Countryside Elementary School
Operation and Maintenance Plan

191 Dedham Street
Newton, MA

Prepared for:

City of Newton

1000 Commonwealth Avenue

Newton Centre, MA 02459

Prepared by:

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Attachments

1.0 OWNER AND RESPONSIBLE PARTY FOR MAINTENANCE

The City of Newton is responsible for the financing and continuous operation, maintenance and required emergency repair for the stormwater management system and associated drainage network.

Owner: City of Newton
School Department
1000 Commonwealth Avenue
Newton Centre, MA 02459

Contact: Newton Public Schools

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Signed:_____

Date:_____

2.0 INTRODUCTION

This Guide provides a general description of the function and maintenance requirements for the Green Stormwater Infrastructure (GSI) located at the Countryside Elementary School (the School) in Newton, Massachusetts. The maintenance provider is required to familiarize themselves with this Guide and inspect and maintain the following practices, as outlined in the Guide, throughout the year. Proper maintenance is vital to its long-term success.

The proposed stormwater management includes a GSI approach to collect, capture, store, and filter stormwater prior to discharge to South Meadow Brook and the municipal stormwater system. The maintenance provider is required to inspect and maintain the following GSI practice (**Figure 1**) throughout the year, as indicated on the construction drawings and as outlined in this Guide.

STORES AND FILTERS PRACTICES

Pollinator/Rain Garden

A rain garden is designed to manage and treat stormwater runoff using a conditioned planting soil bed or “filter” media and plants to filter runoff captured in a shallow depression. The method combines physical filtering and adsorption with bio-geochemical processes to remove pollutants. The system consists of an inflow component, a pretreatment element, an overflow structure, a shallow ponding area, a well-drained planting soil bed, and plants.

Vegetated Swale/Grassed Channel

A grassed channel is considered a water quality practice and is designed to capture and convey stormwater. The vegetation slows down the stormwater allowing more sediment to be removed prior to reaching the downgradient stormwater practice.

Drywell

A drywell is designed to infiltrate uncontaminated runoff from roof tops or lawn areas and provide groundwater recharge using a precast stormwater structure with perforated sides and surrounded by crushed stone.

Subsurface Infiltration Chamber System

Subsurface infiltration chamber systems are stormwater management practices that are designed to capture and infiltrate stormwater runoff to enhance groundwater recharge. Subsurface infiltration chambers are typically manufactured pipes with open bottoms that are placed atop a stone bed and surrounded with crushed, washed stone, and filter fabric. Runoff typically enters and exits the chambers through a manifold connected to a manhole or similar drainage structure.

Infiltration Trench

Infiltration trenches are stormwater management practices that are designed to capture, treat, and infiltrate stormwater runoff using a combination of a stone-filled reservoir and planting materials. Infiltration trenches receive stormwater from an inflow pipe, which is stored in a stone reservoir underneath a planted area. Trees or other landscape plants absorb and filter a portion of the stormwater, while the remaining stormwater infiltrates into the underlying substrate.

Porous Asphalt

Porous or permeable pavement is a paved surface with large voids that allows water to pass through the asphalt and infiltrate into the subsoil. The porous asphalt is a low impact development (LID) feature that replaces traditional pavement. A stone reservoir beneath the pavement acts as a pond, collecting the stormwater and allowing it to infiltrate into the native soil below. The porous asphalt provides stormwater recharge using a combination of a stone-filled reservoir.

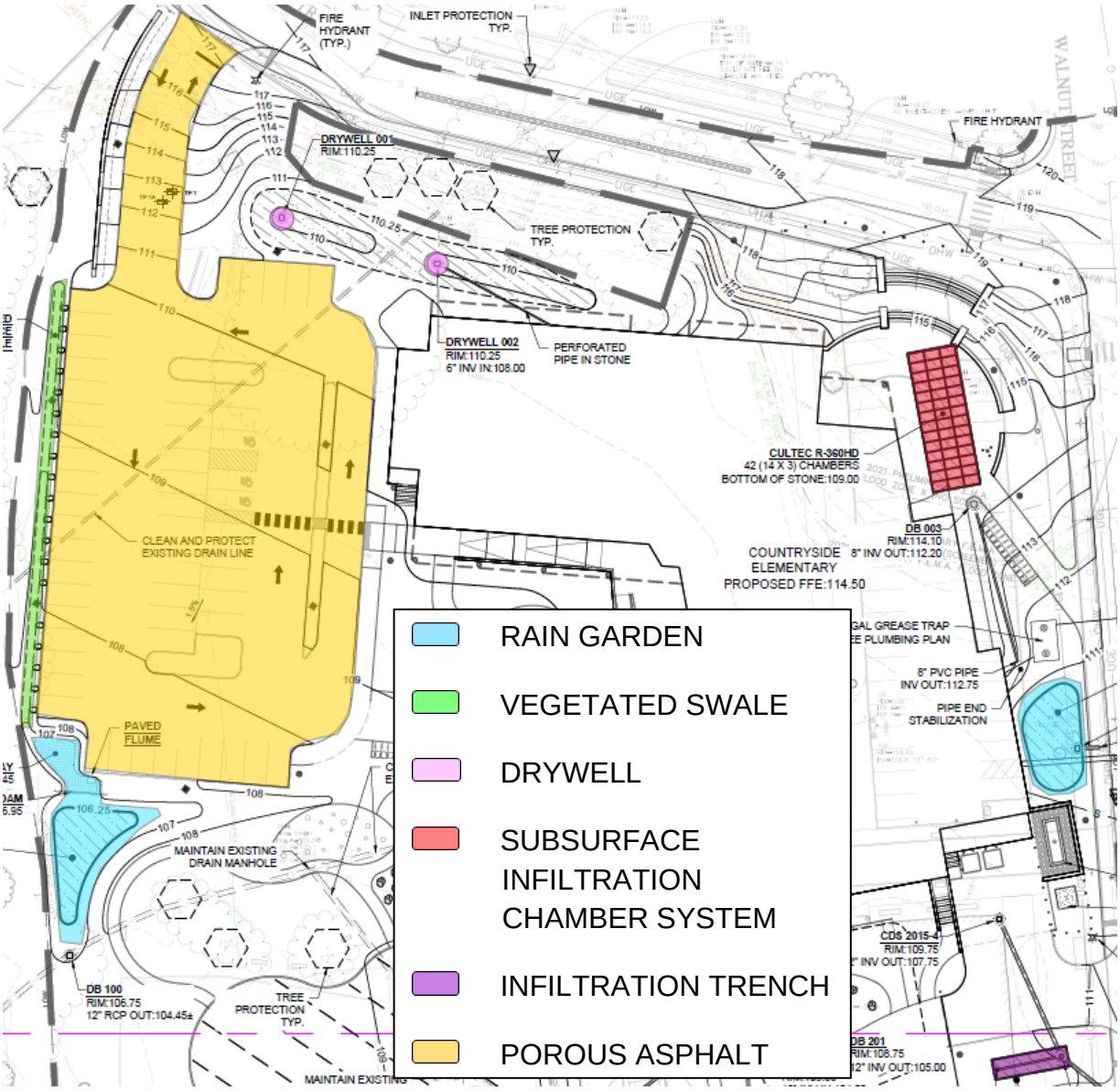


Figure 1. Green Infrastructure & Drainage System

3.0 FUNCTION & MAINTENANCE / INSPECTION SCHEDULE AND TASKS

How Does Green Infrastructure Work?

Green Stormwater Infrastructure (GSI) is a nature-based approach to stormwater treatment and management. These stormwater practices or “treatment areas” are designed to mimic nature and use the natural filtration properties of soil and plants to remove pollutants from stormwater runoff prior to discharging to the municipal drainage system or waterbodies.

GSI relies on the following basic steps to function properly. Structural components of the practices facilitate the functioning of the steps. If one of these steps, or components, does not work properly, the entire system can be compromised and the GSI practice itself could be contributing to maintenance problems. This can lead to landscape nuisances, more frequent maintenance, and costly repairs/improvement.

The steps are:

1. **Collect stormwater (Inlets)**.
2. **Move water (Conveyance)** may come before or after capturing sediment.
3. **Capture sediment (Pretreatment)**.
4. **Treat and Manage (Filter, Infiltrate or Store)**.
5. **Overflow (Structures and Spillways)**.

What is required for Maintenance?

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

General maintenance includes the following:

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

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

- **Early Spring:** during spring cleanup
- **Summer:** during lawn mowing and other routine site maintenance
- **Early Fall:** when leaves begin to fall.
- **Late Fall/Early Winter:** after all the leaves have fallen during leaf removal.

- **After major storm events**: 2” of rain or greater.

The following sections describe the general function and maintenance of each of the practices. A specific O&M checklist that Maintenance Staff will use during inspections is included in **Sections 3.2, 3.3,** and **3.4** and a plan showing the location of the items to be inspected and maintained is included as **Attachment C**.

3.1 DRAINAGE CONVEYANCE STRUCTURES (Inflow/Outflow)

- Area Drains
- Catch Basins
- Drain Manholes
- Drainage Pipes
- Hydrodynamic Separators
- Overflow Structures
- Paved Flumes
- Roof Drains/Down Spouts
- Trench Drains
- Underdrains

All drainage conveyance structures should be inspected quarterly and after major storm events to monitor for proper operation, collection of solids, litter and/or trash, and structural deterioration. These structures will be cleaned when trash or sediment is visible and repaired when required.

Area Drains and Catch Basins: Area drains and catch basins will be inspected quarterly and after major storm events to monitor for proper operation, collection of solids, litter and/or trash, and structural deterioration. These structures should be cleaned annually, or when the depth of sediment exceeds one half the depth from the bottom of the invert and repaired when required. Sediment within catch basins will be removed by a clam shell or vacuum truck, not by flushing. Collected sediment will be disposed of properly in a pre-approved off-site location. Sediment in area drains will be removed by a vacuum truck.

