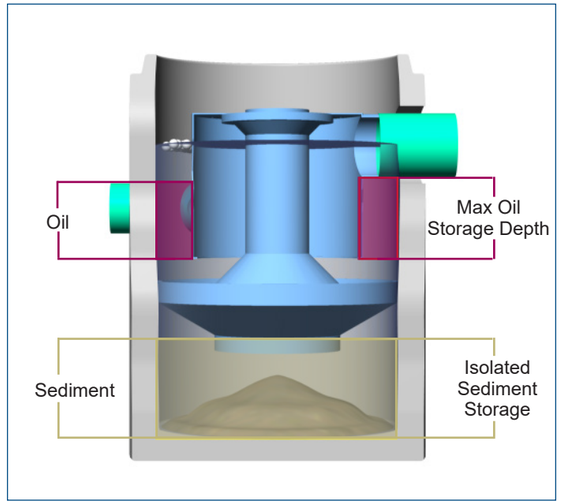

Fig.1 Pollutant storage volumes of the Downswtream Defender®.

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The Downstream Defender® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole. On the 6-ft, 8-ft and 10-ft units, the floatables access port is above the outlet pipe between the concrete manhole wall and the dip plate. The sediment removal access ports for all Downstream Defender® models are located directly over the hollow center shaft.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the Downstream Defender®, nor do they require the internal components of the Downstream Defender® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Determining Your Maintenance Schedule

The frequency of cleanout is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil/flotables removal, for a 6-ft Downstream Defender® typically takes less than 30 minutes and removes a combined water/oil volume of about 500 gallons.

Inspection Procedures

Inspection is a simple process that does not involve entry into the Downstream Defender®. Maintenance crews should be familiar with the Downstream Defender® and its components prior to inspection.

Scheduling

- It is important to inspect your Downstream Defender® every six months during the first year of operation to determine your site-specific rate of pollutant accumulation
- Typically, inspection may be conducted during any season of the year
- Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1

Recommended Equipment

- Safety Equipment and Personal Protective Equipment (traffic cones, work gloves, etc.)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net
- Sediment probe (such as a Sludge Judge®)
- Trash bag for removed floatables
- Downstream Defender® Maintenance Log

Table 1. Downstream Defender® Pollutant Storage Capacities and Max. Cleanout Depths.

Unit Diameter	Total Oil Storage	Oil Clean-out Depth	Total Sediment Storage	Sediment Clean-out Depth	Max. Liquid Volume Removed
(feet)	(gallons)	(inches)	(gallons)	(inches)	(gallons)
4	70	<16	141	<18	384
6	216	<23	424	<24	1,239
8	540	<33	939	<30	2,884
10	1,050	<42	1,757	<36	5,546
12	1,770	<49	2,970	<42	9,460

NOTES

1. Refer to Dowmstream Defender® Clean-out Detail (Fig. 1) for measurement of depths.

2. Oil accumulation is typically less than sediment, however, removal of oil and sediment during the same service is recommended.

3. Remove floatables first, then remove sediment storage volume.

4. Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1.

Fig.4

Fig.5

Fig.6

Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the Downstream Defender® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the lids to the manhole (Fig. 4). NOTE: The 4-ft Downstream Defender® will only have one lid.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. See Fig.7 and 8 for typical inspection views.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the outer annulus of the chamber.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel (Fig.5).

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

Floatables and Sediment Cleanout

Floatables cleanout is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.6).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose and skimmer pole to be lowered to the base of the sump.

Scheduling

- Floatables and sump cleanout are typically conducted once a year during any season.
- If sediment depths are greater than 75% of maximum clean-out depths stated in Table 1, sediment removal is required.
- Floatables and sump cleanout should occur as soon as possible following a spill in the contributing drainage area.

Fig.7 View over center shaft into sediment storage zone.

Fig.8 View of outer annulus of floatables and oil collection zone.

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Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Recommended Equipment

- Safety Equipment (traffic cones, etc)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge Judge®)
- Vactor truck (6-inch flexible hose recommended)
- Downstream Defender® Maintenance Log

1. Set up any necessary safety equipment around the access port or grate of the Downstream Defender® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the lids to the manhole (NOTE: The 4-ft Downstream Defender® will only have one lid).

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.

4. Using the Floatables Port for access, remove oil and floatables stored on the surface of the water with the vactor hose or the skimmer net (Fig.9).

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (Pg.9).

6. Once all floatables have been removed, drop the vactor hose to the base of the sump via the Central Access Port. Vactor out the sediment and gross debris off the sump floor (Fig.6).

7. Retract the vactor hose from the vessel.

8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

9. Securely replace the grate or lid.

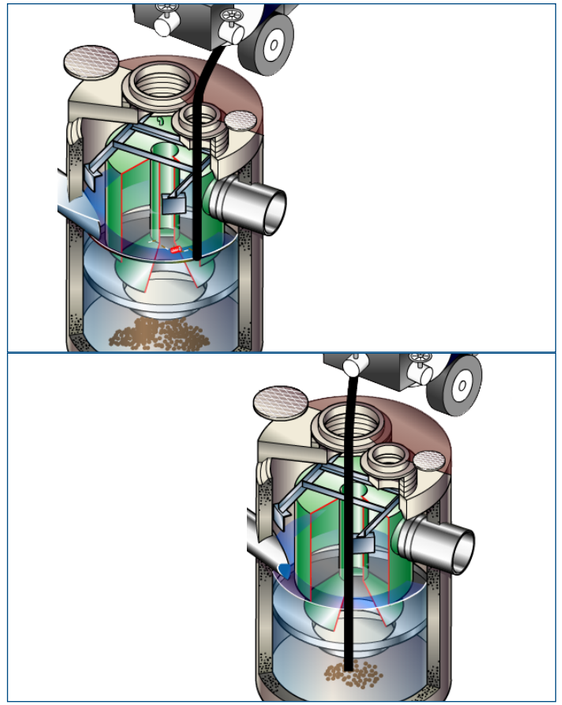

Fig.9 Floatables and sediment are removed with a vactor hose

Maintenance at a Glance

Activity	Frequency
Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, with sediment removal - Following a spill in the drainage area
Sediment Removal	- Once per year or as needed - Following a spill in the drainage area

NOTE: For most cleanouts it is not necessary to remove the entire volume of liquid in the vessel. Only removing the first few inches of oils/floatables and the sediment storage volume is required.

Downstream Defender® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:	
SITE NAME:	
SITE LOCATION:	
OWNER:	CONTRACTOR:
CONTACT NAME:	CONTACT NAME:
COMPANY NAME:	COMPANY NAME:
ADDRESS:	ADDRESS:
TELEPHONE:	TELEPHONE:
FAX:	FAX:

INSTALLATION DATE: / /

MODEL (CIRCLE ONE): **4-FT** **6-FT** **8-FT** **10-FT** **CUSTOM**

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Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Downstream Defender® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment * Depth Measured	Volume of Sediment Removed	Site Activity and Comments

*Note: Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1.

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Notes

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Stormwater Solutions

94 Hutchins Drive
Portland, ME 04102

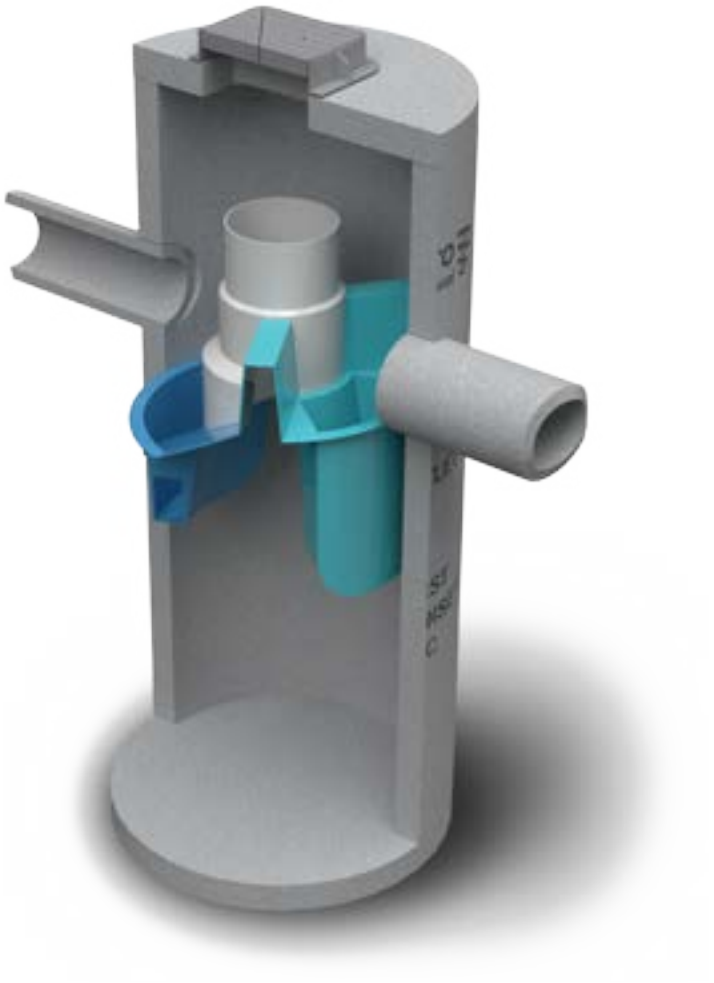
Tel: (207) 756-6200
Fax: (207) 756-6212
stormwaterinquiry@hydro-int.com

www.hydro-int.com

Turning Water Around...®

Appendix D-6
Hydro International First Defense

Hydro International



Operation and Maintenance Manual

First Defense® and First Defense® High Capacity

Vortex Separator for Stormwater Treatment

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- Billing you for replacement parts that might have been covered under your Hydro warranty plan
- Charging for maintenance that may not yet have been required.

Leave the Dirty Work to us

Trash, sediment and polluted water is stored inside treatment systems until they are removed by our team with a vactor truck. Sometimes teams must physically enter the system chambers in order to prepare the system for maintenance and install any replacement parts. Services include but are not limited to:

- Solids removal
- Removal of liquid pollutants
- Replacement media installation (when applicable)

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
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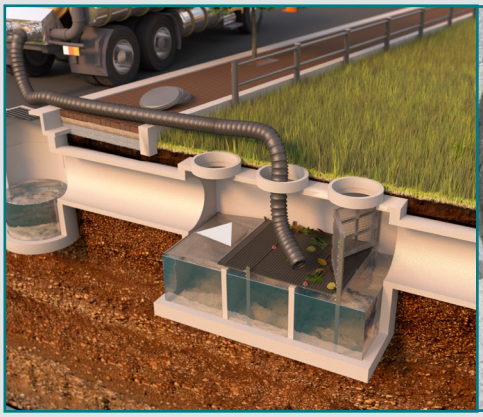

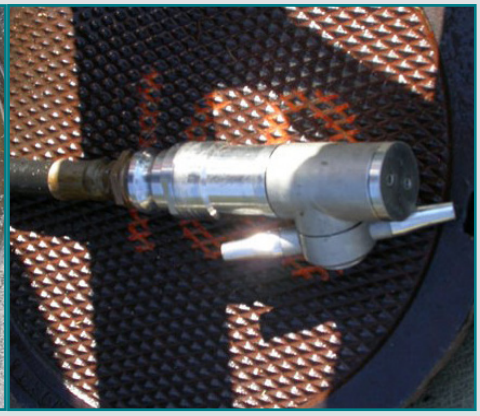

Service Warranty

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Treatment Systems Serviced by Hydro:

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- Stormwater separators
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- Storage structures
- Catch basins
- Stormwater ponds
- Permeable pavement

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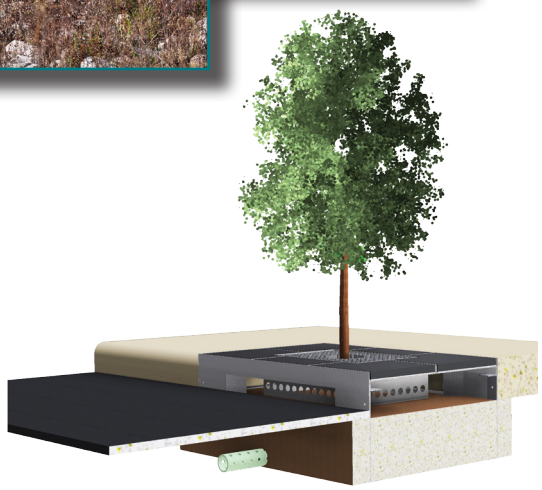

I. First Defense® by Hydro International

Introduction

The First Defense® is an enhanced vortex separator that combines an effective and economical stormwater treatment chamber with an integral peak flow bypass. It efficiently removes total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® is available in several model configurations (refer to *Section II. Model Sizes & Configurations*, page 4) to accommodate a wide range of pipe sizes, peak flows and depth constraints.

Operation

The First Defense® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The First Defense® has been designed to allow for easy and safe access for inspection, monitoring and clean-out procedures. Neither entry into the unit nor removal of the internal components is necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention

The internal components of the First Defense® have been designed to optimize pollutant capture. Sediment is captured and retained in the base of the unit, while oil and floatables are stored on the water surface in the inner volume (Fig.1).

The pollutant storage volumes are isolated from the built-in bypass chamber to prevent washout during high-flow storm events. The sump of the First Defense® retains a standing water level between storm events. This ensures a quiescent flow regime at the onset of a storm, preventing resuspension and washout of pollutants captured during previous events.

Accessories such as oil absorbent pads are available for enhanced oil removal and storage. Due to the separation of the oil and floatable storage volume from the outlet, the potential for washout of stored pollutants between clean-outs is minimized.

Applications

- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
- Pretreatment for filters, infiltration and storage

Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for “offline” arrangements using separate junction manholes
- Proven to prevent pollutant washout at up to 500% of its treatment flow
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

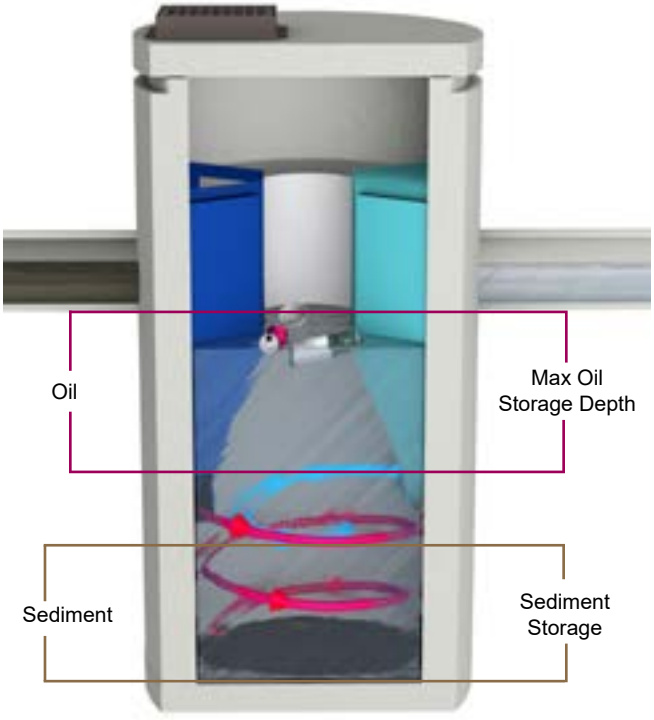

Fig.1 Pollutant storage volumes in the First Defense®.

II. Model Sizes & Configurations

The First Defense® inlet and internal bypass arrangements are available in several model sizes and configurations. The components of the First Defense®-4HC and First Defense®-6HC have modified geometries as to allow greater design flexibility needed to accommodate various site constraints.

All First Defense® models include the internal components that are designed to remove and retain total suspended solids (TSS), gross solids, floatable trash and hydrocarbons (Fig.2a - 2b). First Defense® model parameters and design criteria are shown in Table 1.

First Defense® Components

1. **Built-In Bypass**
2. **Inlet Pipe**
3. **Inlet Chute**
4. **Floatables Draw-off Port**
5. **Outlet Pipe**
6. **Floatables Storage**
7. **Sediment Storage**
8. **Inlet Grate or Cover**

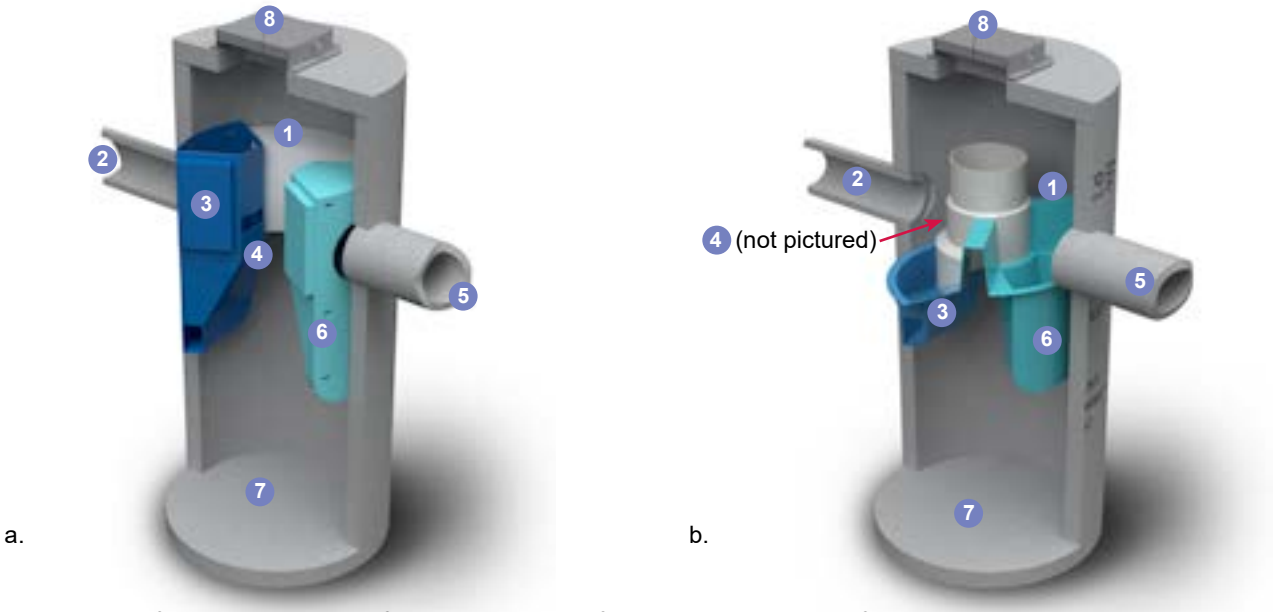

Fig.2a) First Defense®-4 and First Defense®-6; b) First Defense®-4HC and First Defense®-6HC, with higher capacity dual internal bypass and larger maximum pipe diameter.

First Defense® High Capacity Model Number	Diameter	Typical TSS Treatment Flow Rates		Peak Online Flow Rate	Maximum Pipe Diameter[1]	Oil Storage Capacity	Typical Sediment Storage Capacity[2]	Minimum Distance from Outlet Invert to Top of Rim[3]	Standard Distance from Outlet Invert to Sump Floor
		NJDEP Certified	106µm						
	(ft / m)	(cfs / L/s)	(cfs / L/s)	(cfs / L/s)	(in / mm)	(gal / L)	(yd^3 / m^3)	(ft / m)	(ft / m)
FD-3HC	3 / 0.9	0.84 / 23.7	1.60 / 45.3	15 / 424	18 / 457	125 / 473	0.4 / 0.3	2.0 - 3.5 / 0.6 - 1.0	3.71 / 1.13
FD-4HC	4 / 1.2	1.50 / 42.4	1.88 / 50.9	18 / 510	24 / 600	191 / 723	0.7 / 0.5	2.3 - 3.9 / 0.7 - 1.2	4.97 / 1.5
FD-5HC	5 / 1.5	2.34 / 66.2	2.94 / 82.1	20 / 566	24 / 609	300 / 1135	1.1 / .84	2.5 - 4.5 / 0.7 - 1.3	5.19 / 1.5
FD-6HC	6 / 1.8	3.38 / 95.7	4.73 / 133.9	32 / 906	30 / 750	496 / 1,878	1.6 / 1.2	3.0 - 5.1 / 0.9 - 1.6	5.97 / 1.8
FD-8HC	8 / 2.4	6.00 / 169.9	7.52 / 212.9	50 / 1,415	48 / 1219	1120 / 4239	2.8 / 2.1	3.0 - 6.0 / 0.9 -1.8	7.40 / 2.2

[1]Contact Hydro International when larger pipe sizes are required.
[2]Contact Hydro International when custom sediment storage capacity is required.
[3]Minimum distance for models depends on pipe diameter.

III. Maintenance

Overview

The First Defense® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the First Defense®. The First Defense® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the First Defense® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

The First Defense® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the First Defense®, nor do they require the internal components of the First Defense® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Maintenance Equipment Considerations

The internal components of the First Defense®-HC have a centrally located circular shaft through which the sediment storage sump can be accessed with a sump vac hose. The open diameter of this access shaft is 15 inches in diameter (Fig.3). Therefore, the nozzle fitting of any vactor hose used for maintenance should be less than 15 inches in diameter.

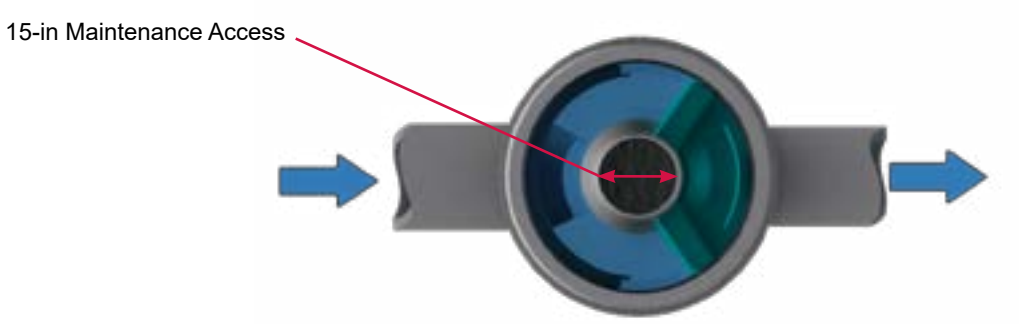

Fig.3 The central opening to the sump of the First Defense®-HC is 15 inches in diameter.

Determining Your Maintenance Schedule

The frequency of clean out is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge-Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil / flotables removal, for a 6-ft First Defense® typically takes less than 30 minutes and removes a combined water/oil volume of about 765 gallons.

Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. Fig.4 shows the standing water level that should be observed.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the components and water surface.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel.

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

Floatables and Sediment Clean Out

Floatables clean out is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.5).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose and skimmer pole to be lowered to the base of the sump.

Scheduling

- Floatables and sump clean out are typically conducted once a year during any season.

- Floatables and sump clean out should occur as soon as possible following a spill in the contributing drainage area.

Fig.4 Floatables are removed with a vactor hose (First Defense model FD-4, shown).

Recommended Equipment

- Safety Equipment (traffic cones, etc)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge Judge®)
- Vactor truck (flexible hose recommended)
- First Defense® Maintenance Log

Floatables and sediment Clean Out Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.

4. Remove oil and floatables stored on the surface of the water with the vactor hose (Fig.5) or with the skimmer or net (not pictured).

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (page 9).

6. Once all floatables have been removed, drop the vactor hose to the base of the sump. Vactor out the sediment and gross debris off the sump floor (Fig.5).

7. Retract the vactor hose from the vessel.

8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components, blockages, or irregularly high or low water levels.

9. Securely replace the grate or lid.

Fig.5 Sediment is removed with a vactor hose (First Defense model FD-4, shown).

Maintenance at a Glance

Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, with sediment removal - Following a spill in the drainage area
Sediment Removal	- Once per year or as needed - Following a spill in the drainage area

NOTE: For most clean outs the entire volume of liquid does not need to be removed from the manhole. Only remove the first few inches of oils and floatables from the water surface to reduce the total volume of liquid removed during a clean out.

First Defense® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:	
SITE NAME:	
SITE LOCATION:	
OWNER:	CONTRACTOR:
CONTACT NAME:	CONTACT NAME:
COMPANY NAME:	COMPANY NAME:
ADDRESS:	ADDRESS:
TELEPHONE:	TELEPHONE:
FAX:	FAX:

INSTALLATION DATE: / /

MODEL SIZE (CIRCLE ONE): **FD-4** **FD-4HC** **FD-6** **FD-6HC**

INLET (CIRCLE ALL THAT APPLY): **GRATED INLET (CATCH BASIN)** **INLET PIPE (FLOW THROUGH)**

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

First Defense® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment Depth Measured	Volume of Sediment Removed	Site Activity and Comments

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Hydro International®

Do it Right the First Time

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CALL **1 (888) 382-7808** TO SCHEDULE AN INSPECTION

Stormwater Solutions

94 Hutchins Drive
Portland, ME 04102

Tel: (207) 756-6200
Fax: (207) 756-6212
stormwaterinquiry@hydro-int.com

www.hydro-int.com

Turning Water Around...®

Appendix D-7
KriStar Flogard Dual Vortex Separator

FloGard® Dual Vortex Hydrodynamic Separator

Operations and Maintenance Manual

(for use with NJDEP projects)

Version 1.01 – October 6, 2009

FloGard® Dual-Vortex Hydrodynamic Separator

Description / Basic Function

The Dual-Vortex Hydrodynamic Separator is a stormwater filtration device used to reduce pollutant loading in runoff from urban developments. Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater, polluting downstream receiving waters. The DVS captures and retains sediment, oils, metals and other target constituents close to the source and reduces the total discharge load.

DVS units are designed to effect greater than 80% removal of TSS reflective of typical urban runoff. Units are sized to treat stormwater at the design removal efficiency in an equal or smaller footprint than other typical hydrodynamic separators. DVS units offer an economical alternative structural BMP for use in developments where land area necessitates compact, effective treatment for removal of suspended pollutants from stormwater runoff.

The DVS internal components may be manufactured from durable stainless steel, concrete or marine-grade fiberglass materials. The internal components are configured to fit into industry standard precast concrete circular or rectangular manholes.

How It Works

Particle settling or floatation is accelerated by centripetal forces induced by the tangential flow pattern augmented by a highly circuitous flow path.. The unit uses two independent cylindrical separators: Low flow is diverted by the inlet to the first separator, while moderate flow begins to overflow the first control weir and enter the second separator. Settled particles collect in the bottom storage area of the unit which is isolated from the fluid outlet, minimizing resuspension. Floating debris and oils are temporarily held at the top of each separator and deposited in the upper storage area by peak storm events. Once the unit treatment capacity is exceeded, excess flow breaches a second control weir at the inlet and passes through the bypass pipe without decreasing the treatment flow or re-entraining captured pollutants.

Maintenance Overview for DVS Systems

State and Local regulations require that stormwater management systems be maintained and serviced on a recurring basis. The purpose of maintaining a clean and obstruction-free system is to preserve the performance and function of the device to ensure the protection of downstream receiving waters. Trash and debris, floatables, gross pollutants and sediment are intended to build up in any stormwater treatment system. Without consistent maintenance, pollutant buildup can cause the system to function improperly by reducing removal efficiency, increasing the potential for pollutant loss through scour, or by impeding flow in orout of the system. Upstream areas may run the risk of flooding and deleterious environmental impact downstream could occur.

Recommended Frequency of Service

It is recommended that FloGard® Dual-Vortex Hydrodynamic Separators be inspected on a regularly occurring basis. Inspections should occur not less than two (2) times per year to assess the sediment level in the sump and remove floatable debris and trash from the collection areas. If the sediment level

exceeds 50% of the depth of the sump, sediment removal should be scheduled immediately to maintain the operating efficiency of the system.

In accordance with the NJDEP Protocol for Manufactured Hydrodynamic Sedimentation Devices for Total Suspended Solids Based on Laboratory Analysis (August 2009, revised September 1, 2009), the required sediment removal intervals are shown in the table below:

Required Sediment Removal Interval (Years) =

$$\frac{\text{(50\% of MTD's Maximum Sediment Storage Volume)}}{\text{(3.366)(MTFR)(TSS Removal Efficiency)}}$$

Model	MTFR[1] (cfs)	% TSS Removal[1]	Maximum Sediment Storage Volume (cf)	Required Sediment Removal Interval (mo)
DVS-36	0.35	50%	8	71
DVS-48	0.63	50%	18	64
DVS-60	1.00	50%	35	62
DVS-72	1.40	50%	60	63
DVS-84	1.90	50%	95	63
DVS-96	2.50	50%	142	63
DVS-120	3.90	50%	278	64
DVS-144	5.70	50%	481	64

Service Procedures

1. Open the access cover
   a. If equipped with an EZ Lift cover, pull the cover back to an upright position and check to see it is locked in place.
   b. If equipped with cast iron access covers, remove the covers and set to one side.
2. Then either:
   a. Use an industrial vacuum with an extension to remove collected floating debris and hydrocarbons from surface, or;
   b. Manually remove collected floating debris and hydrocarbons from the surface.
3.. Measure depth of sediment buildup at bottom of tank through separator tube. Inspect tank and internal components for damage and obstructions.
4. As required, use an industrial vacuum with an extension to remvove sediment from the bottom of the tank through the separator tubes.
5. The EZ-Lift manhole cover shall be pulled back into place, or the cast iron access covers replaced.

Inspection / Maintenance Requirements
Listed below are some recommendations for equipment and training for personnel to inspect and maintain a FloGard® Dual-Vortex Hydrodynamic Separator system.

Personnel – OSHA Confined Space Entry training and certification is a prerequisite for entrance into a system.

Equipment – Record Taking (pen, paper, voice recorder)
Proper Clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
Flashlight
Tape Measure
Measuring Stick
Pry Bar
Traffic Control (Flagging, barricades, signage, cones, etc.)
First aid materials
Debris and Contaminant collectors
Debris and Contaminant containers
Vacuum Truck

Parts - There are no replacement wear parts required. Should any of the internal components be damaged in some manner, contact Kristar for locally available materials

Disposal of Pollutants
The collected gross pollutants, hydrocarbons, sediment, and absorbent (where applicable) shall be disposed of in accordance with local, state and/or federal agency requirements.

