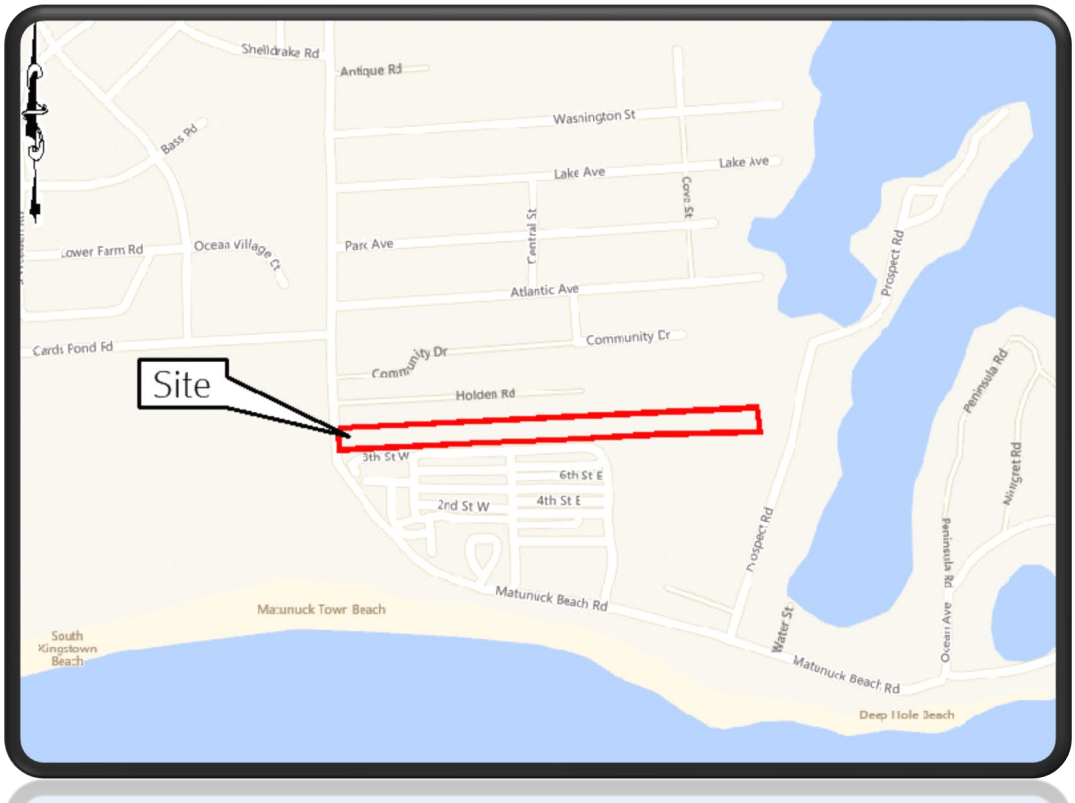
DiPrete Engineering

Stormwater System Operation & Maintenance Plan



Matunuck Beach Condos

Located in South Kingstown, RI

Applicant: Douglas Enterprises, LTD

6-22-2021

Revised 2-17-2022

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Operation & Maintenance Plan Overview

An essential component of a successful Stormwater System (SS) is the ongoing Operation and Maintenance (O&M) of the various components of the stormwater drainage, control, and conveyance systems. These components include swales, pipes, catch basins, and treatment/ control devices are commonly referred to as Best Management Practices (BMPs). Failure to provide effective maintenance can reduce the hydraulic capacity and the pollutant removal efficiency of stormwater practices.

Many people expect that stormwater facilities will continue to function correctly forever. However, it is inevitable that deterioration of the stormwater system will occur once it becomes operational. The question is not whether stormwater system maintenance is necessary but how often.

This plan has been developed to proactively address operations and maintenance to minimize potential problems and maximize potential stormwater runoff treatment and management. Ongoing inspections and maintenance will extend the service life of the Best Management Practices.

This plan addresses:

1. Stormwater management system(s) owners;
2. The party or parties responsible for operation and maintenance, including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;
3. A description and delineation of public safety features;
4. The routine (scheduled) and non-routine (corrective) maintenance tasks for each BMP to be undertaken after construction is complete and a schedule for implementing those tasks;
5. A plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point;
6. An estimated operation and maintenance budget; and
7. Funding source for operation and maintenance activities and equipment.

A major contributor to unmaintained stormwater facilities is a lack of clear ownership and responsibility definition. In order for an inspection and maintenance program to be effective, the roles for each responsibility must be clearly defined prior to construction of a system. This can be accomplished with a maintenance agreement between the site owners and the responsible authority.

This report is suitable for recording as an attachment to a maintenance agreement between the site owner and the responsible authority. A copy of a sample agreement is attached to this report as Appendix B.

Stormwater System Owner / Party Responsible for O&M

Stormwater BMPs are maintained during construction by the site contractor as identified in the Stormwater Pollution Prevention Plan (SWPPP) for the site. A copy of the SWPPP is required to be kept on site during construction. The SWPPP requires maintenance and inspection of the BMPs during the construction phase of project and requires a log be kept of these activities. Once construction is complete and the contractor's warranty period is elapsed, the contractor must obtain the signature of the stormwater system's owner releasing the contractor from his maintenance and inspection responsibilities. A copy of this release of contractor's responsibility must be attached to this document.

The Owners Association will be owner of the stormwater system. Upon completion of construction, and creation of the Owners Association, their legal name along with mailing and emergency contact information must be added below.

Owner: _____
Mailing Address: _____
_____
Emergency Contact Name: _____
Phone: _____

Transfer of Ownership

In the event that the owner of any property included in the Owners Association changes, the current owner (grantor) must provide a copy of this document to the new owner (grantee). In addition, the Owners Association must provide all new members with a copy of this document. The new owner must notify the Coastal Resources Management Council (CRMC) of the change of ownership and provide a signed updated Operations and Maintenance Plan to the CRMC.

The Stormwater System Owner is the Party Responsible for the ongoing O&M of the system.

The two key components to adequately maintain the stormwater infrastructure are:

1. Performance of periodic and scheduled inspections
2. Performance of scheduled maintenance

The actual operation and maintenance of the system may be performed by a third party designated by the owner. If the owner contracts with a third party for O&M the name, address, and emergency contact information must be added below, and updated if the third-party designee changes.

Name: _____
Mailing Address: _____
_____
Emergency Contact Name: _____
Phone: _____

Public Safety

Public safety was a critical factor in designing the stormwater system. Public safety features included in this design are:

- Accessibility to Stormwater BMPs
- Straightforward Subsurface Repairs and Quick Slab Replacements if Needed
- Winter & Non-Winter Maintenance

Accessibility to Stormwater BMPs

As shown on the site plans, the Stormcrete® Precast Porous Concrete Slabs are located along the North side of the roadway and within the parking area to the East, and the Underground Stormwater Treatment System is located off the southern parking spaces. Prior to regular maintenance, the BMP area must be zoned off with traffic cones and must be performed during normal business hours.