Hydrodynamic Separators: Maintenance of proprietary separators shall be performed according to the recommendations set by the manufacturer, included in **Attachment A**. Contech CDS 2015-4 is the model of the hydrodynamic separator used on-site, located within the loading dock area as shown on the attached plan. Hydrodynamic separators should be inspected post-construction, prior to being put into service. A general inspection of the separator will be conducted four times annually. Maintenance will be conducted annually and consists of the following:

- Remove sediment and oil per the manufacturer's recommendations.
- Inspect separators immediately after any oil, fuel, or chemical spill. A licensed waste management company shall remove captured petroleum waste products from any oil, fuel, or chemical spills and dispose of them properly.
- Follow OSHA confined space entry protocols if entry to a unit is required.

Operation and Maintenance Log

See Site Plan - Attachment C

Structure	Date Inspected	Maintenance Required? (Y/N)	Date Maintenance Performed
1. Inlet Flume			
2. Overflow Structure			
3. Drain Manhole			
4. Drain Manhole			
5. Trench Drain			
6. Drain Manhole			
7. Drain Manhole			
8. Drain Manhole			
9. Catch Basin			
10. Catch Basin			
11. Overflow Structure			
12. Water Quality Unit			
13. Cleanout			
14. Drain Manhole			
15. Drain Manhole			
16. Outfall – South Meadow Brook			
17. Outfall – South Meadow Brook			

3.2 RAIN GARDEN

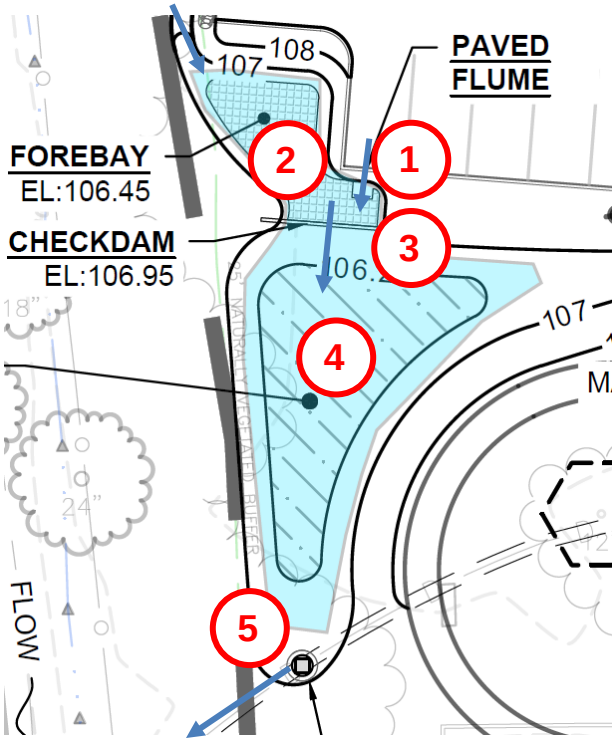


Figure 2. Stormwater Pollinator Garden

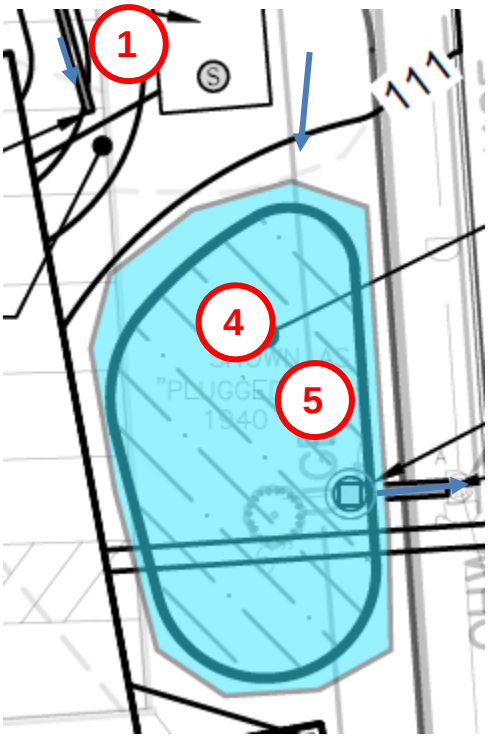


Figure 3. Rain Garden

FUNCTION:

1. COLLECT – Paved Flumes, Drainage Network, and Surface Flow

   Surface runoff from the parking lot is directed to an inlet structure where stormwater enters the stormwater management areas. Stormwater runoff is collected through the drainage network (See Section 3.1). Stormwater surface flows from upgradient areas.

2. CAPTURE SEDIMENT – Sediment Forebay

   Sand and debris settle out within sediment forebays.

3. MOVE WATER – Check Dam Weir

   The stormwater discharges directly to the stormwater management area via a check dam weir.

4. TREAT AND MANAGE – Rain Garden

   Stormwater overtops the forebay check dam and flows through the planted areas. Plants slow the water down, and the soil media and plant roots filter the runoff, removing nutrients and bacteria. The treated water then infiltrates into the soil below or overflows as described below.

5. OVERFLOW – Overflow Structure

During larger rain events, the water level will rise and overflow into the overflow structure will direct excess runoff out of the stormwater management areas.

POLLINATOR GARDEN AND RAIN GARDEN – MAINTENANCE CHECKLIST

Date: **Time:**

Inspected by:

Maintenance Item	Description	Maintenance (Y/N)
1. COLLECT **Includes:** Flume inlet, Trench drain **Frequency:** Inspect four times per year during regular site maintenance and after major storm events (2" of rain or greater) **When:** March, June, September, and November		
Inlet & Trench Drain	Remove all leaf litter and sediment. Check for evidence of frequent overflow or bypass of the inlet.	
Actions to be taken:		
2. CAPTURE SEDIMENT **Includes:** Sediment Forebay **Frequency:** Inspect bi-annually and after major storm events the first year; then annually and after major storm events (2" of rain or greater) **When:** March and November		
Debris Cleanout	Remove all trash and debris from the inlet swale/forebay.	
Forebay Side Slopes	Signs of erosion gullies, animal burrowing, overtopping, or slumping are observed. Repair, as necessary.	
Sediment/Organic Debris Removal	Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches or you cannot see stones. Maintain pervious paver bottom.	
Actions to be taken:		

Maintenance Item	Description	Maintenance (Y/N)
3. MOVE WATER **Includes:** Check dam weir **Frequency:** Inspect bi-annually and after major storm events the first year; then annually and after major storm events (2" of rain or greater) **When:** March and November		
Sediment/Organic Debris Removal	Remove leaf litter, trash, and debris from the surface.	
Erosion	Check for signs of bypassing, erosion, or gullies in the check dam weir or along the sidewalls. Repair, as necessary.	
Actions to be taken:		
4. TREAT AND MANAGE **Includes:** Rain Garden **Frequency:** Inspect four times per year during regular maintenance and after major storm events (2" of rain or greater) **When:** March, June, September, November		
Debris removal	Remove trash and debris from rain garden area. Remove any fallen branches that prevent free flow water movement between cells.	
Erosion	Check for areas of erosion/ gullies, particularly along the side slopes. Repair/reseed/replant as necessary to maintain slope stabilization.	
Vegetation Maintenance	See Landscape Maintenance	
Standing Water	If standing water is observed in the rain garden 48 hours after a storm event, the top 6 inches of the soil/mulch area shall be roto-tilled or cultivated to break up any hard packed sediment and replenished with mulch and replanted. Replant with species as shown on Construction Plans.	
5. OVERFLOW **Includes:** Overflow Structure **Frequency:** Inspect biannually and after major storm events (2" of rain or greater) **When:** March, November		
Water Level	Water level should be below the overflow structure.	
Sediment/Organic Debris Removal	Remove leaf litter, trash, and debris from the inside of overflow structure and surface or overflow	

Maintenance Item	Description	Maintenance (Y/N)
Actions to be taken:		
Other Routine Grounds Maintenance **Includes:** Surrounding landscape beyond the practice. **Frequency:** Inspect four times per year during regular site maintenance and after major storm events **When:** March, June, September, and November		
Pavement Sweeping	Sweep parking lot minimum once a year after spring thaw.	
Debris Removal	Remove, leaf litter, trash, and debris from the surrounding areas.	
Contributing drainage area	Look for sediment sources from erosion in the surrounding area.	
Drainage Network	Maintain the surrounding drainage network to prevent additional runoff being directed to the wetland.	
Actions to be taken:		

3.3 VEGETATED SWALE

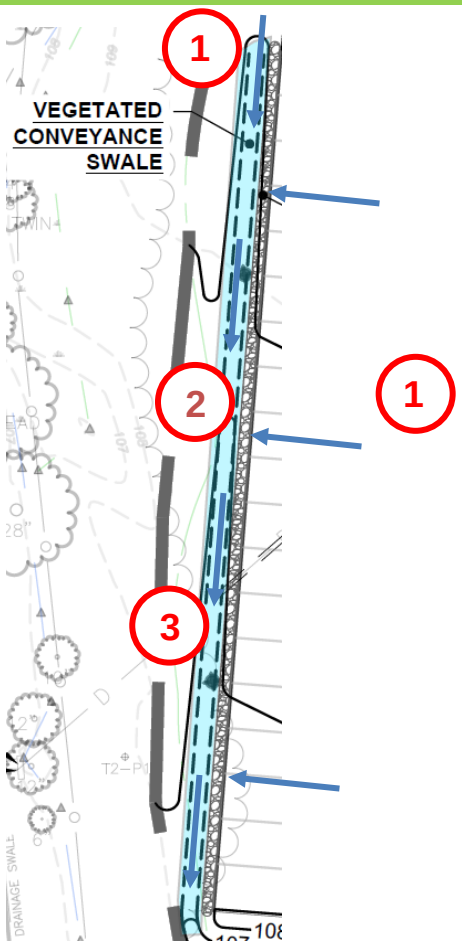


Figure 4. Vegetated Swale

FUNCTION:

1. COLLECT – Surface Flow
   Stormwater runoff surface flows from upgradient areas.
2. CAPTURE SEDIMENT –Vegetation
   The vegetation in the swale slows down the stormwater allowing more sediment to be removed prior to reaching the downgradient stormwater practice.
3. MOVE WATER – Swale
   The swale conveys stormwater to downgradient stormwater practice.
4. TREAT AND MANAGE – NONE
   Stormwater is conveyed to a rain garden where treatment will occur.
5. OVERFLOW – NONE
   Stormwater is conveyed to a rain garden where treatment will occur.

