| BMP | Implementation, Inspection and Maintenance Requirements | Frequency |
|---|---|---|
| Aqua-Swirl | Bypass structures should be inspected whenever the Aqua-Swirl® is inspected. Maintenance should be performed on bypass structures as needed. The Aqua-Swirl system should be inspected at regular intervals and maintained when necessary to ensure optimum performance.<br>For the first year, inspect the Aqua-Swirl® every three (3) months and clean the system as needed.<br>For second and subsequent years, if the Aqua-Swirl® did not reach full sediment or floatable pollutant capacity in the First Year Post-Construction period, the system can be inspected and cleaned once annually.<br>If the Aqua-Swirl® reached full sediment or floatable pollutant capacity in less than 12 months in the First Year Post-Construction period, the system should be inspected once every six (6) months and cleaned as needed. The Aqua-Swirl® should be cleaned annually regardless of whether it reaches its sediment or floatable pollutant storage capacity. Schedule cleaning with local vactor company or AquaShield™ to remove sediment, oil and other floatable pollutants.<br>INSPECTION PROCEDURES:<br>I. Floatable Debris and Oil<br>• Remove manhole lid to expose liquid surface of the Aqua-Swirl®.<br>• Remove floatable debris with basket or net if any present.<br>• If oil is present, measure its depth. Clean liquids from system if one half (½) inch or more oil is present.<br>II. Sediment Accumulation<br>1. Lower measuring device (e.g. stadia rod) into swirl chamber through service access provided until top of sediment pile is reached. (Figure 1 in the Aqua-Swirl® Stormwater Treatment System Inspection and Maintenance Manual Work Sheets from AquaShield™.<br>2. Record distance to top of sediment pile from top of standing water.<br>3. For Aqua-Swirl® Models AS-3 through AS-13, schedule cleaning if value in Step #2 is 48 to 42 inches or less.<br>4. For Aqua-Swirl® Model AS-2, schedule cleaning if value in Step #2 is 32 to 30 inches or less.<br>Keep on-site a log of all inspections and maintenance performed on the Aqua-Swirl®. | As recommended. |

| BMP | Implementation, Inspection and Maintenance Requirements | Frequency |
|---|---|---|
| Corrugated Metal Pipe | Underground storm water detention system should be inspected at regular intervals and maintained when necessary to ensure optimum performance.<br>Inspections should be performed quarterly, before, during and after rain events. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations, or in equipment washdown areas.<br>Systems should be cleaned annually and when inspection reveals that accumulated sediment or trash is clogging the discharge orifice.<br>Maintaining an underground detention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.<br>Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities. | As recommended. |

# Appendix 1

## BMP SITE PLAN

# Appendix 2

## BMP Information
## California Stormwater Quality Association (CASQA) BMP Fact Sheets & System Manufacturer Documents

# Appendix 3

## EDUCATIONAL MATERIALS

**The following is a selection of Educational Materials for property owners, contractors and employees that address BMPS and water quality issues. Many are available in English and Spanish.**

To meet the educational requirements of this O&M Plan, educational brochures can be downloaded or requested at no charge at http://www.rcwatershed.org/about/materials-library/ for inclusion on a website, in a newsletter or mailed to property owners, tenants and/or contractors. Property owners, tenants, staff and/or contractors must receive education/training at least once per year

# Appendix 4

## BMP OPERATION & MAINTENANCE AND TRAINING LOGS

# BMP OPERATION & MAINTENANCE LOG

***SITE ADDRESS -*** _____

**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 |
|---|---|
| MaxWell IV Drywell | |
| Aqua-Swirl | |
| Bypass Structure | |
| CMP Detention Tank | |
| Catch Basin/Drop Inlet Stenciling | |
| | |
| | |
| | |

# TRAINING / EDUCATIONAL LOG

***SITE ADDRESS -*** _____

**Date of Training/Educational Activity:** _____

**Name of Person Performing Activity:** _____

**Signature:** _____

**Topic of Training/Educational Activity:** _____

_____

| Name of Participant | Signature of Participant |
|---|---|
| | |
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| | |
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**For newsletter or mailer educational activities, please include the following information:**

- **Date of mailing**
- **Number distributed**
- **Method of distribution**
- **Topics addressed**

If a newsletter article was distributed, please include a copy of it.

# Appendix 5

# WATER QUALITY MANAGEMENT PLAN (WQMP) VERIFICATION SURVEY

Project Name: _____

Site Address: _____

Responsible Party: _____

Contact Phone: _____ Contact Email: _____

1. **Have your contractors (landscape, maintenance, etc.) been educated regarding the applicable requirements to prevent pollution as outlined in the WQMP?**

   ☐ **Yes** ☐ **No**

   Name of Landscape/Maintenance Contractor: _____

   Method of education (contract language, Copy of O&M, educational brochures, etc.):
   _____

2. **Have the storm drains and inlets been inspected and maintained, at a minimum, annually prior to Oct 1?**

   ☐ **Yes** ☐ **No**

   Date of Last Inspection/Maintenance: _____

   Maintenance conducted by: _____

3. **Have you observed any runoff from the irrigation system?**

   ☐ **Yes** ☐ **No**

   If yes, how was the problem resolved?: _____

   _____

4. **What type of Integrated Pest Management (IPM) practices are used on site?**

   _____

5. **Are native and/or drought tolerant plants established and considered for any new landscaping?**

   ☐ **Yes** ☐ **No**

6. **Have the storm drain stencils been inspected annually for legibility prior to Oct. 1?**

   ☐ **Yes** ☐ **No** Total number of stencils on site: _____

   How many inlets required re-stenciling / date of re-stenciling? _____ /_____

7. **Have education materials been distributed to the residents/tenants/contractors within the past year?**

   ☐ **Yes** ☐ **No**

   Topic / Date of Distribution: _____ / _____

   Method of Distribution: newsletter, billing insert, etc.: _____

8. **Is street sweeping conducted weekly?**

   ☐ **Yes** ☐ **No**

   Contractor: _____

9. **Are trash areas in common area inspected daily?**

   ☐ **Yes** ☐ **No**

10. **Have any vector concerns been observed (standing water, mosquito larvae, etc.)? If yes, please contact local Vector Control District.**

    ☐ **Yes** ☐ **No**

11. **Have the LID BMPs been inspected and maintained per Manufacturer instructions? (attach invoices and inspection/maintenance forms).**

    ☐ **Yes** ☐ **No**

12. **Have there been any issues with operation and maintenance of the LID BMPs units?**

    _____

I certify that the above information is correct and that the BMPs for this project have been implemented and operated and maintained in accordance with the Operation and Maintenance (O&M) Plan on site.

_____
Print Name of Responsible Party

_____ _____
Signature (required) Date

***This form should be completed by September 30 each year.***

| BMP Name | BMP Location | Frequency |
|---|---|---|
| **Structural Treatment** | | |
| Catch Basin Marker Inspection | As designated on WQMP Plot Plan | Bi-annually |
| Catch Basin Marker Maintenance | As designated on WQMP Plot Plan | Yearly |
| Trash Storage Areas | As designated on WQMP Plot Plan | Weekly basis |
| Irrigation and Landscape | As designated on WQMP Plot Plan | Monthly basis |
| **Non-Structural Treatment** | | |
| Educational Material | Manager's Office | Upon hire and annually |
| Activity Restriction | Manager's Office | Daily basis |
| Common Landscape Management | Throughout project site | Monthly basis |
| BMP Maintenance | Manager's Office & staff | Daily basis |
| Common Area Litter Control | Throughout project site | Weekly basis |
| Employee Training | Manager's Office | Upon hire and annually |
| Common Area Catch Basin Inspection | As designated on WQMP Plot Plan | After and before rain storm |
| Sweeping of Parking Structure/Driveway | As designated on WQMP Plot Plan | Monthly basis |
| Fountain and Pool Maintenance | As designated on WQMP Plot Plan | As needed |
| **Treatment Control** | | |
| Aqua-Swirl Inspection | As designated on WQMP Plot Plan | Quarterly, before, during, after rain event |
| Aqua-Swirl Maintenance | As designated on WQMP Plot Plan | Annually and as needed |
| MaxWell IV Drywell Inspection | As designated on WQMP Plot Plan | Quarterly, before, during, after rain event |
| MaxWell IV Drywell Maintenance | As designated on WQMP Plot Plan | Annually and as needed |
| CMP Inspection | As designated on WQMP Plot Plan | Quarterly, before, during, after rain event |
| CMP Maintenance | As designated on WQMP Plot Plan | Annually and as needed |

# Appendix 10: Educational Materials

*BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information*

AquaShield

# AQUA-SWIRL™

## HYDRODYNAMIC SEPARATION


1 Floatable debris, oils, and grease enter the storm drain

2 Contaminated water enters the Aqua-Swirl™ via the main conveyance storm pipe

3 The Aqua-Swirl™ is constructed of durable, lightweight, and high performance materials

4 Vortex separation is used to remove the gross sediment, floating debris and free-oil

5 Independent validation for TSS removal into sensitive receiving waters

INNOVATING GOOD

P19-0683 (PPE) & P20-0133 (CUP) Exhibit 11 - Appendix N
Checklist and Appendices 10411-10481 Magnolia Avenue

# AQUA-SWIRL™

## Pipe Connections

- Systems are designed with custom inlet / outlet diameters at various configuration angles
- Inlet / outlet stubouts are provided for easy coupling


## Inspection & Maintenance

- AquaShield™ offers an extensive maintenance program that ensures system performance efficiency
- Download manuals from the on-line system catalog

## Vortex Separation

- Utilizes hydrodynamic and gravitational forces with quiescent settling to remove gross pollutants
- Extensive full-scale laboratory and field testing by independent third parties