Winter Maintenance

Please follow the Stormcrete® Modular Precast Porous Concrete Stormwater System Operations and Maintenance Manual found in Appendix A of this report. The following tasks must be performed to protect public safety during the winter season:

- Roadways and parking lots to be salted/ sanded/ plowed in accordance with applicable Town of South Kingstown and RIDOT guidelines. Also see Inspections & Maintenance section of this report.
- If any of the Stormcrete® slabs become clogged or otherwise fails beyond the point of rejuvenation, it/they must be replaced.

Non-Winter Maintenance

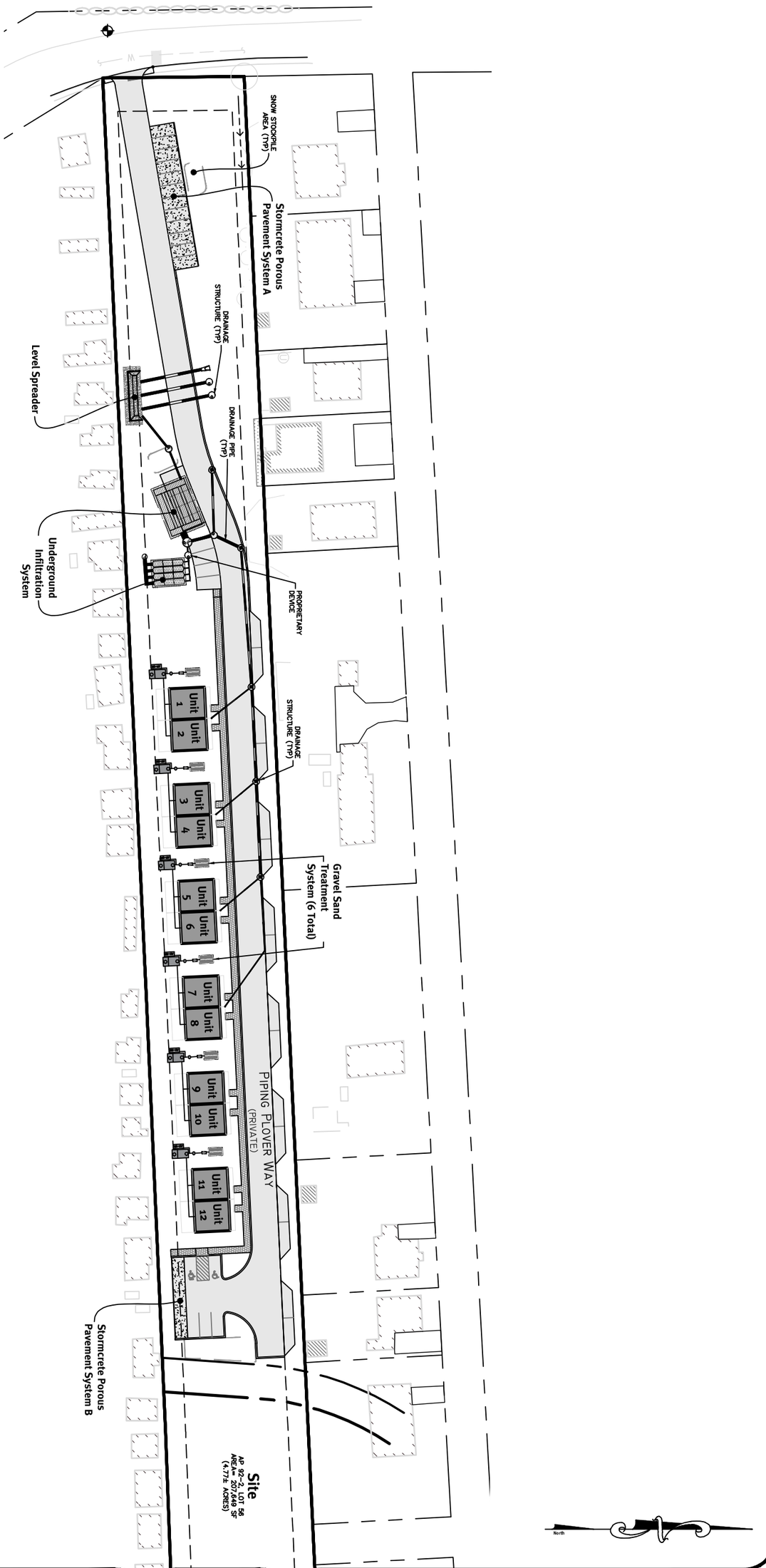
Please follow the Stormcrete® Modular Precast Porous Concrete Stormwater System Operations and Maintenance Manual found in Appendix A of this report. The following tasks must be performed to protect public safety during the non-winter season:

- Roadways and parking lots to be swept in accordance with applicable Town of South Kingstown and RIDOT guidelines.
- Vacuuming of Stormcrete areas must be performed a minimum of 2 times per year using a vacuum truck, Stormwater SUV ™, high-powered backpack blower or approved equal.
- A Manufactured Porous Rehabilitation Device or Focused Power Washer must be used when unclogging plugged areas within the Stormcrete® surfaces.
- If any of the Stormcrete® slabs become clogged or otherwise fails beyond the point of rejuvenation, it/ they must be replaced.
- The storm water management systems must be inspected and maintained in accordance with the enclosed Operations & Maintenance Plan.

Particular care must be taken in the operation and maintenance of these features.

Stormwater System Plan

A plan identifying each component of the stormwater system is included on the following page.



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O&M Plan

Matunuck Beach Condos

South Kingstown, Rhode Island

Date:
02-17-2022

SHEET 1 OF 1

DiPrete Engineering

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Boston • Providence • Newport

Inspections & Maintenance

Inspections must be performed on a regular basis and scheduled based on the BMP type and configuration. It is not mandatory that all inspectors be trained engineers, but they must have some knowledge or experience with stormwater systems and in general, trained stormwater engineers should direct the inspectors. Follow-up inspections by registered professional engineers must be performed where a routine inspection has revealed a question of structural or hydraulic integrity affecting public safety.

Not all inspections can be conducted by direct human observation. For subsurface systems, video equipment may be required. There may be cases where other specialized equipment is necessary. The inspection program must be tailored to address the operational characteristics of the system.

The inspection process must document observations made in the field and must cover structural conditions, hydraulic operational conditions, evidence of vandalism, condition of vegetation, occurrence of obstructions, unsafe conditions, and build-up of trash, sediments and pollutants.

Maintenance of the stormwater management system is essential and can be divided into two types, scheduled and corrective.

Scheduled maintenance tasks are those that are typically accomplished on a regular basis and can generally be scheduled without referencing inspection reports. These items consist of such things as vegetation maintenance (such as mowing) and trash and debris removal. These tasks are required at well-defined time intervals and are a requirement for all stormwater structural facilities.

Corrective maintenance tasks consist of items such as sediment removal, stream bank stabilization, and outlet structure repairs that are done on an as-needed basis. These tasks are typically scheduled based on inspection results or in response to complaints.

Since specialized equipment may be required, some maintenance tasks can be effectively handled on a contract basis with an outside entity specializing in that field. In addition, some maintenance may also require a formal design and bid process to accomplish the work.