VEGETATED SWALE – MAINTENANCE CHECKLIST

Date: **Time:**

Inspected by:

Maintenance Item	Description	Maintenance (Y/N)
1. COLLECT **None**		
2. CAPTURE SEDIMENT **None:** Vegetation **Frequency:** Inspect biannually and after major storm events (2" of rain or greater) **When:** March, November		
Sediment Buildup	Remove sediment from bottom of swale. Repair stone filter strip as needed.	
Actions to be taken:		
3. MOVE WATER **Includes:** Swale **Frequency:** Inspect monthly and after major storm events in the first year; then bi-annually and after major storm events (2" of rain or greater) **When:** March, June, September, and November		
Erosion	Inspect swales to make sure vegetation is adequate and slopes are not eroding. Check for rilling and gullying. Repair eroded areas and revegetate.	
Mowing	Mow grass in swale during regular site maintenance or as needed.	
Actions to be taken:		
4. TREAT AND MANAGE **None**		
5. OVERFLOW **None**		

Maintenance Item	Description	Maintenance (Y/N)
Other Routine Grounds Maintenance **Includes:** Surrounding landscape beyond the practice. **Frequency:** Inspect four times per year during regular site maintenance and after major storm events **When:** March, June, September, and November.		
Contributing drainage area	Look for sediment sources from erosion in the surrounding area.	
Actions to be taken:		

3.4 DRYWELL

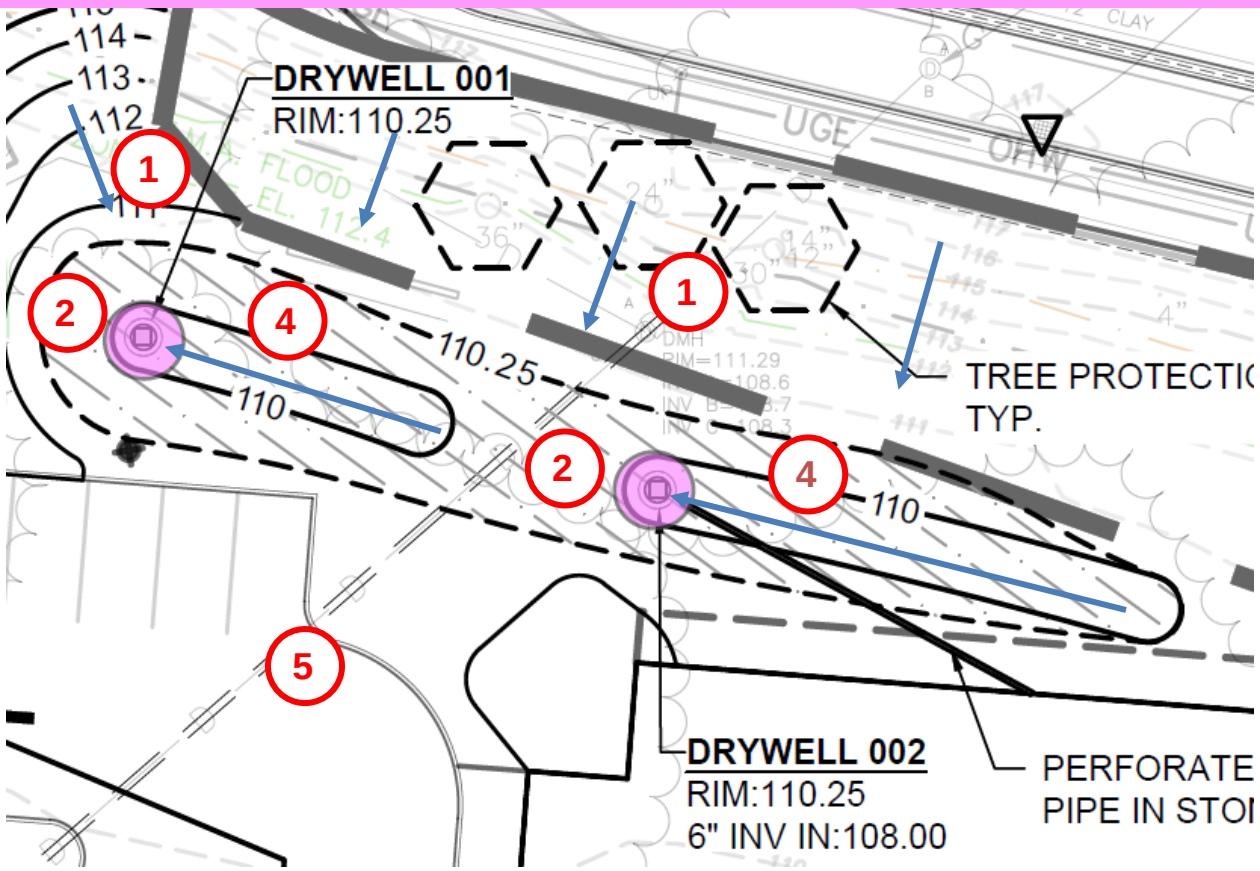


Figure 5. Drywell

FUNCTION:

1. COLLECT – Surface Flow
   . Stormwater runoff surface flows from upgradient areas.
2. CAPTURE SEDIMENT – NONE
   The drywells collect runoff from uncontaminated areas such as sidewalks, lawn, and rooftop. Sediment capture is not provided or needed.
3. MOVE WATER – NONE
   Stormwater is not conveyed to another practice by the drywells.
4. TREAT AND MANAGE – Perforated Drywell Structure
   Stormwater is stored in the drywell structure and infiltrates into the ground through the perforations.
5. OVERFLOW – Parking lot
   Stormwater overflows to the adjacent porous pavement parking lot.

DRYWELL – MAINTENANCE CHECKLIST

Date: **Time:**

Inspected by:

Maintenance Item	Description	Maintenance (Y/N)
1. COLLECT **Includes:** Drainage Network **Frequency:** Inspect biannually and after major storm events (2" of rain or greater) **When:** March, November		
All	See Section 3.1 Drainage Conveyance Structures	
Erosion	Check for signs of erosion and sediment buildup at the bottom of and along the slopes of the grassed depression.	
Actions to be taken:		
2. CAPTURE SEDIMENT **None**		
3. MOVE WATER **None**		
4. TREAT AND MANAGE **Includes:** Drywell Structure **Frequency:** Inspect bi-annually and after major storm events the first year; then annually and after major storm events (2" of rain or greater) **When:** March and November		
Sediment/Organic Debris Removal	Remove sediment and debris from grate and bottom of drywell. Refer to manufacturer recommendations (See Attachment A).	
Actions to be taken:		
5. OVERFLOW **None**		

Maintenance Item	Description	Maintenance (Y/N)
Other Routine Grounds Maintenance **Includes:** Surrounding landscape beyond the practice. **Frequency:** Inspect four times per year during regular site maintenance and after major storm events **When:** March, June, September, and November		
Pavement Sweeping	Sweep parking lot minimum once a year after spring thaw.	
Debris Removal	Remove, leaf litter, trash, and debris from the surrounding areas.	
Contributing drainage area	Look for sediment sources from erosion in the surrounding area.	
Drainage Network	Maintain the surrounding drainage network to prevent additional runoff being directed to the wetland.	
Actions to be taken:		

3.5 SUBSURFACE INFILTRATION CHAMBER SYSTEM

Figure 6. Subsurface Infiltration Chamber System

FUNCTION:

1. COLLECT – Roof Drains and Downspouts
   Stormwater runoff is collected by the roof drains and downspouts (See section 3.1).
2. CAPTURE SEDIMENT – NONE
   The subsurface infiltration system collects runoff from the rooftop which is considered an uncontaminated area. Sediment capture is not provided or needed.
3. MOVE WATER – Distributor Pipe
   Stormwater is distributed into the underground chambers via a sloped drainage pipe.
4. TREAT AND MANAGE – Chambers
   Stormwater is stored in the openings of the chambers where if infiltrates into the ground.
5. OVERFLOW – Outlet & Drainage network
   When the water exceeds the design capacity, the chambers overflow to the connected drainage network and out toward the rain garden.