Appendix D-8
Nyoplast EnviroHood

Nyloplast® A DIVISION OF ADVANCED DRAINAGE SYSTEMS, INC.
Tomorrow's Drainage System Today

Nyloplast EnviroHood
Maintenance Considerations

Background:

The Nyloplast EnviroHood is an innovative stormwater management device attached to the inside of a catch basin or manhole designed to prevent the outflow of floating debris and oil. The need for cleaner stormwater has caused municipal leaders to demand forward-thinking solutions to improve their overall water quality. The EnviroHood offers lower installed costs and less intrusive installations than competitive devices.

Installation shall be in accordance with Nyloplast installation procedures and those issues by local building/ construction regulations. The required minimum sump located in the typical installation is to allow for sediment to accumulate in the sump and allow the EnviroHood to properly function. Any sump larger than the recommended depth will allow more sediment to settle and require less maintenance due to the higher capacity below the EnviroHood structure.

Maintenance Recommendations

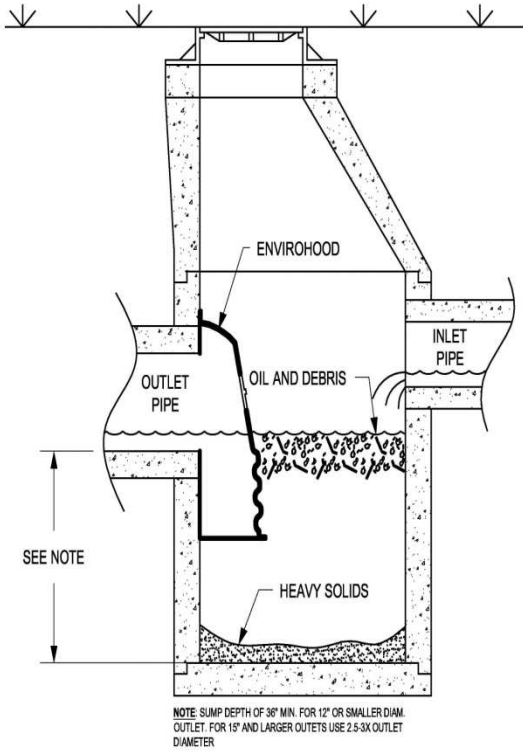
- Over the span of the first year of a new installation, monthly monitoring is recommended once the site has stabilized.
- Measurements should be taken using some sort of probe or other device as it may be difficult to determine how much sediment has accumulated.
- During the monitoring and removal process, check for evidence of restricted flow such as a high water level or clogging debris.
- After the monitoring period, it is best to continually schedule maintenance based on the amount of sediment accumulating in the sump of the structure and how much oil and debris is visible on the surface of the water over time.
- In case of a spill or other occasions where an abnormal amount of pollutants may accumulate in the structure, it is best to clean out the structure as quickly as possible.
- If another device that assists in the removal of pollutants and coarse debris is used, such as a Flexstorm product, it is best to follow the maintenance considerations for that product as their maintenance requirements may be stricter.
- A vacuum truck is best for the removal of debris and pollutants when necessary. After the collection of the waste, it shall be disposed of according to the local environment requirements.
- Once the waste has been removed, check seals and mounting hardware to ensure the EnviroHood can function properly.

3130 Verona Avenue • Buford, Georgia 30518 • Tel: (770) 932-2443 • Fax: (770) 932-2490
www.nyloplast-us.com & www.ads-pipe.com

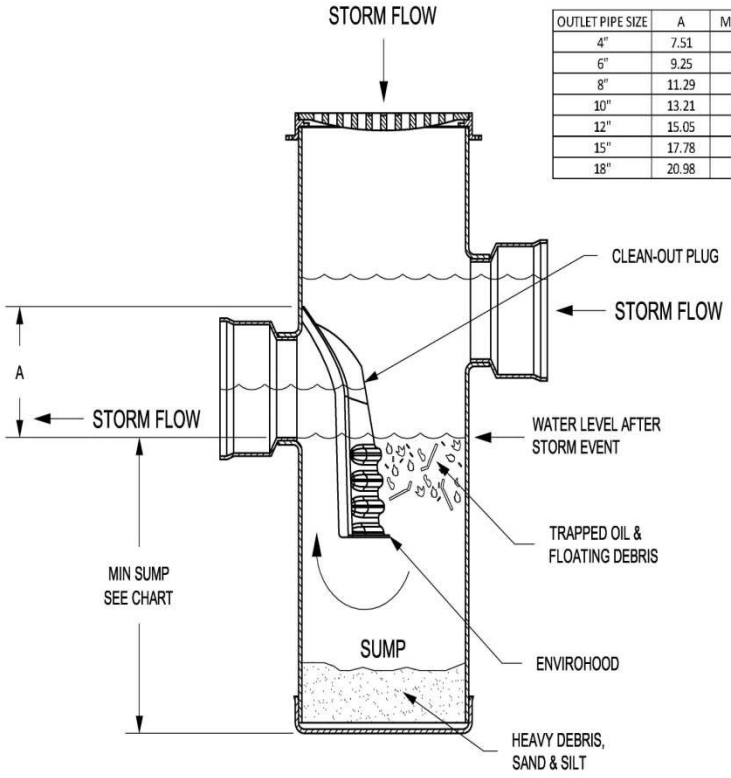
Nyloplast® A DIVISION OF ADVANCED DRAINAGE SYSTEMS, INC.

Tomorrow's Drainage System Today

TYPICAL INSTALLATIONS



NOTE: SUMP DEPTH OF 36" MIN. FOR 12" OR SMALLER DIAM. OUTLET. FOR 15" AND LARGER OUTETS USE 2.5-3X OUTLET DIAMETER



OUTLET PIPE SIZE	A	MIN SUMP
4"	7.51	36.00
6"	9.25	36.00
8"	11.29	36.00
10"	13.21	36.00
12"	15.05	36.00
15"	17.78	42.00
18"	20.98	48.00

3130 Verona Avenue • Buford, Georgia 30518 • Tel: (770) 932-2443 • Fax: (770) 932-2490
www.nyloplast-us.com & www.ads-pipe.com

Appendix D-9
OldCastle Precast 4x6 Oil-Water Separator

University of Kentucky
Research Building 2
2425.0

SUBMITTAL NUMBER: 22A-334100-05-01

ITEM(s): Underground Plumbing - Storm Utility Pre-cast Manholes, WQU, Grease Trap, and Oil/ Water Separator

CONSTRUCTION MANAGER:	**ARCHITECT/ENGINEER:**
The Whiting-Turner Contracting Company One Lakeside Commons 990 Hammond Drive, Suite 1100 Atlanta, GA 30328	Champlin Architecture 720 E Pete Rose Way Suite 140 Cincinnati, OH 45202

WHITING-TURNER STAMP

SHOP DRAWING REVIEW	
REVIEW IS FOR GENERAL COMPLIANCE	
WITH CONTRACT DOCUMENTS	
NO RESPONSIBILITY IS ASSUMED FOR	
CORRECTNESS OF DIMENSIONS	
NO EXCEPTIONS TAKEN	
MAKE CORRECTIONS	
REVISE & RESUBMIT	
REJECTED – SEE REMARKS	
WHITING-TURNER	
DATE 07/11/2016	BY AE

CHAMPLIN

CARMAN
SHOP DRAWING REVIEW

Consultant's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy, for confirming and correcting all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

- ☐ No exceptions taken
- ☒ Make corrections noted
- ☐ Amend & Resubmit
- ☐ Rejected: See remarks

Name: KLW
Date: 7-14-2016

See notes on SM#10 and WQU#1.

PROJECT	UK RESEARCH BUILDING #2 – DESIGN REALEASE 2 UNDERGROUND PLUMBING PACKAGE
CONSULTANTS	CMTA 2429 Member's Way Lexington, KY 40504 (859) 253-0892 CARMAN 310 Old Vine Street, Suite 200 Lexington, Kentucky 40507 (859) 254-9803
CONSTRUCTION MANAGER	The Whiting-Turner Contracting Company 141 Leader Avenue Lexington, Kentucky 40508
MECHANICAL	LAGCO INC. 1490 Sunshine Lane Lexington, KY 40505 (859) 293-7473
SUPPLIER	Oldcastle Precast
MANUFACTURER	Oldcastle Precast, JR HOE
SPECIFICATIONS	334100 Concrete Precast structures and lids: REVISED Manholes, Grease Trap, Oil/Water Separator, Water Qual. Unit

LAGCO, INC.
SHOP DRAWINGS
JUL 08 2016
☑ REVIEWED ☐ NOTE MARKINGS

OLDCASTLE PRECAST

747 ALLENRIDGE POINTE
LEXINGTON, KY. 40517
PHONE (859)-259-1484
FAX (859)-233-9267

PRECAST STORM STRUCTURES
UK RESEARCH BUILDING #2
LEXINGTON, KY

LAGCO INC,

SUBMITTAL

REVISION 1

7-5-16

DATE

OLDCASTLE PRECAST

*OPENINGS CAST AS REQUIRED IN TOP SLAB AS SPECIFIED ON STACKIT PRODUCTION SHEETS

4' TOP SLAB W/G

'H'	Wt.
12'	1760#

ECCENTRIC CONICAL

'H'	Wt.
24'	1280#
30'	1860#
32'	2000#
36'	2440#

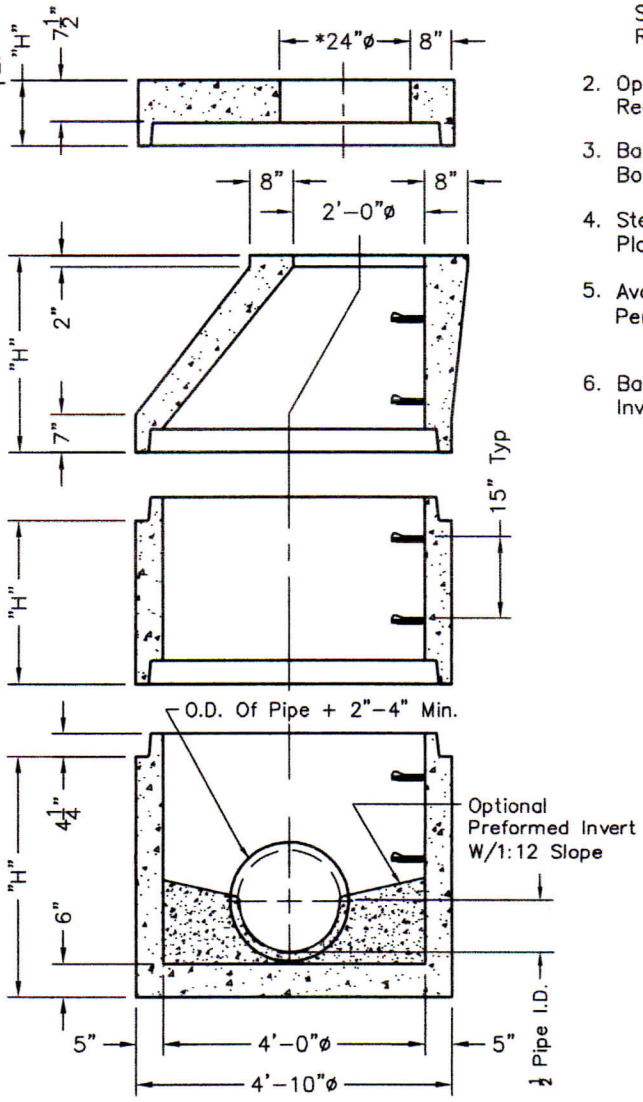
4' DIA. BARREL

'H'	Wt.
15'	1083#
30'	2168#
45'	3251#

4' DIA. BASE

'H'	Wt. w/Invert
23'	3816#
30'	4404#
32'	4485#
34'	4629#
44'	5352#

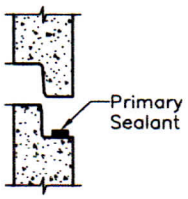
'H'	Wt. w/o Invert
23'	2605#
30'	3111#
32'	3255#
34'	3400#
44'	4122#



SECTIONAL VIEW

GENERAL NOTES:

1. Manhole Are Fabricated To Meet Or Exceed The Following Specifications:
   Concrete: 28 Day Compressive Strength f'c = 4,500 psi
   Reinforcing: ASTM C-478
2. Openings Cored Or Cast As Required
3. Base Is Available With Open Bottom
4. Steps: Copolymer Polypropylene Plastic With #4 In Center
5. Available with Butyl Conseal Sealant Per ASTM C-990-91
6. Bases Available With Preformed Invert Per Utility District Specs



TYPICAL CONSEAL JOINT

SCALE:3/8" = 1'-0"

Oldcastle Precast®
747 Allenridge Point, Lexington, KY 40510
Phone: 859-259-1484 Fax: 859-233-9351

DMM4DSMH

FILE NAME: 384DMM4DSMH.DWG
ISSUE DATE: February, 2011
www.oldcastleprecast.com

Typical 4' Dia. Storm Manhole Components

SW-150

ECCENTRIC CONICAL

"H"	Wt.
48"	4800#

*OPENINGS CAST AS REQUIRED IN TOP SLAB AS SPECIFIED ON STACKIT PRODUCTION SHEETS

5' TOP SLAB

"H"	Wt.
13"	2915#

5' DIA. BARREL

"H"	Wt.
16"	1729#
32"	3460#
48"	5184#

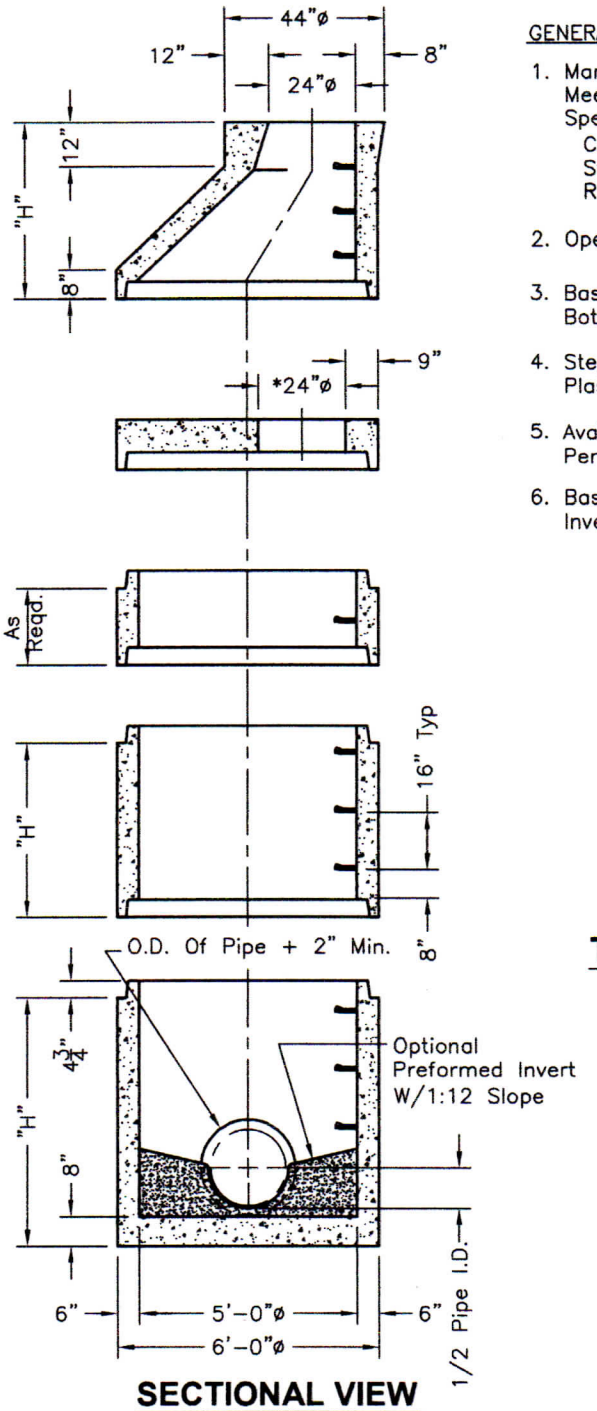
5' DIA. BARREL

"H"	Wt.
16"	1729#
32"	3460#
48"	5184#

5' DIA. BASE

"H"	Wt. w/Invert
48"	10,367#
60"	11,663#
72"	12,959#

"H"	Wt. w/o Invert
48"	7,147#
60"	8,443#
72"	9,739#



SECTIONAL VIEW

GENERAL NOTES:

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   Reinforcing: ASTM C-478
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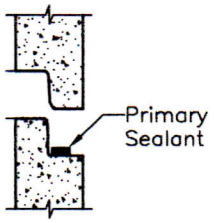
3. Base Is Available With Open Bottom
4. Steps: Copolymer Polypropylene Plastic With #4 In Center
5. Available with Butyl Conseal Sealant Per ASTM C-990-91
6. Bases Available With Preformed Invert Per Utility District Specs



TYPICAL CONSEAL JOINT

SCALE: 1/4" = 1'-0"

Oldcastle Precast®

747 Allenridge Point, Lexington, KY 40510
Phone: 859-259-1484 Fax: 859-233-9351

DMM5DSMH

FILE NAME: 384DMM5DSMH.DWG

ISSUE DATE: January, 2011

www.oldcastleprecast.com

Typical 5' Diameter Storm Manhole Components

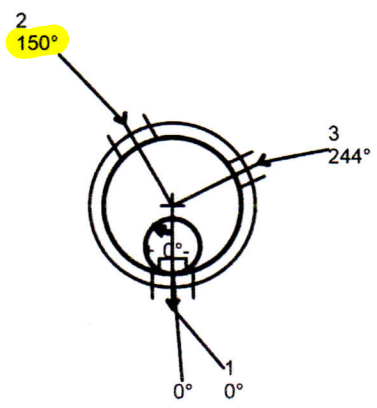
SW-170

Job Name: UK Research Building #2 LAGCO INC. O#96388

Structure ID: **SM #9**

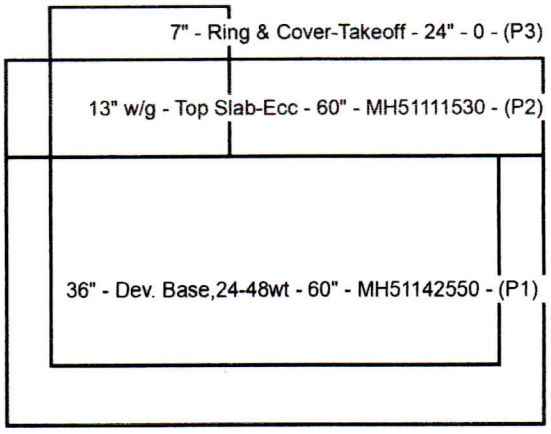
Spec: LFUCG	Rim: 70.2'	Rim to Invert: 3.85'
Type: 5' Storm	Invert: 66.35'	Overall Height: 4.667'
Size: 60"	Catch: 0.167'	Slack: 0.017'

P3) 7" - Ring & Cover-Takeoff - 24" - 0	0 lb
P2) 13" w/g - Top Slab-Ecc - 60" - MH51111530	2292 lb
P1) 36" - Dev. Base,24-48wt - 60" - MH51142550	8988 lb
1) 1"x 17' - Single Conseal - 60" - 7111000	0 lb
2) 18" - Hole - 0	0 lb
1) 12" - Hole - 0	0 lb
2) 15" - Step	0 lb
Structure Total:	11280 lb

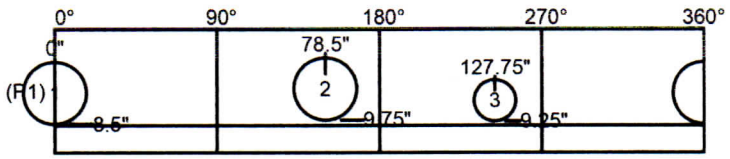


Structure Notes:

Position	Elev	Angle	Hole	Offset	UP (_)	Int. (cw)	Pipe	Connector	Ref
Rim	70.2'								
Reducer									
Invert 1	66.35'	0°	18"	0"	8.5"	0"	15" PVC	Hole 18"	P1
Invert 2	66.45'	150°	18"	0"	9.75"	78.5"	15" PVC	Hole 18"	P1
Invert 3	66.45'	244°	12"	0"	9.25"	127.75"	8" PVC	Hole 12"	P1
Invert 4									
Invert 5									
Invert 6									
Invert 7									
Invert 8									



INSIDE WALL DIMENSIONS



Oldcastle Precast, Inc Lexington, KY 859-259-1484 Prepared by: GED

APPROVED BY: OC Submittal Quote ID: 2016030154
7/5/2016 2:26:10 PM
Page: 1 of 2

Oldcastle Precast®

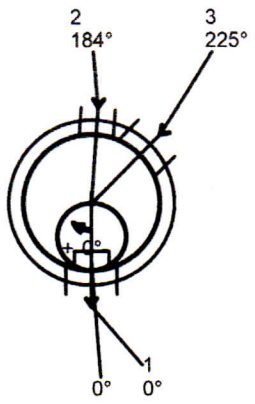
Job Name: UK Research Building #2 LAGCO INC. O#96388

Structure ID: **SM #10**
Spec: LFUCG
Type: 4' Storm MH
Size: 48"

Rim: 74.5'
Invert: 66.8'
Catch: 0.167'

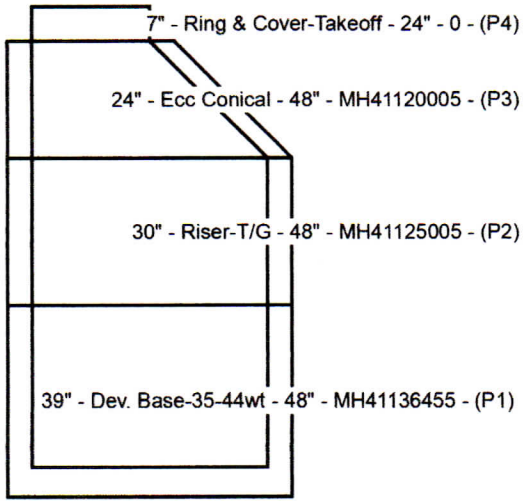
Rim to Invert: 7.7'
Overall Height: 8.333'
Slack: 0.034'

P4)	7" - Ring & Cover-Takeoff - 24" - 0	0 lb
P3)	24" - Ecc Conical - 48" - MH41120005	1280 lb
P2)	30" - Riser-T/G - 48" - MH41125005	2168 lb
P1)	39" - Dev. Base-35-44wt - 48" - MH41136455	4714 lb
2)	1"x 14.5' - Single Conseal - 48" - 7110500	0 lb
2)	18" - Hole - 0	0 lb
1)	12" - Hole - 0	0 lb
6)	15" - Step	0 lb
	Structure Total:	8162 lb

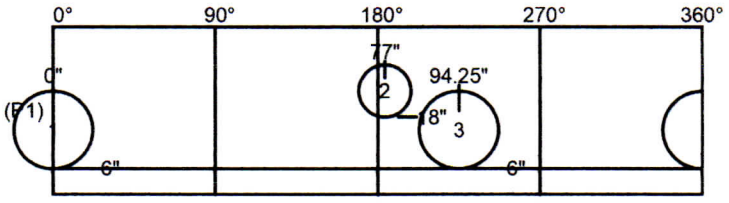


Structure Notes:

Position	Elev	Angle	Hole	Offset	UP (_)	Int. (cw)	Pipe	Connector	Ref
Rim	74.5'								
Reducer									
Invert 1	66.8'	0°	18"	0"	6"	0"	15" SDR35	Hole 18"	P1
Invert 2	67.25'	184°	12"	0"	18"	77"	8" PVC	Hole 12"	P1
Invert 3	66.8'	225°	18"	0"	6"	94.25"	14" C900	Hole 18"	P1
Invert 4									
Invert 5									
Invert 6									
Invert 7									
Invert 8									



INSIDE WALL DIMENSIONS



Oldcastle Precast, Inc Lexington, KY 859-259-1484

Prepared by: GED

APPROVED BY:

OC Submittal Quote ID: 2016030154
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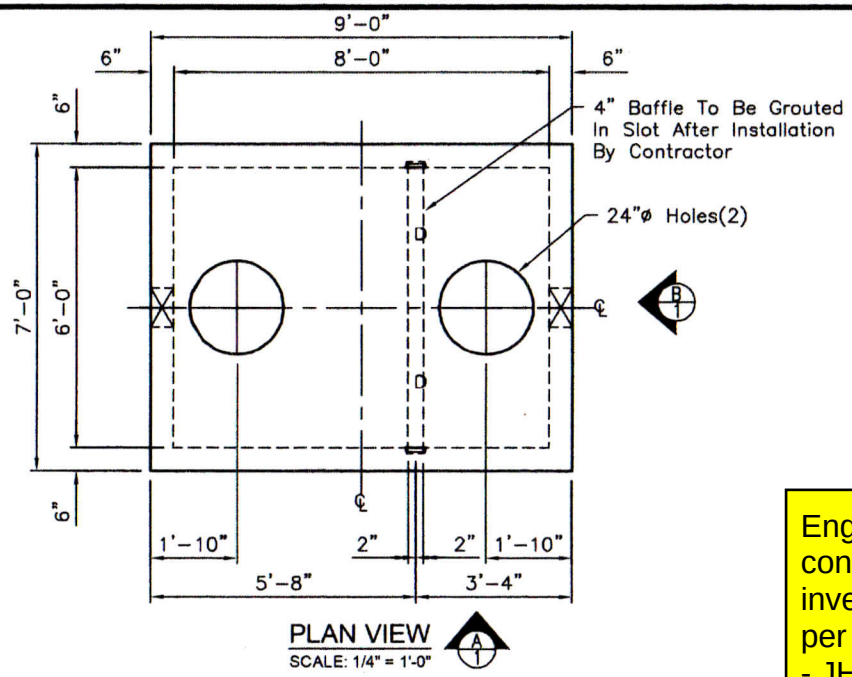
Page: 2 of 2

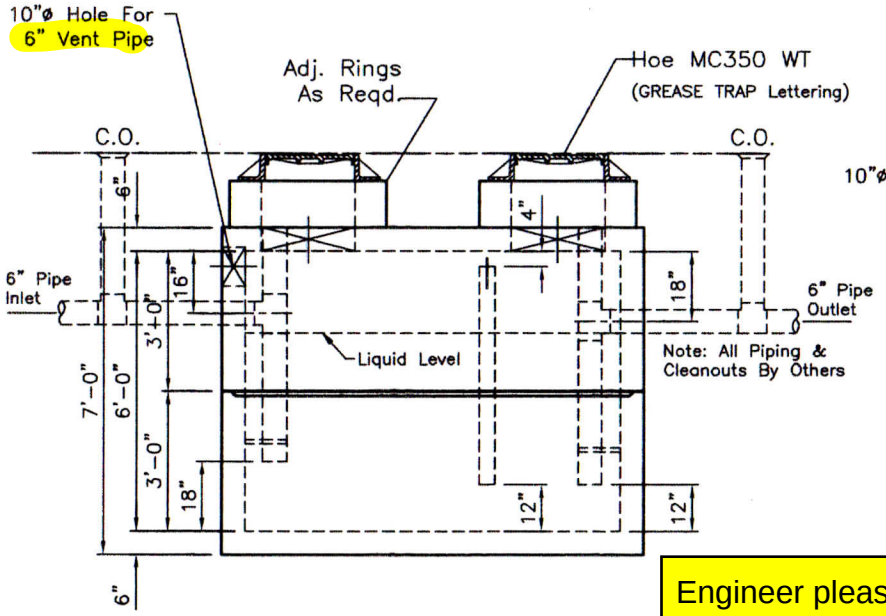
Oldcastle Precast®

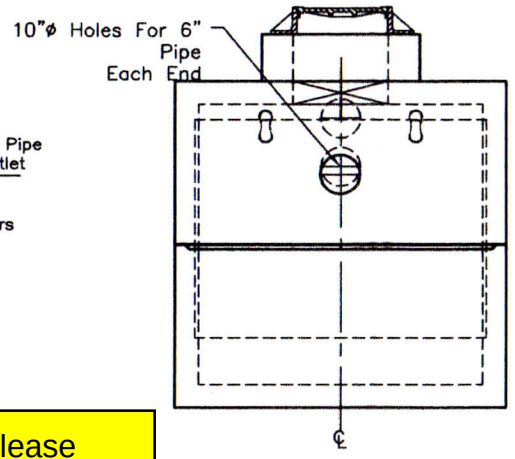


GENERAL DESIGN NOTES

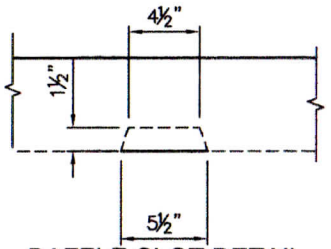
1. ACI 318-11
2. APPLICABLE DESIGN CODES:
   - AASHTO STANDARD SPECIFICATIONS FOR HWY BRIDGES, 17TH EDITION
   - ASTM C858
3. PRECAST RATED FOR HS20 LIVE LOAD W/ IMPACT I.A.W. AASHTO SPECIFICATION
4. DESIGN FILL RANGE = 0'(MIN) TO 2'(MAX)
5. GROUND WATER TABLE ASSUMED AT 5.0' BELOW GRADE. IF DESIGN (OR ACTUAL) WATER TABLE IS LESS THAN ASSUMED, REVIEWING ENGINEER TO NOTIFY OLDCASTLE PRECAST UPON REVIEW OF THIS SUBMITTAL.
6. LATERAL DESIGN PRESSURES:
   - EQUIV DRY SOIL FLUID PRESSURE = 47 PSF (MIN)
   - EQUIV SATURATED SOIL FLUID PRESSURE = 85 PSF (MIN)
   - LIVE LOAD SURCHARGE PRESSURE = 80 PSF (MIN)
7. CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS = 6,100 PSI.
8. REINFORCEMENT: ASTM A615, GRADE 60.
9. JOINT SEALANT: BUTYL RUBBER, CONSEAL CS-102
10. THESE CALCULATIONS DO NOT INCLUDE ANY LATERAL OR SURCHARGE LOADS PRODUCED BY OTHER FOOTINGS OR FOUNDATIONS ADJACENT TO THIS STRUCTURE. THIS STRUCTURE SHALL BE KEPT A MINIMUM OF 1:1 RATIO AWAY FROM OTHER FOOTINGS OR FOUNDATIONS.