Appendix A provides an "Inspection Schedule & Maintenance Checklist" for the stormwater system components on this site. Completed checklists must be maintained as an ongoing record of inspections for each component of the stormwater system.

In addition to the maintenance of the stormwater system, maintenance of other site improvements can significantly enhance the ability for the BMPs to function as designed. Several of these have been listed below, along with the recommended maintenance.

Lawn, Garden and Landscape Management

- Lawns should be cut no shorter than 1-1/2" in the spring and fall to stimulate root growth, and no shorter than 2 to 3 inches throughout the summer.
- Infiltration ponds should be mowed at least twice per year.
- Fertilize no more than twice per year, once in May-June and once in September-October.
- Avoid spreading fertilizer on impervious surfaces.
- Weeds should be dug or pulled out. Large areas of weeds can be removed by covering with large plastic sheet(s) for a few days.
- Chemical pesticides should be used as a last resort. A healthy lawn is naturally disease resistant.
    - Visible insects can be removed by hand, by spraying with water, or even vacuum cleaning.
    - Store bought traps, specific for a species, can be used.
    - Slugs and other soft bodied insects can be eliminated using diatomaceous earth.
    - Plants infected with bacteria and fungi should be removed and disposed of.
    - Beneficial organisms should be maintained on the property and should be encouraged/ attracted to the property. Homeowners and property facility maintenance personal should become familiar with beneficial organisms.
- Irrigation should be minimal if required at all. Most lawns do not require watering and will become dormant during dry periods.
    - Established lawns require no more than one inch of water per week.
    - Lawn areas should be watered before 9am to avoid evaporation.

Road and Parking Area Management

Street and Parking Lot Sweeping

- All street and parking areas on site must be swept a minimum of 2 times per year.

Deicing:

- Salt storage areas must be completely covered and located on an impervious surface.
- Avoid applying sand and deicing chemicals to Stormcrete® surfaces whenever possible.
- Runoff must be contained in appropriate areas.
- See The Rhode Island Stormwater Design and Installation Standards Manual Appendix G for approved deicing agents and ways to reduce deicer impacts. The manual Appendices can be found online at: http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/pdfs/swdsnapd.pdf

Sealants:

- Only asphalt-based sealants are permitted, no coal-tar based asphalt sealants can be used on site.

General Snow Removal:

- Snow must not be dumped in any water body including rivers, reservoirs, ponds, lakes, wetlands, bays, or the ocean.
- Snow piles must be places as shown on the Stormwater System Plan.
- Snow must be stored in upland areas, not in or adjacent to water bodies or wetlands. Snow must be stored in a location that will allow snow melt and enter the onsite drainage system so it can be treated by onsite BMPs.

Stormcrete® Snow Removal:

- Conventional plow blades equipped with wearing shoes can be used for snow removal. It is recommended that the plow passes be made at a 45-degree angle to the joint slabs with no back dragging.
- Snow within the pores will appear to be more snow covered than standard pavement and should not be "over worked" by plows or shovels.

Solid Waste Containment

- Trash and recycling receptacles must be located onsite for all commercial areas.

***Reference**; Additional information relating to operation and maintenance of specific BMPs can be found in the Rhode Island Stormwater Design and Installation Standards Manual.*
(www.dem.ri.gov/pubs/regs/regs/water/swmanual.pdf)

Estimated Inspections & Maintenance Budget

It is important to be able to budget for the O&M costs associated with the stormwater system. To assist the owner in budgeting, below is an estimate of the costs that may be incurred in maintaining the system. The costs have been estimated on a Yearly basis.

Stormcrete® Modular Precast Porous Concrete:
For damaged areas that require replacement, Stormcrete® installation costs approximately $15 per sq ft. A maintenance budget for this system can vary and will be determined following an agreed and accepted maintenance contract with Stormwater Compliance, LLC. On average, the annual cost to provide Stormwater Management Services is approximately $0.80/sq ft of Stormcrete®. This equates to an approximate cost of $1,987 per year to maintain the system.

Infiltration Structure:
For a 25-year finance period, Infiltration Structures cost approximately $1,277.77 per acre of tributary area per year. The site contains approximately 0.732 acres of area flowing to infiltration structures. This equates to an approximate cost of $935 per year to maintain the infiltration structures.

Based on the costs outlined above, the stormwater system will cost approximately $2,922 per year to maintain. This is only an estimate and subject to change following a signed Stormcrete® maintenance contract. Note that Stormwater Compliance, LLC offers a 1-year warranty and the first one-year maintenance is included for free when committing to a long term (3-5 year) maintenance contract.

These costs are the responsibility of the stormwater system owner. Funding for the costs will be provided by the stormwater system owner.

Reference;
Maintenance costs for Stormcrete® are based on information provided by Porous Technologies, LLC (https://www.stormcrete.com/maintenance)

Maintenance costs for Infiltration Structure is based on information provided by Horsley Witten during the January 19, 2011 Stormwater Manual Training.
(http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/t4guide/slides/sess210.ppt)

Appendix A – Inspection Schedule & Maintenance Checklists

Drainage Structures
(Catch Basins, Manholes, etc.)
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

Notes:

- **Beyond inspection frequency noted, inspections shall be completed after storms equal to or greater than the 1-year 24-hour Type III storm event (2.7" of rain fall)**
- **All Checklist Maintenance items are MANDATORY.**
- **During inspections, if maintenance items are found not to be applicable, note as N/A in comments**
- **All removed sediments shall be disposed at an approved and permitted location.**
- **All hazardous debris removed shall be disposed of in accordance with state and federal regulations by a properly licensed contractor**

MAINTENANCE ITEM	SATISFACTORY (YES/NO)	COMMENTS
Semi-annually inspect drainage structures for damage		
Use a vacuum truck or other means to clean out any sediment or debris present in any drainage structure or whenever sediments reach ½ of the sump depth, which ever comes first.		
Semi-annually inspect drainage structures for debris and remove as necessary		

Drainage Structures
(Catch Basins, Manholes, etc.)
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

COMMENTS:

ACTIONS TO BE TAKEN:

Stormcrete® Modular Precast Porous Concrete
Operation, Maintenance, and Management
Inspection Checklist

Project:	Date:
Location:	Time:
Site Status:	Inspector:

Notes:

- **Beyond inspection frequency noted in parenthesis, i.e. (quarterly), inspections shall be completed after storms equal to or greater than the 1-year 24-hour Type III storm event (2.7" of rain fall)**
- **All Checklist Maintenance items are MANDATORY**
- **During inspections, if maintenance items are found not to be applicable, note as N/A in comments**
- **All removed sediments shall be disposed at an approved and permitted location**
- **All hazardous debris removed shall be disposed of in accordance with state and federal regulations by a properly licensed contractor**
- **If any of the Stormcrete® slabs become clogged or otherwise fails beyond the point of rejuvenation, it/ they must be replaced**
- **Follow Stormcrete® Modular Precast Porous Concrete Operation and Maintenance Manual for additional information on routine maintenance, rehabilitation, repairs, and replacement**