## Storage Capacities

- Large storage capacities for oil, debris, and sediment extend maintenance cycles
- Sediment storage capacities range up to 310 $ft^3$
- Oil and debris storage capacities range up to 1986 gallons

## Bypass

- Systems are designed to treat water quality flow rates and bypass peak storm events
- Internal and external bypass configurations are available

## Installation Benefits

- Quick and simple installation, resulting in measurable project cost savings
- H20 loading capabilities
- Small footprint design reduces excavation costs
- Lightweight and durable construction
- Lifting supports & cables provided

## Aqua-Swirl™ System

- Provides customized solutions for project specific requirements
- Systems designed for specific water quality treatment flows
- Modular sizes from 2.5 - 13 ft diameters with attached risers to finish grade
- On-line project and system design tool at http://pda.aquashieldinc.com

AquaShield™
WATER TREATMENT SOLUTIONS

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888.344.9044 • 423.870.8888 • 423.826.2112 (fax)

# STATEMENT OF QUALIFICATIONS

# AQUA-SWIRL® STORMWATER TREATMENT SYSTEM


**January 2017**


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# Aqua-Swirl® Statement of Qualifications

Table of Contents



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# AQUA-SWIRL® STATEMENT OF QUALIFICATIONS

## 1.0 OVERVIEW

### 1.1 Mode of Operation

The Aqua-Swirl® Stormwater Treatment System (Aqua-Swirl®) is a custom engineered, post-construction flow-through structure designed to remove sediment, floating debris, trash and free-floating oil by utilizing hydrodynamic vortex-enhanced separation (Figure 1). The United States patent, "Drainwater Treatment System for Use in a Horizontal Passageway," U.S. Patent No. 6,190,545 currently applies to the Aqua-Swirl®.

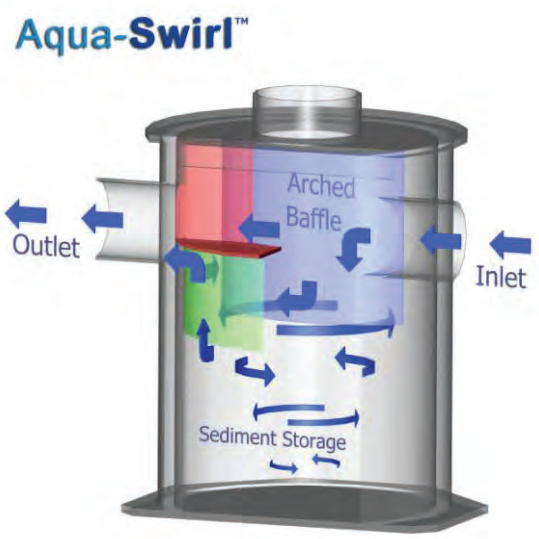


**Figure 1**. Diagram of Aqua-Swirl® Stormwater Treatment System showing the circular flow of water through the system which encourages settling of sediment and retention of floatable materials.

Aqua-Swirl® technology is a rapid or high flow rate device that has no moving parts and operates on gravity flow or movement of the stormwater runoff entering the structure. Operation begins when stormwater enters the Aqua-Swirl® by means of its tangential inlet pipe thereby inducing a circular (swirl or vortex) flow pattern. The diameter of the swirl chamber represents the effective treatment area of the device. Both sediment capture and sediment storage is accomplished within the swirl chamber. A combination of gravitational and hydrodynamic drag forces results in solids dropping out of the flow and migrating to the center of the swirl chamber where velocities are the lowest. Flow circulates downward where water exits the swirl chamber by flowing underneath and upward behind the arched inner baffle. The top of the baffle is sealed across the treatment channel to eliminate floatable pollutants from escaping the swirl chamber. A vent pipe is extended up the riser to expose the backside of the baffle to atmospheric conditions, thus preventing a siphon from forming at the bottom of the baffle. Sediment is stored at the base of the swirl chamber while floatables remain captured with the treatment area.

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## 1.2 General Equipment Design

A unique quality of the Aqua-Swirl® is its modular design which allows for faster and simpler installation on new construction or retrofit projects for existing storm drainage structures. The Aqua-Swirl® can operate in either an offline or online configuration. Offline designs rely on the use of a separate external bypass structures. The diversion structure directs only the designed water quality treatment flow ($WQ_f$) to the unit whereby flows in excess of the $WQ_f$ bypass the Aqua-Swirl®. Online Aqua-Swirl® systems utilize an internal bypass design (models designated as "BYP") to allow for the conveyance of both the $WQ_f$ and the bypass flow volumes. Aqua-Swirl® systems provide for equal invert elevations for both the inlet and outlet pipe stubouts. No external driving head is needed for operation other than that needed to convey flow according to the site design.

The diameter of the swirl chamber's treatment area varies from 2.5 to 13 feet depending on model size necessary to treat the $WQ_f$. Table 1 summarizes the available Aqua-Swirl® models, swirl chamber inner diameters, and oil/debris and sediment storage capacities.

**Table 1. Aqua-Swirl® Models and Storage Capacities**

| Aqua-Swirl® Model | Swirl Chamber Inner Diameter (ft) | Water Quality Treatment Flow Rates (cfs) | Oil/Debris Storage Capacity (gal) | Sediment Storage Capacity ($ft^3$) |
|---|---|---|---|---|
| AS-2 | 2.5 | 1.1 | 37 | 10 |
| AS-3 | 3.3 | 1.8 | 110 | 20 |
| AS-4 | 4.3 | 3.2 | 190 | 32 |
| AS-5 | 5.0 | 4.4 | 270 | 45 |
| AS-6 | 6.0 | 6.3 | 390 | 65 |
| AS-7 | 7.0 | 8.6 | 540 | 90 |
| AS-8 | 8.0 | 11.2 | 710 | 115 |
| AS-9 | 9.0 | 14.2 | 910 | 145 |
| AS-10 | 10.0 | 17.5 | 1,130 | 180 |
| AS-11 | 11.0 | 21.2 | 1,422 | 222 |
| AS-12 | 12.0 | 25.2 | 1,698 | 270 |
| AS-13 | 13.0 | 29.6 | 1,986 | 310 |
| AS-XX | Custom* | | | |

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

The Aqua-Swirl® is also designed so that it can easily be used for retrofit applications. When the invert of the inlet and outlet pipe of the Aqua-Swirl® is positioned at the same elevation the unit can easily be connected directly to the existing storm conveyance drainage system.


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Shop drawings and any other pertinent design drawings are provided on a site-specific basis. Additional information on custom designs and detail drawings can be provided on request for each of the construction materials available for the Aqua-Swirl® (see Section 2.0 construction materials). Given that Aqua-Swirl® systems can be custom designed, a number of offline configurations can be utilized. AquaShield™ can assist with facility layouts to minimize an Aqua-Swirl® footprint.

The Aqua-Swirl® has been designed and fabricated as a modular unit with no moving parts or on-site assembly required. Since the system is fabricated from high performance, lightweight and durable construction materials, the device can be installed without the use of a crane. Lifting supports are provided to allow easy offloading and installation with a backhoe or trackhoe. In addition, manufactured stubouts for the inlet and outlet piping are provided which allows the installer to simply attach the Aqua-Swirl® directly to the main conveyance storm pipe with Fernco™ or equivalent couplings. Pick weights are available on request.

All Aqua-Swirl® systems are supplied with octagonal base plates which typically extend a minimum of six inches beyond the outside diameter of the swirl chamber. The function of the base plate extension is to provide additional surface area to counter any buoyant force exerted on the system. The forces created on the base plate by the weight of the surrounding fill material offsets the buoyant force generated within the system. If needed, concrete can be poured directly onto the base plate to provide additional resistive force. AquaShield™ routinely performs buoyancy calculations for all system installations.

### 1.3 Range of Operating Conditions

Aqua-Swirl® systems have been designed to provide water quality treatment at a range of flow rates. AquaShield™ actively assists design engineers to properly size a system to meet site-specific water quality design storm. It is important to consider that when two identical Aqua-Swirl® units are installed in parallel the operating range can double from that of a single unit such that exceptionally large flow rates can be effectively treated.

### 1.4 Contaminants to be Treated

The primary waterborne contaminants of concern to be treated by the Aqua-Swirl® include:

- Suspended Sediment (commonly referred to as Total Suspended Solids, TSS)
- Trash/Debris
- Free-floating oil

The quantities of the COCs to be treated are based on site-specific pollutant loading factors. While the Aqua-Swirl® is not specifically designed to function in lieu of an oil-water separator, the device still provides treatment against free floating oil when conditions allow.


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## 1.5 Inspection and Maintenance

A comprehensive Aqua-Swirl® Inspection and Maintenance Manual is provided for each site delivery for end users to understand system operations and track and document system inspection and maintenance cycles. AquaShield™ recommends that periodic Aqua-Swirl® system inspections be performed to determine whether the disposal of captured material is needed to ensure proper operation of the treatment system. It is important to keep in mind that *all* stormwater control measures (SCMs), including manufactured treatment devices (MTDs), require some degree of maintenance. Maintenance cycles are ultimately dependent on site-specific pollutant loading conditions.

Upon installation and during construction, AquaShield™ recommends that an Aqua-Swirl® treatment system be inspected every three months and the system be cleaned as needed. A typical maintenance event for the cleaning of the swirl chamber can be accomplished with a vacuum truck without the need to enter the chamber. The Aqua-Swirl® should be inspected and cleaned at the end of construction regardless of whether it has reached its capacity for sediment or oil storage. During the first year post-construction, the Aqua-Swirl® should again be inspected every three months and cleaned as needed. AquaShield™ recommends that the system be inspected and cleaned once annually regardless of whether it has reached its sediment or floatable pollutant storage capacity. For the second and subsequent years post-construction, the Aqua-Swirl® can be inspected and cleaned once annually if the system did not reach full sediment or floatable pollutant capacity in the first year post-construction. If the Aqua-Swirl® reached full sediment or floatable pollutant capacity in less than 12 months in the first year post-construction, the system should be inspected once every six months and cleaned as needed. AquaShield™ further recommends that all external bypass structures (divergent and convergent) should be inspected whenever an inspection and maintenance event is performed. These structures can adversely affect performance and functionality if left unchecked.