Engineer please confirm Outlet invert is 964.9' per P-200UA
- JH, WT 7-8-16





Engineer please confirm vertical drop from Inlet to Outlet
- JH, WT 7-8-16

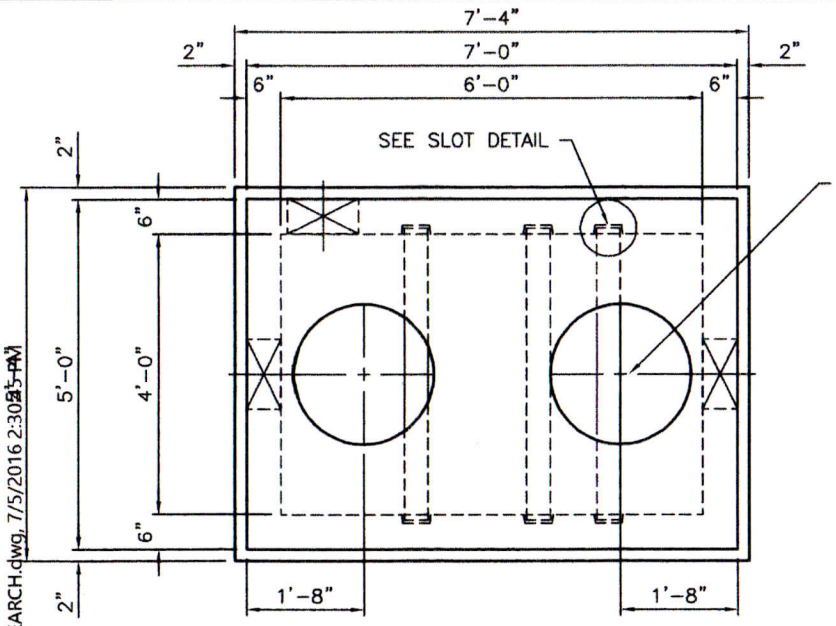


Oldcastle Precast®
747 ALLENRIDGE POINT, LEXINGTON, KY 40510
PHONE: 859-259-1484 FAX: 859-233-9351

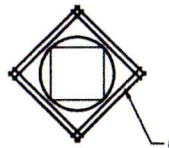
6x8x6 1500 GA GREASE TRAP
SUBMITTAL
STANDARD LFUCG-2016
LEXINGTON, KY.

CUSTOMER					

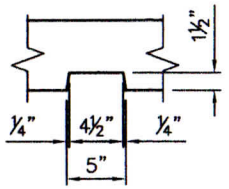
DATE	SALES	DRAWN	ENGINEER	CHECKED	SALES ORDER
7/5/16	-----	KS	KS	-----	-----
DRAWING NUMBER				REVISION	SHEET
6x8x6_1500_GT-LFUCG 2016_UK				-----	OF-----
				REV DATE -----	



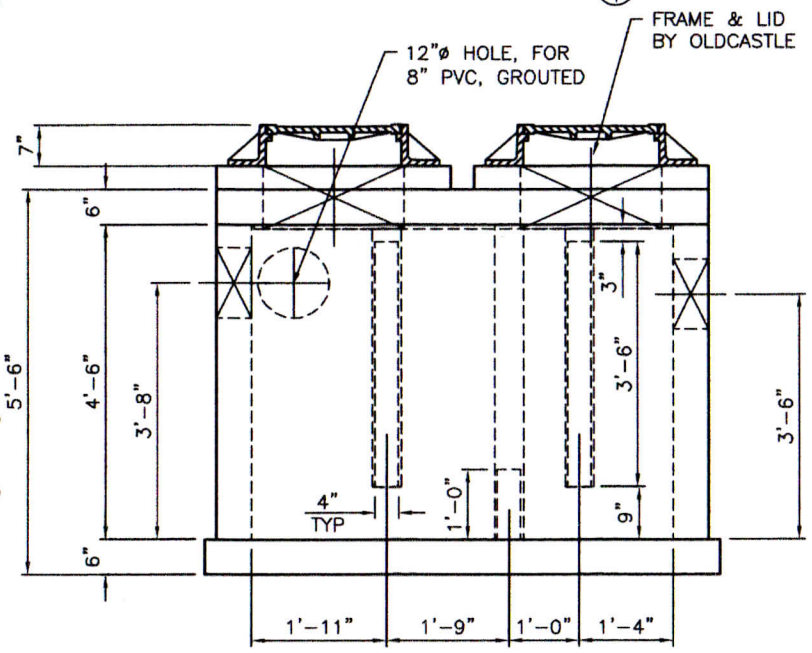
PLAN VIEW
SCALE: 3/8" = 1'-0"



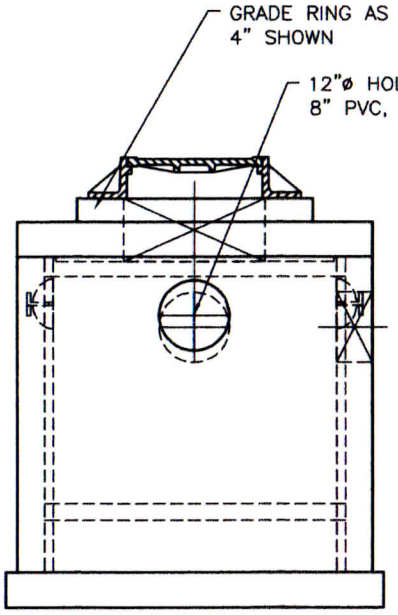
TYPICAL REINFORCEMENT FOR OPENINGS
SCALE: N.T.S.



SLOT DETAIL
SCALE: 3/4" = 1'-0"



SECTION A
SCALE: 3/8" = 1'-0"



SECTION B
SCALE: 3/8" = 1'-0"

GENERAL DESIGN NOTES

1. LOAD FACTOR DESIGN
2. APPLICABLE DESIGN CODES:
   - AASHTO STANDARD SPECIFICATIONS FOR HWY BRIDGES, 17TH EDITION
   - ASTM C857
3. PRECAST RATED FOR 300 PSF LIVE LOAD
4. DESIGN FILL RANGE = 0'(MIN) TO 2'(MAX)
5. GROUND WATER TABLE ASSUMED AT 3.0' BELOW GRADE. IF DESIGN (OR ACTUAL) WATER TABLE IS LESS THAN ASSUMED, REVIEWING ENGINEER TO NOTIFY OLDCASTLE PRECAST UPON REVIEW OF THIS SUBMITTAL.
6. LATERAL DESIGN PRESSURES:
   - EQUIV DRY SOIL FLUID PRESSURE = 47 PSF (MIN)
   - EQUIV SATURATED SOIL FLUID PRESSURE = 85 PSF (MIN)
   - LIVE LOAD SURCHARGE PRESSURE = 80 PSF (MIN)
7. CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS = 6,000 PSI.
8. REINFORCEMENT: ASTM A615, GRADE 60.
9. JOINT SEALANT: BUTYL RUBBER, CONSEAL CS-102
10. THESE CALCULATIONS DO NOT INCLUDE ANY LATERAL OR SURCHARGE LOADS PRODUCED BY OTHER FOOTINGS OR FOUNDATIONS ADJACENT TO THIS STRUCTURE. THIS STRUCTURE SHALL BE KEPT A MINIMUM OF 1:1 RATIO AWAY FROM OTHER FOOTINGS OR FOUNDATIONS.

WEIGHTS

SECTION	WEIGHT
TOP RISER	3,400
BASE SECTION	6,450
TOTAL	9,850 LBS

CONTRACTOR IS TO VERIFY THAT ALL INFORMATION SHOWN ON DRAWINGS HAS BEEN THOROUGHLY CHECKED, COMPLIES WITH CONTRACTOR DOCUMENTS, AND IS ADEQUATE TO MEET FIELD CONDITIONS. OLDCASTLE ACCEPTS NO RESPONSIBILITY FOR INSTALLATION ERRORS BY THE CONTRACTOR AND ERRORS OR OMISSIONS RESULTING AFTER RECEIPT OF APPROVED SHOP DRAWINGS.

NOTE: PRODUCTION WILL NOT COMMENCE UNTIL RECEIPT OF SIGNED APPROVED SHOP DRAWINGS.

APPROVED
FOR PRODUCTION

BY: _____
DATE: _____

Oldcastle Precast®
747 ALLENRIDGE POINT, LEXINGTON, KY 40510
PHONE: 888-888-1484 FAX: 888-233-8881

4'x6' OIL/WATER SEPARATOR

SUBMITTAL
UK RESEARCH BUILDING #2
LEXINGTON, KY

CUSTOMER
LAGCO INC.

DATE	SALES	DRAWN	ENGINEER	CHECKED	SALES ORDER
7/5/16	JM	GED	GED	—	96386

DRAWING NUMBER	REVISION	SHEET
4x6 OWS_UK RESEARCH	—	OF 1
	REV DATE —	

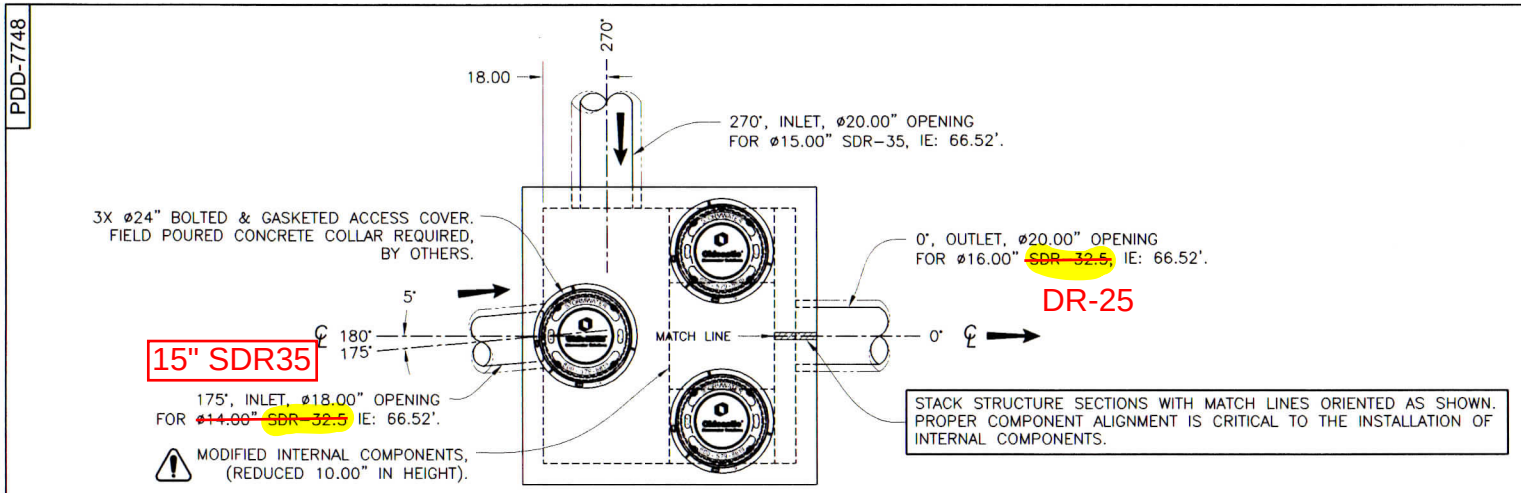
REVISIONS

REV	DATE	BY	DESCRIPTION OF REVISION
1	7/5/16	GED	CHANGE HOLE SIZE & ADD GRADE RING

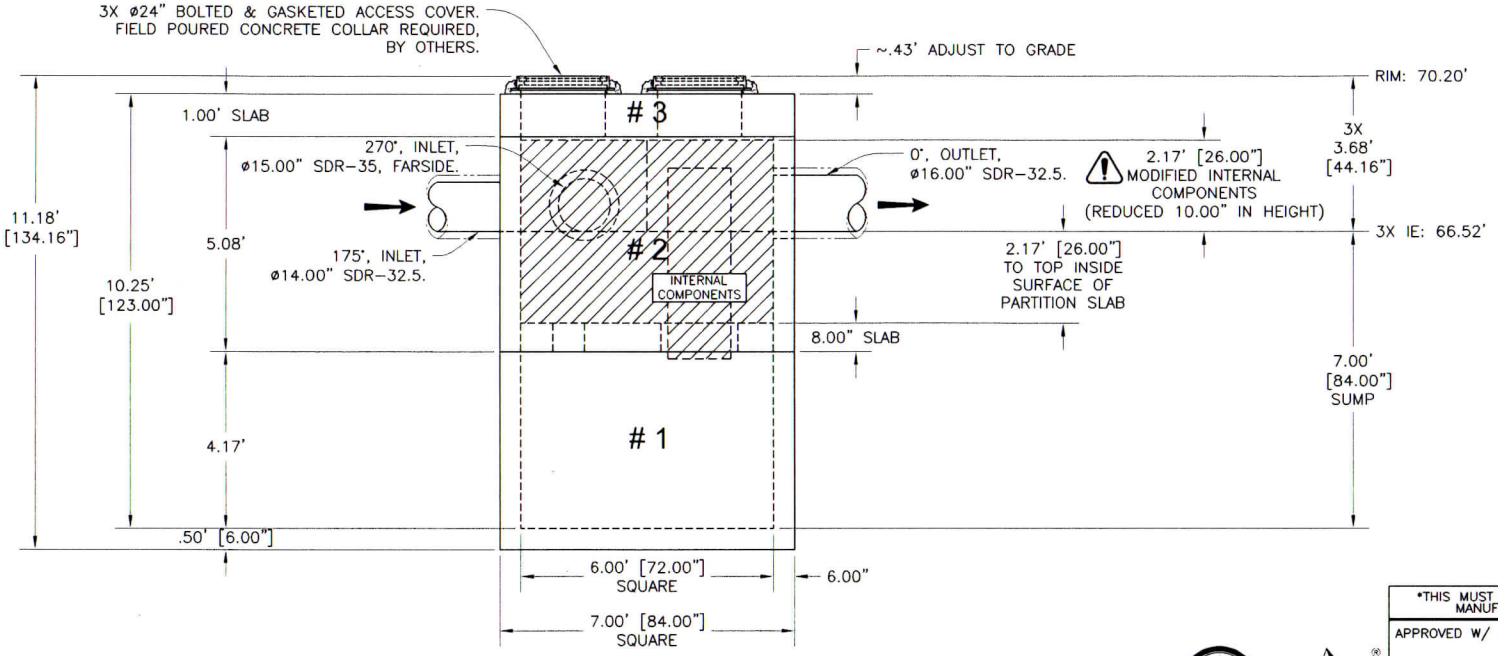
\\OPILEXINGTON\Shared\engineering\PROJECTS\LEXINGTON 384\LAGCO\4x6 OWS_UK RESEARCH.dwg, 7/5/2016 2:30:25 PM

PDD-7748

WQU # 1



PLAN VIEW



ELEVATION VIEW

NOTES:

1. CONCRETE COMPONENTS ARE DESIGNED FOR HS-20 TRUCK LIVE LOAD AND MANUFACTURED IN ACCORDANCE WITH ASTM C890 & C913.
2. DESIGN FILL RANGE 1' (MAX).
3. GROUND WATER TABLE FOR STRUCTURAL CALCULATIONS IS ASSUMED BELOW INVERT.
4. DESIGN CONCRETE COMPRESSIVE STRENGTH IS 5,000 PSI (MIN.) AT 28 DAYS.
5. PRECAST DESIGN DOES NOT INCLUDE ANY LATERAL OR SURCHARGE LOADS FROM OTHER BUILDINGS OR FOUNDATIONS ADJACENT TO THIS STRUCTURE. THIS STRUCTURE SHALL BE KEPT A MINIMUM OF 1:1 RATIO AWAY FROM OTHER FOOTINGS OR FOUNDATIONS.
6. THIS STRUCTURE IS DESIGNED TO THE PARAMETERS NOTED HEREIN. PLEASE VERIFY THAT THESE PARAMETERS MEET PROJECT REQUIREMENTS (I.E. LIVE LOAD, FILL RANGE, WATER TABLE). IF DESIGN PARAMETERS ARE INCORRECT, REVIEWING ENGINEER/AUTHORITY SHALL NOTIFY OLDCASTLE PRECAST UPON REVIEW OF THIS SUBMITTAL.
7. OVERSIZED HOLES TO ACCOMMODATE SPECIFIC PIPE TYPE MUST BE CONCENTRIC TO PIPE ID. AFTER PIPES ARE INSTALLED, ALL ANNULAR SPACES SHALL BE FILLED WITH A MINIMUM OF 3000 PSI CONCRETE FOR FULL THICKNESS OF PRECAST WALLS.
8. CONTRACTOR RESPONSIBLE TO VERIFY ALL SIZES, LOCATIONS AND ELEVATIONS OF OPENINGS.
9. CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED & LEVEL PER PROJECT SPECIFICATIONS)
10. SECTION HEIGHTS, SLAB THICKNESSES & KEYWAYS ARE SUBJECT TO CHANGE DUE TO AVAILABILITY & PRODUCTION PLANT CAPABILITY.
11. MAXIMUM PICK WEIGHT: RISER SECTION #2 ~15,000 LBS / 7.50 TONS. ASSEMBLED WITH INTERNAL COMPONENTS INSTALLED).

Oldcastle Stormwater Solutions
300 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819 Fax: 707.524.8186 www.oldcastlestormwater.com

REV.	ECO NO.	DESCRIPTION	APPROVED
P02	NONE	INLET 175° WAS ø8" HDPE, IE ø14" SDR-32.5, INLET 270° WAS ø15" RCP, IS ø15" SDR-35, OUTLET WAS ø15" RCP, IS ø16" SDR-32.5.	JPR 7/7/16

Hydrodynamic Separation

KRISTAR®

THIS MUST BE FILLED OUT BEFORE MANUFACTURING BEGINS

APPROVED W/ NO EXCEPTIONS TAKEN: ☐
APPROVED AS NOTED: ☐
REVISE AND RESUBMIT: ☐

SIGNATURE DATE

DVS-72S

Customer: Lagco, Inc.

Job Name: UK Research Building 2 - Lexington, KY

JOB DATE	SALES	DRAWN	ENGINEER	CHECKED	SALES ORDER
5/12/16	-	JPR	STS	ISM JMH	S096393

DRAWING NUMBER: PDD-7748

REVISION: P02 REV. DATE: 7-7-16

SHEET: 1 OF 1

Oldcastle Stormwater Solutions™

Dual Vortex Separator (DVS)

Hydrodynamic Separator Sizing Verification

v1.09

Project Name: UK Research Building 2
Project Location: Lexington, KY
Unit ID: DVS-72S
Design Engineer: Sertich

Project Site Input Data:

Drainage Area (A): 3.20 ac
Runoff Coefficient (C): 1.00
Design Intensity (I): 1.00 in/hr

Model: DVS-72
WQF: 3.20 cfs

Sediment Size: OK-110 sand - d50 = 100 um

Removal Target: 80%
Coverage Target: 100%

Basis: Frequency

Average Rainfall Intensity (in/hr)	Frequency[1] (%)	Cumulative Frequency[1] (%)	Flow Rate[2] (cfs)	Minimum Removal Efficiency[3] (%)	Weighted TSS Removal (%)
0.01	26.0%	26.0%	0.032	100.0%	26.0%
0.02	12.9%	38.9%	0.064	100.0%	12.9%
0.03	9.1%	48.0%	0.096	100.0%	9.1%
0.04	7.1%	55.1%	0.128	100.0%	7.1%
0.05	5.3%	60.4%	0.160	100.0%	5.3%
0.06	5.0%	65.4%	0.192	100.0%	5.0%
0.07	4.3%	69.7%	0.224	99.8%	4.3%
0.08	3.4%	73.1%	0.256	99.5%	3.4%
0.09	2.7%	75.8%	0.288	99.3%	2.7%
0.10	2.7%	78.5%	0.320	99.0%	2.7%
0.11	2.0%	80.5%	0.352	98.7%	2.0%
0.12	1.8%	82.3%	0.384	98.3%	1.8%
0.13	1.5%	83.8%	0.416	97.9%	1.5%
0.14	1.4%	85.2%	0.448	97.5%	1.4%
0.15	1.4%	86.6%	0.480	97.1%	1.3%
0.20	0.6%	91.0%	0.640	94.7%	0.5%
0.25	0.5%	93.8%	0.800	91.8%	0.5%
0.50	0.1%	98.4%	1.600	73.4%	0.0%
0.75	0.0%	99.6%	2.400	55.2%	0.0%
1.00	0.0%	99.8%	3.200	41.0%	0.0%
1.25	0.0%	99.9%	4.000	30.9%	0.0%
1.50	0.0%	100.0%	4.800	23.7%	0.0%

No removal credit considered above 100% Frequency

Net Annual TSS Removal = 98.1%

[1]From 60-min precipitation data (NCDC)

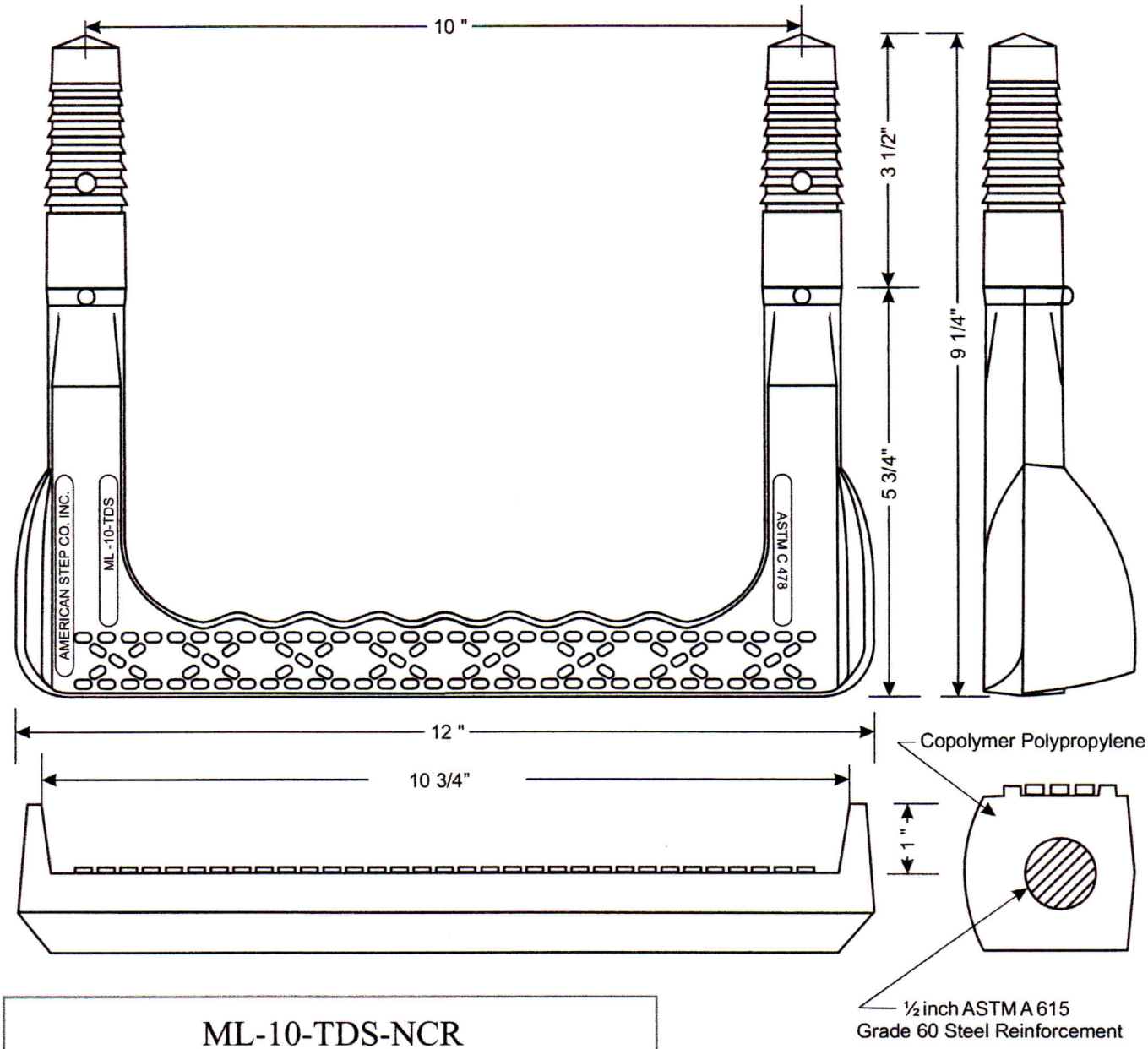
[2]Rational method

[3]Based on independently verified lab testing

Disclaimer: Calculations are best estimate based on information available and are intended only for use by the party to whom they were transmitted and for the project referenced.

http://www.americanstep.com

ML-10-TDS-NCR



ML-10-TDS-NCR

Mechanical Lock Installation Methods
Minimum Concrete Strength Must Be 3000 psi.

Preformed Holes

Two preformed holes on 10" centers
Holes must be parallel
Diameter of holes are 1.1" tapering to 7/8" in 3 ½" of depth

Drilled Holes

Drill two 1" holes on 10" centers with a minimum depth of 3 3/4"
Use 1" masonry bit for drilling.
Holes must be parallel.

Drive step with sledge hammer until both legs are completely seated

This step meets or exceeds ASTM C 478 and OSHA Standards when properly installed.

American Step Company, Inc.
P.O. Box 137
830 East Broadway
Griffin, GA 30224-0137

800-988-STEP
770-467-9844 (OFFICE)
770-467-8011 (FAX)

http://www.americanstep.com

ConSeal™ CS-102

Butyl Rubber Sealant

ConSeal
Concrete Sealants Inc.

Butyl Rubber Sealant for All Precast Concrete Structures - Meets ASTM C-990

Applications

For concrete joints in: Manholes, Concrete Pipe, Vaults, Box Culverts, Septic Tanks, and Vertical Panel Structures. **Not intended for use in expansion joints or joints that move.**

Sealing Properties

- Provides permanently flexible watertight joints.
- Low to high temperature workability: 30°F to 120°F (-1°C to +48°C)
- Rugged service temperature: -30°F to +200°F (-34°C to +93°C)
- Excellent chemical and mechanical adhesion to clean dry surfaces.
- Greater cohesive and adhesive strengths.
- Sealed joints will not shrink, harden or oxidize upon aging.
- Controlled flow resistance for application ease.
- No priming normally necessary. When confronted with difficult installation conditions, such as wet concrete or temperatures below 40°F (4°C), priming the concrete will improve the bonding action. Consult Concrete Sealants for the proper primer to meet your application.

Hydrostatic Strength

ConSeal CS-102 meets the hydrostatic performance requirement as set forth in ASTM C-990 section 10.1 (Performance requirement: 10psi for 10 minutes in straight alignment – in plant, quality control test for joint materials.)

Specifications

ConSeal CS-102 meets or exceeds all of the requirements of Federal Specification SS-S-210 (210-A), AASHTO M-198B, and ASTM C-990-91.

Physical Properties

Description

	Spec	Required	CS-102
Color			Black
Specific Gravity, 77°F	ASTM D71	1.15-1.50	1.25
Ductility, 77°F	ASTM D113	5.0 min.	10
Penetration, cone 77°F (25°C), 150 gm, 5 sec.	ASTM D217	50-100 mm	55-60 mm
Penetration, cone 32°F (0°C), 150 gm, 5 sec.	ASTM D217	40 mm min.	40-65 mm
Flash Point, C.O.C., °F	ASTM D92	350°F min.	450°F
Fire Point, C.O.C., °F	ASTM D92	375°F min.	475°F

Don't Just Seal It, ConSeal It!

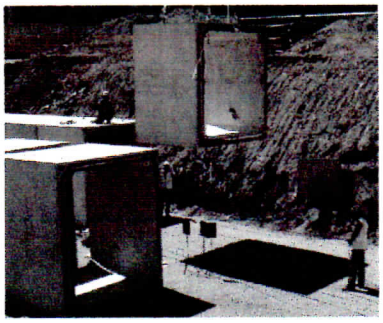
ISO 9001 Registered

Concrete Sealants, Inc. 9325 State Route 201 ■ Tipp City, OH 45371 ■ P.O. Box 176 ■ New Carlisle, OH 45344
P. 937.845.8776 **F.** 937.845.3587 **Toll Free** 800.332.7325 ■ **www.conseal.com**

ConSeal™ CS-102

Butyl Rubber Sealant

ConSeal
Concrete Sealants Inc.



Butyl Rubber Sealant for All Precast Concrete Structures - Meets ASTM C-990

Chemical Composition

Description

	Spec	Required	CS-102
Hydrocarbon plastic content % by weight	ASTM D297	50% min.	51%
Inert mineral filler % by weight	AASHTO T111	30% min.	35%
Volatile Mater % by weight	ASTM D6	2% max.	1.2%
Non-extractable, carbon-based material			12.8%
Recycled Content, % by weight			
Post Consumer:			8.41%
Post Industrial:			10.85%

Immersion Testing

30-Day Immersion Testing: No visible deterioration when tested in 5% Caustic Potash, 5% Hydrochloric Acid, 5% Sulfuric Acid, and 5% saturated Hydrogen Sulfide.

One Year Immersion Testing: No visible deterioration when tested in 5% Formaldehyde, 5% Formic Acid, 5% Sulfuric Acid, 5% Hydrochloric Acid, 5% Sodium Hydroxide, 5% Hydrogen Sulfide, and 5% Potassium Hydroxide.

Limited Warranty

This information is presented in good faith, but we cannot anticipate all conditions under which this information and our products, or the products of other manufactures in combination with our products, may be used. We accept no responsibility for results obtained by the application of this information or the safety and suitability of our products, either alone or in combination with other products. Users are advised to make their own tests to determine the safety and suitability of each such product or product combinations for their own purposes. It is the **users' responsibility** to satisfy himself as to the suitability and completeness of such information for this own particular use. We sell this product without warranty, and buyers and users assume all responsibility and liability for loss or damage arising from the handling and use of this product, whether used alone or in combination with other products.