MAINTENANCE ITEM	SATISFACTORY (YES/NO)	COMMENTS
1. Sediment and Debris Cleanout (Monthly or Manufacturer's Recommendation)		
Contributing area free of sediment and debris. Voids free of any fine material		
Contributing areas stabilized and mown, with grass clippings removed		
Inspect for evidence of run-on from perimeter unpaved areas or nearby erosion		
No signs of clogging or debris (i.e. standing water, leaves, trash, etc.)		
Surface does not require vacuuming		

Stormcrete® Modular Precast Porous Concrete
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

2. Dewatering (Monthly or Manufacturer's Recommendation)		
Permeable pavement dewaters between storms		
3. Surface Repairs (Annually or Manufacturer's Recommendation)		
No evidence of surface deficiencies (i.e. raveling, spalling, cracking, etc.)		
Surface (top and base course) does not need to be replaced		
4. Vacuum Sweeping or Hosing (Semi-Annually)		
Semi-Annual Vacuum Sweeping or Hosing per manufacturer		
5. Miscellaneous		
Minimize use of sand and salt within proximity of Stormcrete® in winter months		
Post signs identifying permeable pavement		
Attached rollers to the bottoms of snowplows to prevent them from catching on the edges of grass pavers and some paving stones		
6. Replacement		
If one or more panels become clogged or otherwise fails beyond the point of rejuvenation, it/ they must be replaced		

Stormcrete® Modular Precast Porous Concrete
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

COMMENTS:

ACTIONS TO BE TAKEN:

Riprap-Lined Channel or Swale
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

Notes:

- **Beyond inspection frequency noted in parenthesis, i.e. (quarterly), inspections shall be completed after storms equal to or greater than the 1-year 24-hour Type III storm event (2.7" of rain fall)**
- **All Checklist Maintenance items are MANDATORY.**
- **During inspections, if maintenance items are found not to be applicable, note as N/A in comments**
- **All removed sediments shall be disposed at an approved and permitted location.**
- **All hazardous debris removed shall be disposed of in accordance with state and federal regulations by a properly licensed contractor**

MAINTENANCE ITEM	SATISFACTORY (YES/NO)	COMMENTS
1. Debris Cleanout (Quarterly)*		
The channel/swale bottom is clear of debris or litter.		
Inflow pipes / inlet areas clear of debris		
Outflow pipes / outlet area clear of debris		
Overflow Weir / outlet area clear of debris		
2. Sedimentation (Quarterly)*		
Obvious trapping of sediment		
When sediment accumulates to a depth of approximately ¼ of the original design depth, it should be removed, and the channel should be reconfigured to its original dimensions		

Riprap-Lined Channel or Swale
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

3. Vegetation (Quarterly)*		
Any vegetation should be kept a maximum height of three inches above the surface of the channel		
4. Embankments (Quarterly)*		
Evidence of erosion		
Damaged or displaced riprap and/or liner should be repaired or replaced within 48 hours of discovery.		

COMMENTS:

Riprap-Lined Channel or Swale
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

ACTIONS TO BE TAKEN:

Street Sweeping
Operation, Maintenance, and Management
Inspection Checklist

Project:	Date:
Location:	Time:
Site Status:	Inspector:

Notes:

- **Beyond inspection frequency noted in parenthesis, i.e. (quarterly), inspections shall be completed after storms equal to or greater than the 1-year 24-hour Type III storm event (2.7" of rain fall)**
- **All Checklist Maintenance items are MANDATORY.**
- **During inspections, if maintenance items are found not to be applicable, note as N/A in comments**
- **All removed sediments shall be disposed at an approved and permitted location.**
- **All hazardous debris removed shall be disposed of in accordance with state and federal regulations by a properly licensed contractor**

MAINTENANCE ITEM	SATISFACTORY (YES/NO)	COMMENTS
Sweep all roadways two times per year. One of these sweepings must occur after winter sanding operations have concluded.		

COMMENTS:

Street Sweeping
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

ACTIONS TO BE TAKEN:

Underground System
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

Notes:

- **Beyond inspection frequency noted in parenthesis, i.e. (quarterly), inspections shall be completed after storms equal to or greater than the 1-year 24-hour Type III storm event (2.7" of rain fall)**
- **All Checklist Maintenance items are MANDATORY.**
- **During inspections, if maintenance items are found not to be applicable, note as N/A in comments**
- **All removed sediments shall be disposed at an approved and permitted location.**
- **All hazardous debris removed shall be disposed of in accordance with state and federal regulations by a properly licensed contractor**
- **Repair or complete replacement to Underground Infiltration System Practice is required if system fails to infiltrate fully within 48 hours.**
- **Inspection Ports are provided over each row of the chambers for inspections. Manholes are provided at one end of each isolator row for access and maintenance.**

MAINTENANCE ITEM	SATISFACTORY (YES/NO)	COMMENTS
1. Debris Cleanout (Quarterly)		
The isolator row chamber(s) clear of debris/ floatables or accumulated sediment.		
Inflow pipes clear of debris/ floatables		
Overflow spillway clear of debris/ floatables		
Inlet area clear of debris/ floatables		
2. Dewatering (Annual)		
Chamber dewaters between storms		
Outlet devices shall be cleaned/repaired when draw down exceeds 36 hours.		

Underground System
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

3. Sediment Cleanout of Chamber (Annual)		
No evidence of sedimentation in chamber		
Sedimentation accumulation doesn't yet require cleanout		
Sediment Shall be removed from the system when sediment volume exceeds 10% of the total vault volume		
Remove sediments by hydro-jetting of sediments and vactoring (vacuuming)		
4. Inlets (Quarterly)		
Good condition		
No evidence of disrepair (presence of structural damage)		
5. Aggregate Repairs (Annual)		
Annual inspection for damage		
Annual inspection for hydrocarbon build-up and removal if detected.		
Annual inspection for sediment accumulation in the facility		
Surface of aggregate clean		
Top layer of stone does not need replacement		
Chamber does not need rehabilitation (presence of structural damage)		

Underground System
Operation, Maintenance, and Management
Inspection Checklist

Project: Date:

Location: Time:

Site Status: Inspector:

COMMENTS:

ACTIONS TO BE TAKEN:

Stormcrete® Modular Precast Porous Concrete Stormwater System

Handling and Installation Manual

1. Recommended Equipment

In addition to the typical earthmoving, materials handling and grading equipment, the following hand tools should also be available –

- 2 or 4-way chains, cables or straps rated to lift the slabs – refer to Table 2 for the number of lifting points and the slab weights
- Cordless impact wrench or ratchet wrench with 3/4” socket for installing and removing lifting swivel bolts
- Lifting swivels supplied by manufacturer
- Rakes and shovels for levelling screed stone
- 1.25” minimum diameter screed rails
- 2”x4” or other material to use as a screed
- Plastic plugs and slab spacers supplied by manufacturer.
- Backpack blower to keep slabs surface clean during and after installation.
- Diamond Bladed Masonry Cutoff Saw (6” cutting depth min. – typically requires a minimum 16” diameter blade – check saw specifications).