Essential elements of a swirl chamber inspection include observing floating materials and measuring the accumulated sediment at the base of the swirl chamber. These two activities can be performed at the ground surface (for a typical subsurface installation) and there is no need to enter the device. Provided that there are no significant access restrictions to the facility, it is considered that a system inspection should not exceed one half hour. A typical maintenance event includes the vacuuming and disposal of floatable pollutants and sediment from the swirl concentrator. Cleaning of the swirl chamber is often accomplished by use of a vacuum truck. It is estimated that the on-site activities for maintenance should not exceed one hour and can be performed by a one or two man crew. AquaShield™ recommends that if entry to the swirl chamber is necessary for any reason, then confined space entry techniques should be followed.

Proper health and safety protocols should be followed during all inspection and maintenance events. AquaShield™ recommends that all materials removed during the maintenance process be handled and disposed in accordance with all applicable federal, state and local guidelines. Depending on the influent pollutant characteristics of the system drainage area, it may be appropriate to perform Toxicity Characteristics Leaching Procedure (TCLP) analyses on representative samples of the removed material to ensure that the handling and disposition of materials complies with all applicable environmental regulations.


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## 2.0 CONSTRUCTION MATERIALS

The Aqua-Swirl® is available using construction materials of either High Density Polyethylene (HDPE) or Polymer Coated Steel (PCS). Unique site conditions may require deviations to standard installation specifications. It is recommended that AquaShield™ be contacted prior to extraordinary installations to determine the extent to which any deviation, if possible, can be made to ensure that the integrity, functionality and product warranty of the device is maintained. Both HDPE and PCS provide high structural integrity for both long term durability and traffic loading conditions. Material specifications can be provided on request.

## 3.0 USE APPLICATIONS

Aqua-Swirl® technology can be applied to a wide variety of land uses and facilities. Common system applications include, but are not limited to, the following types of settings:

- Retail/Commercial Developments
- New and Existing Industrial Facilities
- Highway Construction
- Transportation facilities
- Watershed Protection
- Redevelopment/Retrofit Sites
- Government Facilities
- Military Installations, Bases and Berthing Wharfs
- Vehicle and Equipment Wash Rack Areas
- Fueling Centers and Convenience Stores
- Fast Food Restaurants
- Office Complexes
- Religious Centers
- Educational Facilities
- Residential Developments (single and multi-family)
- Coastal Zone Management Communities
- Drinking Water Well-head Protection Areas

Thousands of Aqua-Swirl® systems have been installed throughout the United States including the Commonwealth of Puerto Rico and the Territory of Guam. Aqua-Swirl® systems are also installed in Brazil, Canada, Hong Kong, India, the Middle East, Russia, South Korea and United Kingdom. Climatic conditions for Aqua-Swirl® installations range anywhere from sub-arctic (e.g., central Alaska) to sub-tropical locales. Information concerning domestic and international projects can be provided on request.

## 4.0 PERFORMANCE TESTING

The Aqua-Swirl® has completed comprehensive, independent full scale model testing in both laboratory and field settings. Summaries of both testing programs are provided in the following two sections.


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P19-0683 (PPE) & P20-0133 (CUP) Exhibit 11 - Appendix N
Checklist and Appendices 10411-10481 Magnolia Avenue

## 4.1 Laboratory Testing

Independent performance testing of an Aqua-Swirl® Model AS-3 was conducted by the Department of Civil and Environmental Engineering at Tennessee Tech University (TTU), Cookeville and is described in the findings report, *Laboratory Evaluation of TSS Removal Efficiency for Aqua-Swirl® Concentrator Stormwater Treatment System*. The test parameters included loading rates, sediment concentrations, specific gravity, head loss, and particle size distribution. The test sediment was OK-110 manufactured by U.S. Silica, having a specific gravity of 2.65. The test material has a particle size range of approximately 50 to 150 microns (µm), representing the finest fraction of sand particulate. The test sediment manufacturer reports a median ($d_{50}$) particle size of 110 µm. However, other independent laboratory-specific testing programs performed in association with Aqua-Swirl® product development actually demonstrated a $d_{50}$ of 90 to 95 µm. Note that OK-110 is no longer manufactured due to the manufacturer's inability to consistently meet the product specification.

Total suspended solids (TSS) concentrations were determined by the Suspended Sediment Concentration (SSC) analytical method consistent with ASTM D3977. The SSC method differs from the commonly cited TSS analytical method, EPA 2540D (formerly EPA 160.2) such that the SSC analysis is a whole sample TSS procedure. The analytical results of influent and effluent sample pair concentrations were used to calculate SSC removal efficiencies for each run at the target loading rates and concentrations. This study concluded that Aqua-Swirl® achieves an SSC removal efficiency of 91% on a net annual basis.

The results of this laboratory testing program have been independently verified by the New Jersey Corporation for Advanced Technology (NJCAT). The Washington State Department of Ecology has also assigned the General Use Level Designation (GULD) for Pretreatment (TSS) for the Aqua-Swirl®.

## 4.2 Field Testing

An Aqua-Swirl® Model AS-5 completed a 27 month independent field testing program in accordance with the Technology Acceptance Reciprocity Partnership (TARP) Tier II Field Testing Protocol. A total of 18 storms and 15.16 inches of rain were sampled between March 2009 and June 2011, demonstrating that the Aqua-Swirl® achieved 86% and 87% TSS and SSC removal efficiency, respectively. AECOM of Philadelphia, Pennsylvania served as the independent field testing organization. The test site is an asphalt covered parking lot with landscaped areas at the urban retail center in Silver Spring, Maryland (metro Washington D.C.). All samples were collected using ISCO autosamplers positioned at the influent and effluent pipe connections. ISCO area-velocity modules were used to gauge influent and effluent flow conditions. Suspended sediment analyses were performed by both the TSS and SSC Methods as cited above. Particle size distribution (PSD) was determined by serial filtration. Average influent PSD data indicates that 86% of the particulate is <125 µm and 72% of the particulate is silt (1.5 to 63 µm). The test site particulate is classified as a clay loam textured sediment. The target NJDEP PSD is to exhibit a particulate range of 1.0 to 1,000 µm and a $d_{50}$ of 67 µm. Figure 1 illustrates the influent PSD curve for the AS-5 and includes the NJDEP PSD standard. All field test analyses were performed by Test America, Inc. of Burlington, Vermont, a NELAP and New Jersey certified facility.


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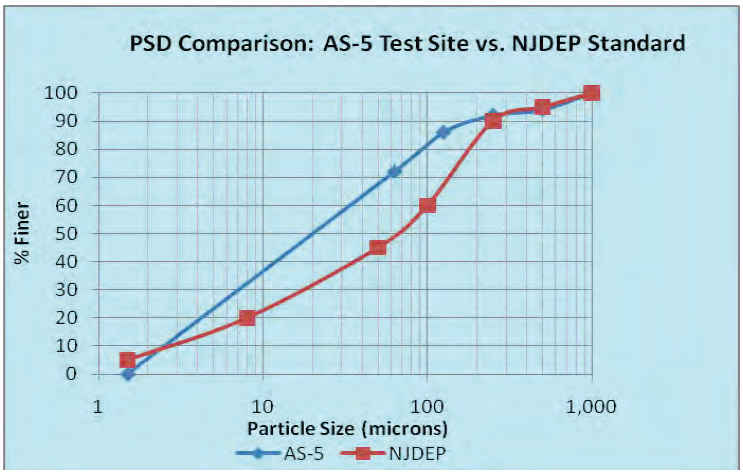


**Figure 2**. Particle size distribution for AS-5 Field test versus NJDEP laboratory test sediment particulate distribution.

Table 2 summarizes TSS and SSC removal efficiencies, storm durations, storm sizes, peak intensities, peak loading rates and percentage TVSS of TSS. Cumulative average sediment removal efficiencies for TSS and SSC are 86 and 87%, respectively. Cumulative average influent TSS and SSC concentrations are 132 and 145 mg/L, respectively. Storm sizes range from 0.11 to 4.4 inches with storm intensities ranging from 0.15 to 5.49 in/hr. Influent loading rates range from 1.9 to 35.4 gpm/ft$^2$.

The AS-5 field testing results have also been independently verified by NJCAT to achieve 86% TSS removal on an annual basis, consistent with the laboratory findings. The Washington State Department of Ecology subsequently issued Conditional Use Level Designation (CULD) for the Aqua-Swirl® based on the results of the AS-5 field test.

## 5.0 REGULATORY APPROVALS

The approval lists included herein are not intended to represent all Aqua-Swirl® approvals or installation locations. Instead, the listings represent regulatory agencies that have some recognized measure of technology review in association with their local approval process for manufactured stormwater treatment devices (MTDs). Given that there are a number of scenarios that can be followed in order to gain a regulatory approval, the lists included below provide a high level of credibility toward the approval of the Aqua-Swirl® in a variety of regional and regulatory diverse settings. Additional information can be provided regarding regulatory approvals and installation locales.