SUBSURFACE INFILTRATION CHAMBER SYSTEM – MAINTENANCE CHECKLIST

Date: **Time:**

Inspected by:

Maintenance Item	Description	Maintenance (Y/N)
1. COLLECT **Includes:** Drainage Network **Frequency:** Inspect biannually and after major storm events (2" of rain or greater) **When:** March, November		
All	See Section 3.1 Drainage Conveyance Structures	
Actions to be taken:		
2. CAPTURE SEDIMENT **None**		
3. MOVE **Includes:** Distributor Pipe/Roof Drain **Frequency:** Inspect bi-annually and after major storm events the first year; then annually and after major storm events (2" of rain or greater) **When:** March and November		
Sediment/Organic Debris Removal	If ponding water of material is observed use a high-pressure jet spray and vacuum truck to remove the sediment that may be clogging the system. Ensure excess sediment doesn't wash into chambers or into drainage network.	
Actions to be taken:		
4. TREAT AND MANAGE **Includes:** Chambers **Frequency:** Inspect bi-annually and after major storm events the first year; then annually and after major storm events (2" of rain or greater) **When:** March and November		

Maintenance Item	Description	Maintenance (Y/N)
Debris, trash and sediment	Remove all trash and debris from structures and inlets. Sediments are best removed mechanically rather than flushing. If flushing is the only option, then great care must be taken not to flush sediments downstream into the receiving waters. Collected sediment will be disposed of properly in a pre-approved off-site location.	
Chambers	Refer to manufacturer maintenance recommendations. See Attachment B.	
Actions to be taken:		
5. OVERFLOW **Includes:** Structure and Drainage Network **Frequency:** Inspect bi-annually and after major storm events the first year; then annually and after major storm events (2" of rain or greater) **When:** March and November		
Outlet	Remove all leaf litter and clogging. Check for evidence of frequent overflows.	
Actions to be taken:		
Other Routine Grounds Maintenance **Includes:** Surrounding landscape beyond the practice. **Frequency:** Inspect four times per year during regular site maintenance and after major storm events **When:** March, June, September, and November		
Pavement Sweeping	Sweep parking lot minimum once a year after spring thaw.	
Debris Removal	Remove, leaf litter, trash, and debris from the surrounding areas.	
Contributing drainage area	Look for sediment sources from erosion in the surrounding area.	
Drainage Network	Maintain the surrounding drainage network to prevent additional runoff being directed to the wetland.	
Actions to be taken:		

3.6 INFILTRATION TRENCH

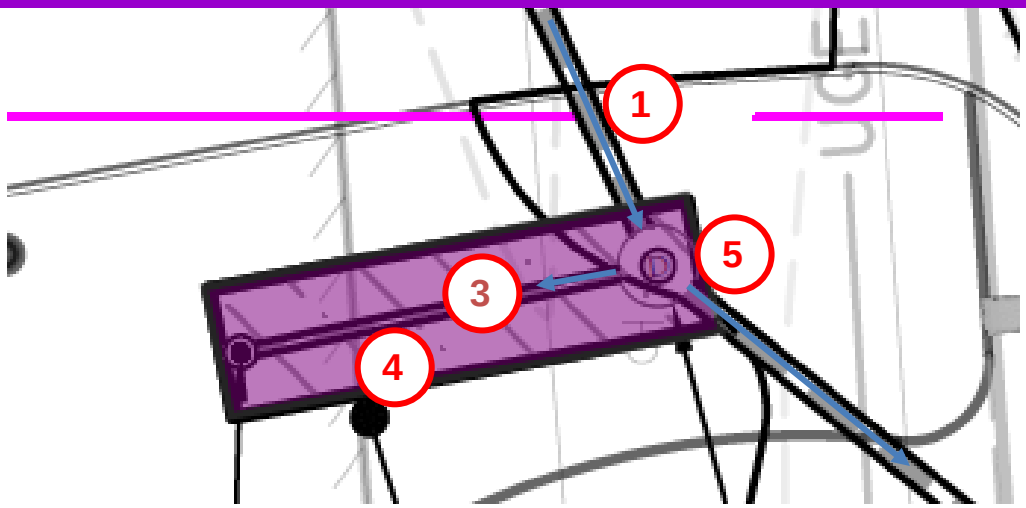


Figure 7. Infiltration Trench

FUNCTION:

1. COLLECT – Drainage Network
   Stormwater runoff is collected through the drainage network (See section 3.1).
2. CAPTURE SEDIMENT – NONE
   Sediment is captured by the CDS unit before stormwater is piped to the infiltration trench (see section 3.1).
3. MOVE WATER – Underdrains
   Stormwater is distributed via the underdrain.
4. TREAT AND MANAGE – Stone Reservoir
   Stormwater moves from the underdrain into the surrounding stone reservoir where it can be infiltrated into the ground and absorbed by adjacent vegetation.
5. OVERFLOW – Downspout Outlet
   When the water exceeds the design capacity (water quality volume), the underdrain pipe is full, and excess water overflows through a drain manhole to the municipal stormwater system.

INFILTRATION TRENCH – MAINTENANCE CHECKLIST

Date: **Time:**

Inspected by:

Maintenance Item	Description	Maintenance (Y/N)
1. COLLECT **Includes:** Drainage Network **Frequency:** Inspect biannually and after major storm events (2" of rain or greater) **When:** March, November		
All	See Section 3.1 Drainage Conveyance Structures	
Erosion	Check for signs of erosion and sediment buildup at the bottom of and along the slopes of the grassed depression.	
2. CAPTURE **None**		
3. MOVE **Includes:** Underdrain **Frequency:** Visually inspect via cleanouts four times per years during regular park maintenance and after major storm events (2" of rain or greater) **When:** March, June, September and November		
Sediment/Organic Debris Removal	If ponding water of material is observed use a high-pressure jet spray and vacuum truck to remove the sediment that may be clogging the system.	
Actions to be taken:		
4. STORE AND FILTER **Includes:** Stone reservoir **Frequency:** Visually inspect for standing water on the surface four times per year during regular maintenance and after major storm events (2" of rain or greater) **When:** March, June, September, November		
Plant Care	Monitor health of plants – see landscape maintenance. If a plant/shrub becomes severely diseased or damaged, remove and replace it with one of a similar type	

Standing Water	If standing water is observed on the surface of the infiltration trench, inspect and clean cleanout (see 4. Move). If significant standing water remains in the trenches, the trenches may need to be excavated and the stone replaced.	
5. OVERFLOW **Includes:** Drain Manhole **Frequency:** Inspect biannually and after major storm events (2" of rain or greater) **When:** March, November		
Outlet	Remove all leaf litter and clogging. Check for evidence of frequent overflows.	
Actions to be taken:		
Other Routine Grounds Maintenance **Includes:** Surrounding landscape beyond the practice. **Frequency:** Inspect four times per year during regular park maintenance and after major storm events **When:** March, June, September and November.		
Debris Removal	Remove, leaf litter, trash and debris from root gutters and the surrounding areas.	
Contributing drainage area	Look for sediment sources from erosion in the surrounding area.	
Actions to be taken:		

3.7 POROUS ASPHALT

Figure 8: Porous Asphalt Parking Lot

Cleaning of the porous asphalt is critical to prevent clogging and to ensure the permeability of the surface. Clean the asphalt each spring with a vacuum sweeping machine. Inspect the asphalt annually for surface deterioration. When plowing, set blade a minimum of one inch above the ground surface to avoid damaging the asphalt. Winter sanding should be avoided and salt use should be minimized. No construction staging or soil/mulch storage should occur on unprotected porous asphalt. Planted areas adjacent to the porous asphalt should be well maintained to prevent transport of soil onto the permeable surfaces.

The surface should never be seal-coated. Permeable areas requiring repairs should be replaced with the same asphalt mix as originally used. Porous asphalt should be installed as shown in the Construction Plans.

Porous Asphalt Maintenance Schedule		
Permeable Materials		
Task	**Frequency**	**Time of Year**
Vacuuming	Annually	April
Inspect Surface Damage	Annually	April
Routine Maintenance		
Task	**Frequency**	**Time of Year**
Debris Removal	Min. once annually	April
Inspect Drainage Function	Annually	April

4.0 LANDSCAPE MAINTENANCE

The green infrastructure and surrounding site are designed to create a welcoming comfortable environment for staff and students while treating stormwater runoff.

Lawn/Landscaping Maintenance

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

Leaves and grass clipping are a nutrient pollutant and high in phosphorus. Avoid blowing leaves and lawn clippings into the forebay and wetland cells.

MOWED AREAS

Landscape maintenance of mowed areas includes the following:

SEED

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

MOWING

Mowing can be done once a week with a mulching mower or every other week during summer months. DO NOT bag grass clippings and dispose of them on site. Maintain a cutting height of 2 ½" to 3 ½". Leave the grass taller during hot, summer months, and cut shorter during cooler periods of the growing season. Trim edges when necessary.

FERTILIZING

No fertilizing shall be used on the lawn area.

WEEDING

Weeding should be limited to invasive and exotic species. Non-chemical methods (hand pulling and hoeing) are required; chemical herbicides are not allowed.

Carefully remove and dispose offsite all invasive species as to prevent colonization elsewhere, this includes disposal on land beyond the project area.

DEBRIS & TRASH

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

LOW MOW AREAS

Landscape maintenance of low mow areas includes the west side of the parking lot, the south side of the walking path from Andrew Street and the west side of the athletic field.

SEED

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

MOWING/WEED WHACKING

Mow the edge along the walkways a minimum of four times per year. The edge should be mowed or weed whacked no more than 4 times per growing season, 2 times is preferred. Do NOT cut area lower than 4". Depending on height of grasses and the time of year, grass cuttings/stalks may need to be raked and removed from site.

WATERING

Allowing the low mow areas to "brown" is desired. Water only during drought conditions or during reseeding establishment period.

FERTILIZING

No fertilizing shall be used.

WEEDING

Weeding should be limited to invasive and exotic species. Non-chemical methods (hand pulling and hoeing) are required; chemical herbicides should be avoided.

MONITORING

During the establishment period, walk the low mow areas monthly without the intent to mow, but to look for invasive species, bare spots and identify potential pest or disease problems. Carefully remove and dispose all invasive species as to prevent colonization elsewhere, this includes disposal on land beyond the project area.

DEBRIS & TRASH

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

NO MOW AREAS

Landscape maintenance of no mow areas includes the wetland resource areas, the pollinator garden, and the rain garden.

SEED

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

MOWING/WEED WHACKING

Do not mow or weed whack this area.

WATERING

Water only during drought conditions or during reseeding / plant establishment period.

FERTILIZING

No fertilizing shall be used.

WEEDING

Weeding should be limited to invasive and exotic species. Non-chemical methods (hand pulling and hoeing) are required; chemical herbicides should be avoided.

MONITORING

During the establishment period, walk the no mow areas monthly to look for invasive species, bare spots and identify potential pest or disease problems. Carefully remove and dispose all invasive species as to prevent colonization elsewhere, this includes disposal on land beyond the project area.