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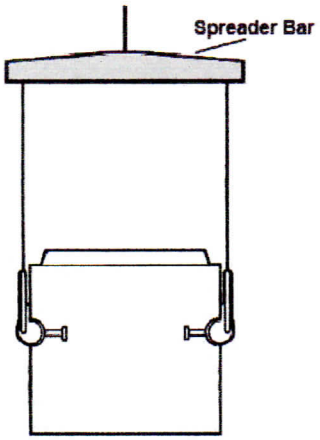
RECOMMENDED INSTALLATION PROCEDURES STORM AND SANITARY SEWER MANHOLES

Lifting Apparatus

Use approved lifting devices that will safely lift the weight of the unit with applicable OSHA requirements (Title 29 Part 1926) safety factor. When lifting manhole bases and risers, make sure the chain or cable lengths are long enough to prevent contact with the tongue and groove area, and are kept at appropriate lifting angles. Where safe lifting angles cannot be achieved, use appropriately rated spreader bars. The manhole lifting apparatus must meet or exceed safe working load capacity with respect to the lifting points. All lifting points should be used, and the product should be handled with equal "picking" force on all lifting points.



Recommended Manhole Bedding

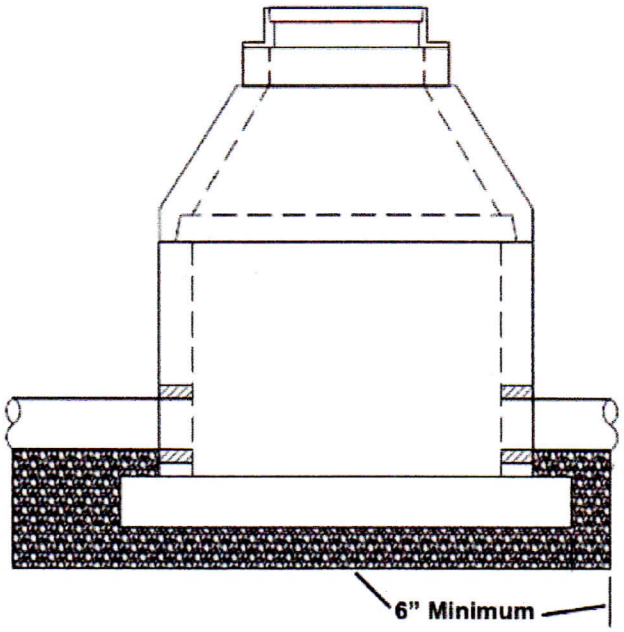
Use a minimum of 6 inches of approved bedding material compacted to 90% Proctor in an area not less than the base area but preferably 6 inches beyond the outside radius of the manhole base. The area under incoming and outgoing pipes should be treated the same to prevent shearing of pipes and provide proper alignment for the watertight connector/pipe interface, if connectors are being utilized. Local ground conditions may require additional bedding thickness, based on the engineer's recommendations.

Handling Manhole Components

Manhole components should not be lifted using backhoes or front end loaders, unless they are of sufficient capacity to handle the product. Avoid transporting products across bumpy terrain at a speed that causes the product to bounce. Excessive travel bouncing of the product can cause damage. Also, avoid pushing or rolling a manhole product on the ground with on-site machinery.

Setting the Manhole Base and Risers

Set the manhole base on a graded bedding per job specifications making sure the connectors or pipe openings match design elevations. Level the top of the manhole base in both directions. Make sure each additional riser section is plumb as installed before installing the next riser, cone or cap.



Use a minimum of 6" of approved bedding material compacted to 90% Proctor in an area that is 6" beyond the ouside radius of the manhole base.

Pipe Connections

Should be based on manufacturer's recommendations. Check with the manufacturer if precast inverts are supplied.

Flexible Boot Connections – Clean the pipe surface and inside of boot. Insert the pipe flush with the inside of the manhole wall or as allowed by jurisdiction, keeping the pipe centered in the connector. Install all take up clamps(s) in groove(s), if provided, at the receiving end of connector. Tighten the clamp to the recommended torque, which will vary depending on size and manufacturer's specifications. Clamps should be tightened when the pipe is in straight alignment for proper seating of clamps. Any grouting that will inhibit the design/flexibility of the connector should be avoided.

Compression Type Connector – Cut a ¾ inch bevel on the end of the pipe to be inserted into manhole. Clean the pipe and connector surfaces and the inside area of the connector. Lubricate the surface of the connector and exterior area of the pipe being inserted with the approved lubricant. Center the beveled end of pipe into the connector. Keeping the pipe level, push the pipe into the connector until the pipe is flush with the inside of manhole wall or as required per local specifications.

Mortar Joint – Set the pipe into the opening to meet elevations. Using non-stick mortar, fill the voids around the pipe completely. Allow proper curing time before backfilling.

NPCA
Precast ... The Concrete Solution

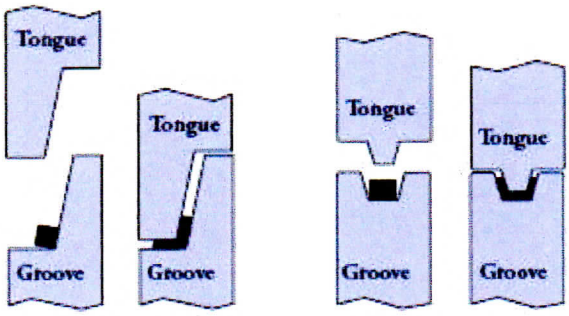
Pipe Stubs

Any pipe stubs installed in the manhole must be restrained from movement to prevent blowout, resulting from groundwater or any testing.

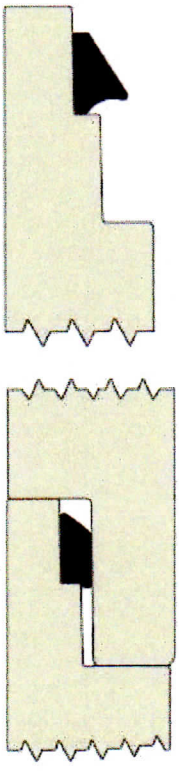
Joint Installation

Ensure joints are free of debris.

Butyl Gasket – Use only manufacturer recommended sizes for specific diameters. Clean and inspect tongue and groove surfaces. Surfaces should be free from all dust and debris. On the tongue-up manhole, place butyl material next to the vertical surface of the tongue. Wrap the material completely around the unit overlapping ends. Knead the ends together to form a unified splice. Make sure all protective paper is removed. Lower the bell end of the next unit, making sure steps are aligned (if applicable) into the final position. If the bell is up, place butyl material next to the vertical surface of the groove and follow above procedure.



Confined O-Ring – Clean and inspect joint surfaces. Lubricate the joint surface liberally. Lubricate the O-Ring gasket thoroughly before placing it into the confined groove space provided. Run a smooth round object between the gasket and tongue around the entire circumference several times to equalize the gasket diameter. Lower the lubricated end of the next unit, making sure steps are aligned into the final position. Keep units plumb while setting to prevent the gasket from rolling out of the confined groove, which could result in breaking the bell.



Offset and Prelubricated Gaskets – Install per the manufacturer's specifications.

Precast Lift Hole Sealing (full penetration):

If required by an authority with jurisdiction, lifting holes should be sealed by inserting a rubber plug or other approved material into the hole (if supplied) and/or filling with non-shrink mortar from inside and outside. When using embed anchors, voids should be filled with non-shrink grout.

Backfill Procedure

Backfill around the manhole equally to prevent tipping. Compact the fill in the same way as the standard trench procedure. Backfill material should be clean and free of large rocks. The size of the vibration equipment should be suited for site conditions to avoid damage to the manhole.

Testing Procedures

vacuum tests should be performed before backfilling in accordance with ASTM C1244. There is no applicable standard for vacuum testing after backfilling, and this may require special consideration to vacuum pressure to account for soil and hydrostatic loads. Refer to the NPCA Manhole Vacuum Testing Brochure (precast.org/vacuum) for vacuum, hydrostatic and pressure testing where required.

Storage

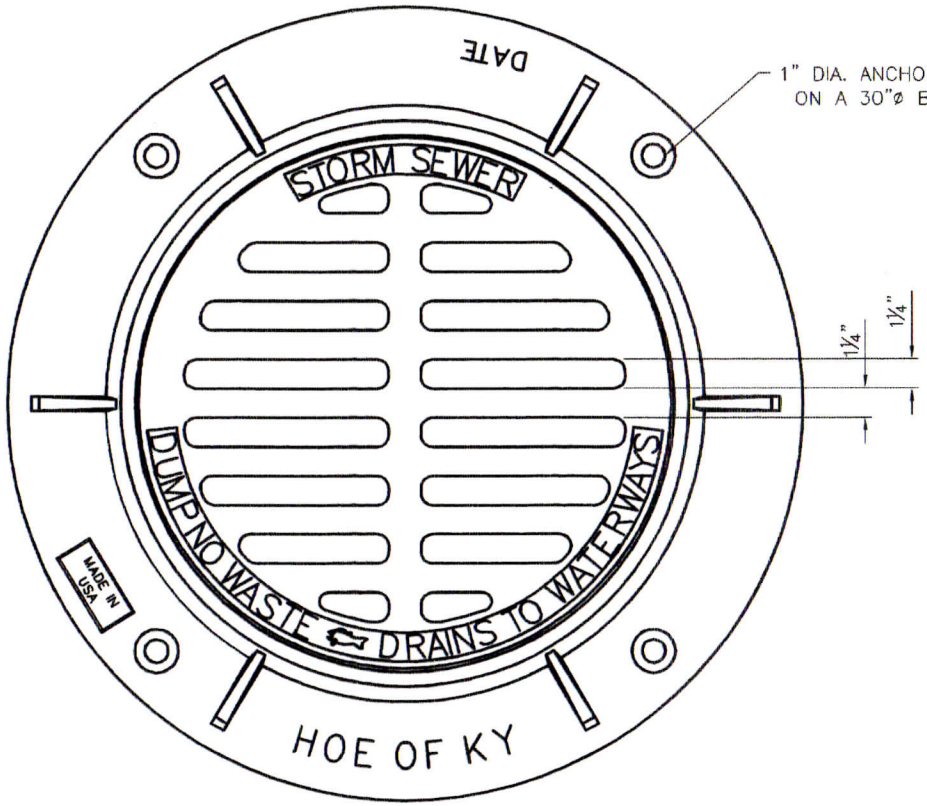
If manhole products need to be stored on-site, make sure they are placed on level ground and not in mud or water to prevent damage. Dunnage can be used in these situations to avoid problems. Please consult with the manufacturer when storing manhole products for long periods.

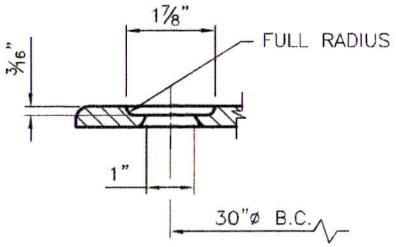
Disclaimer

These procedures do not claim or imply that all safety-related issues, if any, associated with their use have been addressed. The manufacture of precast concrete products may involve the use of hazardous materials, operations and equipment. It is the user's responsibility to determine appropriate safety, health and environmental practices, and applicable regulatory requirements associated with the use of this manual and the manufacture of precast concrete products.

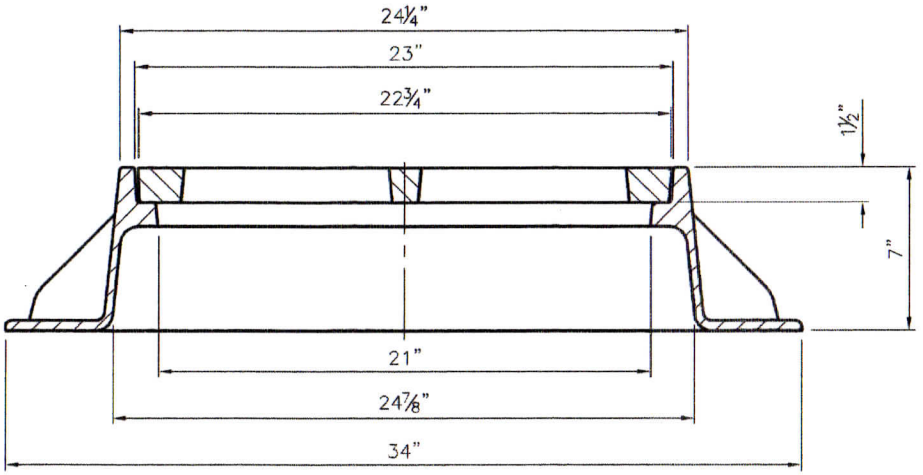
The use of these procedures does not guarantee the proper function or performance of any product manufactured in accordance with the requirements contained in the manual. Routine conformance to the requirements of this manual should result in products of an acceptable quality, according to current industry standards.

HOE MCB-350B ROUND MANHOLE FRAME & BAR GRATE





ANCHOR HOLE DETAIL
N.T.S.



J.R. HOE AND SONS

www.jrhoe.com 800-245-5521

Material Specs:	ASTM A48 Class 35B, Gray Iron
Frame Weight:	180 LBS
Grate Weight:	113 LBS
Load Rating:	H-20
Open Drainage Area:	1.3 SQ. FT.

Drawing Date: 04-01-12 **By:** SCD

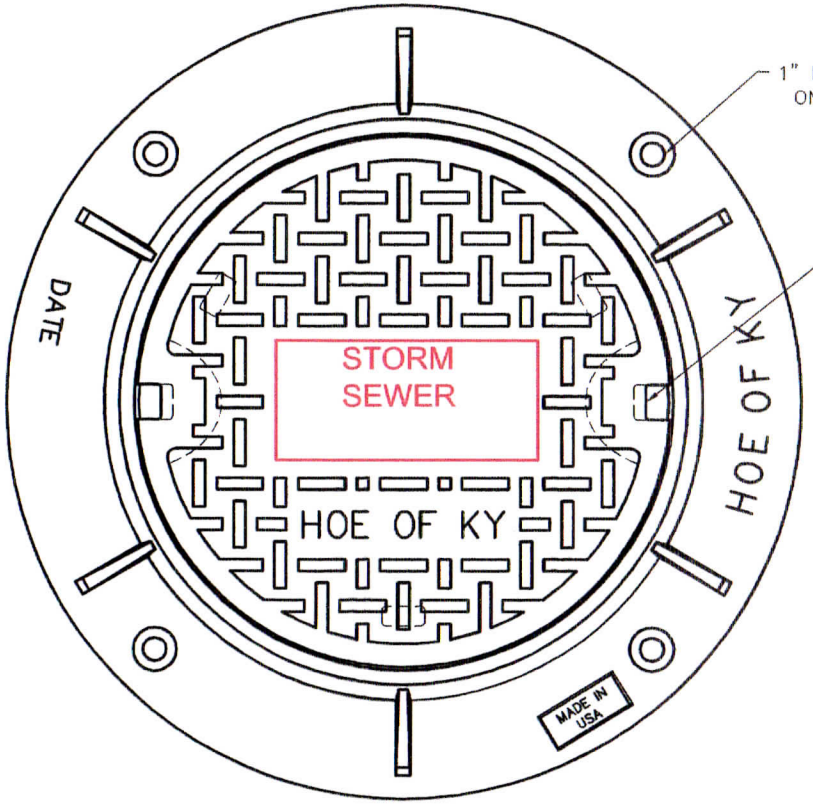
Revision Date: . **By:** .

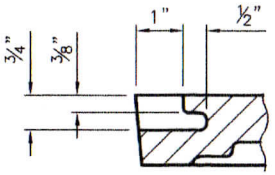
LEED: **Gray iron castings are eligible for LEED credits under sections MR4 Recycled Content and MR5 Regional Materials.**

OPTIONS:

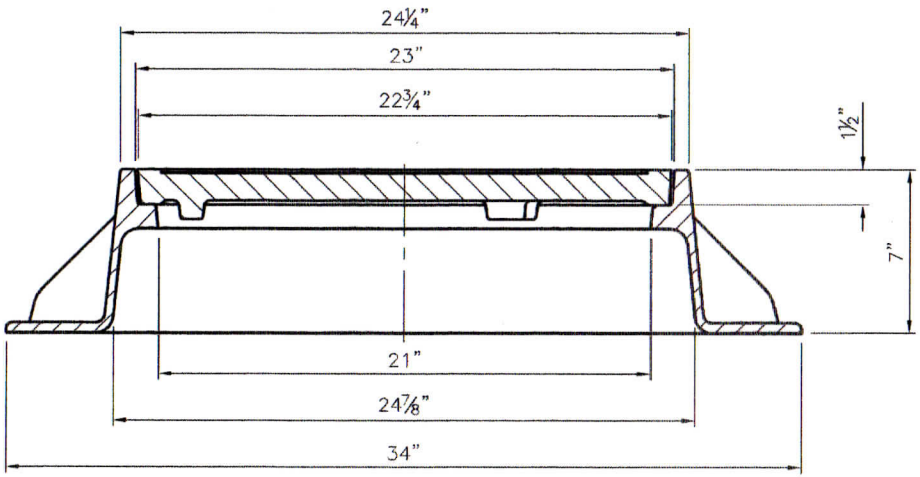
BICYCLE SAFE

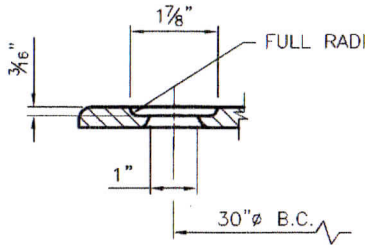
HOE MC-350 ROUND MANHOLE FRAME & COVER





CONCEALED PICKHOLE DETAIL





ANCHOR HOLE DETAIL
N.T.S.

J.R. HOE AND SONS

www.jrhoe.com 800-245-5521

Material Specs:	ASTM A48 Class 35B, Gray Iron
Frame Weight:	180 LBS
Cover Weight:	125 LBS
Load Rating:	H-20

Drawing Date: 04-01-12 **By:** SCD

Revision Date: . **By:** .

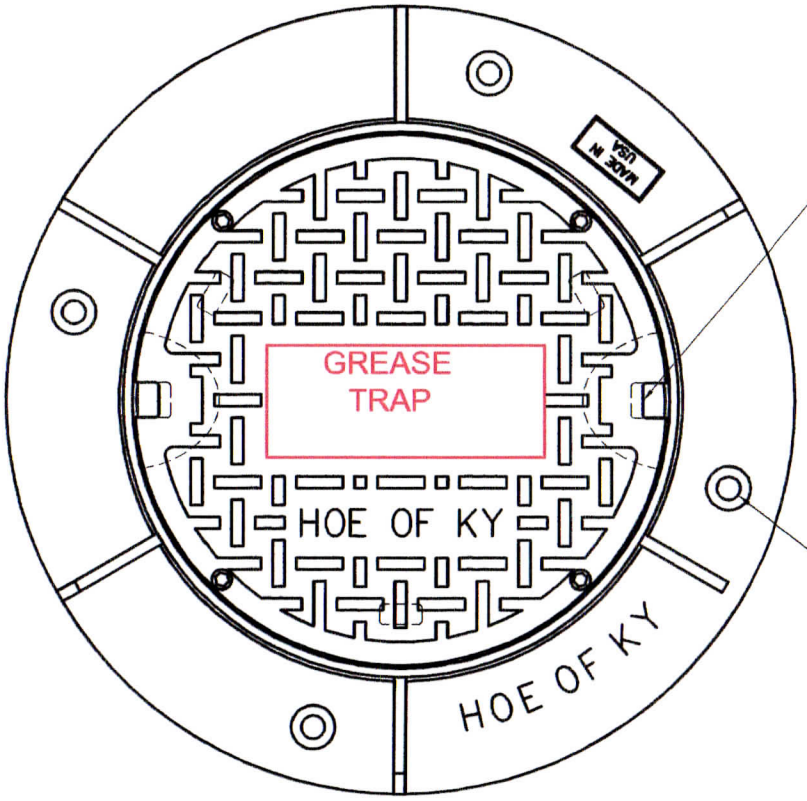
LEED: **Gray iron castings are eligible for LEED credits under sections MR4 Recycled Content and MR5 Regional Materials.**

OPTIONS:

COVER LETTERED SANITARY, STORM, PLAIN, GREASE TRAP OR AS SPECIFIED

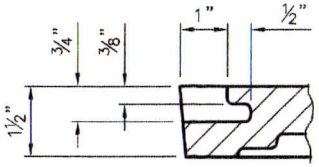
- storm sewer lettering on MH #10
- OIL/WATER on O/W separator

HOE MC-350-WT ROUND MANHOLE FRAME & COVER

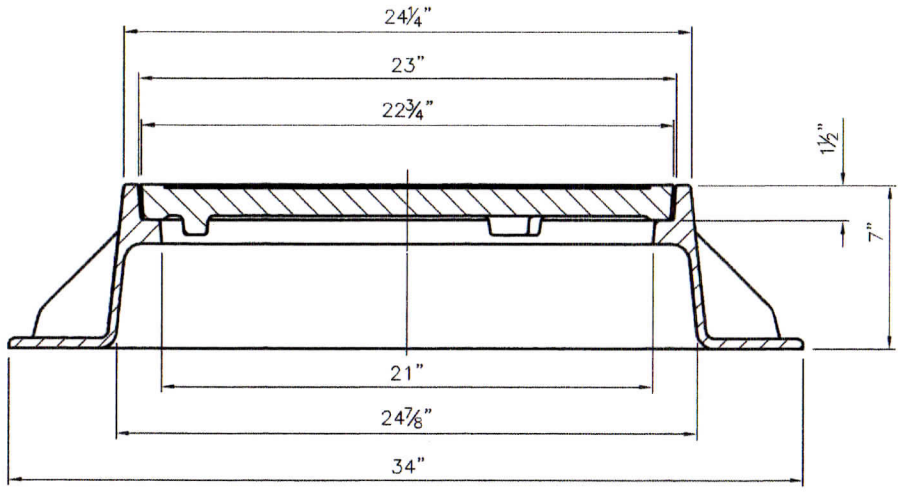


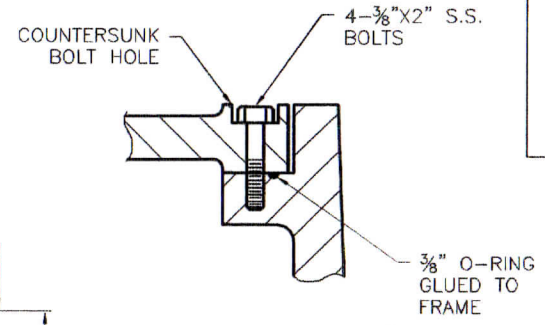
CONCEALED PICKHOLE (2)

1"ø ANCHOR HOLE (4) ON 30"ø B.C.



CONCEALED PICKHOLE DETAIL





TYPICAL WATERTIGHT DETAIL

J.R. HOE AND SONS

www.jrhoe.com 800-245-5521

Material Specs:	ASTM A48 Class 35B, Gray Iron
Frame Weight:	180 LBS
Cover Weight:	125 LBS
Load Rating:	H-20

Drawing Date: 04-01-12 **By:** SCD

Revision Date: . **By:** .

LEED: **Gray iron castings are eligible for LEED credits under sections MR4 Recycled Content and MR5 Regional Materials.**

OPTIONS:

COVER LETTERED SANITARY, STORM, PLAIN, GREASE TRAP OR AS SPECIFIED

Appendix D-10
Zurn Z1186 and Z1188 Oil Interceptor

Z1186-ST AND Z1188-ST SERIES

ZURN ENGINEERED OIL INTERCEPTORS WITH INTEGRAL STORAGE TANKS

Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice

PURPOSE

For nearly sixty years, Zurn Oil Interceptors have been used in plumbing waste systems to help protect property and the environment against explosion, fire and pollution.

HOW THE ZURN OIL INTERCEPTOR OPERATES

The baffle plate opposite the inlet of the oil interceptor defuses the flow into the interceptor and lessens the turbulence of the oil-laden water as it enters the intercepting chamber. Solids and sludge carried in the water are stopped by the baffle and held in the solids retaining bucket between the inlet and the flow-retarding baffle. Such accumulation can then be removed. The resulting, quiet, even flow of water through the interceptor permits the oils and other light density substances to rise to the surface by the "flotation" principle of separation. Maximum separation and interception is affected in proportion to the elimination of turbulence of waste water within the interceptor to the point of practically eliminating it.

INSTALLATION CONSIDERATIONS

Install the interceptor as close as practical to the fixture or fixtures being serviced. The interceptor may be set on the floor, partially recessed in the floor, with top flush with the floor, or fully recessed below the floor to suit piping and structural conditions.

Anticipate sufficient clearance for removal of the interceptor cover for cleaning. Also, take into consideration the placement of the flow control fitting, and ventilation requirements. See recommended installation drawing (Fig.1).

RECOMMENDED INSTALLATIONS

Commercial Uses	Industrial Uses
Filling and Service Stations	Machine Shops
Maintenance Garages	Refineries
Airport Hangars	Fabrication & Welding Plants
Laundries & Cleaning Establishments	Foundries
Parking Facilities	

SIZING

The rate of flow through the drainage line (GPM) and into the Interceptor is the main consideration in selecting the proper sized oil interceptor. In addition, the viscosity characteristics and probable amounts of oils and other light density substances to be separated should be taken into consideration, since the volume involved may influence the intercepting chamber size. As the size of the interceptor increases, the flow rate and quantity of oil that it separates efficiently also increases. If the oil interceptor is undersized, an overload condition will develop and oil will pass through the interceptor in the waste water and into the drainage system. Overload conditions may also cause water levels in the trap to rise. Therefore, water will be drawn off over the oil draw-off gate plate.

FLOW CONTROL

An oil interceptor correctly designed to separate oil and light density substances from waste water will not, by itself, govern or regulate the flow of water through it at all times. The Zurn flow control fitting (Z-1108) must be installed properly in every installation to sufficiently assure the flotation separation of the entrained substances, which are to be intercepted at maximum efficiency.

The flow control fitting, designed with an integral orifice, gives a pre-determined optimum flow rate and assures the elimination of turbulence in the oil interceptor, which could otherwise occur from sudden surges through the drainage line.

The orifice openings are related to the size and flow rating of the oil interceptor. It should also be noted that standard orifice sizing is for gravity flow conditions, where no pressure build-up is considered. If the maximum recommended flow is exceeded, the efficiency of the interceptor will decrease considerably. If necessary, additional flow control fittings should be installed at all sources of flow.

VENTING

The Zurn oil interceptor with integral storage tank is furnished with 2" ips vent connections located on all sides of the unit to accommodate the installation of the vent piping. Three of the vent connections are located on the oil storage tank, and one vent connection is located on the interceptor body upstream of the double wall trap seal. It is important that the unit be vented using any one of the vent connections provided. This will allow any of the volatile gases rising from the intercepted substances to be carried from the interceptor and storage tank to the atmosphere.

ADJUSTABLE DRAW-OFF

The Zurn oil interceptor with integral storage tank is furnished with an adjustable oil draw-off gate plate . This draw-off creates a passageway for intercepted oils to travel from the main separation chamber to the oil storage tank. The oil draw-off consists of an adjustable gate plate on the inside of the intercepting chamber. The adjustable gate plate can be raised or lowered inside of the interceptor chamber to the proper height for draining off the separated oils and similar light density substances that have separated and floated to the surface of the interceptor chamber.

Thus, after the oils and other substances have accumulated inside the interceptor, they will drain from the interceptor chamber by gravity flow over the internal gate plate. The gate plate shall be adjusted so that it's top edge is 1/8" above the operating water flow level in the interceptor chamber. There is no need to manually skim or dip out the oil, since the oil will drain off by gravity flow over the draw-off gate plate after it has been properly adjusted and tightened.

HOW TO SET ADJUSTABLE DRAW-OFF

The Zurn oil interceptor with integral storage tank should be completely installed and all connections made, including the adjustable draw-off gate plate. If the gate plate was not set at it's highest position, loosen all bolts securing the gate plate as well as those above the gate plate. Slide the gate plate up to it's highest position and tighten in place.

Clean water is then run through the oil interceptor at the gpm flow rate that the interceptor will be operating at. This establishes the operating water level. Mark the operating water level on the inside of the intercepting chamber next to the gate plate and a mark 1/8" above the operating level mark. The marking of the operating water level must be done while there is water flowing through the interceptor. If the mark is established at the static water level, excess amounts of water will pass over the draw-off gate plate when the flow rate through the interceptor increases to its operating level. In this case, the draw-off gate plate would become submerged.

Loosen the bolts securing the gate plate and slide the gate plate down so that the top edge is at the 1/8" mark above the operating water level mark. Tighten bolts securing the gate plate at this level. After the oil interceptor is put into operation and a film of oil and low density substances has accumulated at the surface, the adjustable draw-off setting should be checked by taking samples while the oil interceptor is in operation. If the gate plate is properly set to the correct height, the drawn-off oil should have no water in it. If it is apparent that water is present in the drawn-off oil, the adjustable gate plate should be moved up until only oil travels over the draw-off gate plate.