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**Table 2. Summary of Sediment Removal Efficiency and Storm Characteristics**

| # | Sample Date | TSS RE (%) | SSC RE (%) | Storm Duration (hr:min) | Storm Size (in) | Peak Storm Intensity (in/hr) | Peak Loading Rate (gpm/ft$^2$) | % TVSS of TSS |
|---|---|---|---|---|---|---|---|---|
| 1 | 3/14/2009 | 98.3 | 99.3 | 0:30 | 0.11 | 0.26 | 4.1 | NA |
| 2 | 4/1/2009 | 86.8 | 82.7 | 0:50 | 0.18 | 0.46 | 8.1 | NA |
| 3 | 4/6/2009 | 82.5 | 85.5 | 2:00 | 0.15 | 0.26 | 4.8 | NA |
| 4 | 12/25-26/2009 | 99.0 | 99.5 | 11:45 | 0.56 | 0.38 | 4.8 | NA |
| 5 | 1/17/2010 | 94.8 | 96.3 | 4:48 | 0.59 | 0.42 | 10.4 | NA |
| 6 | 7/25/2010 | 94.1 | 96.5 | 0:46 | 0.55 | 1.21 | 16.9 | 38.8 |
| 7 | 8/12/2010 | 63.9 | 68.0 | 3:00 | 1.82 | 5.49 | 30.9 | 22.3 |
| 8 | 9/12/2010 | 96.5 | 96.6 | 3:45 | 0.61 | 0.49 | 13.1 | 31.0 |
| 9 | 9/29-30/2010 | 59.9 | 57.4 | 12:05 | 4.40 | 2.56 | 35.4 | 20.9 |
| 10 | 12/1/2010 | 89.1 | 86.9 | 6:20 | 0.71 | 1.82 | 4.1 | 16.7 |
| 11 | 12/11/2010 | 96.1 | 97.7 | 3:40 | 0.72 | 0.58 | 2.3 | 29.2 |
| 12 | 2/25/2011 | 73.0 | 72.8 | 2:15 | 0.29 | 0.25 | 4.1 | 29.0 |
| 13 | 3/6/2011 | 86.1 | 92.5 | 4:50 | 1.42 | 0.46 | 11.0 | 25.4 |
| 14 | 3/15-16/2011 | 88.1 | 91.7 | 5:06 | 0.42 | 0.35 | 1.9 | 24.4 |
| 15 | 4/8/2011 | 94.1 | 95.8 | 3:55 | 0.52 | 0.15 | 3.4 | 25.2 |
| 16 | 4/28/2011 | 80.4 | 82.0 | 2:19 | 0.23 | 0.23 | 12.5 | 71.4 |
| 17 | 5/14/2011 | 90.6 | 90.3 | 3:05 | 0.85 | 0.47 | 5.7 | 48.9 |
| 18 | 6/16/2011 | 74.3 | 82.7 | 3:20 | 1.03 | 0.91 | 13.1 | 48.9 |
| | **Average** | **86.0** | **87.3** | | **0.84** | **0.93** | **10.4** | **33.2** |
| | | | | Total | 15.16 | | | |

## 5.1 States and Provinces

The following states and Ontario are recognized to issue use level designation for MTDs. Both NJDEP and Washington State administer the most widely recognized stormwater management programs throughout the U.S.

| State / Province | Agency | Aqua-Swirl® Approval Status |
|---|---|---|
| New Jersey | Department of Environmental Protection | Field Test Certification |
| | | Laboratory Test Certification |
| Washington | Department of Ecology | General Use Level Designation for Pretreatment (TSS) |
| | | Conditional Use Level Designation for Basic (TSS) Treatment |
| Maryland | Department of the Environment | Approved |
| Virginia | Department of Environmental Quality | Approved (Total Phosphorus 20%) |
| Wisconsin | Department of Commerce. | Approved |
| Ontario | Ministry of the Environment | Certificate of Technology Assessment |


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### 5.2 State Departments of Transportation

Several states utilize their respective Departments of Transportation as a regulatory agency to administer the MTD approval process. These approvals can include use level designations specific to highway projects and can extend to most other installation applications for which MTD technologies can be utilized. It should also be kept in mind that a number of local jurisdictions also rely on their state's DOT for MTD approvals. The table below lists state DOTs that have approved the Aqua-Swirl®.

| State DOT | Aqua-Swirl® Designation |
|---|---|
| California | Approved |
| Michigan | Approved |
| New Jersey | Approved |
| North Carolina | Provisional Use |
| Ohio | Qualified Products List |
| Rhode Island | Approved |
| Texas | Approved |
| Utah | Approved |

### 5.3 Regional Planning Authorities / Water Use Districts

The Aqua-Swirl® maintains several approvals at the regional planning authority or water use district levels such that municipalities within those jurisdictions typically adopt these MTD approvals. Examples of such jurisdictional approvals for which the Aqua-Swirl® are cited below.

| Jurisdiction | Example Municipality(s) |
|---|---|
| Northwest Florida Water Mgmt. District | Tallahassee |
| Nashville, TN Metro Water Services | Nashville, Brentwood, Franklin |
| Puerto Rico Electric Power Authority | Island |
| St. Louis, MO Metro Sewer District | St. Louis and surrounding municipalities, Missouri |
| Tahoe Regional Planning Agency | Lake Tahoe Basin, Nevada and California |

### 5.4 Counties

Aqua-Swirl® approvals have also been issued through several counties that administer stormwater management programs that include an MTD approval process. These approvals may be implemented such that an MTD can be installed at locations only outside of an incorporated municipality in that county (e.g., Montgomery County). Or, the county approval can be used such that an Aqua-Swirl® can be installed at any location within the county (e.g., Whitfield County). The Aqua-Swirl® is approved at the following county levels:


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| County | State | Example Municipality(s) w/in County |
|---|---|---|
| Ada, Highway District | Idaho | Boise |
| Hamilton | Tennessee | Chattanooga |
| Knox | Tennessee | Knoxville |
| Los Angeles | California | Greater Los Angeles area |
| Montgomery | Maryland | Unincorporated areas |
| San Diego | California | San Diego |
| Whitfield | Georgia | Dalton |

### 5.5 Municipalities

A representative list of municipalities that have required some degree of Aqua-Swirl® evaluation and approval is provided below. It should again be kept in mind that this list does not include every locale where either approvals or installations have occurred.

| State / Province | Municipality | State / Province | Municipality |
|---|---|---|---|
| Alabama | Mobile | North Carolina | Hendersonville |
| California | Santa Monica | Ontario | Hamilton |
| | Stockton | | Oshawa |
| Georgia | Alpharetta | | Ottawa |
| Hawaii | Honolulu | | Simcoe |
| Idaho | Boise | | Toronto (pending) |
| | Caldwell | Oregon | Eugene |
| | Meridian | | Prineville |
| Indiana | Auburn | Quebec | Montréal |
| | Fishers | | Port de Tois-Rivières |
| | Indianapolis | | Quebec City |
| Maryland | Rockville | | Lac Mégantic |
| | Bethesda | Tennessee | Chattanooga |
| | Laurel | | Knoxville |
| | Waldorf | | Murfreesboro |
| Michigan | Farmington Hills | Utah | Salt Lake City |
| | Fenton | | South Jordan |
| | Novi | | Vernal |
| Montana | Billings | Washington (Eastern) | Spokane |
| | Bozeman | Washington D.C. | District of Columbia |
| | Butte | Wyoming | Jackson Hole |

## 6.0 LIMITED WARRANTY

An Aqua-Swirl® one year limited warranty comes standard with each device and covers against failure due to improper workmanship or defective materials for one year from delivery date. Liability limitations are described in the warranty which is available on request.


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# Aqua-Swirl®
# Stormwater Treatment System

## Inspection and Maintenance Manual

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

**March 2014**


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# Table of Contents




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# AquaShield™, Inc
## Stormwater Treatment Solutions

The highest priority of AquaShield™, Inc. (AquaShield™) is to protect waterways by providing stormwater treatment solutions to businesses across the world. These solutions have a reliable foundation based on over 20 years of water treatment experience.

Local regulators, engineers, and contractors have praised the AquaShield™ systems for their simple design and ease of installation. All the systems are fabricated from high performance, durable and lightweight materials. Contractors prefer the quick and simple installation of our structures that saves them money.

The patented line of AquaShield™ stormwater treatment products that provide high levels of stormwater treatment include the following:

- **Aqua-Swirl® Stormwater Treatment System:** hydrodynamic separator, which provides a highly effective means for the removal of sediment, floating debris and free-oil.

- **Aqua-Filter™ Stormwater Filtration System:** treatment train stormwater filtration system capable of removing gross contaminants, fine sediments, waterborne hydrocarbons, heavy metals and total phosphorous.

**Aqua-Swirl® Stormwater Treatment System**

**Aqua-Filter™ Stormwater Filtration System**


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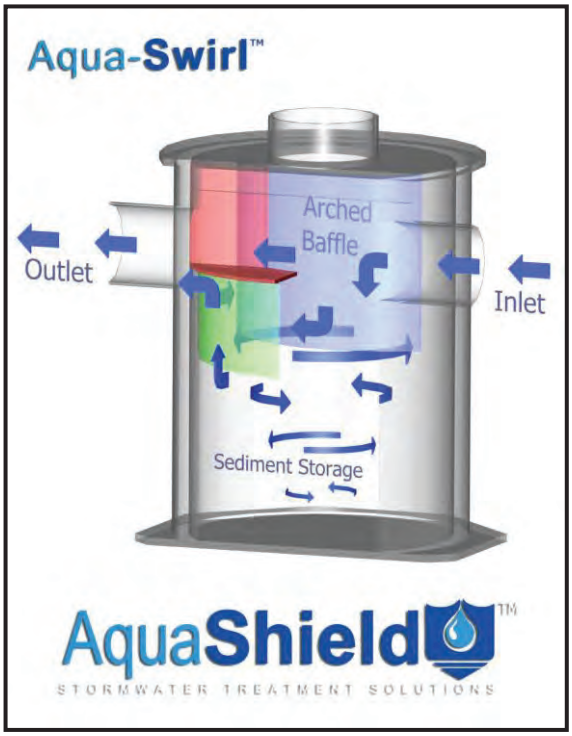
# Aqua-Swirl® Stormwater Treatment System

The patented Aqua-Swirl® Stormwater Treatment System is a single chamber hydrodynamic separator which provides a highly effective means for the removal of sediment, free oil, and floating debris. Both treatment and storage are accomplished in the swirl chamber without the use of multiple or "blind" chambers. Independent laboratory and field performance verifications have shown that the Aqua-Swirl® achieves over 80% suspended solids removal efficiency on a net annual basis.