DEBRIS & TRASH

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

Yellow Toadflax *(Linaris vulgaris)*

Redroot Pigweed- (*Amaranthus retroflexus)*

Smartweed *(Polygonum lapathifolium)*

Dandelion *(Taraxacum officinale)*

Fireweed *(Erechtites hieracifolia)*

Spotted Spurge (Euphorbia maculata)

Catalpa Tree Seedling (Catalpa speciosa)

Crabgrass *(Digitaria ischaemum)*

Green Foxtail (Setaria viridis)

Norway Maple Tree Seedling (Acer platanoides)

Ragweed (*Ambrosia artemisiifolia*)

Japanese Knotweed (Polygonum cuspidatum)

INVASIVE SPECIES MANAGEMENT

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

Methods for the management of invasive species fall into three basic categories:

- Physical/Mechanical (cutting, pulling, grubbing, covering, etc.);
- Chemical (use of herbicides); and
- Biological (using living organisms such as insects or domestic grazing animals).

In general, mechanical controls, such as cutting or pulling, have the least adverse impacts on the adjacent, native communities; however, mechanical methods are often not as effective in the control of certain plant species. When warranted and appropriate, chemical controls (through the use of herbicides) are most effective through modest, precisely targeted applications of specific herbicides. Selective application of herbicides also functions to reduce adverse effects on desirable native species from herbicide use. While not applicable for the Reading site, biological control, or use of living organisms as a control agent, has also been proven effective on certain species. Upon effective removal or control of invasive species, native plant species are then planted and/or promoted (via existing native populations and seed banks) in order to restore a native plant community, which provides a number of ecological benefits, and serves as the primary factor for limiting invasive plant establishment and spread in the future. With establishment of a robust and diverse native plant community, the system becomes more resilient to potential future invasions, and only minor ongoing invasive plant management efforts/interventions are required to maintain the long-term ecological integrity of the site.

Invasive Species at this Site

Several invasive species have been identified at this site including trees, shrubs, and herbaceous species. Most abundant is the highly aggressive Japanese knotweed (*Fallopia* japonica), which is concentrated in dense stands adjacent to the open/mown and woodland areas at the southwestern section of the site. With an adaptive invasive plant management plan the site will continue to be monitored for the presence of any existing or newly arriving Massachusetts State-listed invasive species. Any newly identified invasive species will be documented and added to the targeted management list. Currently, the below species have been identified and targeted for management at this site:

Species of Primary Concern (abundant occurrence)

- Japanese Knotweed (*Fallopia japonica*);

Species of Secondary Concern (sporadic occurrence)

- Black Locust (*Robinia pseudoacacia*);
- Norway Maple (*Acer platanoides*);
- Common Buckthorn (*Rhamnus cathartica*);
- Grey Willow (*Salix cinerea*);
- Amur Corktree (*Phellodendron amurense*);
- Multiflora Rose (*Rosa multiflora*);
- Japanese Barberry (*berberis thunbergii*);
- Burning Bush (*Euonymus alatus*);
- Shrub Honeysuckle (*Lonicera spp.*);
- Purple Loosestrife (*Lythrum salicaria*);
- Asiatic Bittersweet (*Celastrus orbiculatus*);
- Garlic Mustard (*Allaria petiolate*);

A discussion of each species, recommended management practices, and a preferred management method for each of these species that is specific to the existing conditions at this site follows. Additional details are provided in the notes on the site plans.

Recommended Management Approach for Species of Primary Concern

Japanese Knotweed (*Fallopia japonica*)

Japanese knotweed is an upright, herbaceous, shrub-like perennial native to eastern Asia. Its stems are hollow, smooth, and swollen at the joints. The alternate leaves are broad and oval, triangular, or heart-shaped with a pointed tip and may become six inches long and three to four inches wide. It has greenish white flowers and can spread by seed as well as via rhizomes, runners, and stems (vegetative growth). Damaged stem segments are able to re-grow if the buds at the nodes are viable. Once a population of knotweed becomes established, it spreads primarily by growth along its large rhizomes, which can become up to 30 feet long. Japanese knotweed flowers in August and September, with seeds emerging two weeks following flowering. Japanese knotweed requires high amounts of sunlight and normally does not establish within forest understory.

Physical/Mechanical Control

Removal of early growth is recommended early in the growing season (late-April to mid-May), where new growth of knotweed canes will be flush cut to the ground and all cut vegetation is bagged, removed from the site, and disposed of at an appropriate facility. At this time, older, dead growth of Japanese knotweed should also be removed, bagged, and disposed of similarly to allow for growth of understory to continue with fewer impediments. Cutting is repeated later in the growing season (mid-July to mid-August), and cut growth is again disposed of in a similar manner. Once regrowth of Japanese knotweed develops leaves, during this final (third) flush, it may be effectively treated with herbicides (see ‘Chemical Control’ below).

Chemical Control

For the best control results, systemic herbicide treatments should be performed in the fall when plants are translocating nutrients to the rhizomes.

Foliar treatments can be applied to established stands and/or individual plants but is most effective if stalks are first cut to ground level and the regrowth is sprayed with a solution of glyphosate (or triclopyr) and water. Foliar treatments with glyphosate or triclopyr formulations should be applied as directed by the label of the specific product used (typically 2-5% concentration by volume, mixed with water and a small amount of non-ionic surfactant).

To reduce the risk to non-target species, use *cut-stem treatments* rather than foliar sprays. Cut stalks about 2 inches above ground level and immediately apply a solution of glyphosate (or triclopyr) and water to the cut. A follow-up foliar spray may be needed to control resprouts. Additionally, in areas where knotweed is in close proximity to non-target desirable (native) vegetation, foliar and stem application of the herbicide solution with the use of a "weed glove" is also an option to avoid herbicide application on non-target plants and to reduce the potential for herbicides within the aquatic environment. Cut-stum treatments with glyphosate or triclopyr formulations should be applied as directed by the label of the specific product used (typically at concentrations ranging from 20-100%, mixed with water).

Maintenance and Monitoring

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

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

Maintenance Plan

Annual maintenance includes monitoring the area and applying recommended treatments as necessary to prevent re-growth. The recommended best practice for invasive plant maintenance, after initial treatments are completed, is to perform follow-up treatments at least two times per year (late-June & late-September are generally recommended) for three to five

years after the initial treatments. The exact timing and number of each year's visits and number of years of follow-up maintenance needed to achieve adequate control of the invasive plants is subject to a number of site-specific variables (existing invasive seed bank, effectiveness of initial treatments, etc.) which can be difficult to predict in advance. For the best long-term results, the maintenance phase should be approached in an adaptive manner and utilize site condition feedback from monitoring visits to inform and develop the scope and strategy for each year's maintenance work. Note that the maintenance phase should generally be viewed as an ongoing process, even after successful control has been achieved after a 3–5-year effort, but that the time and cost requirements typically follow a descending trajectory until a modest, minimum annual (or biannual) "bench/floor" level is reached.

Monitoring Plan

Following the implementation of invasive species management and the introduction of native plant species, HW recommends that the site be monitored for a minimum of three growing seasons to ensure successful restoration of the river corridor and buffer areas. Monitoring should occur at least twice annually (approximately mid-June and mid-September) to assess the relative success of the restored areas. Semi-annual site inspections conducted during late spring and late summer will include an evaluation of the relative health and vigor of the planted vegetation, overall percent of vegetation cover, extent of invasive species regrowth if any, and general compliance with overall restoration plan goals. Additional measures should be taken during construction and monitoring of the restoration area to discourage the invasion of exotic species within the newly disturbed soils. If additional growth of invasive species is encountered, these details will be documented, and recommendations will be provided to the Project Team to facilitate the effectiveness of the adaptive maintenance approach.

5.0 ROUTINE MAINTENANCE

Other routine maintenance should include the following:

- Removal of trash and litter from paved and perimeter areas.
- Pavement Sweeping:
    - Minimum of once per year after the spring thaw.
- Check for erosions problems and sediment source(s) along the GSI practice sidewalls if excessive, frequent sediment accumulation occurs in practice area.
- Check for erosions problems and sediment source(s) in the contributing drainage area if excessive, frequent sediment accumulation occurs at inlet flume of sediment forebay.
- Contributing drainage network
    - Inspect annually for proper operation to ensure excess stormwater is not being directed to the GSI retrofit.
- Pet waste should be picked up and disposed of properly to reduce bacteria levels.

6.0 SNOW REMOVAL

Snow removal from stormwater practices is not necessary. Plowed or shoveled snow piles should not block the inlet to prevent proper drainage during the winter months.

Excessive salting or other de-icing practices should be avoided.

Use of sand should be avoided to avoid obstructing/clogging the conveyance system. Sand should not be used on the permeable pavement parking lot.

7.0 LONG-TERM POLLUTION PREVENTION PLAN

Long-term pollution prevention measures implemented at each project site will further reduce pollutants in stormwater discharges after construction. The following practices will be employed on an on-going basis.

Spill Prevention and Control Measures

To minimize the risk of spills or other accidental exposure of materials and substances to stormwater runoff, the following material management practices will be used throughout the project:

- An effort will be made to store only enough products required for operation and maintenance of the facility.
- All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.
- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.

- Whenever possible, the maximum amount of a product will be used before disposing of a container.
- Manufacturers' recommendations for proper use and disposal will be followed.
- The site superintendent will be issued the O&M to ensure the proper use and disposal of materials.

To reduce the risk associated with hazardous materials used on the site, the following practices will be used:

- Products will be kept in original containers unless they are not resealable.
- Original labels and material safety data sheets will be retained and kept on-site; they contain important product information.
- If surplus product must be disposed of, manufacturers' or local and state recommended methods for proper disposal will be followed.