2. Offloading and Storage

- Prior to offloading a delivery truck the slabs on the truck shall be carefully inspected for any damage. Any observed damage shall be immediately reported to the delivery driver and the quantity and type of damage shall be noted on the delivery ticket.

- Offloading should be performed by a **trained** and **experienced** equipment operator. Due to the unique structural properties of porous concrete, extra care should be taken when handling the slabs.

- A forklift or similar equipment should be used when offloading *Stormcrete®* slabs. It is recommended that the equipment be fitted with forks. ***Chains, cables or slings should never be wrapped around slabs for offloading or installation.***

- Slabs should be offloaded evenly from both sides of the truck to ensure that the trailer does not become unstable.

- Slabs delivered on pallets should be offloaded as shipped. Slabs delivered on dunnage must be picked from the highest level of dunnage. **Never pick up slabs with more than one layer of dunnage.** (*Please see Table 1 for Stormcrete® slab sizes, shipping configurations and corresponding weights*).

Slab Size	Number of slabs per pallet/dunnage	Number of slabs per stack	Approx. Slab Weight (lbs.)	Approx. Lift Weight (lbs.)
5' x 4' x 6"	3	9	1290	3870
5' x 2' x 6"	6	9	645	3870
4' x 2.5' x 6"	6	9	645	3870

Table 1

- Stored slabs must be placed on a level or nearly level stable surface. In dusty environments slabs should be covered to prevent dust and debris from settling on slab surfaces.

- Allow approximately 1 s.f. of storage area for every 3 s.f. of Stormcrete® Slabs purchased.

- When stacking or restacking slabs 4” by 4” timbers should be placed parallel to one another and **located directly beneath imbedded lifting points**. **Do not place timbers in the middle of the slabs or on the ends**. Timbers should be at a minimum 1” thicker than the fork thickness. Place timbers between each double stack of slabs (see image below).

- Lower slabs evenly such that the slab comes into contact with both timbers simultaneously. To prevent edge damage, slabs should be set flat on timbers so that one edge does not contact timbers while opposite edge is supported by forks.

3. Sub-Base Preparation

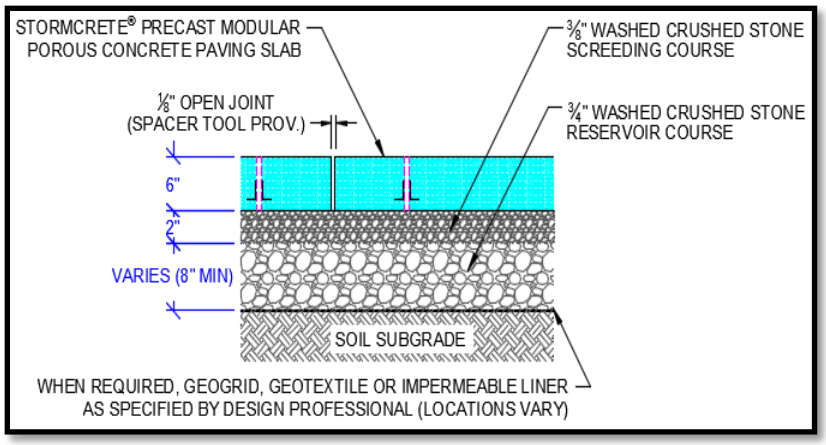
Reservoir Layer Placement:

Reservoir layer shall not be placed and/or compact in rain or snow, or on saturated or frozen subgrade.

In all cases reservoir stone shall be placed and compacted against rigid lateral boundaries, i.e., in situ, undisturbed native soils, fill materials compacted to 98% Standard Proctor density or concrete curb and headers. Compaction of reservoir stone against any flexible boundaries shall not be permitted.

Although the approved plans shall govern over installation details and specifications, the following instructions are provided by the manufacturer as minimum guidelines:

- Reservoir stone layer shall be constructed per approved drawings using ¾" or AASHTO No. 57 crushed angular stone. The stone must be washed and free of fines.



- Compact reservoir storage layer in maximum 12" lifts, with a minimum of two complete coverages, one pass each in mutually perpendicular directions, with a 3 to 5 ton smooth, single or double drum roller operated in vibratory mode. Following vibratory compaction, repeat two complete coverage's, one pass each in mutually perpendicular directions, with the roller operated in static mode. Continue static rolling until there is no visible movement, weaving or deflection in the surface of the storage reservoir layer.

- For small areas inaccessible by large rollers follow the above directions using a walk-behind plate compactor. Repeat two complete coverages in each direction.

- The surface tolerance of the compacted storage reservoir layer shall be +/- 3/4 in. under a 10 ft. straightedge.

- Where specified on the design plans, place geotextile on prepared subgrade side slopes and extend a maximum of 1 foot under the bottom of the storage reservoir. Do not place geotextile under other areas of infiltrating system unless specified on the approved plans. Secure in place to prevent disturbance from vehicles and/or worker foot traffic.

Screeding Layer Placement

It is critical that the crushed stone leveling course surface be SCREEDED flat so that the slabs are fully supported with no bridging or mounding beneath. Crushed stone base shall not be placed and/or screeded in rain or snow, or on saturated or frozen subbase.

- Screeding layer shall be placed per approved drawings using 3/8" crushed angular stone or No. 8 Stone. The stone must be washed and free of fines.

- Place and spread the stone evenly over the reservoir course to a thickness of +/- 2". Level the surface of crushed stone (screeding is strongly recommended).

- Screed using a minimum 1.25" diameter rigid screed rail placed adjacent or below the slab location with the top of the rails set at the screeding level.

- Do not compact or disturb leveled screeding layer (if screed rails are placed in panel locations, carefully remove them to prevent disturbance to the leveling base layer).

- The uniformity of the leveling (base) layer determines the differential settlement between precast porous concrete paving slabs.

- The slab installation contractor **should not correct deficiencies in the leveling layer by shimming** with additional stone rather the slabs should be lifted out and the entire area should be re-leveled.

4. Setting Stormcrete® Porous Concrete Slabs

Recommended Lifting Hardware

- Slabs shall only be lifted and placed using supplied hoist ring swivels. 2 or 4-way chains, wire rope or nylon straps rated for the lift weight shall be used per the manufacturer's recommendations to lift slabs – do not exceed minimum recommended angle for lifting chains.

- Swivels shall be securely bolted snug to the slab. Check to ensure that the bolt extends the full depth of the lifting socket. To avoid damage to the surface do not over-tightened bolts. (An electric impact wrench with a 3/4" socket is the most efficient way to attach and remove the swivels).

Individual slabs should only be lifted by equipment that is rated for the slab weights shown in the adjacent table:

Slab Dimension (ft)	Max Slab Weight (lbs.)	Lifting Points
5' x 4' x 6"	1290	4
5' x 2' x 6"	645	2
4' x 2.5' x 6"	645	2

Chains, cables or slings should never be wrapped around slabs for placement under any circumstances.