The Aqua-Swirl® is most commonly installed in an "off-line" configuration. Or, depending on local regulations, an "in-line" (on-line) conveyance flow diversion (CFD) system can be used. The CFD model allows simple installation by connecting directly to the existing storm conveyance pipe thereby providing full treatment of the "first flush," while the peak design storm is diverted and channeled through the main conveyance pipe.




The patented Aqua-Swirl® Stormwater Treatment System provides a highly effective means for the removal of sediment, floating debris, and free oil. Swirl technology, or vortex separation, is a proven form of treatment utilized in the stormwater industry to accelerate gravitational separation.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**Floatable debris in the Aqua-Swirl®**

Each Aqua-Swirl® is constructed of high performance, lightweight and durable materials including polymer coated steel (PCS), high density polyethylene (HDPE), or fiberglass reinforced polymer (FRP). These materials eliminate the need for heavy lifting equipment during installation.

## System Operation

The treatment operation begins when stormwater enters the Aqua-Swirl® through a tangential inlet pipe that produces a circular (or vortex) flow pattern that causes contaminates to settle to the base of the unit. Since stormwater flow is intermittent by nature, the Aqua-Swirl® retains water between storm events providing both dynamic and quiescent settling of solids. The dynamic settling occurs during each storm event while the quiescent settling takes place between successive storms. A combination of gravitational and hydrodynamic drag forces encourages the solids to drop out of the flow and migrate to the center of the chamber where velocities are the lowest.

The treated flow then exits the Aqua-Swirl® behind the arched outer baffle. The top of the baffle is sealed across the treatment channel, thereby eliminating floatable pollutants from escaping the system. A vent pipe is extended up the riser to expose the backside of the baffle to atmospheric conditions, preventing a siphon from forming at the bottom of the baffle.

## Custom Applications

The Aqua-Swirl® system can be modified to fit a variety of purposes in the field, and the angles for inlet and outlet lines can be modified to fit most applications. The photo below demonstrates the flexibility of Aqua-Swirl® installations using a “twin” configuration in order to double the


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water quality treatment capacity. Two Aqua-Swirl® units were placed side by side in order to treat a high volume of water while occupying a small amount of space.

**Custom designed AS-9 Twin Aqua-Swirl®**

## Retrofit Applications

The Aqua-Swirl® system is designed so that it can easily be used for retrofit applications. With the invert of the inlet and outlet pipe at the same elevation, the Aqua-Swirl® can easily be connected directly to the existing storm conveyance drainage system. Furthermore, because of the lightweight nature and small footprint of the Aqua-Swirl®, existing infrastructure utilities (i.e., wires, poles, trees) would be unaffected by installation.

## AquaShield™ Product System Maintenance

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

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

In order to ensure that our systems are being maintained properly, AquaShield™ offers a maintenance solution to all of our customers. We will arrange to have maintenance performed.


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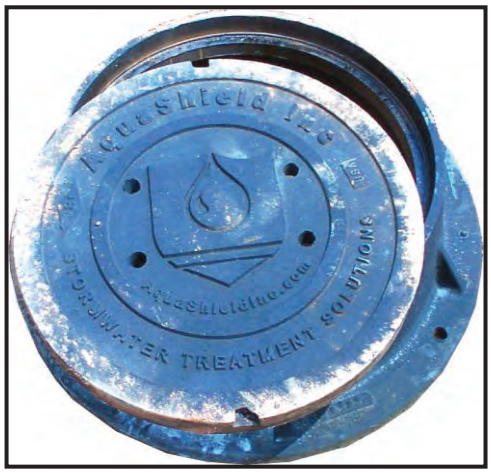


## Inspection

All AquaShield™ products can be inspected from the surface, eliminating the need to enter the systems to determine when cleanout should be performed. In most cases, AquaShield™ recommends a quarterly inspection for the first year of operation to develop an appropriate schedule of maintenance. Based on experience of the system's first year in operation, we recommend that the inspection schedule be revised to reflect the site-specific conditions encountered. Typically, the inspection schedule for subsequent years is reduced to semi-annual inspection.

## Aqua-Swirl® Maintenance

The Aqua-Swirl® has been designed to minimize and simplify the inspection and maintenance process. The single chamber system can be inspected and maintained entirely from the surface thereby eliminating the need for confined space entry. Furthermore, the entire structure (specifically, the floor) is accessible for visual inspection from the surface. There are no areas of the structure that are blocked from visual inspection or periodic cleaning. Inspection of any free-floating oil and floatable debris can be directly observed and maintained through the manhole access provided directly over the swirl chamber.

**Aqua-Swirl® Inspection Procedure**

To inspect the Aqua-Swirl®, a hook is needed to remove the manhole cover. AquaShield™ provides a customized manhole cover with our distinctive logo to make it easy for maintenance crews to locate the system in the field. We also provide a permanent metal information plate


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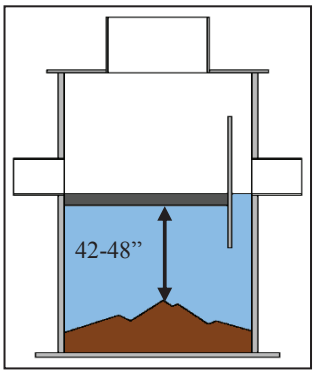
affixed inside the access riser which provides our contact information, the Aqua-Swirl® model size, and serial number.

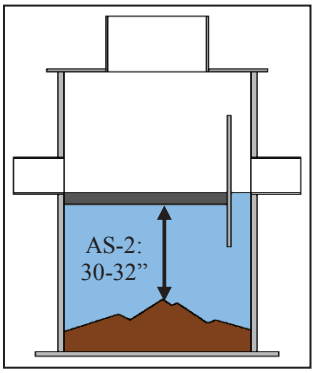
The only tools needed to inspect the Aqua-Swirl® system are a flashlight and a measuring device such as a stadia rod or pole. Given the easy and direct accessibility provided, floating oil and debris can be observed directly from the surface. Sediment depths can easily be determined by lowering a measuring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

**Sediment inspection using a stadia rod in a single chamber**

The maintenance trigger for Aqua-Swirl® Models AS-3 through AS-13 occurs when the sediment pile is within 42 to 48 inches of the standing water surface. For the Aqua-Swirl® Model AS-2, maintenance is needed when the top of the sediment pile is measured to be 30 to 32 inches below the standing water surface.




**Maintenance trigger for Aqua-Swirl® Models AS-3 through AS-13 occurs when sediment pile is 42-48 inches below water surface.**




**Maintenance trigger for Aqua-Swirl® Model AS-2 occurs when sediment pile is 30 to 32 inches below water surface.**

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

**Aqua-Swirl® Cleanout Procedure**

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

**Disposal of Recovered Materials**

Disposal of recovered material is typically handled in the same fashion as catch basin cleanouts. AquaShield™ recommends that all maintenance activities be performed in accordance with appropriate health and safety practices for the tasks and equipment being used.

AquaShield™ also recommends that all materials removed from the Aqua-Swirl® and any external structures (e.g, bypass features) be handled and disposed in full accordance with any applicable local and state requirements.

**Vacuum truck quickly cleans the Aqua-Swirl® from a single chamber**

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


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# Aqua-Swirl® Inspection and Maintenance Manual
# Work Sheets

## SITE and OWNER INFORMATION

Site Name: _____

Site Location: _____

Date: _____ Time: _____

Inspector Name: _____

Inspector Company: _____ Phone #: _____

Owner Name: _____

Owner Address: _____

Owner Phone #: _____ Emergency Phone #: _____

## INSPECTIONS

### I. Floatable Debris and Oil

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

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

### II. Sediment Accumulation

1. Lower measuring device (e.g. stadia rod) into swirl chamber through service access provided until top of sediment pile is reached.
2. Record distance to top of sediment pile from top of standing water: _____ inches
3. For Aqua-Swirl® Models AS-3 through AS-13, schedule cleaning if value in Step #2 is 48 to 42 inches or less.
4. For Aqua-Swirl® Model AS-2, schedule cleaning if value in Step #2 is 32 to 30 inches or less.


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### III. Diversion Structures (External Bypass Features)

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

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

## CLEANING

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

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

## MAINTENANCE SCHEDULE

### I. During Construction

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

### II. First Year Post-Construction

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

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

### III. Second and Subsequent Years Post-Construction

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

If the Aqua-Swirl® reached full sediment or floatable pollutant capacity in less than 12 months in the First Year Post-Construction period, the system should be inspected once


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every six (6) months and cleaned as needed. The Aqua-Swirl® should be cleaned annually regardless of whether it reaches its sediment or floatable pollutant capacity.

## IV. Bypass Structures

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

## MAINTENANCE COMPANY INFORMATION

Company Name: _____

Street Address: _____

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

Contact: _____ Title: _____

Office Phone: _____ Cell Phone: _____

## ACTIVITY LOG

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

Time of Cleaning: Start: _____ End: _____

Date of Next Inspection: _____

Floatable debris present: Yes No

Notes: _____

_____

_____

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

Measurement method and notes: _____

_____

_____

## STRUCTURAL CONDITIONS and OBSERVATIONS

Structural damage: Yes No Where: _____


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Structural wear: Yes No Where: _____

Odors present: Yes No Describe: _____

Clogging: Yes No Describe: _____

Other Observations: _____

_____

_____

## NOTES

| Additional Comments and/or Actions To Be Taken | Time Frame |
|---|---|
| | |
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## ATTACHMENTS

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


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# Aqua-Swirl®

## TABULAR MAINTENANCE SCHEDULE

Date Construction Started: _____

Date Construction Ended: _____

### During Construction

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

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

### First Year Post-Construction

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

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

### Second and Subsequent Years Post-Construction

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

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

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


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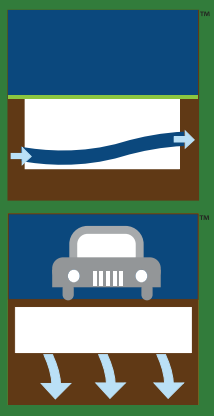
# UrbanGreen™

## Metal Detention and Infiltration Products



Scan Me!