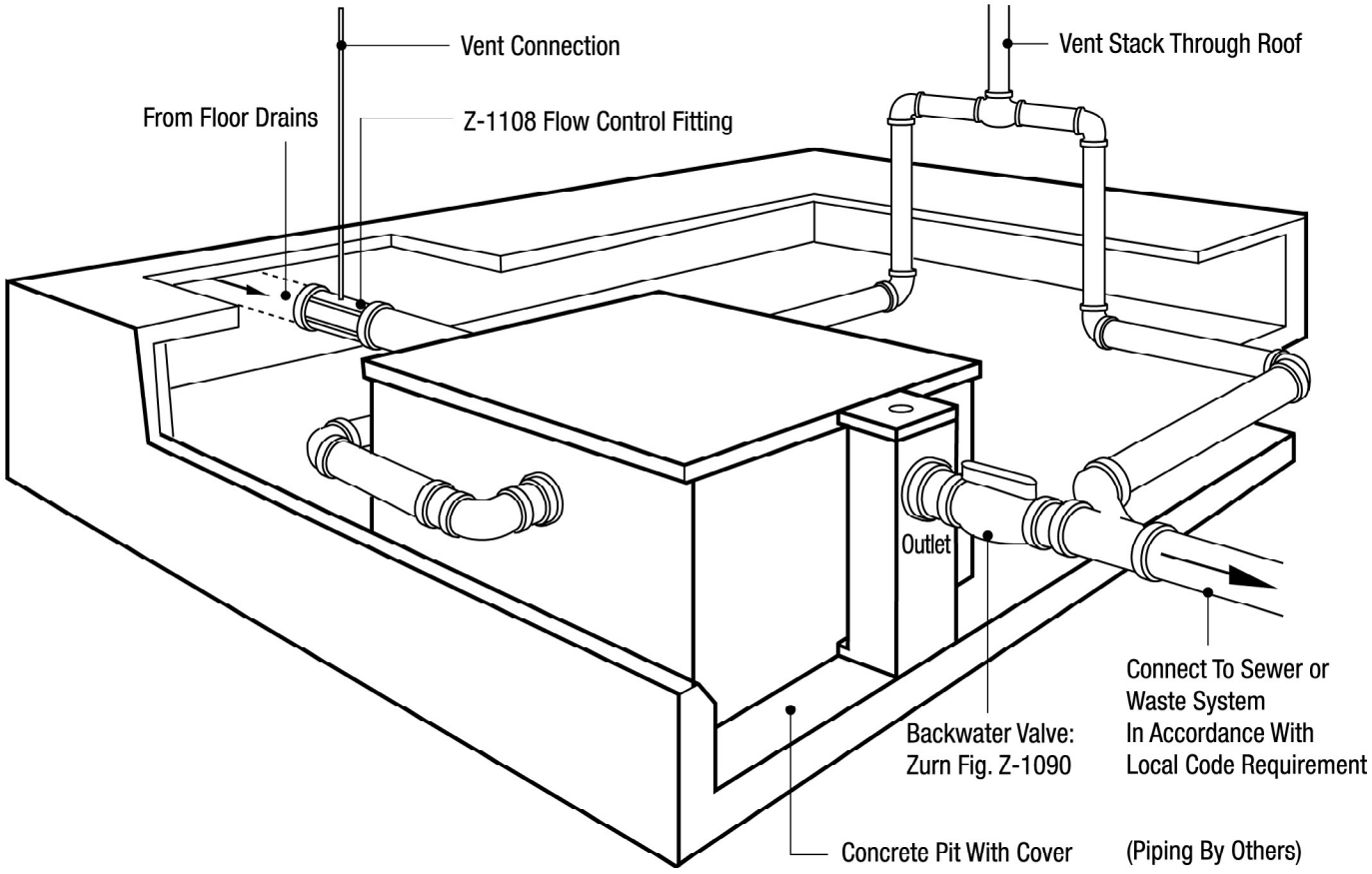
Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice

MAINTENANCE

Periodic checks of the oil level in the oil storage compartment is recommended. The accumulated oil in the storage compartment should be pumped out before the oil level has risen to the gate plate height. As these periodic checks are made, a general inspection of the interceptor, plumbing connections and gasketing should be made. Any required maintenance needed should be performed at this time.

FIG. 1

Pictured is a Zurn oil interceptor with integral storage tank installed in a pit with vent connections. It is installed with a Z-1108 flow control fitting and a Z-1090 backwater valve.



Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice

OPERATION

Figure number 2 below shows the conditions inside the interceptor in a “non-operating mode. It can be seen that the oil has separated itself from the water. The oil is floating on the surface of the water in the main separation compartment and the top of the oil is below the top of the adjustable oil draw-off gate plate (see “how to set adjustable draw off” section).

FIG 2.

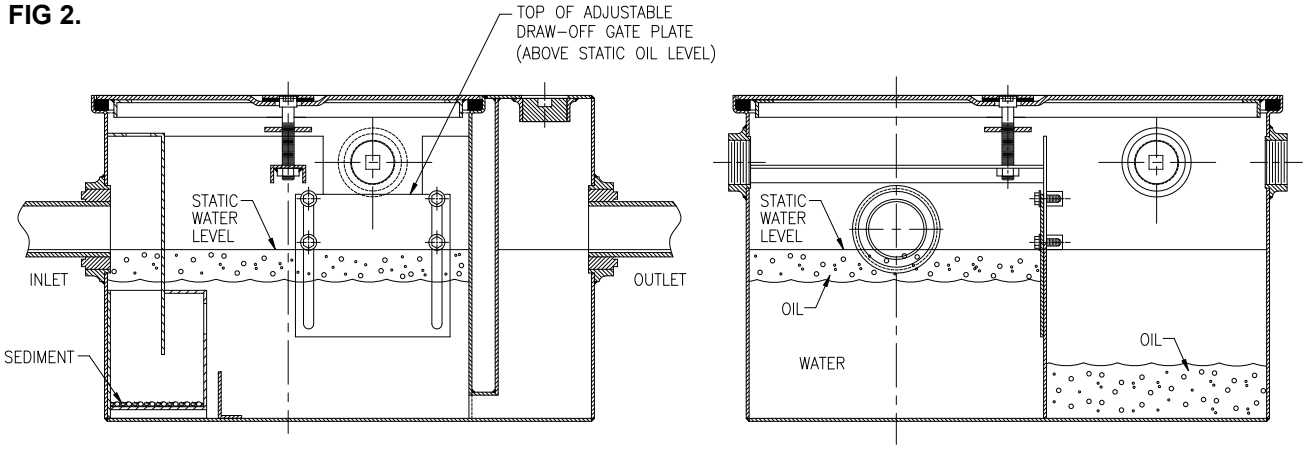
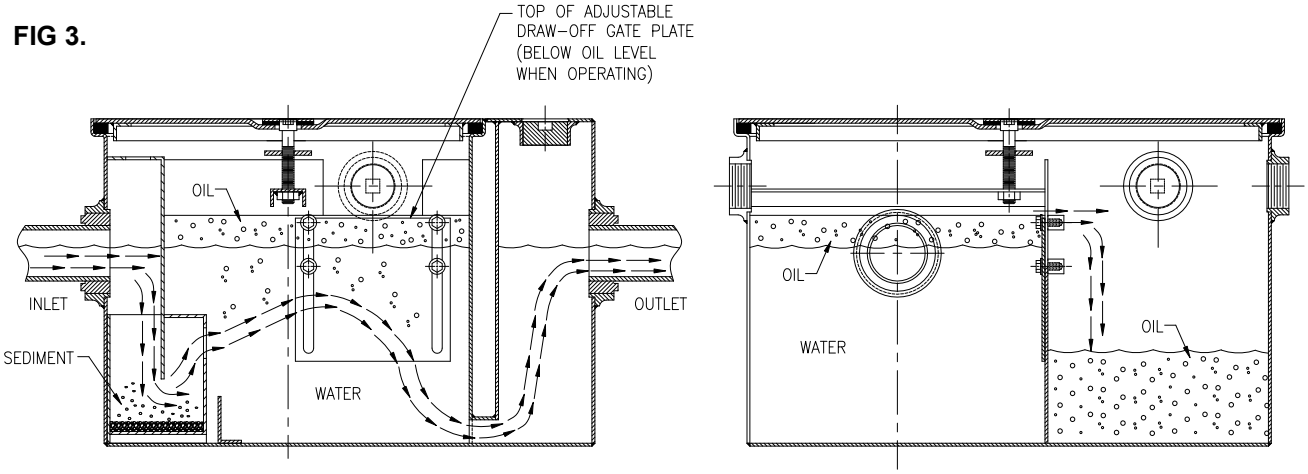


Figure number 3 below shows the conditions inside the interceptor in an “operating” or “flowing” mode. The oil/water mixture flows from the inlet piping into the interceptor and causes the oil/water level to rise. The mixture is directed downward into and through a removable sediment bucket. Heavier particles and sediment are collected in the bucket while the oil/water mixture continues through the bucket and is directed into the main separation compartment. The oil separates from the water by rising to the top and is now on the surface of the water. the oil/water level inside the interceptor has risen to a level which puts the layer of oil above the top of the adjustable draw-off gate plate allowing the oil to “spill” over the top of the gate plate and into the oil storage compartment. The water exits the main separation compartment through the outlet opening at the bottom of the unit passing through the outlet trap and into the discharge waste system plumbing.

FIG 3.



APPENDIX E
UNDERGROUND DETENTION O&M MANUALS

Appendix E-1
ADS StormTech Isolator Row MC-3500 and MC-4500

MC-3500 / MC-4500

StormTech®

Detention • Retention • Water Quality

MC-3500 and MC-4500 Design Manual

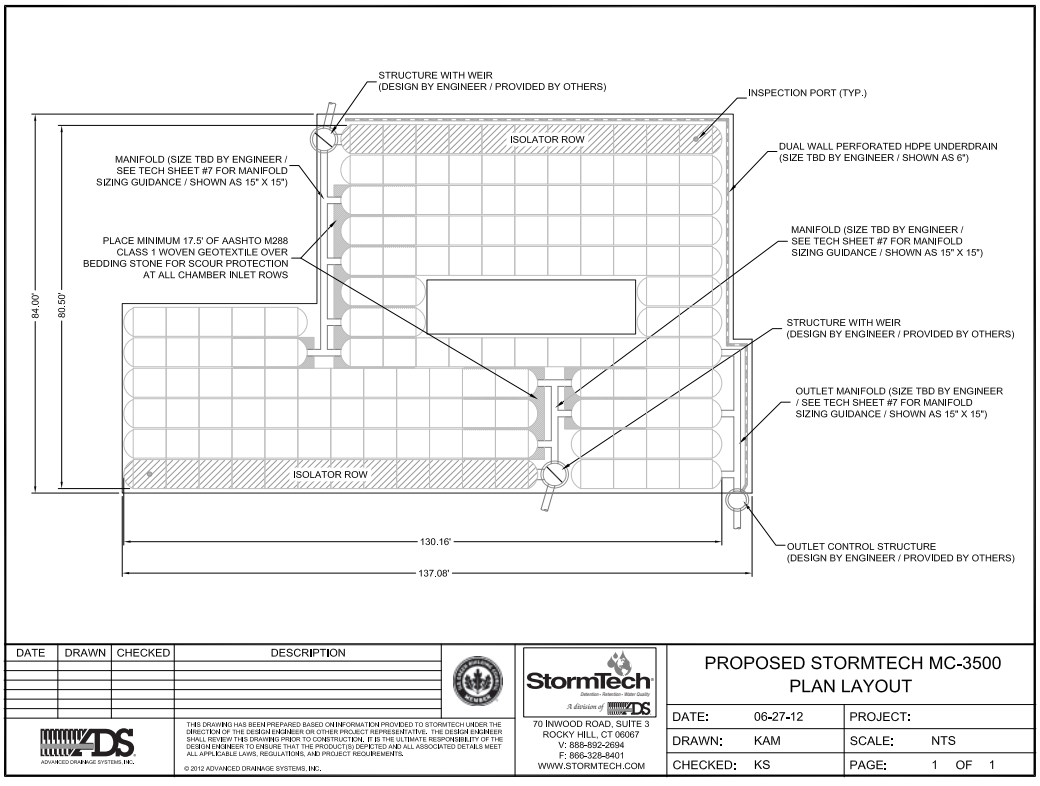
StormTech® Chamber Systems for Stormwater Management

U.S. GREEN BUILDING COUNCIL MEMBER

Table of Contents

*For SC-310, SC-740 & DC-780 designs, please refer to the SC-310/SC-740/DC-780 Design Manual.

StormTech Technical Services Department assists design professionals in specifying StormTech stormwater systems. This assistance includes the layout of chambers to meet the engineer's volume requirements and the connections to and from the chambers. The Technical Department can also assist converting and cost engineering projects currently specified with ponds, pipe, concrete vaults and other manufactured stormwater detention/retention products. Please note that it is the responsibility of the design engineer to ensure that the chamber bed layout meets all design requirements and is in compliance with applicable laws and regulations governing a project.



This manual is exclusively intended to assist engineers in the design of subsurface stormwater systems using StormTech chambers.

1.0 Product Information

FIGURE 1 – StormTech MC-3500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	90" (2286 mm) x 77" (1956 mm) x 45" (1143 mm)
Chamber Storage	109.9 ft³ (3.11 m³)
Min. Installed Storage*	178.9 ft³ (5.06 m³)
Nominal Weight	134 lbs (60.8 kg)

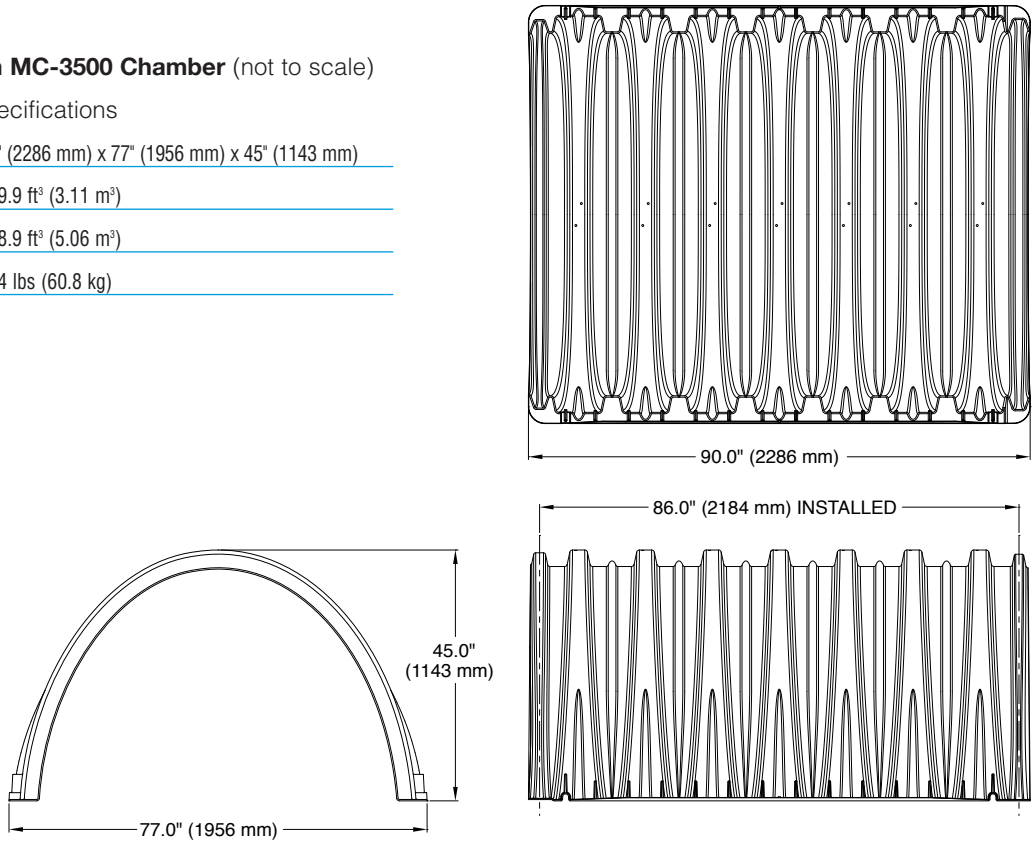
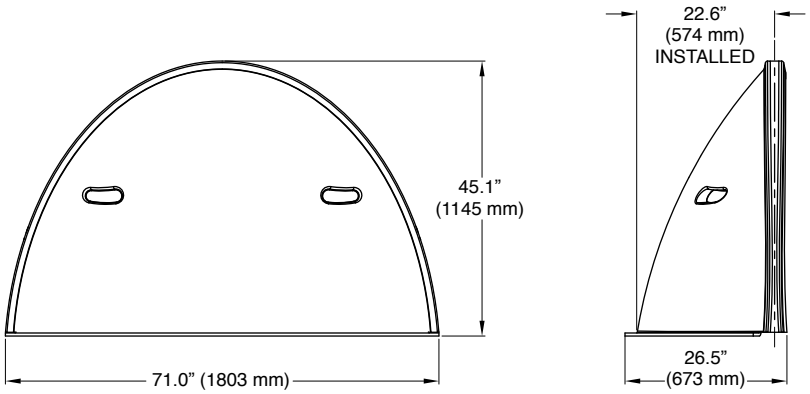


FIGURE 2 – StormTech MC-3500 End Cap (not to scale)

Nominal End Cap Specifications

Size (L x W x H)	26.5" (673 mm) x 71" (1803 mm) x 45.1" (1145 mm)
End Cap Storage	15.6 ft³ (0.44 m³)
Min. Installed Storage*	46.9 ft³ (1.33 m³)
Nominal Weight	43 lbs (19.5 kg)



* This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below and 9" (229 mm) of stone between the chambers/end caps and 40% stone porosity. The end cap minimum installed storage also includes the stone storage located in the 6" (152 mm) stone perimeter.

1.0 Product Information

FIGURE 3 – StormTech MC-4500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	52" (1321 mm) x 100" (2540 mm) x 60" (1524 mm)
Chamber Storage	106.5 ft³ (3.01 m³)
Min. Installed Storage*	162.6 ft³ (4.60 m³)
Nominal Weight	120 lbs (54.4 kg)

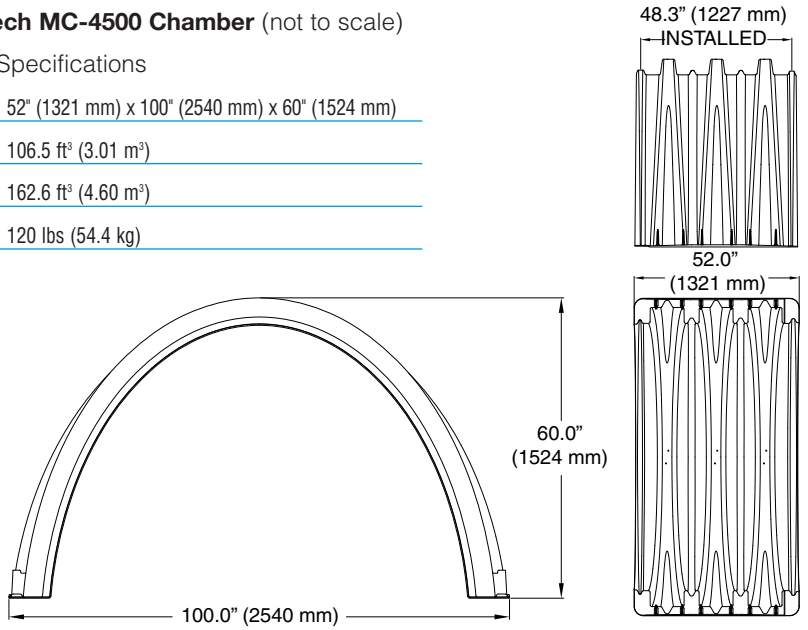
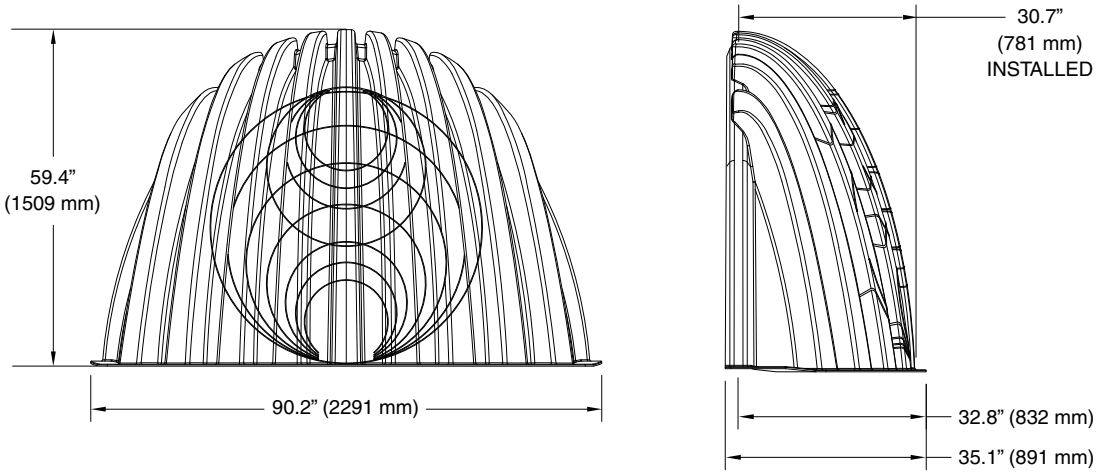


FIGURE 4 – StormTech MC-4500 End Cap (not to scale)

Nominal End Cap Specifications

Size (L x W x H)	35.1" (891 mm) x 90.2" (2291 mm) x 59.4" (1509 mm)
End Cap Storage	35.7 ft³ (1.01 m³)
Min. Installed Storage*	108.7 ft³ (3.08 m³)
Nominal Weight	120 lbs (54.4 kg)



* This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below and 9" (229 mm) of stone between the chambers/end caps and 40% stone porosity. The end cap minimum installed storage also includes the stone storage located in the 12" (305 mm) stone perimeter.

1.0 Product Information

1.1 PRODUCT DESIGN

StormTech's commitment to thorough product testing programs, materials evaluation and adherence to national standards has resulted in two more superior products. Like other StormTech chambers, the MC-3500 and MC-4500 are designed to meet the full scope of design requirements of Section 12.12 of the AASHTO LRFD Bridge Design Specifications and produced to the requirements of the American Society of Testing Materials (ASTM) International specification F 2418 "Standard Specification for Polypropylene (PP) Corrugated Stormwater Collection Chambers".

The StormTech MC-3500 and MC-4500 chambers provide the full AASHTO safety factors for live loads and permanent earth loads. The ASTM F 2418 standard is linked to the AASHTO LRFD Bridge Design Specifications Section 12.12 design standard. ASTM F 2418 requires that the safety factors included in the AASHTO guidance are achieved as a prerequisite to meeting ASTM F 2418. StormTech chambers are also designed in accordance with ASTM F 2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers" which provides specific guidance on how to design thermoplastic chambers in accordance with AASHTO Section 12.12. The three standards provide both the assurance of product quality and safe structural design.

The design of larger chambers in the same tradition of our other chambers required the collaboration of experts in soil-structure interaction, plastics and manufacturing. Years of extensive research, including laboratory testing and field verification, were required to produce chambers that are ready to meet both the rigors of installation and the longevity expected by engineers and owners.

This Design Manual provides the details and specifications necessary for consulting engineers to design stormwater management systems using the MC-3500 and MC-4500 chambers. It provides specifications for storage capacities, layout dimensions as well as requirements for design to ensure a long service life. The basic design concepts for foundation and backfill materials, subgrade bearing capacities and row spacing remain equally as pertinent for the MC-3500 and MC-4500 as the SC-740, SC-310 and DC-780 chamber systems. However, since many design values and dimensional requirements are different for these larger chambers than the SC-740, SC-310 and DC-780 chambers, design manuals and installation instructions are not interchangeable.

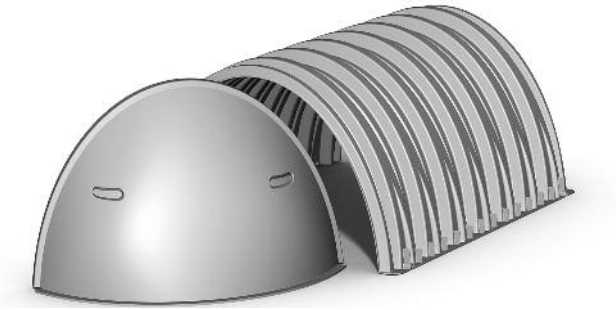
This manual includes only those details, dimensions, cover limits, etc for the MC-3500 and MC-4500 and is intended to be a stand-alone design guide for the MC-3500 and MC-4500 chambers. A Construction Guide specifically for these two chamber models has also been published.

1.2 TECHNICAL SUPPORT

The StormTech Technical Services Department is available to assist the engineer with the layout of MC-3500 and MC-4500 chamber systems and answer questions regarding all the StormTech chamber models. Call the Technical Services Department, email us at info@stormtech.com or contact your local StormTech representative.

1.3 MC-3500 AND MC-4500 CHAMBERS

All StormTech chambers are designed to the full scope of AASHTO requirements without repeating end walls or other structural reinforcing. StormTech's continuously curved, elliptical arch and the surrounding angular backfill are the key components of the structural system. With the addition of patent pending integral stiffening ribs **(Figure 5)**, the MC-3500 and MC-4500 are assured to provide a long, safe service life. Like other StormTech chambers, the MC-3500 and MC-4500 are produced from high quality, impact modified resins which are tested for short-term and long-term mechanical properties.



With all StormTech chambers, one chamber type is used for the start, middle and end of rows. Rows are formed by overlapping the *upper joint corrugation* of the next chamber over the *lower joint corrugation* of the previous chamber **(Figure 6)**.

1.4 CHAMBER JOINTS

All StormTech chambers are designed with an optimized joining system. The height and width of the end corrugations have been designed to provide the required structural safety factors while providing an unobstructed flow path down each row.

MC-4500 chamber joints require (6) screws for joint assembly. See the MC-3500/MC-4500 Construction Guide for details.

To assist the contractor, StormTech chambers are molded with simple assembly instructions and arrows that indicate the direction in which to build rows. The corrugation valley immediately adjacent to the lower joint corrugation is marked “Overlap Here - Lower Joint.” The corrugation valley immediately adjacent to the upper joint corrugation is marked “Build This Direction - Upper Joint.”

Two people can safely and efficiently carry and place chambers without cumbersome connectors, special tools or heavy equipment. Each row of chambers must begin and end with a joint corrugation. Since joint corrugations are of a different size than the corrugations along the body of the chamber, chambers cannot be field cut and installed. Only whole MC-3500 and MC-4500 chambers can be used. For system layout assistance contact StormTech.

1.5 MC-3500 AND MC-4500 END CAPS

The MC-3500 and MC-4500 end caps are easy to install. These end caps are designed with a corrugation joint that fits over the top of either end of the chamber. The end cap joint is simply set over the top of either of the upper or lower chamber joint corrugations **(Figure 7)**. MC-3500 end caps require three (3) screws to fasten the end cap to the chamber. See the MC-3500/MC-4500 Construction Guide for details.

1.6 MC-3500 END CAPS

Handles are molded into the MC-3500 end cap to enable one person to carry and set the end cap in place. MC-3500 end caps are available pre-cored for a variety of pipe sizes at predetermined inverts. See StormTech details. Custom invert pre-cored end caps are also available.

FIGURE 5 – Chamber and End Cap Components

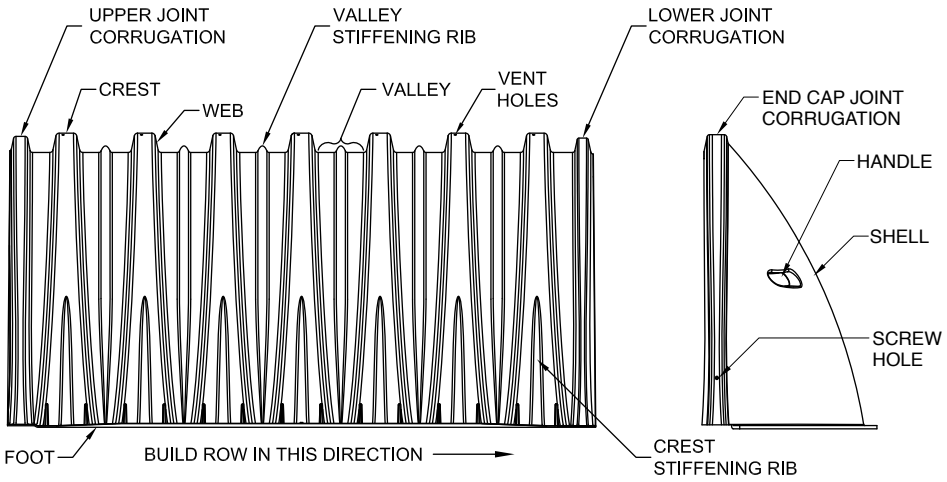
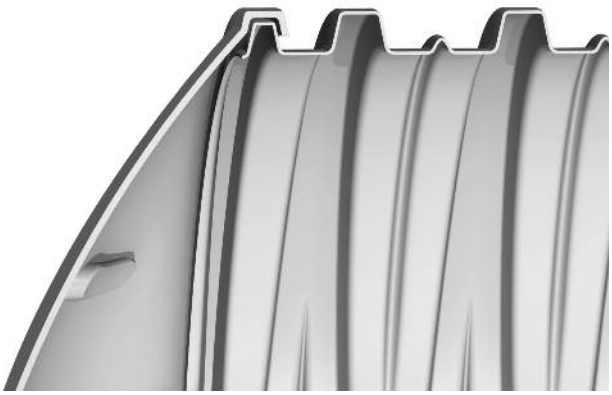


FIGURE 6 – Chamber Joint Overlap

FIGURE 7 – End Cap Joint Overlap



1.7 MC-4500 END CAPS

The MC-4500 end cap has pipe cutting guides for 12"– 42" (300 mm – 1050 mm) bottom inverts and 12" – 24" (300 mm – 600 mm) top inverts. Standard and custom, pre-cored end caps are available.