Materials or substances listed below may be present on-site for operation and maintenance:

- Materials List:
    - Concrete
    - Fertilizers
    - Asphalt
    - Petroleum Based Products
    - Paints (enamel and latex)
    - Cleaning Solvents
    - Wood
    - Tar
    - Adhesives
    - Sealant

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

- Petroleum Products – All on-site vehicles will be monitored for leaks and receive preventative maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers which are clearly labeled. Any asphalt substances used on-site will be applied according to the manufacturers' recommendations.

- Fertilizers – Fertilizers shall be slow release, low-nitrogen types (<5%) and phosphorus free. Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to stormwater. Products will be stored in a covered shed. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.

- Paints – All containers will be tightly sealed and stored indoors when not required for use. Excess paint will not be discharged to the storm and/or sewer system but will be properly disposed of according to the manufacturer's instructions or state and local regulations.

- Concrete Trucks – Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum was water on the site.

Lawn/ Landscaping Maintenance
Lawn and landscaping maintenance will be conducted with minimal use of fertilizers and pesticides to protect the water resources. Fertilizers utilized for landscaping and lawn care shall be slow release, low-nitrogen (<5%) and phosphorus free. Fertilizer will be applied a maximum of three times during the growing season, and pesticides will be applied sparingly, as needed, following the manufacturers' directions for application. Any fertilizer/pesticide that lands on paved surfaces such as sidewalks and/or parking areas will be swept up and removed immediately to prevent it from entering the storm drain network.

Pet Waste Management
Visitors will be encouraged to pick up after their pets with signage along lawn areas.

Solid Waste Management
An enclosed dumpster with a lid will be provided on-site for solid waste management at this site during facility operations.

Snow Management/Removal Plan
Plowed snow collected from the parking area will not be directed to the stormwater management system. Winter road salt and/or sand will not be stored on-site and will be used minimally as necessary for safe driving conditions at the site. Snow storage areas shall be those identified on the Operation and Maintenance figure. If the identified locations are insufficient, snow will be transported to appropriate alternate locations as required.

Pavement Sweeping Schedules
The parking area will be swept annually after spring snowmelt.

Illicit Discharges
No sewer pipes or floor drains will be connected to the drainage network. Any wastewater will be connected to the sanitary sewer.

Personnel Training
All contracted personnel retained for work on site will be given a copy of this Plan and will receive training in applicable practices and implementation to prevent pollutants from entering the storm system.

8.0 ESTIMATED OPERATION AND MAINTENANCE BUDGET

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

Rain Garden (2):	**$1,000** ($500/area)
Sediment Forebay (1):	**$ 500**
Vegetated Swale (1):	**$ 500**
Drywell (2):	**$1,000** ($500/field)
Subsurface Infiltration Chamber System (1):	**$1,000**
Infiltration Trench (1):	**$ 500**
Porous Asphalt (sweeping):	**$1,000**
Catch Basins and Drain Structures (11):	**$2,200** ($200/location)
Other Routine Maintenance: Removal of trash and litter Pipe network/outfall inspections	**$ 500**
Total	**$8,200/yr**

ATTACHMENT A

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.

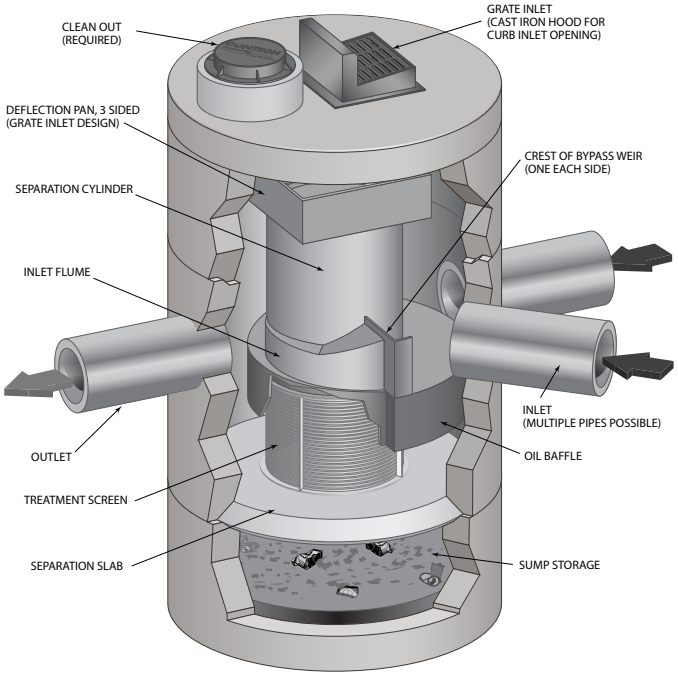
Operation Overview

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.

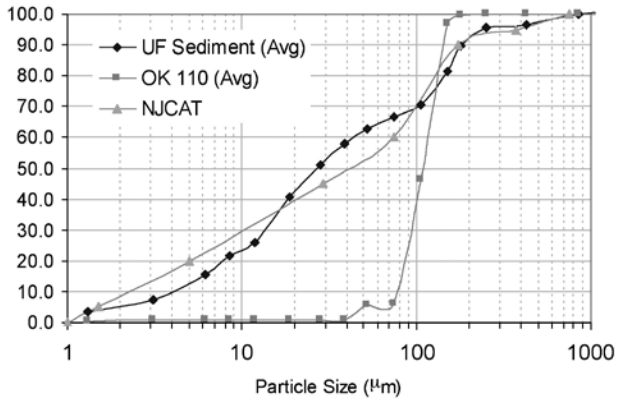


Figure 1. Particle size distributions

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.

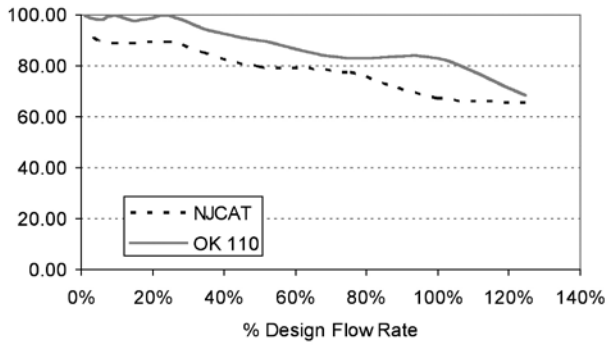


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

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).

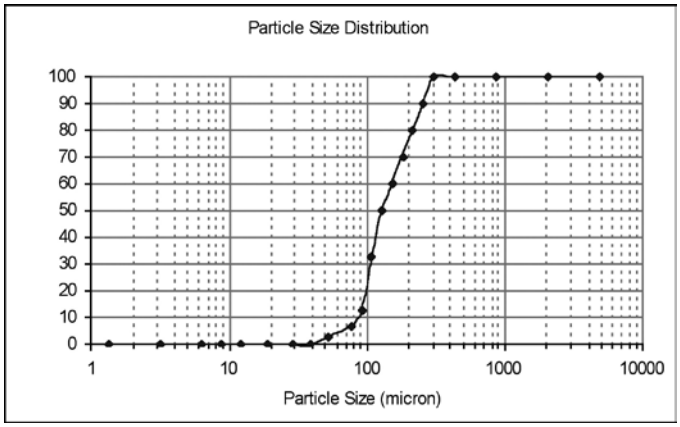


Figure 3. WASDOE PSD

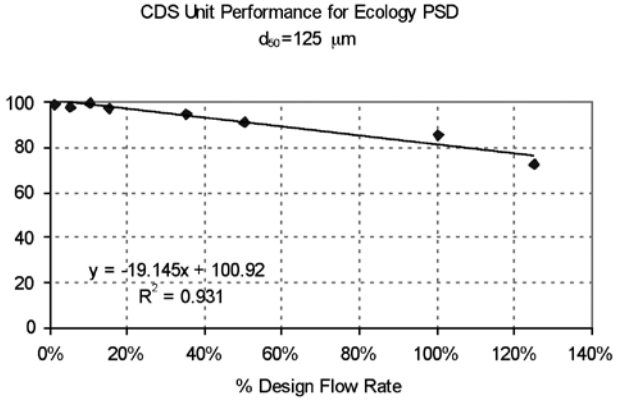


Figure 4. Modeled performance for WASDOE PSD.

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.