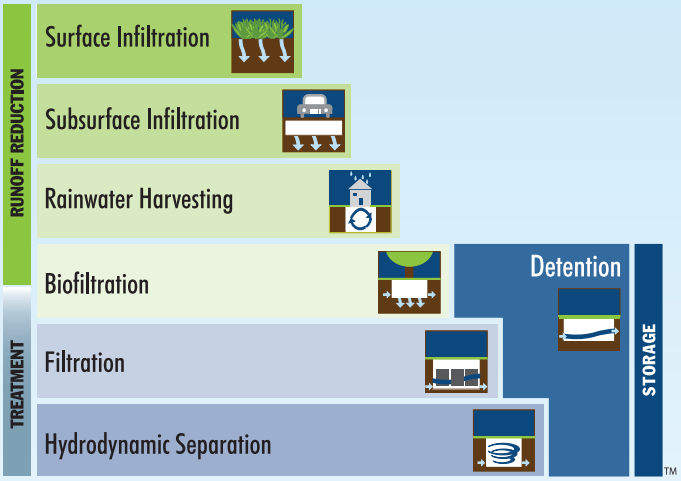
CONTECH® ENGINEERED SOLUTIONS

P19-0683 (PPE) & P20-0133 (CUP) Exhibit 11 - Appendix N
Checklist and Appendices 10411-10481 Magnolia Avenue

# Corrugated Metal Pipe for Stormwater Detention and Infiltration

## Selecting the right stormwater solution just got easier...

It's simple to choose the right low impact development (LID) solution to achieve your runoff reduction goals with the Contech UrbanGreen™ Staircase. First, select the runoff reduction practices that are most appropriate for your site, paying particular attention to pretreatment needs. If the entire design storm cannot be retained, select a treatment best management practice (BMP) for the balance. Finally, select a detention system to address any outstanding downstream erosion.




© 2012 Contech Engineered Solutions LLC

Learn more about our low impact development at:
www.ContechES.com/lid

## Meet your stormwater quantity and runoff reduction requirements with ease.

Contech's corrugated metal pipe (CMP) underground detention/infiltration systems can be sized and shaped to meet your site-specific needs. The versatile material provides almost limitless opportunities to match individual site requirements while lowering site development costs.

### Durable

- Proven service life – Exceeds 100-years with proper specification that meets all AASHTO and ASTM pipe specifications
- Handles fill heights in excess of 100 feet – steel combines strength with soil
- 100% traceable material – maintains performance even when recycled
- Homogenous material – eliminates failures due to stress cracks, shrinkage cracks and air voids
- Various coatings available with predictable service life
  - Aluminized Steel™ Type 2
  - Galvanized
  - CORLIX®
  - TRENCHCOAT®

Learn more about our available coatings at:
www.ContechES.com/cmp

various coatings available

## Versatile

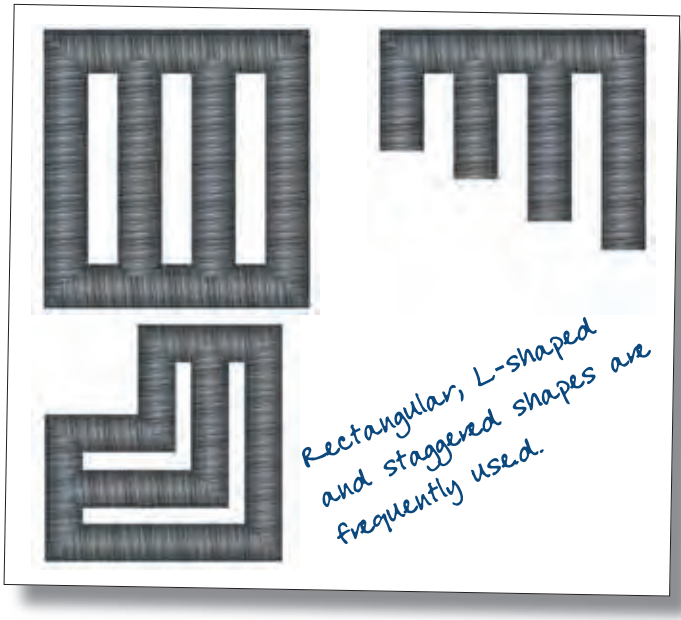
- Wide range of shapes and sizes – round and pipe-arch in diameters from 6 to 144 inches
- Variety of layouts – rectangular, L-shape and staggered cells are frequently used
- Array of fittings – tees, wyes, elbow, saddle branches, manifolds, reducers and custom fabrication available

## Sustainable

- World's most recycled content – can count towards LEED® credits
- Requires less energy and materials to produce – lowers carbon footprint

Learn how Contech products can help contribute to LEED credits at: www.ContechES.com/LEED

Tees, wyes, elbows, saddle branches, manifolds and reducers are available

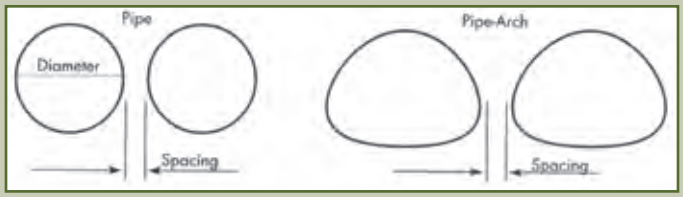


Rectangular, L-shaped and staggered shapes are frequently used.

## Easy to Install and Maintain

- Flexible and forgiving during installation
- Lightweight for easy handling
- Quick assembly shortens site development time
- Integrated outlet control structure eliminates need for downstream control structure
- Manhole riser sections, complete with ladders facilitate any access and scheduled maintenance

# Typical Spacing for Multiple Barrels




| Diameter | Spacing* | Pipe-Arch Span | Spacing* |
|---|---|---|---|
| Up to 24" | 12" | Up to 36" | 12" |
| 24" to 72" | 1/2 Diameter of Pipe | 36" to 108" | 1/3 Span of Pipe-Arch |
| 72" + | 36" | 108" to 189" | 36" |

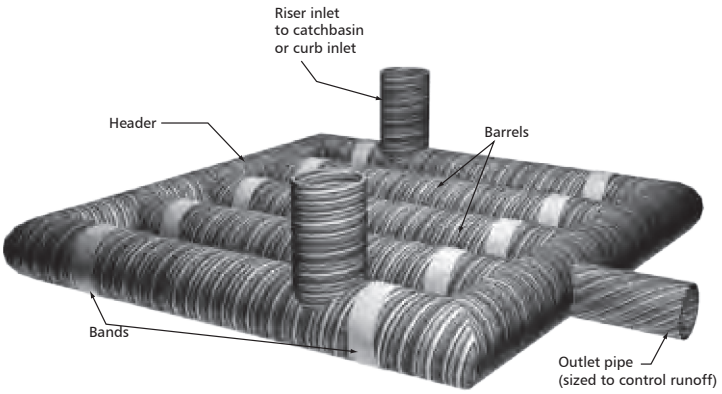
* Spacing shown provides room for proper backfill to enable the structure to develop adequate side support. Spacing with AASHTO M-145, A-1, A-2, A-3 granular fill. Closer spacing is possible depending on quality of backfill and placing and compaction methods.


P19-0683 (PPE) & P20-0133 (CUP) Exhibit 11 - Appendix N
Checklist and Appendices 10411-10481 Magnolia Avenue

# Applications

## Detention

Contech CMP detention systems store stormwater runoff exceeding a site's allowable discharge rate and release it slowly over time. Installed belowgrade, the systems maximize property usage and meet your specific water quantity requirements. CMP detention systems are available in all AASHTO M-36 Types. For larger systems, the Optimizer™ flow control device can reduce required storage volume.




CMP detention system

## High Volume Storage

Contech plate systems allow for high volume stormwater storage in small footprint areas. The systems are offered in a wide variety of shapes and sizes in both aluminum and galvanized steel. Full-pipe systems and three-sided structures with open bottoms can be used for infiltration.

Typically, Contech plate systems are used on high vertical rise applications or in areas where the smallest possible footprint is of the greatest concern. The systems are bolted together in the field, which reduces the number of freight loads. Remote sites or projects with challenging accessibility often utilize plate systems.

Plate system for high volume storage



P19-0683 (PPE) & P20-0133 (CUP) Exhibit 11 - Appendix N
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Perforated CMP infiltration system

## Infiltration

CMP pipe and pipe-arch is available fully or partially perforated to meet your Low Impact Development (LID) requirements. Standard pipe-wall perforations (3/8" diameter holes meeting AASHTO M-36, Class 2) provide approximately 2.5% open area. Subsurface perforated CMP infiltration systems store stormwater runoff in the pipe and surrounding stone during a storm until it can be slowly released into the surrounding native soil.

Stormwater runoff is stored in the pipe and surrounding stone.

# Meet Your Low Impact Development Requirements


Pipe-arch for low profile application.