FIGURE 8 – MC-4500 End Cap Inverts

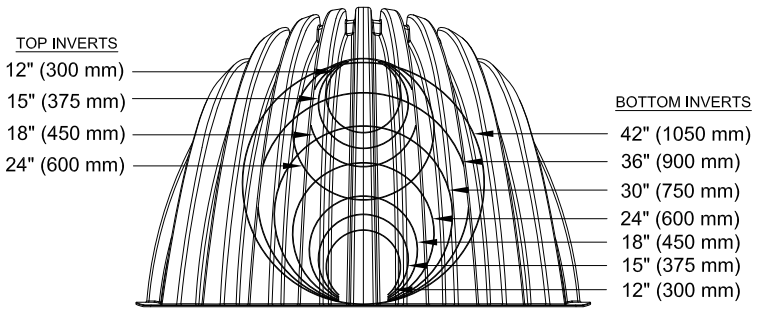
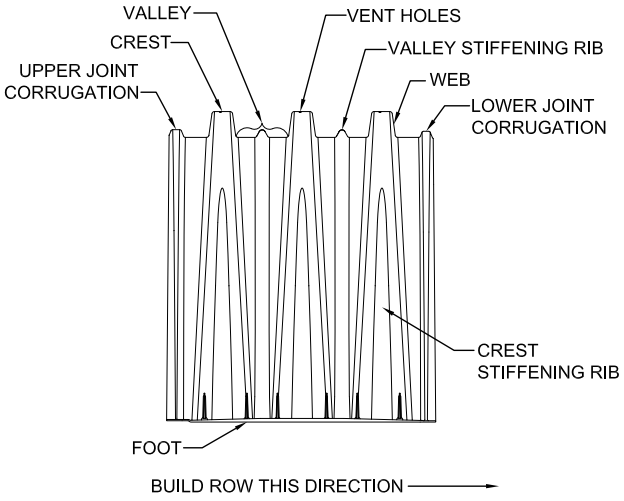
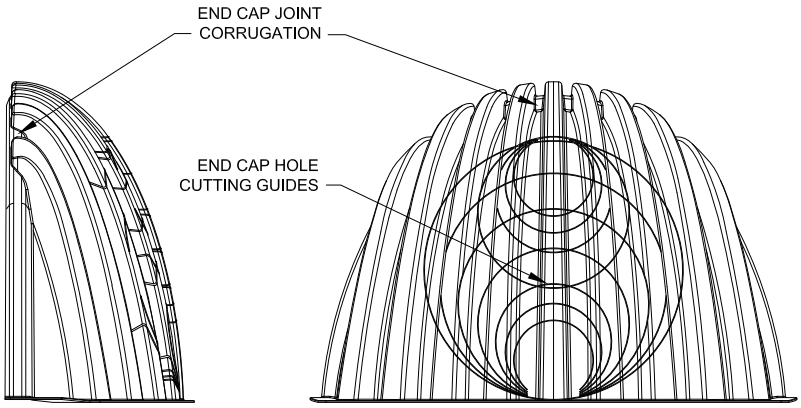


FIGURE 9 – MC-4500 Chamber and End Cap Components



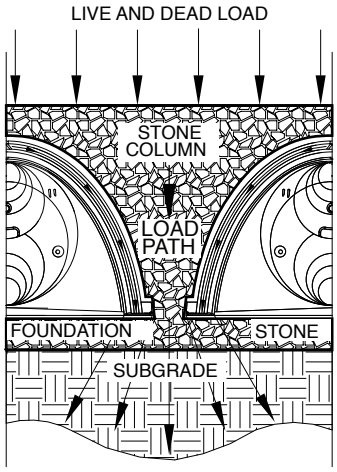


2.0 Foundations for Chambers

2.1 FOUNDATION REQUIREMENTS

StormTech chamber systems can be installed in various soil types. The subgrade bearing capacity and the cover height over the chambers determine the required depth of clean, crushed, angular foundation stone below the chambers. Foundation stone, also called bedding, is the stone between the subgrade soils and the feet of the chamber. Flexible structures are designed to transfer a significant portion of both live and dead loads through the surrounding soils. Chamber systems accomplish this by creating load paths through the columns of embedment stone between and around the rows of chambers. This creates load concentrations at the base of the columns between the rows. The foundation stone spreads out the concentrated loads to distributed loads that can be supported by the subgrade soils.

Since increasing the cover height (top of chamber to finished grade) causes increasing soil load, a greater depth of foundation stone is necessary to distribute the load to the subgrade soils. **Table 1** and **2** specify the minimum required foundation depths for varying cover heights and allowable subgrade bearing capacities. These tables are based on StormTech service loads. The minimum required foundation depth is 9" (229 mm) for both chambers.



2.2 WEAKER SOILS

StormTech has not provided guidance for subgrade bearing capacities less than 2000 pounds per square foot [(2.0 ksf) (96 kPa)]. These soils are often highly variable, may contain organic materials and could be more sensitive to moisture. A geotechnical engineer must be consulted if soils with bearing capacities less than 2000 psf (96 kPa) are present.

TABLE 1 – MC-3500 Minimum Required Foundation Depth in inches (millimeters)
Assumes 9" (229 mm) row spacing.

Cover Hgt. ft. (m)	Minimum Bearing Resistance for Service Loads ksf (kPa)																								
	4.4 (211)	4.3 (206)	4.2 (201)	4.1 (196)	4.0 (192)	3.9 (187)	3.8 (182)	3.7 (177)	3.6 (172)	3.5 (168)	3.4 (163)	3.3 (158)	3.2 (153)	3.1 (148)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
2.0 (0.61)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)
2.5 (0.76)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)
3.0 (0.91)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)
3.5 (1.07)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)
4.0 (1.22)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)
4.5 (1.37)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)
5.0 (1.52)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)
5.5 (1.68)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)
6.0 (1.83)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	30 (762)
6.5 (1.98)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	30 (762)	30 (762)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

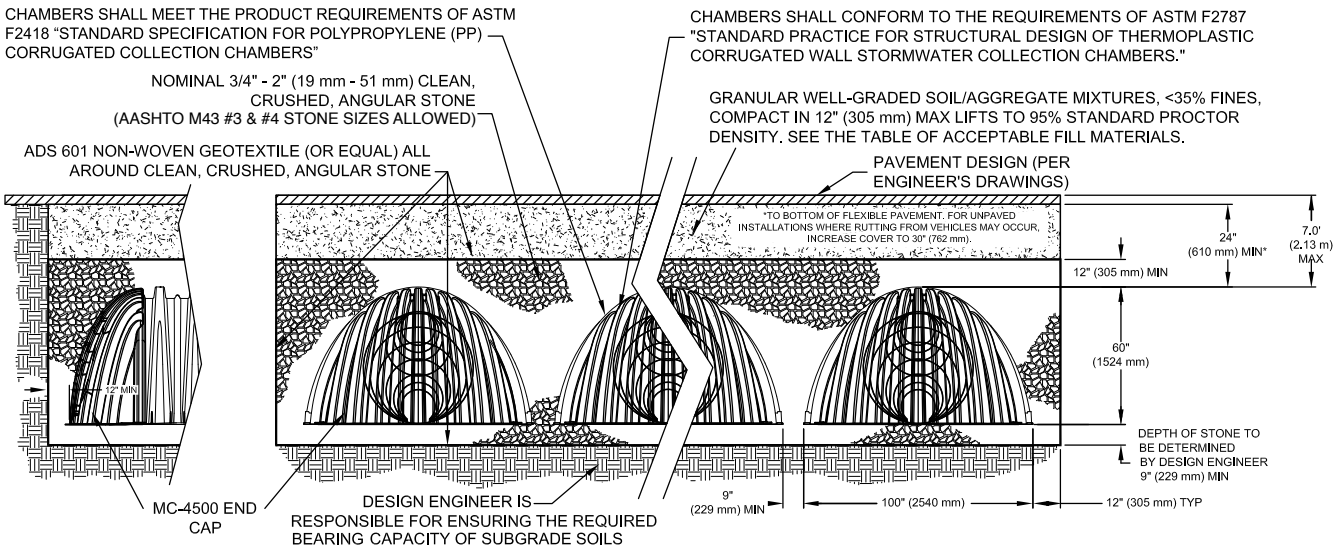
2.0 Foundations for Chambers

TABLE 2 – MC-4500 Minimum Required Foundation Depth in inches (millimeters)
Assumes 9" (229 mm) row spacing.

Cover Hgt. ft. (m)	Minimum Bearing Resistance for Service Loads ksf (kPa)																					
	4.1 (196)	4.0 (192)	3.9 (187)	3.8 (182)	3.7 (177)	3.6 (172)	3.5 (168)	3.4 (163)	3.3 (158)	3.2 (153)	3.1 (148)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
2.0 (0.61)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)
2.5 (0.76)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)
3.0 (0.91)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	30 (762)
3.5 (1.07)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	36 (914)
4.0 (1.22)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	36 (914)	36 (914)
4.5 (1.37)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)
5.0 (1.52)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)	48 (1219)
5.5 (1.68)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)	48 (1219)	54 (1371)
6.0 (1.83)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)	42 (1067)	48 (1219)	54 (1372)
6.5 (1.98)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)	42 (1067)	48 (1219)	54 (1372)	66 (1676)
7.0 (2.13)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)	42 (1067)	48 (1219)	54 (1372)	60 (1524)	66 (1676)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

FIGURE 10 – MC-4500 Structural Cross Section Detail (Not to Scale)



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

3.1 FOUNDATION AND EMBEDMENT STONE

The stone surrounding the chambers consists of the *foundation* stone below the chambers and *embedment* stone surrounding the chambers. The foundation stone and embedment stone are important components of the structural system and also provide open void space for stormwater storage. **Table 3** provides the stone specifications that achieve both structural requirements and a porosity of 40% for stormwater storage. **Figure 11** specifies the extents of each backfill stone location.

TABLE 3 – Acceptable Fill Materials

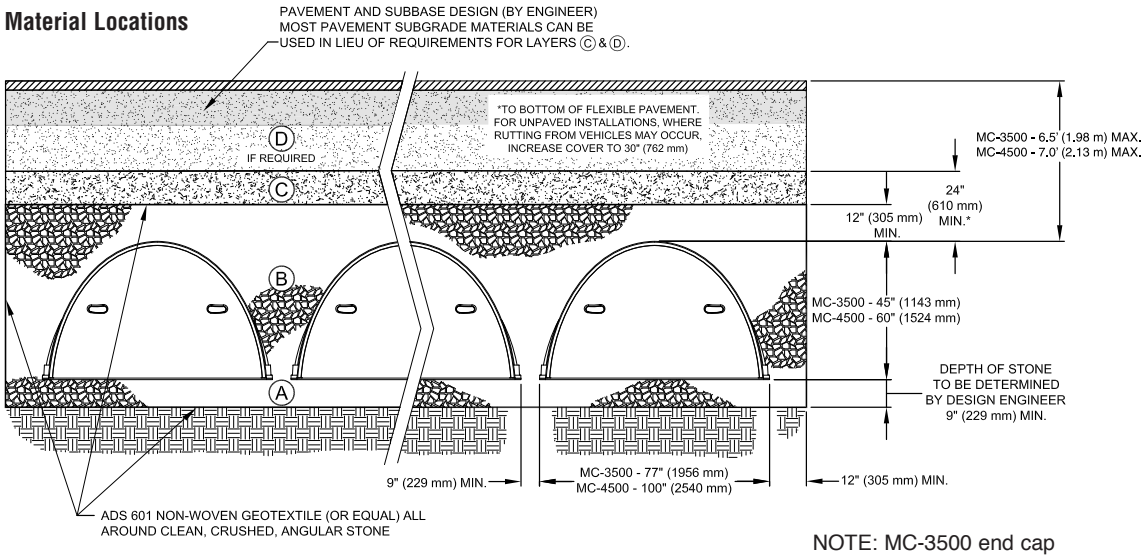
Material Location	Description	AASHTO M43 Designation[1]	Compaction/Density Requirement
(D) Fill Material for layer 'D' starts from the top of the 'C' layer to the bottom of flexible pavement or unpaved finished grade above. Note that the pavement subbase may be part of the 'D' layer.	Any soil/rock materials, native soils or per engineer's plans. Check plans for pavement subgrade requirements.	N/A	Prepare per engineer's plans. Paved installations may have stringent material and preparation requirements.
(C) Fill Material for layer 'C' starts from the top of the embedment stone ('B' layer) to 24" (610 mm) above the top of the chamber. Note that pavement subbase may be part of the 'C' layer.	Granular well-graded soil/aggregate mixtures, <35% fines. Most pavement subbase materials can be used in lieu of this layer. (AASHTO M145 A-1, A-2, A-3)	3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	Begin compaction after 24" (610 mm) of material over the chambers is reached. Compact additional layers in 12" (305 mm) max. lifts to a min. 95% Standard Proctor density. See MC-3500 and MC-4500 Construction Guide for acceptable compaction equipment loads.
(B) Embedment Stone surrounding chambers from the foundation stone to the 'C' layer above.	Clean, crushed, angular stone, nominal size distribution 3/4 - 2" (19 mm - 51 mm)	3, 4	No compaction required.
(A) Foundation Stone below the chambers from the subgrade up to the foot (bottom) of the chamber.	Clean, crushed, angular stone, nominal size distribution 3/4 - 2" (19 mm - 51 mm)	3, 4	Plate compact or roll to achieve a 95% Standard Proctor Density.[2]

PLEASE NOTE:

1. ***The listed AASHTO designations are for gradations only. The stone must also be clean, crushed, angular. For example, a specification for #4 stone would state: "clean, crushed, angular no. 4 (AASHTO M43) stone."***
2. ***As an alternate to Proctor Testing and field density measurements on open graded stone, StormTech compaction requirements are met for 'A' location materials when placed and compacted in 9" (229 mm) (max) lifts using two full passes with an appropriate compactor.***

FIGURE 11 – Fill Material Locations

Once layer "C" is placed any soil/material can be placed in layer "D" up to the finished grade. Most pavement subbase soils can be used to replace the materials requirements of layer "C" or "D" at the design engineer's discretion.



NOTE: MC-3500 end cap shown.

3.0 Required Materials/Row Separation

3.2 FILL ABOVE CHAMBERS

Refer to **Table 3** and **Figure 11** for acceptable fill material above the clean, crushed, angular stone. StormTech requires a minimum of 24" (610 mm) from the top of the chamber to the bottom of flexible pavement. For non-paved installations where rutting from vehicles may occur StormTech requires a minimum of 30" (762 mm) from top of chamber to finished grade.

3.3 GEOTEXTILE SEPARATION

A non-woven geotextile meeting AASHTO M288 Class 2 separation requirements must be installed to completely envelope the system and prevent soil intrusion into the crushed, angular stone. Overlap adjacent geotextile rolls per AASHTO M288 separation guidelines. Contact StormTech for a list of acceptable geotextiles.

3.4 PARALLEL ROW SEPARATION/ PERPENDICULAR BED SEPARATION

Parallel Row Separation

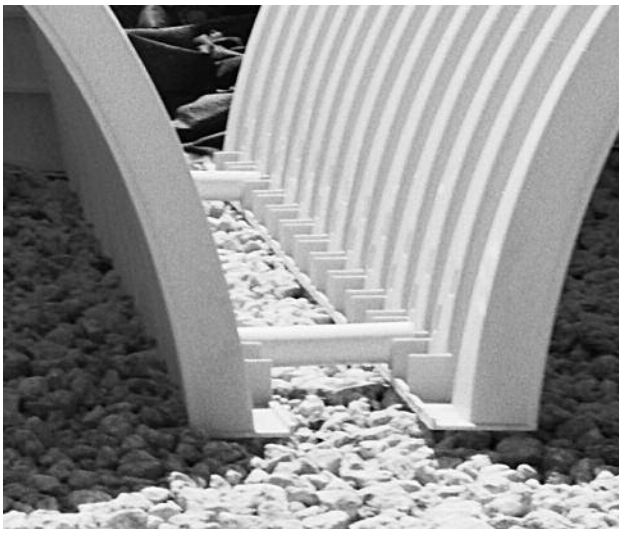
The minimum installed spacing between parallel rows after backfilling is 9” (229 mm) for the MC-3500 and MC-4500 chambers (measurement taken between the outside edges of the feet). Spacers may be used for layout convenience. Row spacing wider than the minimum spacing above may be specified.

Increasing the spacing between chamber rows may allow the application of StormTech chambers with either less foundation stone or with weaker subgrade soils. This may be a good option where vertical restrictions on site prevent the use of a deeper foundation.

Perpendicular Bed Separation

When beds are laid perpendicular to each other, a minimum installed spacing of 36" (914 mm) between beds is required.

System cross section.



Spacers for row separation.

4.1 GENERAL

StormTech subsurface chamber systems offer the flexibility for a variety of inlet and outlet configurations. Contact the StormTech Technical Services Department or your local StormTech representative for assistance configuring inlet and outlet connections.

The open graded stone around and under the chambers provides a significant conveyance capacity ranging from approximately 0.8 cfs (23 l/s) to 13 cfs (368 l/s) per MC-3500 chamber and 0.54 cfs (15 l/s) to 8.5 cfs (240 l/s) for the MC-4500 chamber. The actual conveyance capacity is dependent upon stone size, depth of foundation stone and head of water. Although the high conveyance capacity of the open graded stone is an important component of the flow network, StormTech recommends that a system of inlet and outlet manifolds be designed to distribute and convey the peak flow through the chamber system.

It is the responsibility of the design engineer to provide the design flow rates and storage volumes for the stormwater system and to ensure that the final design meets all conveyance and storage requirements. However, StormTech will work with the design engineer to assist with manifold and chamber layouts that meet the design objectives.

4.2 THE ISOLATOR® ROW

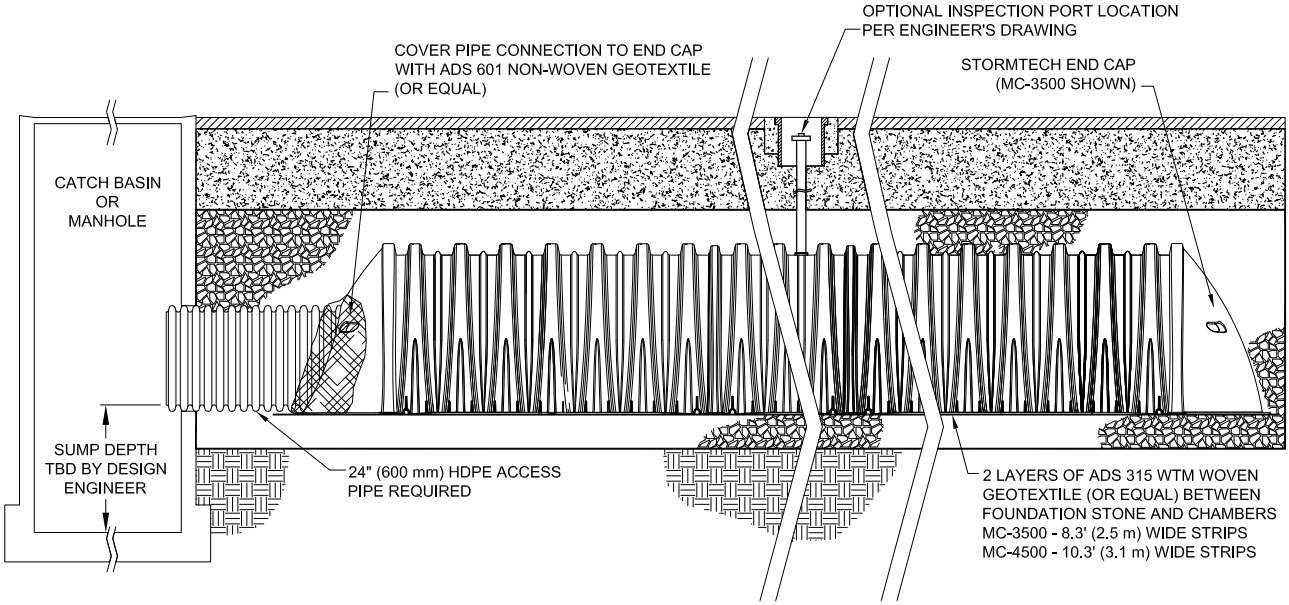
The Isolator Row is a patented system that inexpensively captures total suspended solids (TSS) and debris and provides easy access for inspection and maintenance. A double layer of woven geotextile between the bottom of the chambers and the foundation stone provides the filter media that satisfies most contaminant removal objectives. Each installed MC-3500 chamber and MC-3500 end cap provides 42.9 ft² (4.0 m²) and 7.5 ft² (0.7 m²) of bottom filter area respectively. Each installed MC-4500 chamber and MC-4500 end cap provides 30.1 ft² (2.80 m²) and 12.8 ft² (1.19 m²) of bottom filter area respectively.

The Isolator Row can be configured for maintenance objectives or, in some regulatory jurisdictions, for water quality objectives. For water quality applications, Isolator Rows can be sized based on water quality volume or flow rate.

All Isolator Rows require: 1) a manhole for maintenance access, 2) a means of diversion of flows to the Isolator Row and 3) a high flow bypass. Flow diversion can be accomplished by either a weir in the upstream access manhole or simply by feeding the Isolator Row at a lower elevation than the high flow bypass. Contact StormTech for assistance sizing Isolator Rows.

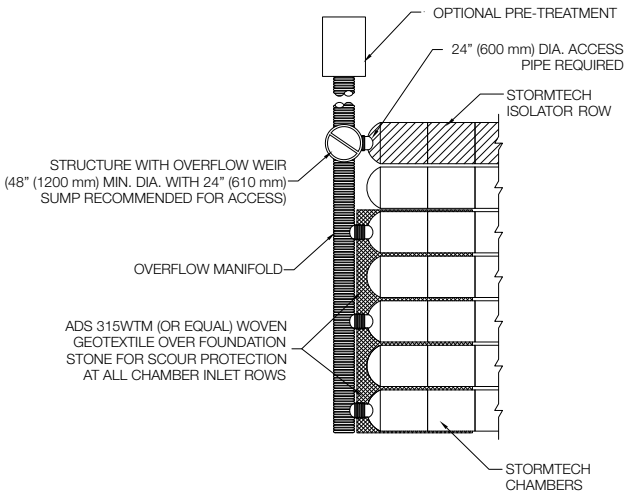
When additional stormwater treatment is required, StormTech systems can be configured using a treatment train approach where other stormwater BMPs are located in series.

FIGURE 12 – StormTech Isolator Row Detail



4.0 Hydraulics

FIGURE 13 – Typical Inlet Configuration With Isolator Row and Scour Protection



4.3 INLET MANIFOLDS

The primary function of the inlet manifold is to convey and distribute flows to a sufficient number of rows in the chamber bed such that there is ample conveyance capacity to pass the peak flows without creating an unacceptable backwater condition in upstream piping or scour the foundation stone under the chambers.

Manifolds are connected to the end caps either at the top or bottom of the end cap. High inlet flow rates from either connection location produce a shear scour potential of the foundation stone. Inlet flows from top inlets also produce impingement scour potential. Scour potential is reduced when standing water is present over the foundation stone. However, for safe design across the wide range of applications, StormTech assumes minimal standing water at the time the design flow occurs.

To minimize scour potential, StormTech recommends the installation of woven scour protection fabric at each inlet row. This enables a protected transition zone from the concentrated flow coming out of the inlet pipe to a uniform flow across the entire width of the chamber for both top and bottom connections.

Allowable flow rates for design are dependent upon: the elevation of inlet pipe, foundation stone size and scour protection. With an appropriate scour protection geotextile installed from the end cap to at least 14.5' (4.42 m) in front of the inlet pipe for the MC-3500 and for the MC-4500, for both top and bottom feeds, the flow rates listed in **Table 4** can be used for all StormTech specified foundation stone gradations.

***See StormTech's Tech Sheet #7 for manifold sizing guidance.**

TABLE 4 – Allowable Inlet Flows*

Inlet Pipe Diameter Inches (mm)	Allowable Maximum Flow Rate cfs (l/s)
12 (300)	2 (57)
15 (375)	3.5 (99)
18 (450)	5.5 (156)
24 (600)	8.5 (241) [MC-3500]
24 (600)	9.5 (269) [MC-4500]

* Assumes appropriate length of scour fabric per section 4.3.

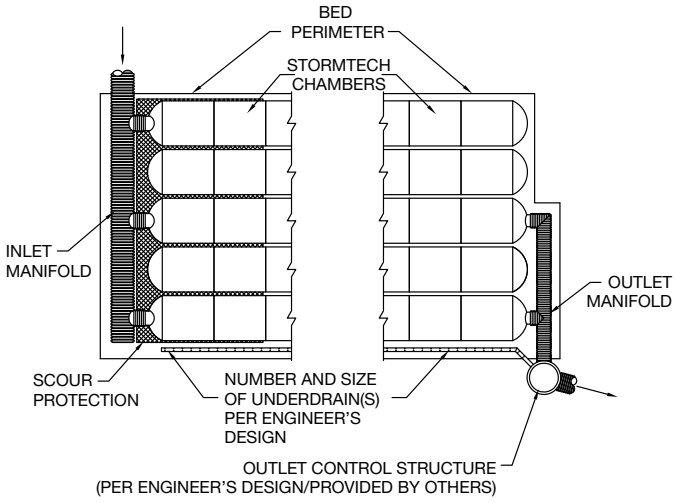
4.4 OUTLET MANIFOLDS

The primary function of the outlet manifold is to convey peak flows from the chamber system to the outlet control structure. Outlet manifolds are often sized for attenuated flows. They may be smaller in diameter and have fewer row connections than inlet manifolds. In some applications however, the intent of the outlet piping is to convey an unattenuated bypass flow rate and manifolds may be sized similar to inlet manifolds.

Since chambers are generally flowing at or near full at the time of the peak outlet flow rate, scour is generally not governing and outlet manifold sizing is based on pipe flow equations. In most cases, StormTech recommends that outlet manifolds connect the same rows that are connected to an inlet manifold. This provides a continuous flow path through open conduits to pass the peak flow without dependence on passing peak flows through stone.

The primary function of the underdrains is to draw down water stored in the stone below the invert of the manifold. Underdrains are generally not sized for conveyance of the peak flow.

FIGURE 14 – Typical Inlet, Outlet and Underdrain Configuration



5.0 Cumulative Storage Volumes

Tables 5 and **6** provide cumulative storage volumes for the MC-3500 chamber and end cap. These tables can be used to calculate the stage–storage relationship for the retention or detention system. Digital spreadsheets in which the number of chambers and end caps can be input for quick cumulative storage calculations are available at www.stormtech.com. For assistance with site-specific calculations or input into routing software, contact the StormTech Technical Services Department.

TABLE 5 – MC-3500 Incremental Storage Volume Per Chamber

Assumes 40% stone porosity. Calculations are based upon a 9" (229 mm) stone base under the chambers, 12" (305 mm) of stone above chambers, and 9" (229 mm) spacing between chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
66 (1676)	0.00	178.96 (5.068)
65 (1651)	0.00	177.25 (5.019)
64 (1626)	Stone 0.00	175.54 (4.971)
63 (1600)	Cover 0.00	173.83 (4.922)
62 (1575)	0.00	172.11 (4.874)
61 (1549)	0.00	170.40 (4.825)
60 (1524)	0.00	168.69 (4.777)
59 (1499)	0.00	166.98 (4.728)
58 (1473)	0.00	165.27 (4.680)
57 (1448)	0.00	163.55 (4.631)
56 (1422)	0.00	161.84 (4.583)
55 (1397)	0.00	160.13 (4.534)
54 (1372)	109.95 (3.113)	158.42 (4.486)
53 (1346)	109.89 (3.112)	156.67 (4.436)
52 (1321)	109.69 (3.106)	154.84 (4.385)
51 (1295)	109.40 (3.098)	152.95 (4.331)
50 (1270)	109.00 (3.086)	151.00 (4.276)
49 (1245)	108.31 (3.067)	148.88 (4.216)
48 (1219)	107.28 (3.038)	146.55 (4.150)
47 (1194)	106.03 (3.003)	144.09 (4.080)
46 (1168)	104.61 (2.962)	141.52 (4.007)
45 (1143)	103.04 (2.918)	138.86 (3.932)
44 (1118)	101.33 (2.869)	136.13 (3.855)
43 (1092)	99.50 (2.818)	133.32 (3.775)
42 (1067)	97.56 (2.763)	130.44 (3.694)
41 (1041)	95.52 (2.705)	127.51 (3.611)
40 (1016)	93.39 (2.644)	124.51 (3.526)
39 (991)	91.16 (2.581)	121.47 (3.440)
38 (965)	88.86 (2.516)	118.37 (3.352)
37 (940)	86.47 (2.449)	115.23 (3.263)
36 (914)	84.01 (2.379)	112.04 (3.173)
35 (889)	81.49 (2.307)	108.81 (3.081)
34 (864)	78.89 (2.234)	105.54 (2.989)
33 (838)	76.24 (2.159)	102.24 (2.895)
32 (813)	73.52 (2.082)	98.90 (2.800)
31 (787)	70.75 (2.003)	95.52 (2.705)
30 (762)	67.92 (1.923)	92.12 (2.608)
29 (737)	65.05 (1.842)	88.68 (2.511)
28 (711)	62.12 (1.759)	85.21 (2.413)
27 (686)	59.15 (1.675)	81.72 (2.314)
26 (660)	56.14 (1.590)	78.20 (2.214)
25 (635)	53.09 (1.503)	74.65 (2.114)
24 (610)	49.99 (1.416)	71.09 (2.013)
23 (584)	46.86 (1.327)	67.50 (1.911)
22 (559)	43.70 (1.237)	63.88 (1.809)
21 (533)	40.50 (1.147)	60.25 (1.706)
20 (508)	37.27 (1.055)	56.60 (1.603)
19 (483)	34.01 (0.963)	52.93 (1.499)
18 (457)	30.72 (0.870)	49.25 (1.395)
17 (432)	27.40 (0.776)	45.54 (1.290)
16 (406)	24.05 (0.681)	41.83 (1.184)
15 (381)	20.69 (0.586)	38.09 (1.079)
14 (356)	17.29 (0.490)	34.34 (0.973)
13 (330)	13.88 (0.393)	30.58 (0.866)
12 (305)	10.44 (0.296)	26.81 (0.759)
11 (279)	6.98 (0.198)	23.02 (0.652)
10 (254)	3.51 (0.099)	19.22 (0.544)
9 (229)	0.00	15.41 (0.436)
8 (203)	0.00	13.70 (0.388)
7 (178)	0.00	11.98 (0.339)
6 (152)	Stone 0.00	10.27 (0.291)
5 (127)	Foundation 0.00	8.56 (0.242)
4 (102)	0.00	6.85 (0.194)
3 (76)	0.00	5.14 (0.145)
2 (51)	0.00	3.42 (0.097)
1 (25)	0.00	1.71 (0.048)

NOTE: Add 1.71 ft³ (0.048 m³) of storage for each additional inch (25 mm) of stone foundation.

Contact StormTech for cumulative volume spreadsheets in digital format.

5.0 Cumulative Storage Volumes

TABLE 6 – MC-3500 Incremental Storage Volume Per End Cap

Assumes 40% stone porosity. Calculations are based upon a 9" (229 mm) stone base under the end caps, 12" (305 mm) of stone above end caps, 9" (229 mm) of spacing between end caps and 6" (152 mm) of stone perimeter.