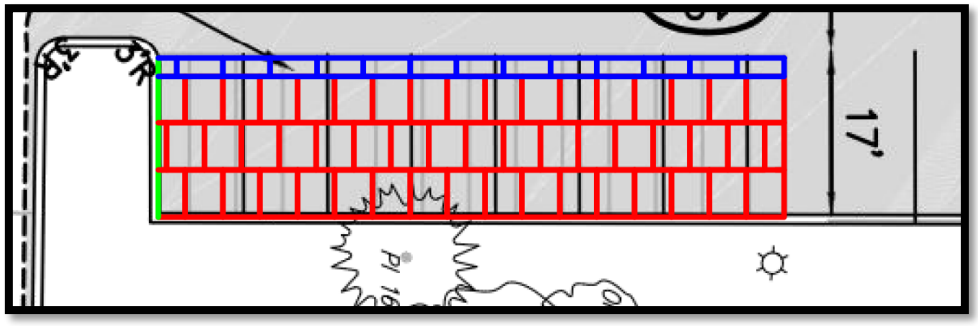
Placing Slabs

Precast porous concrete slabs shall not be placed in heavy rain or snow, or on saturated or frozen base.

Because the units are precast in a controlled environment, they are delivered to the site pre-cured which allows them to be parked or driven on immediately after placement. They may also be placed year-round, in almost any type of weather or temperature conditions.

WARNING! – ENSURE THAT PLASTIC SPACER THAT ARE USED TO SEPARATE SLABS IN A STACK ARE REMOVED FROM THE BOTTOM OF ALL SLABS BEFORE SLAB PLACEMENT.

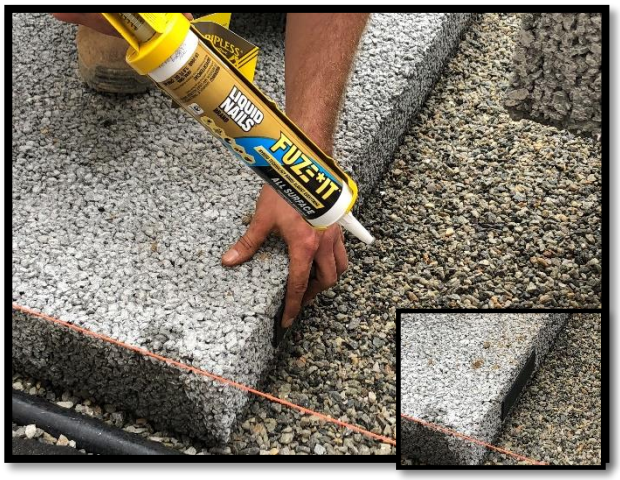
- Whenever possible place slabs in a staggered pattern(s) as shown below or as depicted on approved drawings.



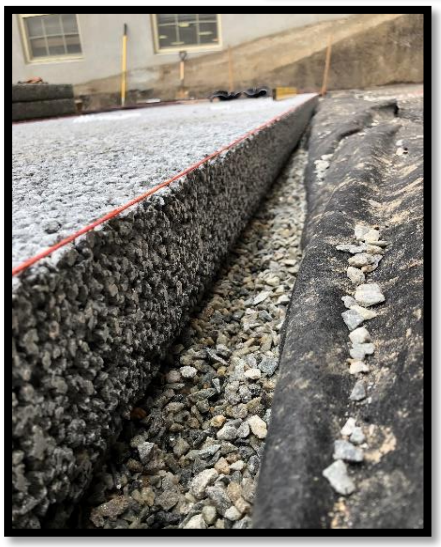
- On gutter applications a string line shall be used to ensure that the curbing is straight enough to allow for proper placement of the slabs. If the existing curbing does not follow a straight alignment then the slabs should follow the alignment of a string line placed mostly parallel to the curb and ½" away from the point that is furthest toward the roadway to allow for a minimum ½" joint. .

- Guide units into place by hand, being careful not to pinch fingers. Horizontal adjustments can be made with wood wedges, levers, and rubber mallets as needed (If pry bars are used they should never come into direct contact with the top corner of the slab).

- Adjacent slabs shall be separated from each other by the placement of two 3/8" thick High-Density Polyethylene spacers (Part No. 18SP) supplied by the manufacturer. Spacer shall be trimmed to the right height to fit and adhered to previously placed slab with a construction adhesive such as Liquid Nails Heavy Duty Construction Adhesive or approved equal.



- Care should be taken to place adjacent slabs at same elevation (i.e. level to each other). Slab surfaces shall not deviate by more than 1/8" vertically and horizontally from one to the next.



- Placed Slabs should maintain consistent 1/8" joint widths and horizontal and vertical alignments should be continuously straightened as necessary as paving proceeds.

- Joints between adjacent rows of panels shall be staggered when possible.

- Keep slabs covered until all adjacent areas are stabilized to prevent dust and debris from reducing porosity of slabs. A backpack blower should be employed throughout the installation process to keep slab surfaces clean. Place erosion and sediment control barriers to prevent eroding areas from draining onto slabs.

- Whenever possible set slabs with equipment positioned next to slab area and not on previously installed slabs. When it is necessary to position equipment on slabs during setting use only light machines equipped with either rubber tires or rubber tracks.

- Immediately after the Stormcrete® system has been placed; use provided ½" nylon caps (Part No. 12NC) to fill imbedded lifting points. Care should be taken to make sure the plastic caps are flush with the surface; do not press caps down into the imbedded lifting points.

- Keep equipment off unrestrained paving slabs and subgrade material.
- Report any damage immediately to the project design professional.

Cutting

- When required, cut slabs with a diamond bladed masonry saw with a plunge depth of 6" minimum.

- If field adjustments are required, slabs should be cut as indicated on the approved drawings.
- Cut slabs shall be no narrower than 18" and cutting shall occur so that a minimum of two embedded lifters remain for safe lifting and setting.

- Cutting should be performed away from sub-base material and other slabs. Do not cut slabs while in a stack or on top of another slab.
- Cover adjacent areas of slab being cut to prevent dust and debris from entering into the porous concrete.
- Slab layouts shall be planned to minimize or eliminate locations where utility structures intersect with slab joints. Whole and half slabs shall be used in combination with cast in place collars to surround utilities.

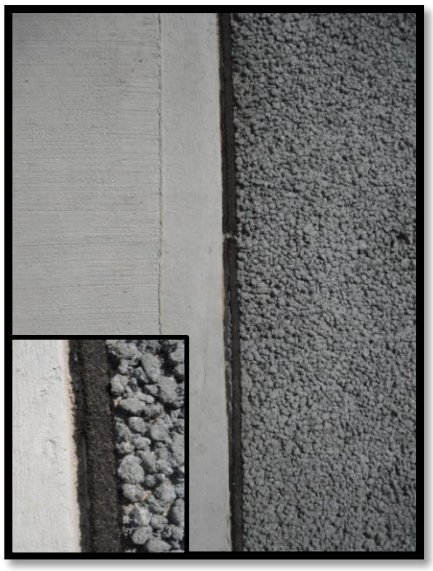
Grade Breaks

- Stormcrete® slabs should be placed on a level sub-base. If grade breaks are present, ensure that they occur at an open joint.