## Low Profile

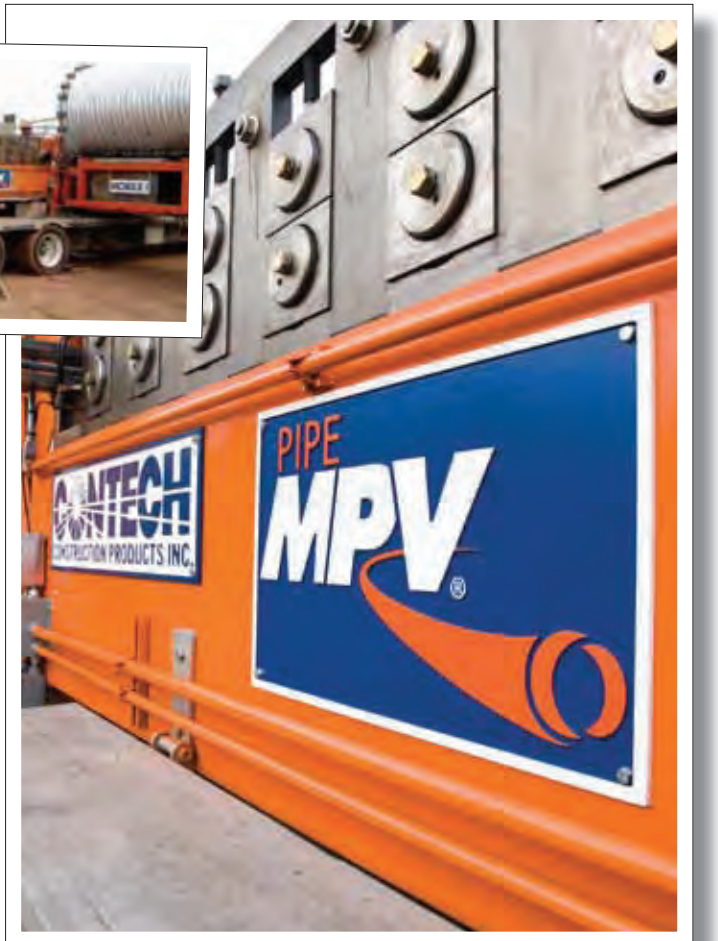
When vertical space must be maximized, the CMP can be utilized in a pipe-arch shape. The low, wide pipe-arch design allows for greater storage in a shallow profile than typical round pipe without losing any structural integrity. Like our round pipe, pipe arch is produced in six wall thicknesses including 18, 16, 14, 12, 10 and 8 gage, which are available with either helical or annular corrugations.

# Applications

## On-Site Manufacturing

If your job site is remote or you have limited storage space or restricted traffic patterns, take advantage of our Mobile Production Vehicle (MPV) for fast and cost effective on-site steel pipe manufacturing. The PIPE MPV® is designed to be a self-supporting factory that can be quickly deployed and put into production. Once on site, pipe manufacturing progresses quickly enough to allow pipe installation within four hours.

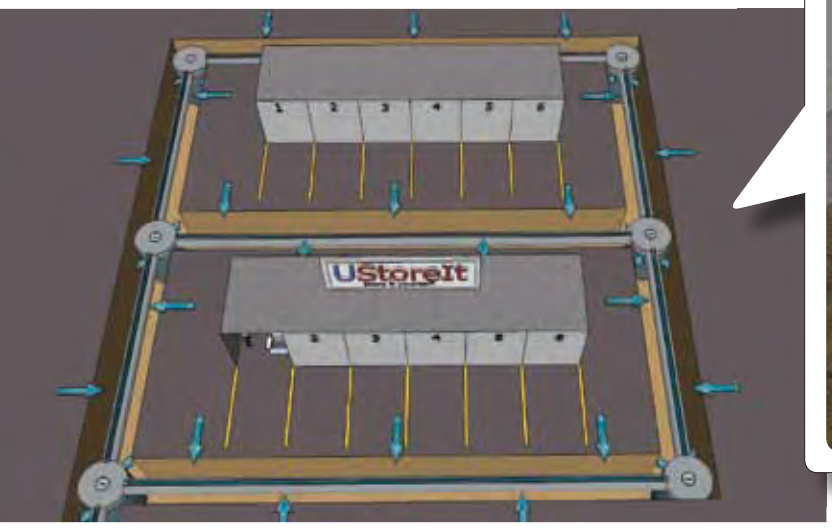
The PIPE MPV can produce corrugated metal pipe in a variety of sizes. Diameters from 36" – 192" and lengths up to 35' can be accommodated. This pipe meets the same levels of quality construction as does all Contech manufactured pipe, with high coil feedrate speeds and the same lock-seem edge process used in conventional pipe manufacturing.

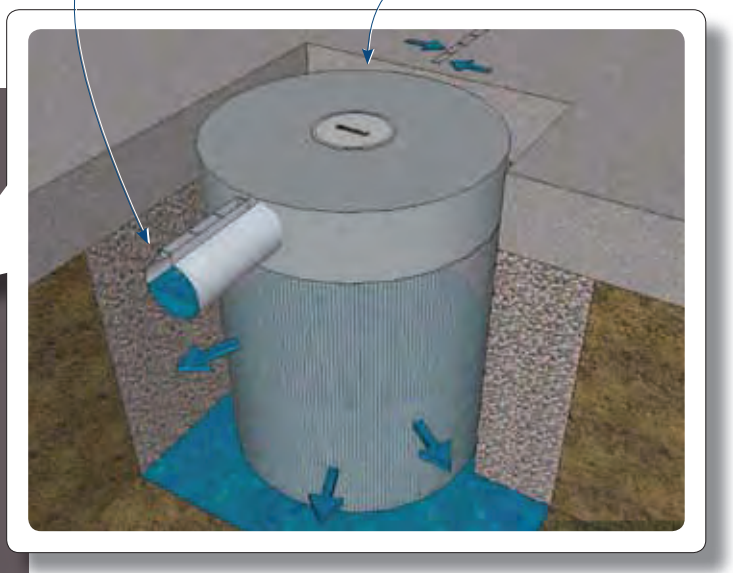



Mobile Production vehicle

## Innovative Solutions for Challenging Sites

The flexibility of CMP allows you to create innovative solutions when dealing with challenging sites. For example, when trying to meet runoff reduction requirements, your site may be mostly impervious or you may have a thin, shallow clay layer just below the surface, limiting the infiltration capacity of surface BMPs. One solution is to utilize CMP infiltration wells. First, collect the site runoff using our Slotted Drain™ around the perimeter of each drive isle. The Slotted Drain then directs water into vertical lengths of perforated CMP. The vertical perforated CMP is long enough to penetrate the clay layer and infiltrate the stormwater into a highly permeable alluvial layer about 12'-14' belowground. This allows the developer to meet the LID requirements and eliminate the need for the extended detention basin.



# Sizing

## Round Pipe - CMP and Plate (CMP → 12-in to 144-in; Plate → 60-in to 240-in)

| Diameter (inches) | Volume ($ft^3/ft$) | Min. Cover Height | Diameter (inches) | Volume ($ft^3/ft$) | Min. Cover Height | Diameter (inches) | Volume ($ft^3/ft$) | Min. Cover Height | Diameter (inches) | Volume ($ft^3/ft$) | Min. Cover Height |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | .78 | 12″ | 60 | 19.6 | 12″ | 120 | 78.5 | 18″ | 180 | 176 | 24″ |
| 15 | 1.22 | 12″ | 66 | 23.7 | 12″ | 126 | 86.5 | 18″ | 186 | 188 | 24″ |
| 18 | 1.76 | 12″ | 72 | 28.2 | 12″ | 132 | 95.0 | 18″ | 192 | 201 | 24″ |
| 21 | 2.40 | 12″ | 78 | 33.1 | 12″ | 138 | 103.8 | 18″ | 198 | 213 | 30″ |
| 24 | 3.14 | 12″ | 84 | 38.4 | 12″ | 144 | 113.1 | 18″ | 204 | 227 | 30″ |
| 30 | 4.9 | 12″ | 90 | 44.1 | 12″ | 150 | 122 | 24″ | 210 | 240 | 30″ |
| 36 | 7.0 | 12″ | 96 | 50.2 | 12″ | 156 | 132 | 24″ | 216 | 254 | 30″ |
| 42 | 9.6 | 12″ | 102 | 56.7 | 18″ | 162 | 143 | 24″ | 222 | 268 | 30″ |
| 48 | 12.5 | 12″ | 108 | 63.6 | 18″ | 168 | 153 | 24″ | 228 | 283 | 30″ |
| 54 | 15.9 | 12″ | 114 | 70.8 | 18″ | 174 | 165 | 24″ | 234 | 298 | 30″ |

## Pipe-Arch - CMP

| 1/2″ Deep Corrugations | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shape (inches) | Volume ($ft^3/ft$) | Min. Cover Height | Shape (inches) | Volume ($ft^3/ft$) | Min. Cover Height | Shape (inches) | Volume ($ft^3/ft$) | Min. Cover Height | Shape (inches) | Volume ($ft^3/ft$) | Min. Cover Height |
| 17 x 13 | 1.1 | 12″ | 28 x 20 | 2.9 | 12″ | 49 x 33 | 8.9 | 12″ | 71 x 47 | 18.1 | 12″ |
| 21 x 15 | 1.6 | 12″ | 35 x 24 | 4.5 | 12″ | 57 x 38 | 11.6 | 12″ | 77 x 52 | 21.9 | 12″ |
| 24 x 18 | 2.2 | 12″ | 42 x 29 | 6.5 | 12″ | 64 x 43 | 14.7 | 12″ | 83 x 57 | 26.0 | 12″ |
| 1″ Deep Corrugations | | | | | | | | | | | |
| 60 x 46 | 15.6 | 15″ | 81 x 59 | 27.4 | 18″ | 103 x 71 | 42.4 | 18″ | 128 x 83 | 60.5 | 24″ |
| 66 x 51 | 19.3 | 15″ | 87 x 63 | 32.1 | 18″ | 112 x 75 | 48.0 | 21″ | 137 x 87 | 67.4 | 24″ |
| 73 x 55 | 23.2 | 18″ | 95 x 67 | 37.0 | 18″ | 117 x 79 | 54.2 | 21″ | 142 x 91 | 74.5 | 24″ |