Depth of Water in System Inches (mm)	Cumulative End Cap Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
66 (1676)	0	46.96 (1.330)
65 (1651)	0	46.39 (1.314)
64 (1626)	Stone 0	45.82 (1.298)
63 (1600)	Cover 0	45.25 (1.281)
62 (1575)	0	44.68 (1.265)
61 (1549)	0	44.11 (1.249)
60 (1524)	0	43.54 (1.233)
59 (1499)	0	42.98 (1.217)
58 (1473)	0	42.41 (1.201)
57 (1448)	0	41.84 (1.185)
56 (1422)	0	41.27 (1.169)
55 (1397)	0	40.70 (1.152)
54 (1372)	15.64 (0.443)	40.13 (1.136)
53 (1346)	15.64 (0.443)	39.56 (1.120)
52 (1321)	15.63 (0.443)	38.99 (1.104)
51 (1295)	15.62 (0.442)	38.41 (1.088)
50 (1270)	15.60 (0.442)	37.83 (1.071)
49 (1245)	15.56 (0.441)	37.24 (1.054)
48 (1219)	15.51 (0.439)	36.64 (1.037)
47 (1194)	15.44 (0.437)	36.02 (1.020)
46 (1168)	15.35 (0.435)	35.40 (1.003)
45 (1143)	15.25 (0.432)	34.77 (0.985)
44 (1118)	15.13 (0.428)	34.13 (0.966)
43 (1092)	14.99 (0.424)	33.48 (0.948)
42 (1067)	14.83 (0.420)	32.81 (0.929)
41 (1041)	14.65 (0.415)	32.13 (0.910)
40 (1016)	14.45 (0.409)	31.45 (0.890)
39 (991)	14.24 (0.403)	30.75 (0.871)
38 (965)	14.00 (0.396)	30.03 (0.850)
37 (948)	13.74 (0.389)	29.31 (0.830)
36 (914)	13.47 (0.381)	28.58 (0.809)
35 (889)	13.18 (0.373)	27.84 (0.788)
34 (864)	12.86 (0.364)	27.08 (0.767)
33 (838)	12.53 (0.355)	26.30 (0.745)
32 (813)	12.18 (0.345)	25.53 (0.723)
31 (787)	11.81 (0.335)	24.74 (0.701)
30 (762)	11.42 (0.323)	23.93 (0.678)
29 (737)	11.01 (0.312)	23.12 (0.655)
28 (711)	10.58 (0.300)	22.29 (0.631)
27 (686)	10.13 (0.287)	21.45 (0.607)
26 (680)	9.67 (0.274)	20.61 (0.583)
25 (610)	9.19 (0.260)	19.75 (0.559)
24 (609)	8.70 (0.246)	18.88 (0.559)
23 (584)	8.19 (0.232)	18.01 (0.510)
22 (559)	7.67 (0.217)	17.13 (0.485)
21 (533)	7.13 (0.202)	16.24 (0.460)
20 (508)	6.59 (0.187)	15.34 (0.434)
19 (483)	6.03 (0.171)	14.43 (0.409)
18 (457)	5.46 (0.155)	13.52 (0.383)
17 (432)	4.88 (0.138)	12.61 (0.357)
16 (406)	4.30 (0.122)	11.69 (0.331)
15 (381)	3.70 (0.105)	10.76 (0.305)
14 (356)	3.10 (0.088)	9.83 (0.278)
13 (330)	2.49 (0.071)	8.90 (0.252)
12 (305)	1.88 (0.053)	7.96 (0.225)
11 (279)	1.26 (0.036)	7.02 (0.199)
10 (254)	0.63 (0.018)	6.07 (0.172)
9 (229)	0	5.12 (0.145)
8 (203)	0	4.55 (0.129)
7 (178)	0	3.99 (0.113)
6 (152)	0	3.42 (0.097)
5 (127)	Stone 0	2.85 (0.081)
4 (102)	Foundation 0	2.28 (0.064)
3 (76)	0	1.71 (0.048)
2 (51)	0	1.14 (0.032)
1 (25)	0	0.56 (0.016)

NOTE: Add 0.56 ft³ (0.016 m³) of storage for each additional inch (25 mm) of stone foundation.

Contact StormTech for cumulative volume spreadsheets in digital format.

5.0 Cumulative Storage Volumes

Tables 7 and **8** provide cumulative storage volumes for the MC-4500 chamber and end cap. These tables can be used to calculate the stage-storage relationship for the retention or detention system. Digital spreadsheets in which the number of chambers and end caps can be input for quick cumulative storage calculations are available at www.stormtech.com. For assistance with site-specific calculations or input into routing software, contact the StormTech Technical Services Department.

TABLE 7 – MC-4500 Incremental Storage Volume Per Chamber

Assumes 40% stone porosity. Calculations are based upon a 9" (229 mm) stone base under the chambers, 12" (305 mm) of stone above chambers, and 9" (229 mm) spacing between chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
81 (2057)	0	162.62 (4.605)
80 (2032)	0	161.40 (4.570)
79 (2007)	Stone 0	160.18 (4.536)
78 (1981)	Cover 0	158.96 (4.501)
77 (1956)	0	157.74 (4.467)
76 (1930)	0	156.52 (4.432)
75 (1905)	0	155.30 (4.398)
74 (1880)	0	154.09 (4.363)
73 (1854)	0	152.87 (4.329)
72 (1829)	0	151.65 (4.294)
71 (1803)	0	150.43 (4.260)
70 (1778)	0	149.21 (4.225)
69 (1753)	106.51 (3.016)	147.99 (4.191)
68 (1727)	106.47 (3.015)	146.75 (4.156)
67 (1702)	106.35 (3.012)	145.46 (4.119)
66 (1676)	106.18 (3.007)	144.14 (4.082)
65 (1651)	105.98 (3.001)	142.80 (4.044)
64 (1626)	105.71 (2.993)	141.42 (4.005)
63 (1600)	105.25 (2.981)	139.93 (3.962)
62 (1575)	104.59 (2.962)	138.31 (3.917)
61 (1549)	103.79 (2.939)	136.61 (3.869)
60 (1524)	102.88 (2.913)	134.85 (3.819)
59 (1499)	101.88 (2.885)	133.03 (3.767)
58 (1473)	100.79 (2.854)	131.16 (3.714)
57 (1448)	99.63 (2.821)	129.24 (3.660)
56 (1422)	98.39 (2.786)	127.28 (3.604)
55 (1397)	97.10 (2.749)	125.28 (3.548)
54 (1372)	95.73 (2.711)	123.25 (3.490)
53 (1346)	94.32 (2.671)	121.18 (3.431)
52 (1321)	92.84 (2.629)	119.08 (3.372)
51 (1295)	91.32 (2.586)	116.94 (3.311)
50 (1270)	89.74 (2.541)	114.78 (3.250)
49 (1245)	88.12 (2.495)	112.59 (3.188)
48 (1219)	86.45 (2.448)	110.37 (3.125)
47 (1194)	84.75 (2.400)	108.13 (3.062)
46 (1168)	83.00 (2.350)	105.86 (2.998)
45 (1143)	81.21 (2.300)	103.56 (2.933)
44 (1118)	79.38 (2.248)	101.25 (2.867)
43 (1092)	77.52 (2.195)	98.91 (2.801)

NOTE: Add 1.22 ft³ (0.035 m³) of storage for each additional inch (25 mm) of stone foundation. Contact StormTech for cumulative volume spreadsheets in digital format.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
42 (1067)	75.62 (2.141)	96.55 (2.734)
41 (1041)	73.69 (2.087)	94.18 (2.667)
40 (1016)	71.72 (2.031)	91.78 (2.599)
39 (991)	69.73 (1.974)	89.36 (2.531)
38 (965)	67.70 (1.917)	86.93 (2.462)
37 (948)	65.65 (1.859)	84.48 (2.392)
36 (914)	63.57 (1.800)	82.01 (2.322)
35 (889)	61.46 (1.740)	79.53 (2.252)
34 (864)	59.32 (1.680)	77.03 (2.181)
33 (838)	57.17 (1.619)	74.52 (2.110)
32 (813)	54.98 (1.557)	71.99 (2.038)
31 (787)	52.78 (1.495)	69.45 (1.966)
30 (762)	50.55 (1.431)	66.89 (1.894)
29 (737)	48.30 (1.368)	64.32 (1.821)
28 (711)	46.03 (1.303)	61.74 (1.748)
27 (686)	43.74 (1.239)	59.15 (1.675)
26 (680)	41.43 (1.173)	56.55 (1.601)
25 (610)	39.11 (1.107)	53.93 (1.527)
24 (609)	36.77 (1.041)	51.31 (1.453)
23 (584)	34.41 (0.974)	48.67 (1.378)
22 (559)	32.03 (0.907)	46.03 (1.303)
21 (533)	29.64 (0.839)	43.38 (1.228)
20 (508)	27.23 (0.771)	40.71 (1.153)
19 (483)	24.81 (0.703)	38.04 (1.077)
18 (457)	22.38 (0.634)	35.37 (1.001)
17 (432)	19.94 (0.565)	32.68 (0.925)
16 (406)	17.48 (0.495)	29.99 (0.849)
15 (381)	15.01 (0.425)	27.29 (0.773)
14 (356)	12.53 (0.355)	24.58 (0.696)
13 (330)	10.05 (0.284)	21.87 (0.619)
12 (305)	7.55 (0.214)	19.15 (0.542)
11 (279)	5.04 (0.143)	16.43 (0.465)
10 (254)	2.53 (0.072)	13.70 (0.388)
9 (229)	0	10.97 (0.311)
8 (203)	0	9.75 (0.276)
7 (178)	0	8.53 (0.242)
6 (152)	Stone 0	7.31 (0.207)
5 (127)	Foundation 0	6.09 (0.173)
4 (102)	0	4.87 (0.138)
3 (76)	0	3.66 (0.104)
2 (51)	0	2.44 (0.069)
1 (25)	0	1.22 (0.035)

5.0 Cumulative Storage Volumes

TABLE 8 – MC-4500 Incremental Storage Volume Per End Cap

Assumes 40% stone porosity. Calculations are based upon a 9" (229 mm) stone base under the end caps, 12" (305 mm) of stone above end caps, 9" (229 mm) of spacing between end caps and 12" (305 mm) of stone perimeter.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
81 (2057)	0	108.69 (3.078)
80 (2032)	0	107.62 (3.047)
79 (2007)	Stone 0	106.54 (3.017)
78 (1981)	Cover 0	105.46 (2.986)
77 (1956)	0	104.38 (2.956)
76 (1930)	0	103.31 (2.925)
75 (1905)	0	102.23 (2.895)
74 (1880)	0	101.15 (2.864)
73 (1854)	0	100.07 (2.834)
72 (1829)	0	99.00 (2.803)
71 (1803)	0	97.92 (2.773)
70 (1778)	0	96.84 (2.742)
69 (1753)	35.71 (1.011)	95.76 (2.712)
68 (1727)	35.71 (1.011)	94.69 (2.681)
67 (1702)	35.70 (1.011)	93.60 (2.651)
66 (1676)	35.67 (1.010)	92.51 (2.620)
65 (1651)	35.62 (1.009)	91.40 (2.588)
64 (1626)	35.56 (1.007)	90.29 (2.557)
63 (1600)	35.47 (1.004)	89.16 (2.525)
62 (1575)	35.36 (1.001)	88.01 (2.492)
61 (1549)	35.21 (0.997)	86.85 (2.459)
60 (1524)	35.05 (0.992)	85.67 (2.426)
59 (1499)	34.86 (0.987)	84.48 (2.392)
58 (1473)	34.64 (0.981)	83.27 (2.358)
57 (1448)	34.40 (0.974)	82.05 (2.323)
56 (1422)	34.13 (0.966)	80.81 (2.288)
55 (1397)	33.83 (0.958)	79.55 (2.253)
54 (1372)	33.51 (0.949)	78.28 (2.217)
53 (1346)	33.16 (0.939)	77.00 (2.180)
52 (1321)	32.79 (0.928)	75.70 (2.144)
51 (1295)	32.39 (0.917)	74.38 (2.106)
50 (1270)	31.98 (0.906)	73.06 (2.069)
49 (1245)	31.54 (0.893)	71.71 (2.031)
48 (1219)	31.07 (0.880)	70.36 (1.992)
47 (1194)	30.59 (0.866)	68.99 (1.954)
46 (1168)	30.09 (0.852)	67.61 (1.915)
45 (1143)	29.56 (0.837)	66.22 (1.875)
44 (1118)	29.02 (0.822)	64.81 (1.835)
43 (1092)	28.45 (0.806)	63.40 (1.795)

NOTE: Add 1.08 ft³ (0.031 m³) of storage for each additional inch (25 mm) of stone foundation. Contact stormtech for cumulative volume spreadsheets in digital format.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
42 (1067)	27.87 (0.789)	61.97 (1.755)
41 (1041)	27.27 (0.772)	60.53 (1.714)
40 (1016)	26.65 (0.755)	59.08 (1.673)
39 (991)	26.01 (0.736)	57.62 (1.632)
38 (965)	25.35 (0.718)	56.15 (1.590)
37 (948)	24.68 (0.699)	54.67 (1.548)
36 (914)	23.99 (0.679)	53.18 (1.506)
35 (889)	23.28 (0.659)	51.68 (1.463)
34 (864)	22.56 (0.639)	50.17 (1.421)
33 (838)	21.82 (0.618)	48.64 (1.377)
32 (813)	21.06 (0.596)	47.11 (1.334)
31 (787)	20.29 (0.575)	45.57 (1.290)
30 (762)	19.50 (0.552)	44.02 (1.247)
29 (737)	18.70 (0.530)	42.46 (1.202)
28 (711)	17.88 (0.506)	40.89 (1.158)
27 (686)	17.04 (0.483)	39.31 (1.113)
26 (680)	16.19 (0.459)	37.73 (1.068)
25 (610)	15.33 (0.434)	36.14 (1.023)
24 (609)	14.46 (0.410)	34.53 (0.978)
23 (584)	13.58 (0.384)	32.93 (0.932)
22 (559)	12.68 (0.359)	31.31 (0.887)
21 (533)	11.77 (0.333)	29.69 (0.841)
20 (508)	10.85 (0.307)	28.06 (0.794)
19 (483)	9.91 (0.281)	26.42 (0.748)
18 (457)	8.97 (0.254)	24.77 (0.702)
17 (432)	8.01 (0.227)	23.12 (0.655)
16 (406)	7.04 (0.199)	21.46 (0.608)
15 (381)	6.07 (0.172)	19.80 (0.561)
14 (356)	5.08 (0.144)	18.13 (0.513)
13 (330)	4.08 (0.116)	16.45 (0.466)
12 (305)	3.07 (0.087)	14.77 (0.418)
11 (279)	2.06 (0.058)	13.09 (0.371)
10 (254)	1.03 (0.029)	11.39 (0.323)
9 (229)	0	9.70 (0.275)
8 (203)	0	8.62 (0.244)
7 (178)	0	7.54 (0.214)
6 (152)	Stone 0	6.46 (0.183)
5 (127)	Foundation 0	5.39 (0.153)
4 (102)	0	4.31 (0.122)
3 (76)	0	3.23 (0.092)
2 (51)	0	2.15 (0.061)
1 (25)	0	1.08 (0.031)

6.0 MC-3500 Chamber System Sizing

The following steps provide the calculations necessary for preliminary sizing of an MC-3500 chamber system. For custom bed configurations to fit specific sites, contact the StormTech Technical Services Department or your local StormTech representative.

1) Determine the amount of storage volume (V_S) required. It is the design engineer's sole responsibility to determine the storage volume required.

TABLE 9 – Storage Volume Per Chamber/End Cap ft³ (m³)

MC-3500	Bare Unit Storage ft³ (m³)	Chamber/End Cap and Stone Volume — Stone Foundation Depth in. (mm)			
		9" (229 mm)	12" (305 mm)	15" (381 mm)	18" (457 mm)
Chamber	109.9 (3.11)	178.9 (5.06)	184.0 (5.21)	189.2 (5.36)	194.3 (5.5)
End Cap	15.64 (0.44)	46.9 (1.33)	48.6 (1.38)	50.3 (1.43)	52.0 (1.47)

NOTE: Assumes 9" (229 mm) row spacing, 40% stone porosity, 12" (305 mm) stone above and includes the bare chamber/end cap volume. End cap volume assumes 6" (152 mm) stone perimeter.

2) Determine the number of chambers (C) required. To calculate the number of chambers required for adequate storage, divide the storage volume (Vs) by the storage volume of the chamber (from **Table 9**), as follows: **C = Vs / Storage Volume per Chamber**

3) Determine the number of end caps required. The number of end caps (EC) required depends on the number of rows required by the project. Once the number of chamber rows is determined, multiply the number of chamber rows by 2 to determine the number of end caps required. **EC = No. of Chamber Rows x 2**

NOTE: Additional end caps may be required for systems having inlet locations within the chamber bed.

4) Determine additional storage provided by end caps. End Caps will provide additional storage to the project. Multiply the number of end caps (EC) by the storage volume per end cap (ECs) to determine the additional storage (As) provided by the end caps. **As = EC x ECs**

5) Adjust number of chambers (C) to account for additional end cap storage (As). The original number of chambers (C) can now be reduced due to the additional storage in the end caps. Divide the additional storage (As) by the storage volume per chamber to determine the number of chambers that can be removed. **Number of chambers to remove = As/ volume per chamber**

NOTE: Additional storage exists in the stone perimeter as well as in the inlet and outlet manifold systems. Contact StormTech's Technical Services Department for assistance with determining the number of chambers and end caps required for your project.

6) Determine the required bed size (S). The size of the bed will depend on the number of chambers and end caps required:
MC-3500 area per chamber = 51.4 ft² (4.8 m²)
MC-3500 area per end cap = 13.5 ft² (1.3 m²)

S = (C x area per chamber) + (EC x area per end cap)

NOTE: It is necessary to add 12" (305 mm) of stone perimeter parallel to the chamber rows and 6" (152 mm) of stone perimeter from the base of all end caps. The additional area due to perimeter stone is not included in the area numbers above.

7) Determine the amount of stone (V_{St}) required. To calculate the total amount of clean, crushed, angular stone required, multiply the number of chambers (C) and the number of end caps (EC) by the selected weight of stone from **Table 10.**

NOTE: Clean, crushed, angular stone is also required around the perimeter of the system.

TABLE 10 – Amount of Stone Per Chamber/End Cap

ENGLISH tons (yds³)	Stone Foundation Depth			
	9"	12"	15"	18"
MC-3500	9.1 (6.4 yd³)	9.7 (6.9 yd³)	10.4 (7.3 yd³)	11.1 (7.8 yd³)
End Cap	4.1 (2.9 yd³)	4.3 (3.1 yd³)	4.6 (3.2 yd³)	4.8 (3.4 yd³)
METRIC kg (m³)	**229 mm**	**305 mm**	**381 mm**	**457 mm**
MC-3500	8220 (4.9 m³)	8831 (5.3 m³)	9443 (5.6 m³)	10054 (6.0 m³)
End Cap	3729 (2.2 m³)	3933 (2.3 m³)	4136 (2.5 m³)	4339 (2.6 m³)

NOTE: Assumes 12" (305 mm) of stone above, 9" (229 mm) row spacing, and 6" (152 mm) of perimeter stone in front of end caps.

8) Determine the volume of excavation (Ex) required. Each additional foot of cover will add a volume of excavation of 1.9 yd³ (1.5 m³) per MC-3500 chamber and 0.6 yd³ (0.5 m³) per MC-3500 end cap.

TABLE 11 – Volume of Excavation Per Chamber/End Cap in yd³ (m³)

	Stone Foundation Depth			
	9" (229 mm)	12" (305 mm)	15" (381 mm)	18" (457 mm)
MC-3500	12.4 (9.5)	12.8 (9.8)	13.3 (10.2)	13.8 (10.5)
End Cap	4.1 (3.1)	4.3 (3.3)	4.4 (3.4)	4.6 (3.5)

NOTE: Assumes 9" (229 mm) of separation between chamber rows, 6" (152 mm) of perimeter in front of end caps, and 24" (610 mm) of cover. The volume of excavation will vary as the depth of cover increases.

9) Determine the area of geotextile (F) required. The bottom, top and sides of the bed must be covered with a non-woven geotextile (filter fabric) that meets AASHTO M288 Class 2 requirements. The area of the sidewalls must be calculated and a 24" (610 mm) overlap must be included for all seams. Geotextiles typically come in 15 foot (4.57 m) wide rolls.

6.0 MC-4500 Chamber System Sizing

The following steps provide the calculations necessary for preliminary sizing of an MC-4500 chamber system. For custom bed configurations to fit specific sites, contact the StormTech Technical Services Department or your local StormTech representative.

1) Determine the amount of storage volume (V_S) required. It is the design engineer's sole responsibility to determine the storage volume required.

TABLE 12 – Storage Volume Per Chamber/End Cap ft³ (m³)

MC-4500	Bare Unit Storage ft³ (m³)	Chamber/End Cap and Stone Volume — Stone Foundation Depth in. (mm) 9" (229 mm)	12" (305 mm)	15" (381 mm)	18" (457 mm)
Chamber	106.5 (3.01)	162.6 (4.60)	166.3 (4.71)	169.9 (4.81)	173.6 (4.91)
End Cap	35.7 (1.01)	108.7 (3.08)	111.9 (3.17)	115.2 (3.26)	118.4 (3.35)

NOTE: Assumes 9" (229 mm) row spacing, 40% stone porosity, 12" (305 mm) stone above and includes the bare chamber/end cap volume. End cap volume assumes 12" (305 mm) stone perimeter.

2) Determine the number of chambers (C) required. To calculate the number of chambers required for adequate storage, divide the storage volume (Vs) by the storage volume of the chamber (from **Table 12**), as follows: **C = Vs / Storage Volume per Chamber**

3) Determine the number of end caps required. The number of end caps (EC) required depends on the number of rows required by the project. Once the number of chamber rows is determined, multiply the number of chamber rows by 2 to determine the number of end caps required. **EC = No. of Chamber Rows x 2**

NOTE: Additional end caps may be required for systems having inlet locations within the chamber bed.

4) Determine additional storage provided by end caps. End Caps will provide additional storage to the project. Multiply the number of end caps (EC) by the storage volume per end cap (ECs) to determine the additional storage (As) provided by the end caps. **As = EC x ECs**

5) Adjust number of chambers (C) to account for additional end cap storage (As). The original number of chambers (C) can now be reduced due to the additional storage in the end caps. Divide the additional storage (As) by the storage volume per chamber to determine the number of chambers that can be removed. **Number of chambers to remove = As/ volume per chamber**

NOTE: Additional storage exists in the stone perimeter as well as in the inlet and outlet manifold systems. Contact StormTech's Technical Services Department for assistance with determining the number of chambers and end caps required for your project.

6) Determine the required bed size (S). The size of the bed will depend on the number of chambers and end caps required:
MC-4500 area per chamber = 36.6 ft² (3.4 m²)
MC-4500 area per end cap = 23.2 ft² (2.2 m²)

S = (C x area per chamber) + (EC x area per end cap)

NOTE: It is necessary to add 12" (305 mm) of stone perimeter parallel to the chamber rows and 12" (305 mm) of stone perimeter from the base of all end caps. The additional area due to perimeter stone is not included in the area numbers above.

7) Determine the amount of stone (V_{St}) required. To calculate the total amount of clean, crushed, angular stone required, multiply the number of chambers (C) and the number of end caps (EC) by the selected weight of stone from **Table 13.**

NOTE: Clean, crushed, angular stone is also required around the perimeter of the system.

TABLE 13 – Amount of Stone Per Chamber/End Cap

ENGLISH tons (yds³)	Stone Foundation Depth 9"	12"	15"	18"
MC-4500	7.4 (5.2)	7.8 (5.5)	8.3 (5.9)	8.8 (6.2)
End Cap	9.6 (6.8)	10.0 (7.1)	10.4 (7.4)	10.9 (7.7)
METRIC kg (m³)	**229 mm**	**305 mm**	**381 mm**	**457 mm**
MC-4500	6681 (4.0)	7117 (4.2)	7552 (4.5)	7987 (4.7)
End Cap	8691 (5.2)	9075 (5.4)	9460 (5.6)	9845 (5.9)

NOTE: Assumes 12" (305 mm) of stone above, 9" (229 mm) row spacing, and 12" (305 mm) of perimeter stone in front of end caps.

8) Determine the volume of excavation (Ex) required. Each additional foot of cover will add a volume of excavation of 1.4 yd³ (1.0 m³) per MC-4500 chamber and 1.2 yd³ (0.9 m³) per MC-4500 end cap.

TABLE 14 – Volume of Excavation Per Chamber/End Cap in yd³ (m³)

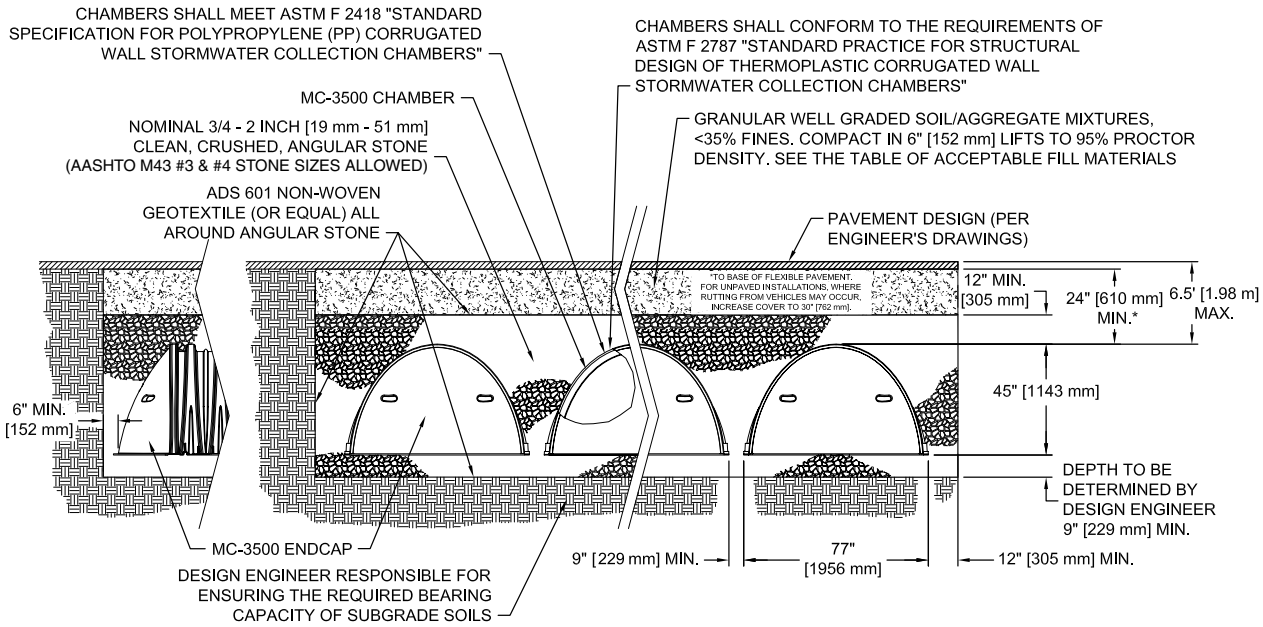
	Stone Foundation Depth 9" (229 mm)	12" (305 mm)	15" (381 mm)	18" (457 mm)
MC-4500	10.5 (8.0)	10.8 (8.3)	11.2 (8.5)	11.5 (8.8)
End Cap	9.3 (7.1)	9.6 (7.3)	9.9 (7.6)	10.2 (7.8)

NOTE: Assumes 9" (229 mm) of separation between chamber rows, 12" (305 mm) of perimeter in front of end caps, and 24" (610 mm) of cover. The volume of excavation will vary as the depth of cover increases.

9) Determine the area of geotextile (F) required. The bottom, top and sides of the bed must be covered with a non-woven geotextile (filter fabric) that meets AASHTO M288 Class 2 requirements. The area of the sidewalls must be calculated and a 24" (610 mm) overlap must be included for all seams. Geotextiles typically come in 15 foot (4.57 m) wide rolls.

7.0 Structural Cross Sections and Specifications

Figure 15 – MC-3500 Structural Cross Section Detail – (not to scale)



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

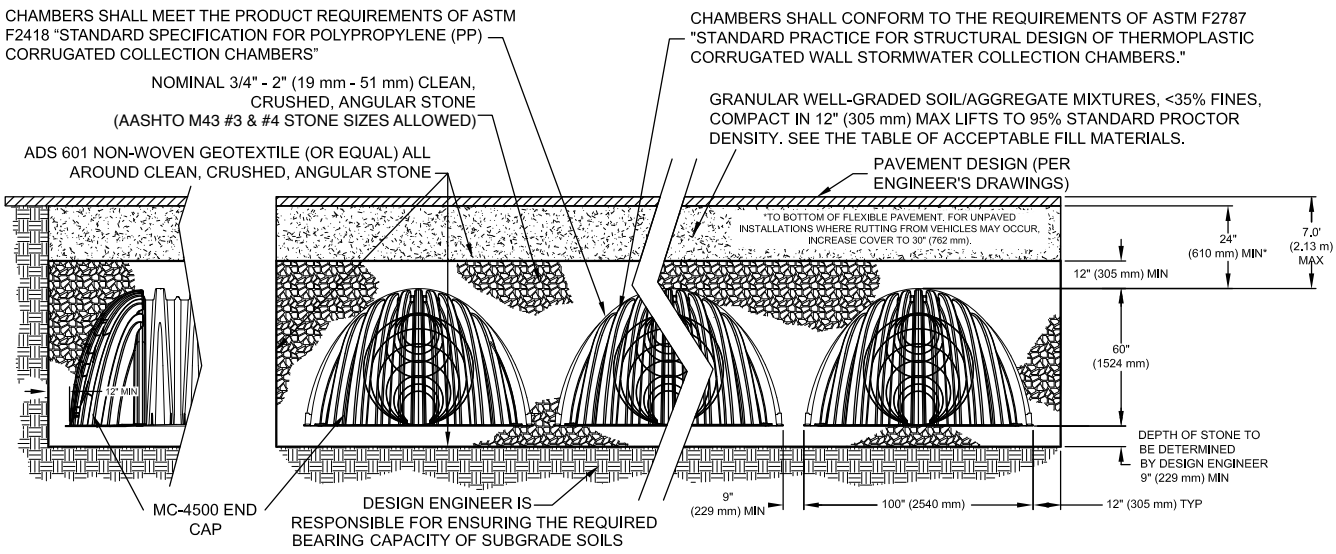
MC-3500 STORMWATER CHAMBER SPECIFICATIONS:

1. Chambers shall be StormTech MC-3500 or approved equal.
2. Chambers shall be made from virgin, impact-modified polypropylene copolymers.
3. Chamber rows shall provide continuous, unobstructed internal space with no internal panels that would impede flow.
4. The structural design of the chambers, the structural backfill and the installation requirements shall ensure that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met for: 1) long-duration dead loads and 2) short-duration live loads, based on the AASHTO Design Truck with consideration for impact and multiple vehicle presences.
5. Chambers shall meet the requirements of ASTM F 2418, “Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers.”
6. Chambers shall conform to the requirements of ASTM F 2787, “Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers.”
7. Only chambers that are approved by the engineer will be allowed. The contractor shall submit (3 sets) of the following to the engineer for approval before delivering chambers to the project site:
   - A structural evaluation by a registered structural engineer that demonstrates that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met. The 50-year creep modulus data specified in ASTM F 2418 must be used as part of the AASHTO structural evaluation to verify long-term performance.
   - Structural cross section detail on which the structural cross section is based.
8. The installation of chambers shall be in accordance with the manufacturer’s latest Construction Guide.