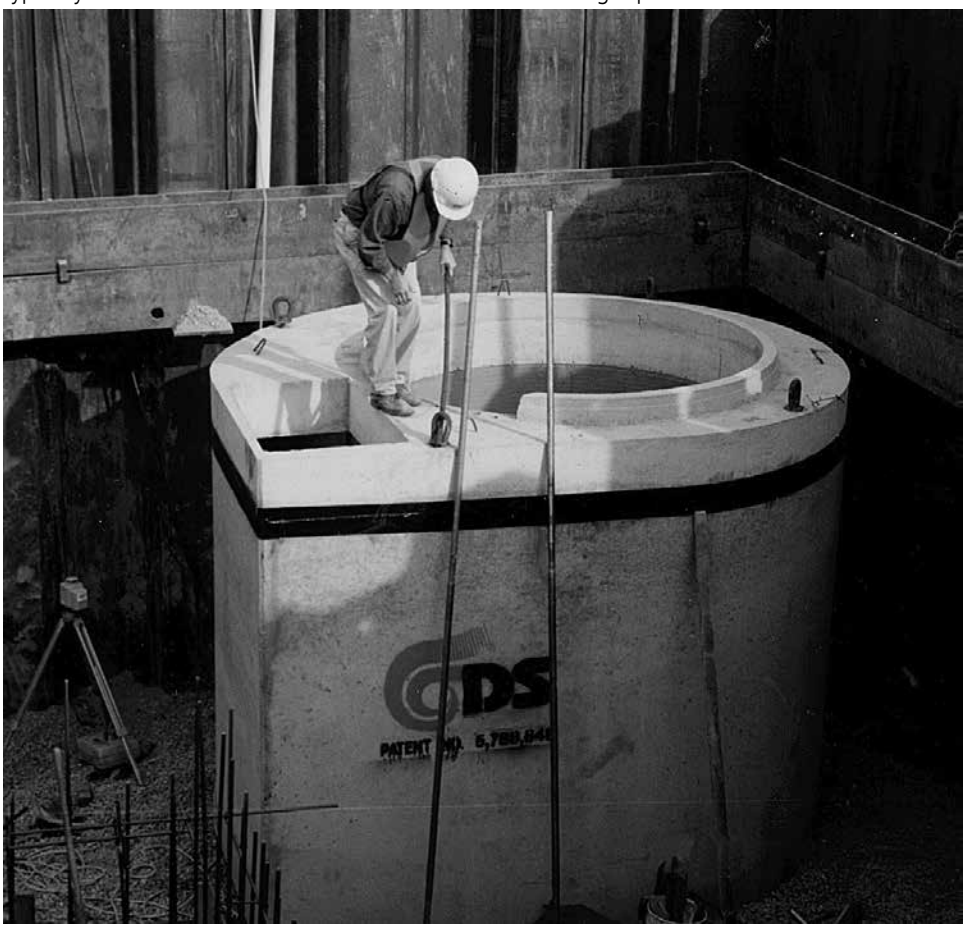
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should 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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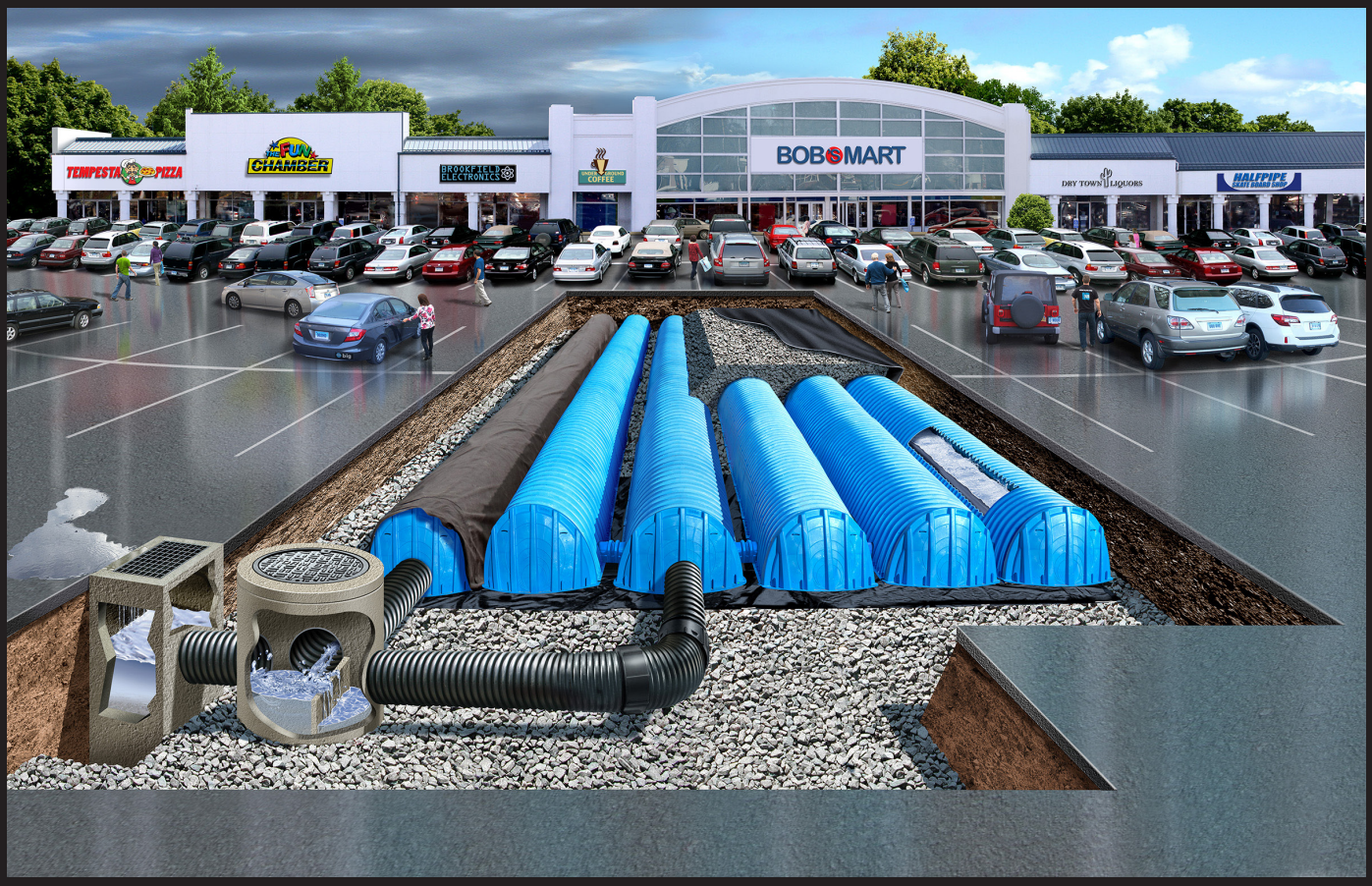
The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

cds_manual 3/17 PDF

ATTACHMENT B

CONTACTOR® & RECHARGER®

STORMWATER MANAGEMENT SOLUTIONS



OPERATION & MAINTENANCE GUIDELINES

FOR CULTEC STORMWATER MANAGEMENT SYSTEMS

CULTEC®

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www.cultec.com

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U.S. Patents 6,129,482; 6,322,288; 6,854,925; 7,226,241; 7,806,627; 8,366,346; 8,425,148; U.S. Designs D613,819; D638,095; D668,318; Canadian Patent 2,450,565; 2,591,255; Canadian Designs 129144; 135983; 159073; 160977; and/or other U.S. or Foreign Patent(s) or Patent(s) Pending.

Contact Information:
For general information on our other products and services, please contact our offices within the United States at (800)428-5832, (203)775-4416 ext. 202, or e-mail us at custservice@cultec.com.

For technical support, please call (203)775-4416 ext. 203 or e-mail tech@cultec.com.

Visit www.cultec.com/downloads.html for Product Downloads and CAD details.

Doc ID: CLT057 01-20
January 2020

These instructions are for single-layer traffic applications only. For multi-layer applications, contact CULTEC.
All illustrations and photos shown herein are examples of typical situations. Be sure to follow the engineer's drawings.
Actual designs may vary.

This manual contains guidelines recommended by CULTEC, Inc. and may be used in conjunction with, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Introduction

The CULTEC Subsurface Stormwater Management System is a high-density polyethylene (HDPE) chamber system arranged in parallel rows surrounded by washed stone. The CULTEC chambers create arch-shaped voids within the washed stone to provide stormwater detention, retention, infiltration, and reclamation. Filter fabric is placed between the native soil and stone interface to prevent the intrusion of fines into the system. In order to minimize the amount of sediment which may enter the CULTEC system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the CULTEC chamber system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with CULTEC chambers. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the CULTEC chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

I. Operation

CULTEC stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. CULTEC subsurface stormwater management chambers operate at peak performance when installed in series with pretreatment. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

II. Inspection and Maintenance Options

A. The CULTEC system may be equipped with an inspection port located on the inlet row. The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the CULTEC Chamber row below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream manhole or through the CULTEC StormFilter Unit (or other pretreatment device). CCTV inspection of this row can be deployed through this access port to deter mine if any sediment has accumulated in the inlet row.

B. If the CULTEC bed is not equipped with an inspection port, then access to the inlet row will be through an upstream manhole or the CULTEC StormFilter.

1. Manhole Access
This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

2. StormFilter Access
Remove the manhole cover to allow access to the unit. Typically a 30-inch (750 mm) pipe is used as a riser from the StormFilter to the surface. As in the case with manhole access, this access point requires a technician trained in confined space entry with proper gas detection equipment. This individual must be equipped with the proper safety equipment for entry into the StormFilter. The technician will be lowered onto the StormFilter unit. The hatch on the unit must be removed. Inside the unit are two filters which may be removed according to StormFilter maintenance guidelines. Once these filters are removed the inspector can enter the StormFilter unit to launch the CCTV camera robot.

C. The inlet row of the CULTEC system is placed on a polyethylene liner to prevent scouring of the washed stone beneath this row. This also facilitates the flushing of this row with high pressure water through a culvert cleaning nozzle. The nozzle is deployed through a manhole or the StormFilter and extended to the end of the row. The water is turned on and the inlet row is back-flushed into the manhole or StormFilter. This water is to be removed from the manhole or StormFilter using a vacuum truck.

III. Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the CULTEC stormwater management system:

A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.

B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.

C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.

D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

IV. Suggested Maintenance Schedules

A. Minor Maintenance
The following suggested schedule shall be followed for routine maintenance during the regular operation of the stormwater system:

Frequency	Action
Monthly in first year	Check inlets and outlets for clogging and remove any debris, as required.
Spring and Fall	Check inlets and outlets for clogging and remove any debris, as required.
One year after commissioning and every third year following	Check inlets and outlets for clogging and remove any debris, as required.

B. Major Maintenance
The following suggested maintenance schedule shall be followed to maintain the performance of the CULTEC stormwater management chambers. Additional work may be necessary due to insufficient performance and other issues that might be found during the inspection of the stormwater management chambers. (See table on next page)

	Frequency	Action
Inlets and Outlets	Every 3 years	• Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
	Spring and Fall	• Check inlet and outlets for clogging and remove any debris as required.
CULTEC Stormwater Chambers	2 years after commissioning	• Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
	9 years after commissioning every 9 years following	• Clean stormwater management chambers and feed connectors of any debris. • Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended.
	45 years after commissioning	• Clean stormwater management chambers and feed connectors of any debris. • Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. • Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique. • Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. • Attain the appropriate approvals as required. • Establish a new operation and maintenance schedule.
Surrounding Site	Monthly in 1st year	• Check for depressions in areas over and surrounding the stormwater management system.
	Spring and Fall	• Check for depressions in areas over and surrounding the stormwater management system.
	Yearly	• Confirm that no unauthorized modifications have been performed to the site.