- If a grade break does not occur at an open joint cut the slab to create an open joint at the break. If cutting is required reference the cutting section above.

Edge Restraints

- **NEVER** place fluid material (asphalt, concrete, soil, etc.) directly up against the Stormcrete® slabs. Fluid materials shall be separated from Stormcrete® slabs by the use of a ½" preformed expansion joint material conforming to ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction



• Install edge restraints per approved drawings and manufacturer's recommendations at the indicated locations and elevations.

• Anchor edge restraints directly to finished leveling layer in accordance with the manufacturer's requirements.

• The use of loose stone as a filler material adjacent to slabs should be avoided in favor of expansion joint material conforming to ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (preferred).

- When placing Stormcrete® Precast Porous Concrete slabs against existing concrete structures where it is not possible to pre-install ½" expansion joint material joints may be filled with No.8 clean washed gravel beneath closed cell foam backer rod and a maximum depth of ½" of elastomeric sealant such as

Sikasil 728 RCS Limestone joint filler or approved equal. In all cases the use of a preformed expansion joint material conforming to ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction is preferred.

5. SLAB PROTECTION & FINAL INSPECTION

- After work in the section is complete, the contractor shall be responsible for protecting the precast porous paving slab system from damage and/or contamination from mud, dirt, grass cuttings and accumulation of foliage and debris through the duration of construction. This should include a regular vacuum sweeping schedule. It is important that you do not attempt to wash the construction area clean. This will result in lose debris draining into the slabs/stone.

- Any slabs cracked or damaged during installation shall be replaced with new ones at the installers cost.

- Reset slabs not in conformance with specified installation tolerances.

- Check for and remove any accumulation of sediment or debris observed. This can be done by manually sweeping, vacuum sweepers, and in some cases, back pack blowers.



- Check final surface elevations of set slabs for conformance to design drawings. Slab surfaces shall not deviate by more than 1/8" vertically from one to the next and to adjacent surfaces.

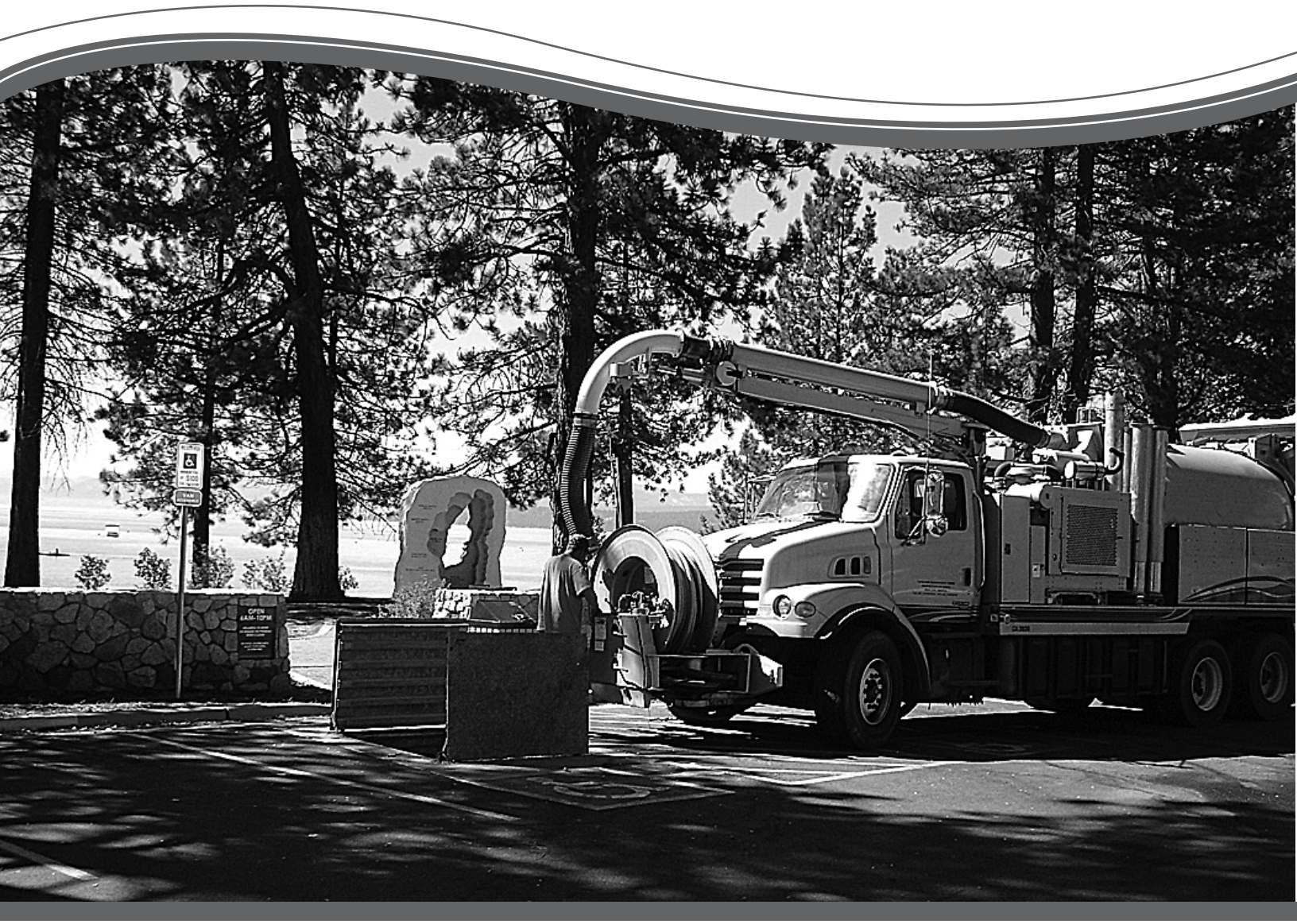
- The surface elevation of set slabs shall be flush with manholes or the top of utility structures.

6. STORMCRETE® PRECAST POROUS CONCRETE INSTALLATION TRAINING PROGRAM

- Installation contractors are strongly encouraged to participate in the Stormcrete® Precast Porous Concrete Installation Training Program. This program ensures that Installers are properly trained in the installation of Stormcrete® products. Installers successfully completing the Training Program shall receive a certificate valid for 2 years and shall be responsible for reviewing the Handling and Installation Manual and Training Program Test Questions (with correct answers) with Laborers under their employ.

CONTECH®
ENGINEERED SOLUTIONS

Cascade Separator® Inspection and Maintenance Guide



CASCADE
separator®

Maintenance

The Cascade Separator® system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump 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 (i.e. spring and fall). However, more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment wash-down areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

A visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet chamber, flumes or outlet channel. 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 in this Inspection and Maintenance Guide.