Detail drawings available in Cad Rev. 2000 format at www.stormtech.com.

7.0 Structural Cross Sections and Specifications

Figure 16 – MC-4500 Structural Cross Section Detail – (not to scale)



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

MC-4500 STORMWATER CHAMBER SPECIFICATIONS:

1. Chambers shall be StormTech MC-4500 or approved equal
2. Chambers shall be made from virgin, impact-modified polypropylene copolymers.
3. Chamber rows shall provide continuous, unobstructed internal space with no internal panels that would impede flow.
4. The structural design of the chambers, the structural backfill and the installation requirements shall ensure that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met for: 1) long-duration dead loads and 2) short duration live loads, based on the AASHTO Design Truck with consideration for impact and multiple vehicle presences.
5. Chambers shall meet the requirements of ASTM F 2418, "Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers."
6. Chambers shall conform to the requirements of ASTM F 2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers."
7. Only chambers that are approved by the engineer will be allowed. The contractor shall submit (3 sets) of the following to the engineer for approval before delivering chambers to the project site:
   - A structural evaluation by a registered structural engineer that demonstrates that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met. The 50-year creep modulus data specified in ASTM F 2418 must be used as part of the AASHTO structural evaluation to verify long-term performance.
   - Structural cross section detail on which the structural cross section is based.
8. The installation of chambers shall be in accordance with the manufacturer's latest Construction Guide.

Detail drawings available in Cad Rev. 2000 format at www.stormtech.com.

8.0 General Notes

1. StormTech ("StormTech") requires installing contractors to use and understand the latest **StormTech MC-3500 and MC-4500 Construction Guide** prior to beginning system installation.
2. StormTech offers installation consultations to installing contractors. Contact our Technical Service Department or local StormTech representative at least 30 days prior to system installation to arrange a pre-installation consultation. Our representatives can then answer questions or address comments on the StormTech chamber system and inform the Installing contractor of the minimum installation requirements before beginning the system's construction. Call 860-529-8188 to speak to a Technical Service Representative or visit www.stormtech.com to receive a copy of our Construction Guide.
3. StormTech requirements for systems with pavement design (asphalt, concrete pavers, etc.): Minimum cover is 24" (610 mm) not including pavement; MC-3500 maximum cover is 6.5' (1.98 m) and MC-4500 maximum cover is 7.0' (2.13 m) both including pavement. For installations that do not include pavement, where rutting from vehicles may occur, minimum required cover is increased to 30" (762 mm).
4. The contractor must report any discrepancies with the bearing capacity of the subgrade materials to the design engineer.
5. AASHTO M288 Class 2 non-woven geotextile (ADS601 or equal) (filter fabric) must be used as indicated in the project plans.
6. Stone placement between chamber rows and around perimeter must follow instructions as indicated in the most current version of StormTech MC-3500 / MC-4500 Construction Guide.
7. Backfilling over the chambers must follow requirements as indicated in the most current version of StormTech MC-3500 / MC-4500 Construction Guide.
8. The contractor must refer to StormTech MC-3500 / MC-4500 Construction Guide for a Table of Acceptable Vehicle Loads at various depths of cover. This information is also available at the StormTech website: www.stormtech.com. The contractor is responsible for preventing vehicles that exceed StormTech requirements from traveling across or parking over the stormwater system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.
9. The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.
10. STORMTECH PRODUCT WARRANTY IS LIMITED. Contact StormTech for warranty information.

9.0 Inspection and Maintenance

9.1 ISOLATOR ROW INSPECTION

Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3" (76 mm), cleanout is required.

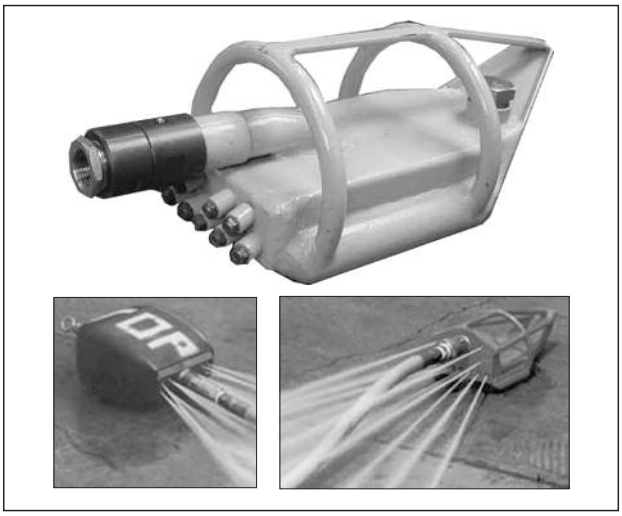
A StormTech Isolator Row should initially be inspected immediately after completion of the site's construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site's owner. Once in normal service, a StormTech Isolator Row should be inspected bi-annually until an understanding of the sites characteristics is developed. The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

9.2 ISOLATOR ROW MAINTENANCE

JetVac maintenance is recommended if sediment has been collected to an average depth of 3" (76 mm) inside the Isolator Row. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row. 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, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" (1143 mm) are best. The JetVac process shall only be performed on StormTech Rows that have AASHTO class 1 woven geotextile over their foundation stone (ADS 315WTM or equal).

Looking down the Isolator Row.

A typical JetVac truck. (This is not a StormTech product.)



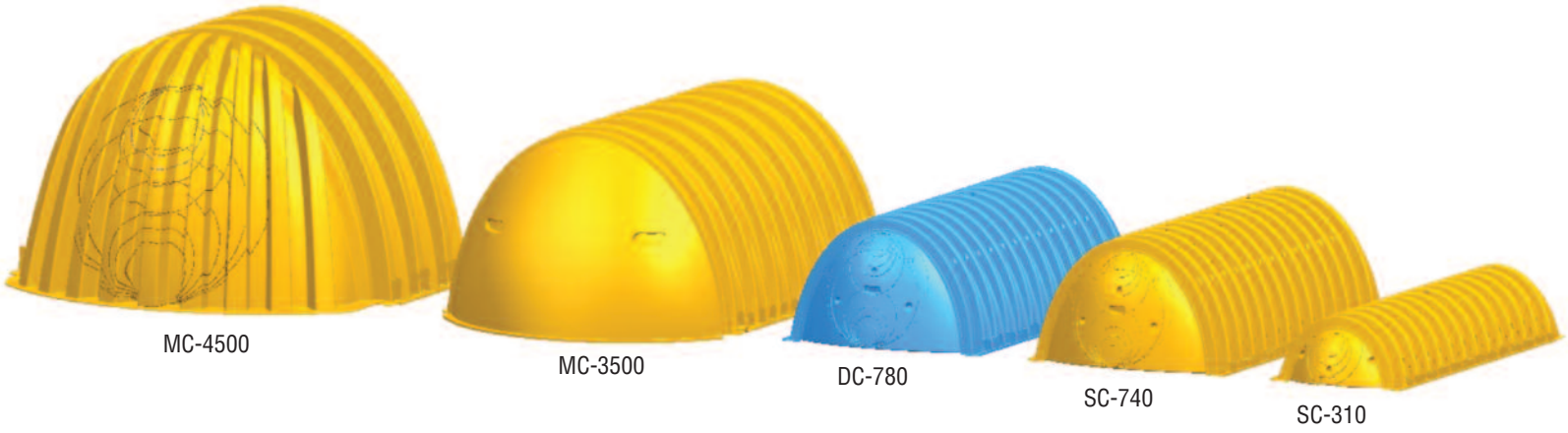
Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

A Family of Products and Services for the Stormwater Industry:

- MC-3500 and MC-4500 Chambers and End Caps
- SC-310 and SC-740 Chambers and End Caps
- DC-780 Chambers and End Caps
- Fabricated End Caps
- Fabricated Manifold Fittings
- Patented Isolator Row for Maintenance and Water Quality
- Chamber Separation Spacers
- In-House System Layout Assistance
- On-Site Educational Seminars
- Worldwide Technical Sales Group
- Centralized Product Applications Department
- Research and Development Team
- Technical Literature, O&M Manuals and Detailed CAD drawings all downloadable via our Web Site

StormTech provides state of the art products and services that meet or exceed industry performance standards and expectations. We offer designers, regulators, owners and contractors the highest quality products and services for stormwater management that "Saves Valuable Land and Protects Water Resources."

Please contact one of our inside project application professionals or Engineered Product Managers (EPMs) to discuss your particular application. A wide variety of technical support material is available in print, electronic media or from our website at www.stormtech.com. For any questions, please call StormTech at 888-892-2694.



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Save Valuable Land and Protect Water Resources

Isolator® Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator® Row

1.1 INTRODUCTION

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

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

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either 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.

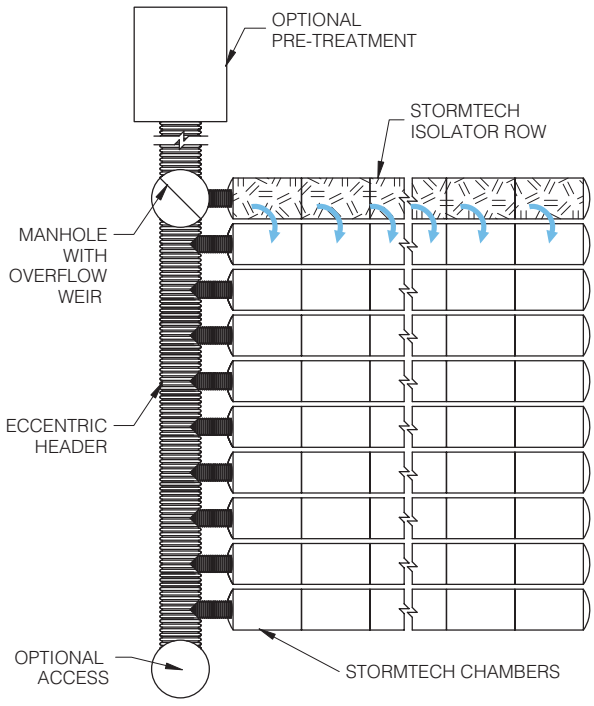
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain 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 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 not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. 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.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 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.

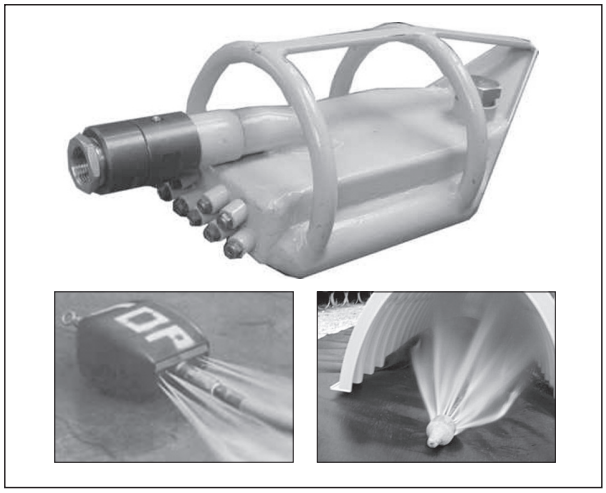
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

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.

2.2 MAINTENANCE

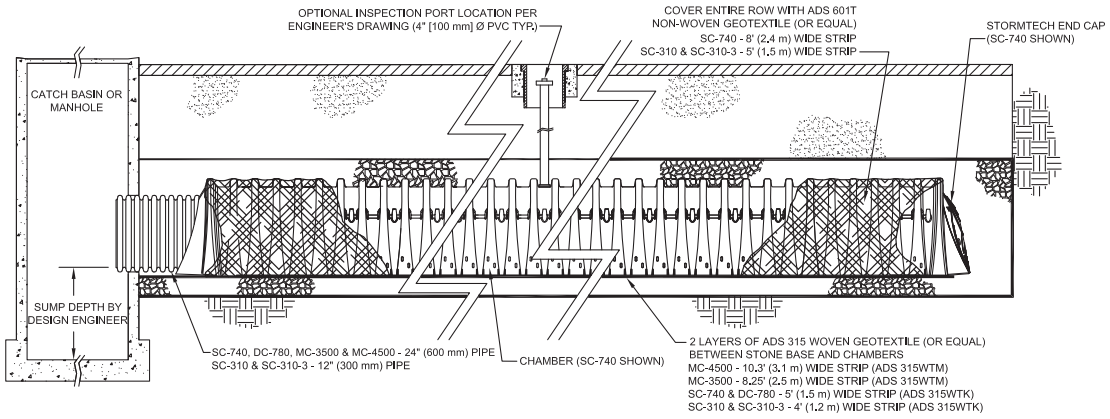
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via 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.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

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 DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

3.0 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

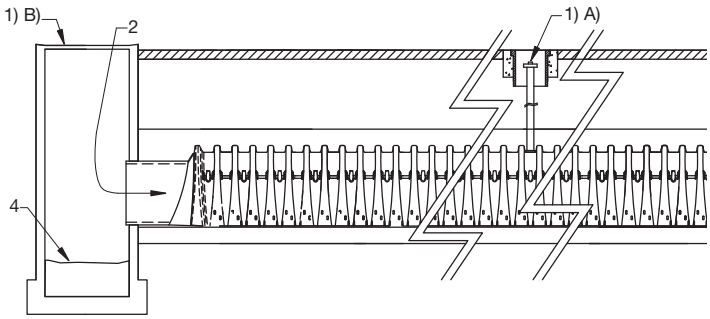
i. Remove cover from manhole at upstream end of Isolator Row

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.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process

A) A fixed culvert 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)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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70 Inwood Road, Suite 3 | Rocky Hill | Connecticut | 06067

860.529.8188 | 888.892.2694 | fax 866.328.8401 | www.stormtech.com

Appendix E-2
ADS StormTech Isolator Row

StormTech
Detention • Retention • Water Quality
An ADS company

Isolator® Row O&M Manual

THE MOST ADVANCED NAME IN WATER MANAGEMENT SOLUTIONS™

ADS®

THE ISOLATOR® ROW

INTRODUCTION

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

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160LP, 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.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain 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-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

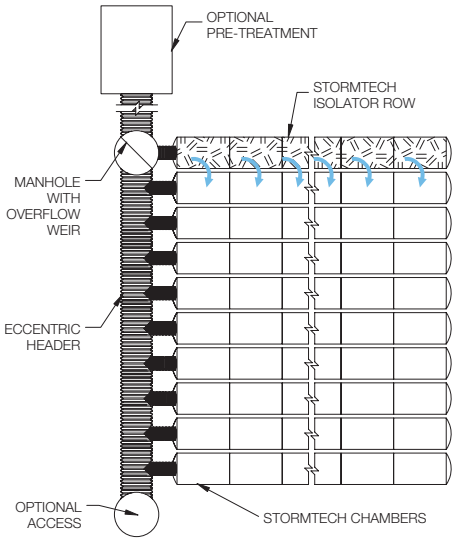
The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. 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.

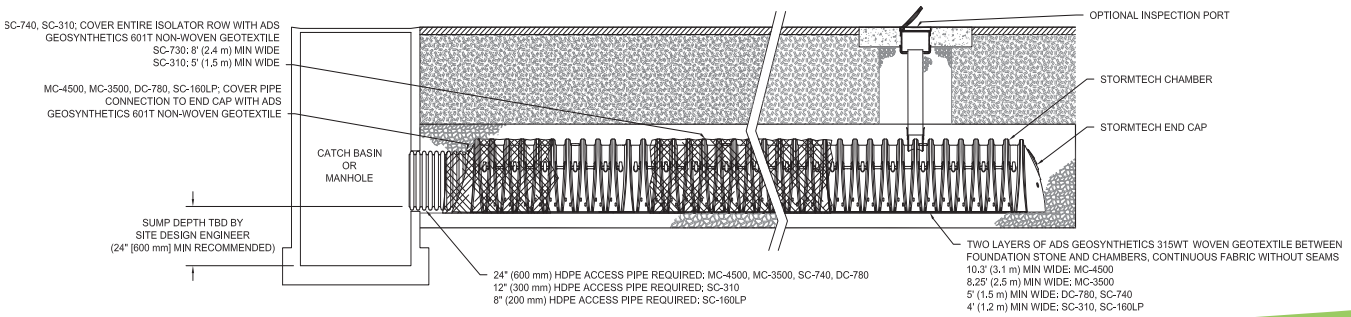
MAINTENANCE

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.



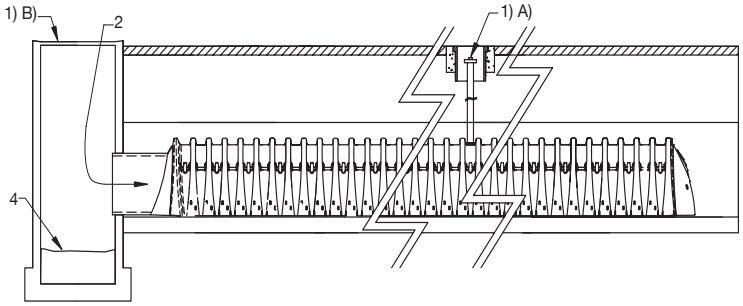
ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

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

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4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

Appendix E-3
ADS StormTech Isolator Row SC-310

Isolator® Row
O&M Manual

ADS StormTech™

The Isolator® Row

Introduction

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

The Isolator Row

The Isolator Row is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-7200 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for sediment settling and filtration as stormwater rises in the Isolator Row and passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow stormwater to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the adjacent stone and chambers storage areas from sediment accumulation.

ADS 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 chamber's sidewall. The non-woven fabric is not required over the SC-160, DC-780, MC-3500 or MC-7200 models as these chambers do not have perforated side walls.

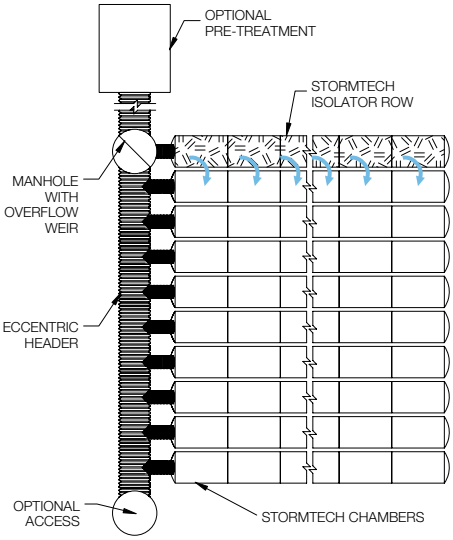
The Isolator Row is designed to capture the "first flush" runoff and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole provides access to the Isolator Row and includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row bypass through a manifold to the other chambers. This is achieved with an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row. After Stormwater flows through the Isolator Row and into the rest of the chamber system it is either exfiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure.

The Isolator Row may be part of a treatment train system. The treatment train design and pretreatment device selection by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, StormTech recommend using the Isolator Row 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 Fabric 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.

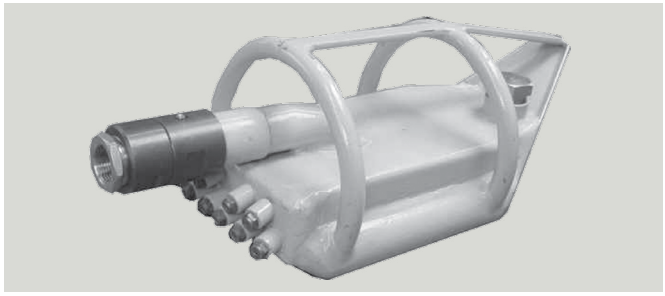
The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

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

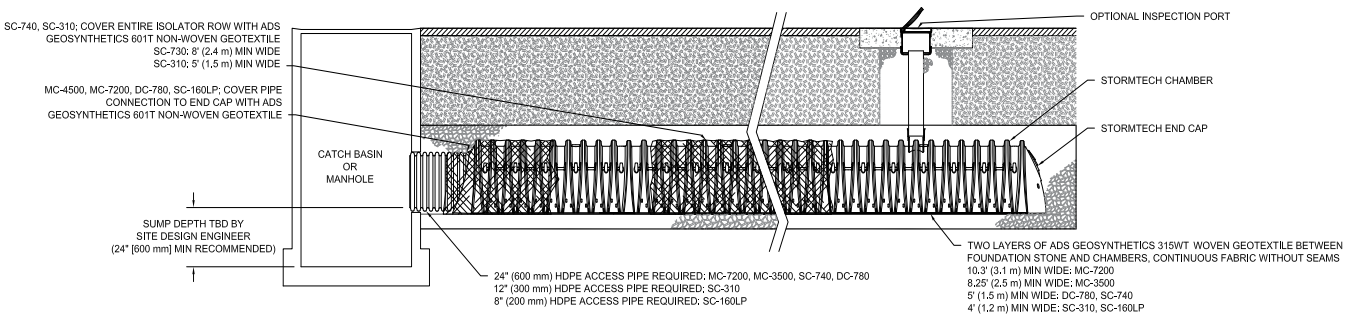
The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via 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. JetVac reels can vary in length. For ease of maintenance, ADS recommends Isolator Row lengths up to 200" (61 m). **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-7200 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 Row
   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.

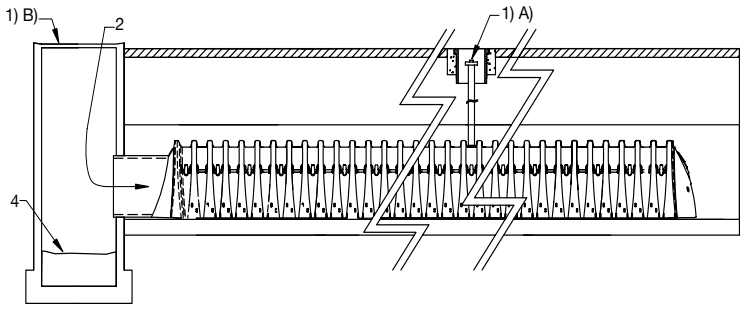
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

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		Sedi-ment 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

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800-821-6710

Appendix E-4
Track and Field Underground Detention

rosstarrant architects

MEMORANDUM

September 20, 2012

TO: Keith Ingram
University of Kentucky
Capital Projects Management Division
Room 222 Peterson Service Building
Lexington, Kentucky 40506

FROM: Steven E. Maggard, PE
RossTarrant Architects, Inc.

RE: Underground Detention System Operation and Maintenance
University of Kentucky
Shively Track & Field Renovation
Lexington, Kentucky
RTA 1027

Operation

Successful operation depends on maintaining the storage volume and the discharge rate.

Maintenance

The detention system is comprised of a series of pipes and box culverts that form an underground storage area, which detains storm water runoff. As sediment and debris settle out of the detained storm water, build up occurs that requires the system to be regularly inspected and cleaned in order for the system to perform as originally designed.

Maintaining a clean and obstruction-free detention system helps to ensure the system performs the intended function of the primary design. Build up of debris reduces storage volume and may obstruct the outlet pipe. This may result in ineffective operation or complete failure of the system. Additionally, surrounding areas may potentially run the risk of damage due to flooding or other similar issues.

Activities necessary to maintain the functioning of an underground detention system include:
• Annual inspection of structure to assess accumulated sediment, debris, and litter. When sediment build up is approximately 3" deep by the outlet pipe, cleaning should occur.
• Use of a water-jetting device and vacuum truck is the ideal method for cleaning the system.
•While maintenance can generally be performed year round, it should be scheduled during a relatively dry season.

Inspection

Inspection should be performed at a minimum of once per year or after major rain events if necessary.

Inspections should include the following:
• Conducted by licensed engineer or equally qualified person.
• Look for obstructions of the inlet or outlet devices by trash and debris
• Look for excessive sediment, debris, and litter accumulation
• Look for Deterioration of structure and pipes including cracking, settling, or joint movement.
• Look at the condition of the outlet structure weir and orifice.

END OF MEMORANDUM

c: Laith M. Ross, PE, LEED AP, Randy S. Brookshire, AIA, LEED AP BD+C
File 1027-4c
ME120920-undergrounddetention-O&M-1027

Appendix E-5
UK Science Building Underground Stone Detention

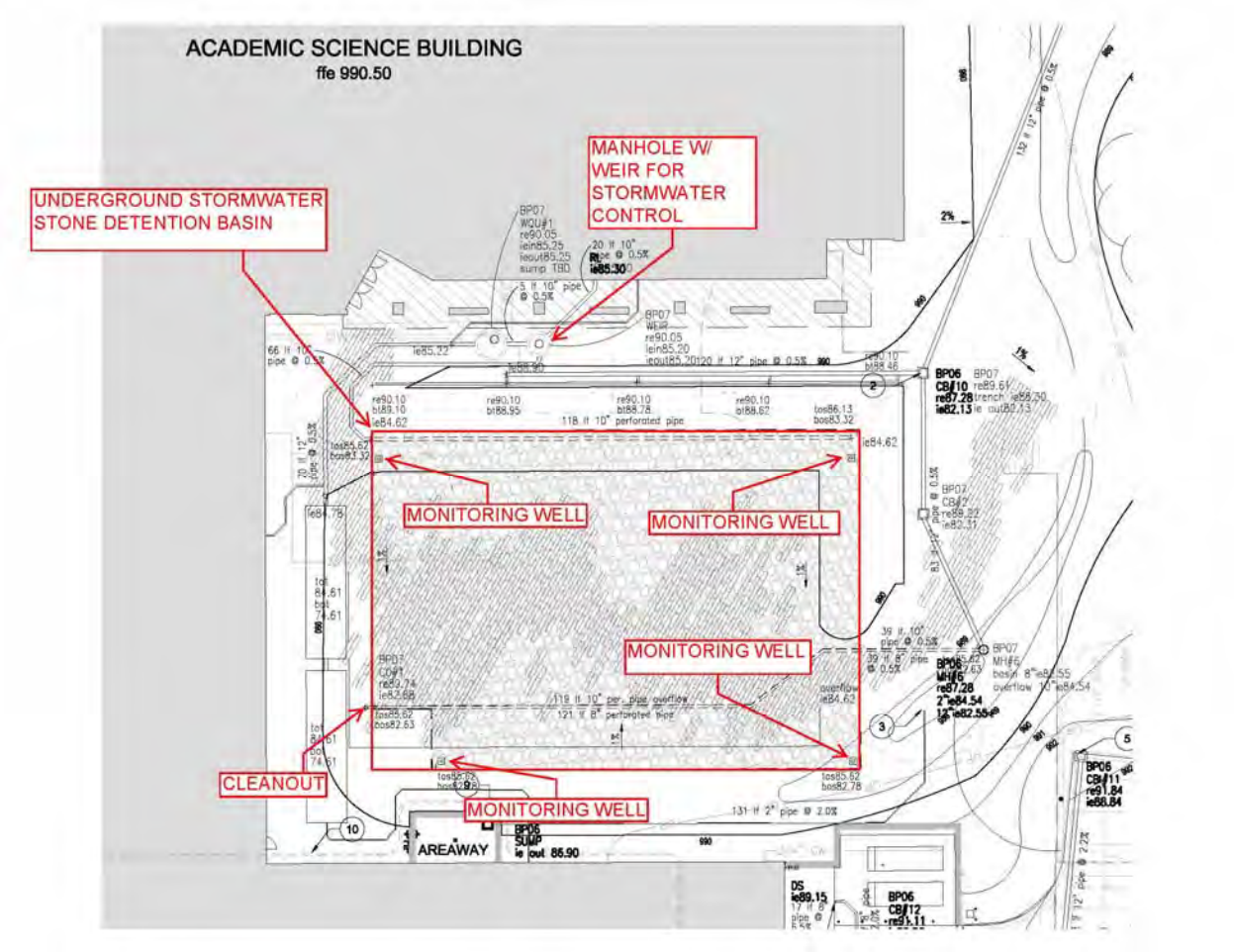
University of Kentucky

ACADEMIC SCIENCE BUILDING

STORM WATER BEST MANAGEMENT PRACTICES MAINTENANCE MANUAL FOR (2) RAINWATER HARVESTING SYSTEMS, (3) WATER QUALITY UNITS, UNDERGROUND STORMWATER STONE BASIN, AND PAVERS.

ENVIRONMENTS FULLY REALIZED
CARMAN

An underground storm water stone detention basin fully wrapped with filter fabric is located below the courtyard on the east side of the Academic Science Building. A manhole upstream has weir to divert water to the stone basin. Both the manhole with the weir and the stone basin must be maintained. The underground stone basin also includes four (4) monitoring wells.



Task Description	Minimum Frequency
All structure components must be inspected for cracking, subsidence, spalling, erosion and deterioration	**At least once annually**
Remove all trash and debris, including from the manhole with the weir. The manhole with the weir must be inspected for clogging and any sediment or trapped debris.	**Monthly and after every storm event exceeding 1 inch of rainfall**
The underground stone basin is to be monitored by the four (4) monitoring wells to determine if the basin is working adequately.	**Monthly and after every storm event exceeding 1 inch of rainfall**
Maintain top surface (pavers) See paver maintenance in section below.	**See paver section below.**