For additional information concerning the maintenance of CULTEC Subsurface Stormwater Management Chambers, please contact CULTEC, Inc. at 1-800-428-5832.

WQMP
Operation & Maintenance (O&M) Plan

Project Name:_____

Prepared for:

Project Name: _____

Address:_____

City, State Zip:_____

Prepared on:

Date:_____

This O&M Plan describes the designated responsible party for implementation of this WQMP, including: operation and maintenance of all the structural BMP(s), conducting the training/educational program and duties, and any other necessary activities. The O&M Plan includes detailed inspection and maintenance requirements for all structural BMPs, including copies of any maintenance contract agreements, manufacturer's maintenance requirements, permits, etc.

8.1.1 Project Information

Project name	
Address	
City, State Zip	
Site size	
List of structural BMPs, number of each	
Other notes	

8.1.2 Responsible Party

The responsible party for implementation of this WQMP is:

Name of Person or HOA Property Manager	
Address	
City, State Zip	
Phone number	
24-Hour Emergency Contact number	
Email	

8.1.3 Record Keeping

Parties responsible for the O&M plan shall retain records for at least 5 years.

All training and educational activities and BMP operation and maintenance shall be documented to verify compliance with this O&M Plan. A sample Training Log and Inspection and Maintenance Log are included in this document.

8.1.4 Electronic Data Submittal

This document along with the Site Plan and Attachments shall be provided in PDF format. AutoCAD files and/or GIS coordinates of BMPs shall also be submitted to the City.

Appendix ____

BMP SITE PLAN

Site plan is preferred on minimum 11” by 17” colored sheets, as long as legible.

BMP OPERATION & MAINTENANCE LOG

Project Name: _____

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

Minor Maintenance

Frequency		Action
Monthly in first year		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Month 1	Date:	
□ Month 2	Date:	
□ Month 3	Date:	
□ Month 4	Date	
□ Month 5	Date:	
□ Month 6	Date:	
□ Month 7	Date:	
□ Month 8	Date:	
□ Month 9	Date:	
□ Month 10	Date:	
□ Month 11	Date:	
□ Month 12	Date:	
Spring and Fall		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
One year after commissioning and every third year following		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Year 1	Date:	
□ Year 4	Date:	
□ Year 7	Date:	
□ Year 10	Date:	
□ Year 13	Date:	
□ Year 16	Date:	
□ Year 19	Date:	
□ Year 22	Date:	

Major Maintenance

	Frequency		Action
Inlets and Outlets	**Every 3 years**		Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
			Notes
	□ Year 1	Date:	
	□ Year 4	Date:	
	□ Year 7	Date:	
	□ Year 10	Date:	
	□ Year 13	Date:	
	□ Year 16	Date:	
	□ Year 19	Date:	
	□ Year 22	Date:	
	Spring and Fall		Check inlet and outlets for clogging and remove any debris, as required.
			Notes
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
CULTEC Stormwater Chambers	**2 years after commissioning**		□ Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. □ Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
			Notes
	□ Year 2	Date:	

Major Maintenance

	Frequency		Action
CULTEC Stormwater Chambers	**9 years after commissioning every 9 years following**		□ Clean stormwater management chambers and feed connectors of any debris. □ Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. □ Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended.
			Notes
	□ Year 9	Date:	
	□ Year 18	Date:	
	□ Year 27	Date:	
	□ Year 36	Date:	
	45 years after commissioning		□ Clean stormwater management chambers and feed connectors of any debris. □ Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. □ Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique. □ Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. □ Attain the appropriate approvals as required. □ Establish a new operation and maintenance schedule.
			Notes
	□ Year 45	Date:	

Major Maintenance

	Frequency		Action
Surrounding Site	**Monthly in 1st year**		□ Check for depressions in areas over and surrounding the stormwater management system.
			Notes
	□ Month 1	Date:	
	□ Month 2	Date:	
	□ Month 3	Date:	
	□ Month 4	Date:	
	□ Month 5	Date:	
	□ Month 6	Date:	
	□ Month 7	Date:	
	□ Month 8	Date:	
	□ Month 9	Date:	
	□ Month 10	Date:	
	□ Month 11	Date:	
	□ Month 12	Date:	
	Spring and Fall		□ Check for depressions in areas over and surrounding the stormwater management system.
			Notes
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	Yearly		□ Confirm that no unauthorized modifications have been performed to the site.
			Notes
	□ Year 1	Date:	
	□ Year 2	Date:	
	□ Year 3	Date:	
	□ Year 4	Date:	
	□ Year 5	Date:	
	□ Year 6	Date:	
	□ Year 7	Date:	

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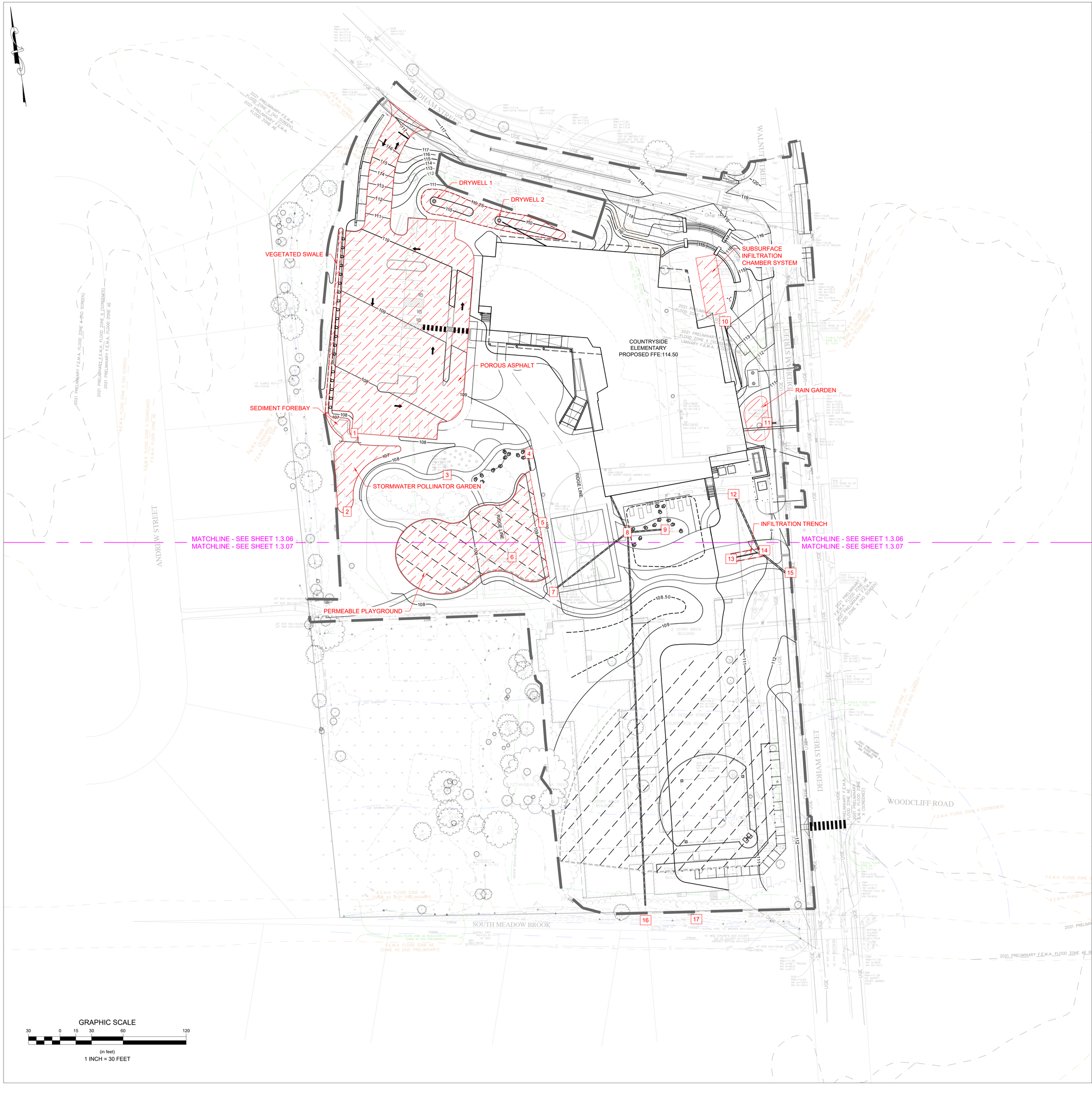
P: (203) 775-4416 • Toll Free: 1(800) 4-CULTEC • www.cultec.com

RETENTION • DETENTION • INFILTRATION • WATER QUALITY

ATTACHMENT C



GRAPHIC SCALE

30 0 15 30 60 120

(in feet)

1 INCH = 30 FEET

COUNTRYSIDE ELEMENTARY SCHOOL

Newton, MA

DINISCO DESIGN
architects + planners

99 Chauncy Street, Suite 901
Boston, MA 02111
(617) 426-2858

Horsley Witten Group
Civil & Environmental Engineers
90 Route 6A, Unit 1
Sandwich, MA 02563
(508) 833-6600

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Landscape Architects
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Foley Buhl Roberts & Assoc., Inc.
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Technology Consultants
300 Brickstone Square, Suite 201
Andover, MA 01880
(978) 256-9900

FOR SITE PLAN APPROVAL

Called North N

NORTH ARROW

STAMP

Date: 25 OCTOBER 2023

Drawn By: VSA

Scale:

Revisions

Number	Date	Description

SCHEMATIC DESIGN

OPERATION AND MAINTENANCE SITE PLAN

1