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

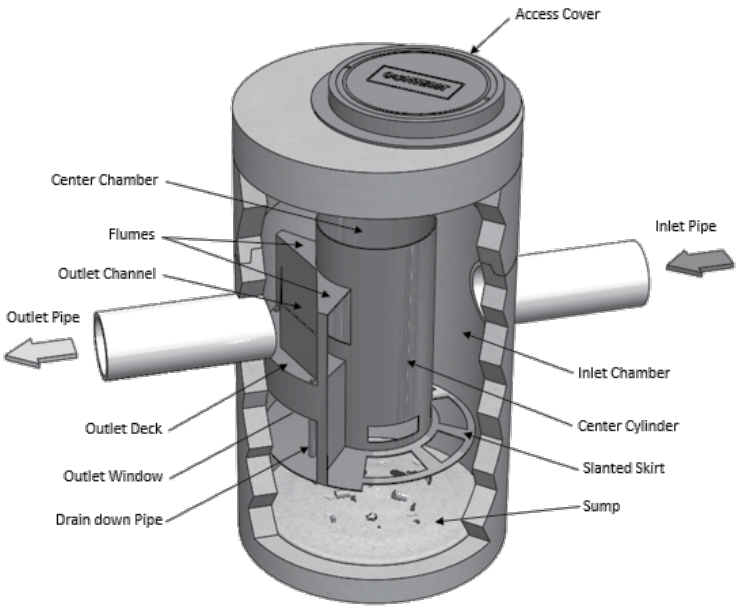
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) 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. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

Cleaning

Cleaning of a Cascade Separator system 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 cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

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. Then the system should be power washed 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 to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



Cascade Separator® Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CS-3	3	0.9	1.5	0.5	0.4	0.3
CS-4	4	1.2	2.5	0.8	0.7	0.5
CS-5	5	1.3	3	0.9	1.1	0.8
CS-6	6	1.8	3.5	1	1.6	1.2
CS-8	8	2.4	4.8	1.4	2.8	2.1
CS-10	10	3.0	6.2	1.9	4.4	3.3
CS-12	12	3.6	7.5	2.3	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.

A Cascade Separator unit can be easily cleaned in less than 30 minutes.

A vacuum truck excavates pollutants from the systems.

Cascade Separator® Inspection & Maintenance Log

Cascade Model:			Location:		
Date	Depth Below Invert to Top of Sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. 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.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, and earth stabilization products. For information, visit www.ContechES.com or call 800.338.1122

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Appendix B –Sample Stormwater Facility Maintenance Agreement

****A site specific Stormwater Facility Maintenance Agreement between the Owner and Authority Having Jurisdiction must be developed prior to construction****

Sample Stormwater Facility Maintenance Agreement

THIS AGREEMENT, made and entered into this ___ day of _____, 20___, by and between (Insert Full Name of Owner)
_____ hereinafter called the "Landowner", and the [Local Jurisdiction], hereinafter called the "[Town/City]".
WITNESSETH, that WHEREAS, the Landowner is the owner of certain real property described as (Tax Map/Parcel Identification Number) _____ as recorded by deed in the land records of [Local Jurisdiction] Deed Book _____ Page _____, hereinafter called the "Property".

WHEREAS, the Landowner is proceeding to build on and develop the property; and
WHEREAS, the Site Plan/Subdivision Plan known as
_____, (Name of Plan/Development) hereinafter called the "Plan", which is expressly made a part hereof, as approved or to be approved by the [Town/City], provides for detention of stormwater within the confines of the property; and

WHEREAS, the [Town/City] and the Landowner, its successors and assigns, including any homeowners association, agree that the health, safety, and welfare of the residents of [Local Jurisdiction] require that on-site stormwater management facilities be constructed and maintained on the Property; and

WHEREAS, the [Town/City] requires that on-site stormwater management facilities as shown on the Plan be constructed and adequately maintained by the Landowner, its successors and assigns, including any homeowners association.

NOW, THEREFORE, in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The on-site stormwater management facilities shall be constructed by the Landowner, its successors and assigns, in accordance with the plans and specifications identified in the Plan.
2. The Landowner, its successors and assigns, including any homeowners association, shall adequately maintain the stormwater management facilities in accordance with the required Operation and Maintenance Plan. This includes all pipes, channels or other conveyances built to convey stormwater to the facility, as well as all structures, improvements, and vegetation provided to control the quantity and quality of the stormwater. Adequate maintenance is herein defined as good working condition so that these facilities are performing their design functions. The Stormwater Best Management Practices Operation, Maintenance and Management Checklists are to be used to establish what good working condition is acceptable to the [Town/City].

3. The Landowner, its successors and assigns, shall inspect the stormwater management facility and submit an inspection report annually. The purpose of the inspection is to assure safe and proper functioning of the facilities. The inspection shall cover the entire facilities, berms, outlet structure, basin areas, access roads, etc. Deficiencies shall be noted in the inspection report.
4. The Landowner, its successors and assigns, hereby grant permission to the [Town/City], its authorized agents and employees, to enter upon the Property and to inspect the stormwater management facilities whenever the [Town/City] deems necessary. The purpose of inspection is to follow-up on reported deficiencies and/or to respond to citizen complaints. The [Town/City] shall provide the Landowner, its successors and assigns, copies of the inspection findings and a directive to commence with the repairs if necessary.
5. In the event the Landowner, its successors and assigns, fails to maintain the stormwater management facilities in good working condition acceptable to the [Town/City], the [Town/City] may enter upon the Property and take whatever steps necessary to correct deficiencies identified in the inspection report and to charge the costs of such repairs to the Landowner, its successors and assigns. This provision shall not be construed to allow the [Town/City] to erect any structure of permanent nature on the land of the Landowner outside of the easement for the stormwater management facilities. It is expressly understood and agreed that the [Town/City] is under no obligation to routinely maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the [Town/City].
6. The Landowner, its successors and assigns, will perform the work necessary to keep these facilities in good working order as appropriate. In the event a maintenance schedule for the stormwater management facilities (including sediment removal) is outlined on the approved plans, the schedule will be followed.
7. In the event the [Town/City] pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner, its successors and assigns, shall reimburse the [Town/City] upon demand, within thirty (30) days of receipt thereof for all actual costs incurred by the [Town/City] hereunder.
8. This Agreement imposes no liability of any kind whatsoever on the [Town/City] and the Landowner agrees to hold the [Town/City] harmless from any liability in the event the stormwater management facilities fail to operate properly.
9. This Agreement shall be recorded among the land records of [Local Jurisdiction] and shall constitute a covenant running with the land, and shall be binding on the Landowner, its administrators, executors, assigns, heirs and any other successors in interests, including any homeowners association.

WITNESS the following signatures and seals:

_____
Company/Corporation/Partnership Name (Seal)

By: _____

_____
(Type Name and Title)

The foregoing Agreement was acknowledged before me this ____ day of _____, 20___, by _____ ___.

_____
NOTARY PUBLIC
My Commission Expires: _____

By: _____
_____
(Type Name and Title)

The foregoing Agreement was acknowledged before me this ____ day of _____, 20___, by _____ ___.

_____
NOTARY PUBLIC
My Commission Expires: _____

Approved as to Form:

_____ _____
[Town/City] Attorney Date