## Pipe-Arch - MULTI-PLATE®

| 2″ Deep Corrugations | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Shape (ft-in) | Volume ($ft^3/ft$) | Min. Cover Height | Shape (inches) | Volume ($ft^3/ft$) | Min. Cover Height | Shape (inches) | Volume ($ft^3/ft$) | Min. Cover Height | Shape (inches) | Volume ($ft^3/ft$) | Min. Cover Height |
| 18-in Corner Radius (Rc) | 6-1 x 4-7 | 22 | 12″ | 8-7 x 5-11 | 41 | 18″ | 8-7 x 5-11 | 41 | 18″ | 14-1 x 8-9 | 97 | 24″ |
| | 6-4 x 4-9 | 24 | 12″ | 8-10 x 6-1 | 43 | 18″ | 8-10 x 6-1 | 43 | 18″ | 14-3 x 8-11 | 101 | 24″ |
| | 6-9 x 4-11 | 26 | 12″ | 9-4 x 6-3 | 46 | 18″ | 9-4 x 6-3 | 46 | 18″ | 14-10 x 9-1 | 105 | 24″ |
| | 7-0 x 5-1 | 29 | 12″ | 9-6 x 6-5 | 49 | 18″ | 9-6 x 6-5 | 49 | 18″ | 15-4 x 9-3 | 109 | 24″ |
| | 7-3 x 5-3 | 31 | 12″ | 9-9 x 6-7 | 52 | 18″ | 9-9 x 6-7 | 52 | 18″ | 15-6 x 9-5 | 114 | 24″ |
| | 7-8 x 5-5 | 33 | 12″ | 10-3 x 6-9 | 55 | 18″ | 10-3 x 6-9 | 55 | 18″ | 15-8 x 9-7 | 118 | 24″ |
| | 7-11 x 5-7 | 36 | 12″ | 10-8 x 6-11 | 58 | 18″ | 10-8 x 6-11 | 58 | 18″ | 15-10 x 9-10 | 122 | 24″ |
| | 8-2 x 5-9 | 38 | 18″ | 10-11 x 7-1 | 61 | 18″ | 10-11 x 7-1 | 61 | 18″ | 16-5 x 9-11 | 126 | 30″ |
| | | | | | | | 13-11 x 8-7 | 93 | 24″ | 16-7 x 10-1 | 131 | 30″ |
| 31-in Corner Radius (Rc) | 13-3 x 9-4 | 98 | 24″ | 15-4 x 10-4 | 124 | 24″ | 17-2 x 11-4 | 153 | 30″ | 19-3 x 12-4 | 185 | 30″ |
| | 13-6 x 9-6 | 102 | 24″ | 15-7 x 10-6 | 129 | 24″ | 17-5 x 11-6 | 158 | 30″ | 19-6 x 12-6 | 191 | 30″ |
| | 14-0 x 9-8 | 106 | 24″ | 15-10 x 10-8 | 134 | 24″ | 17-11 x 11-8 | 163 | 30″ | 19-8 x 12-8 | 196 | 30″ |
| | 14-2 x 9-10 | 111 | 24″ | 16-3 x 10-10 | 138 | 30″ | 18-1 x 11-10 | 168 | 30″ | 19-11 x 12-10 | 202 | 30″ |
| | 14-5 x 10-0 | 115 | 24″ | 16-6 x 11-0 | 143 | 30″ | 18-7 x 12-0 | 174 | 30″ | 20-5 x 13-0 | 208 | 30″ |
| | 14-11 x 10-2 | 120 | 24″ | 17-0 x 11-2 | 148 | 30″ | 18-9 x 12-2 | 179 | 30″ | 20-7 x 13-2 | 214 | 36″ |

# Next Steps

## Learn more

Read our white paper, *Economic Optimization of Infiltration Systems*, to learn more. You'll receive free PDH credits for completing a quick quiz.

Available at www.ContechES.com/cmp

## Quick Links:

- LEED information – www.ContechES.com/leed
- LID Application Guide – www.ContechES.com/lid
- Articles – www.ContechES.com/pdh

## Connect with us

We're here to make your job easier – and that includes being able to get in touch with us when you need to. Search for your local rep at **www.ContechES.com**

While you're there, be sure to check out our upcoming seminar schedule or request an in-house technical presentation.

## Links to Stormwater Tools:

To use the Design Your Own Detention System tool, visit: www.ContechES.com/dyods

To use the Land Value Calculator, visit: www.ContechES.com/lvc

*(Please scroll to the bottom right to download the Land Value Calculator)*

To use the Rain Water Harvesting Runoff Reduction Calculator tool, visit: www.ContechES.com/rwh-calculator

## Start a Project

If you are ready to begin a project, contact your local representative to get started. Or you can check out our design toolbox for all our online resources at www.ContechES.com/designtoolbox.

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## Maintenance

Underground storm water detention and retention systems 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 or configuration of the system.

## Inspection

Inspection is the key to effective maintenance and is easily performed. CONTECH recommends ongoing quarterly inspections of the accumulated sediment. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations, or in equipment washdown areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice. CONTECH suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

## Cleaning

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

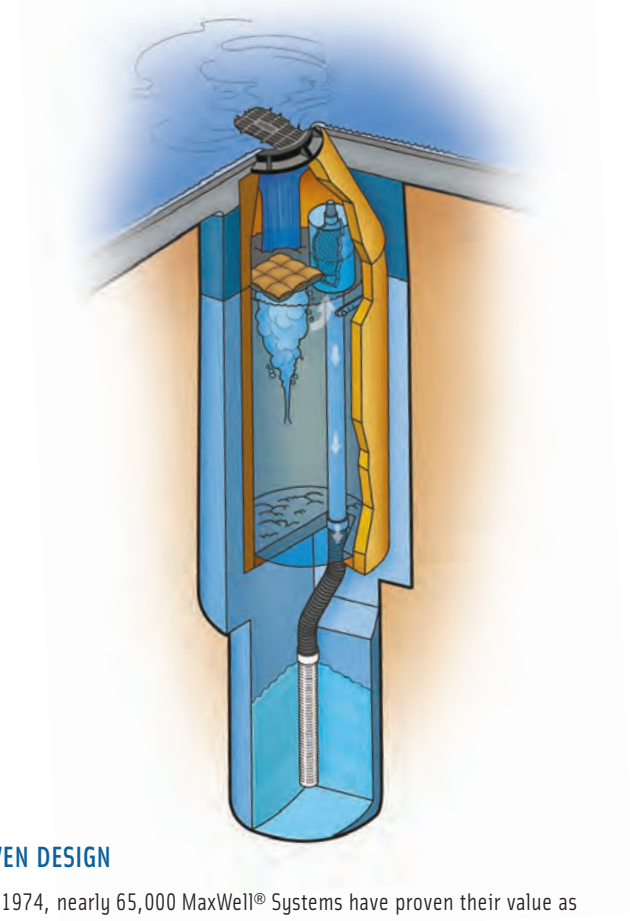
Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities.

# MaxWell® IV DRAINAGE SYSTEM

*Product Information and Design Features*

TORRENT® RESOURCES

The ***MaxWell® IV,*** as manufactured and installed exclusively by Torrent Resources Incorporated, is the industry standard for draining landscaped developments and paved areas. This patented system incorporates the latest refinements in pre-treatment technology.



## PROVEN DESIGN

Since 1974, nearly 65,000 MaxWell® Systems have proven their value as a cost-effective solution in a wide variety of drainage applications. They are accepted by state and municipal agencies and are a standard detail in numerous drainage manuals.

## ADVANCED PRE-TREATMENT

Industry research, together with Torrent Resources' own experience, have shown that initial storm drainage flows have the greatest impact on system performance. This "first flush" occurs during the first few minutes of runoff, and carries the majority of sediment and debris. This results in the need for effective processing of runoff from landscaped and paved surfaces. In the ***MaxWell® IV,*** preliminary treatment is provided through collection and separation in a deep, large-volume chamber where silt and other heavy particles settle to the bottom. The standard MaxWell IV System has over 1,500 gallons of capacity to contain sediment and debris carried by incoming water. Floating trash, paper, pavement oil, etc. are effectively stopped by the **PureFlo®** Debris Shield on top of the overflow pipe. Water is drained from the system by rising up to the top of the overflow pipe and under the Debris Shield. The solid metal shields are equipped with an internal screen to filter suspended matter and are vented to prevent siphoning of floating surface debris. The drainage assembly returns the cleaned water into the surrounding soil through the **FloFast®** Drainage Screen.

## ABSORBENT TECHNOLOGY

The MaxWell IV settling chamber is equipped with an absorbent sponge to provide prompt removal of pavement oils. These floating pillow-like devices are 100% water repellent and literally wick petrochemical compounds from the water. Each sponge has a capacity of up to 128 ounces to accommodate effective, long-term treatment. The absorbent is completely inert and will safely remove runoff constituents down to rainbow sheens that are typically no more than one molecule thick.

## SECURITY FEATURES

MaxWell IV Systems include bolted, theft-deterrent, cast iron gratings and covers as standard security features. Special inset castings that are resistant to loosening from accidental impact are available for use in landscaped applications. Machined mating surfaces and "Storm Water Only" wording are standard.

## THE MAXWELL FIVE-YEAR WARRANTY

*Innovative engineering, quality materials and exacting construction are standard with every MaxWell System designed, manufactured and installed by Torrent Resources Incorporated. The MaxWell Drainage System Warranty is the best in the industry and guarantees against failures due to workmanship or materials for a period of five years from date of completion.*

Manufactured and Installed Exclusively by Torrent Resources Incorporated

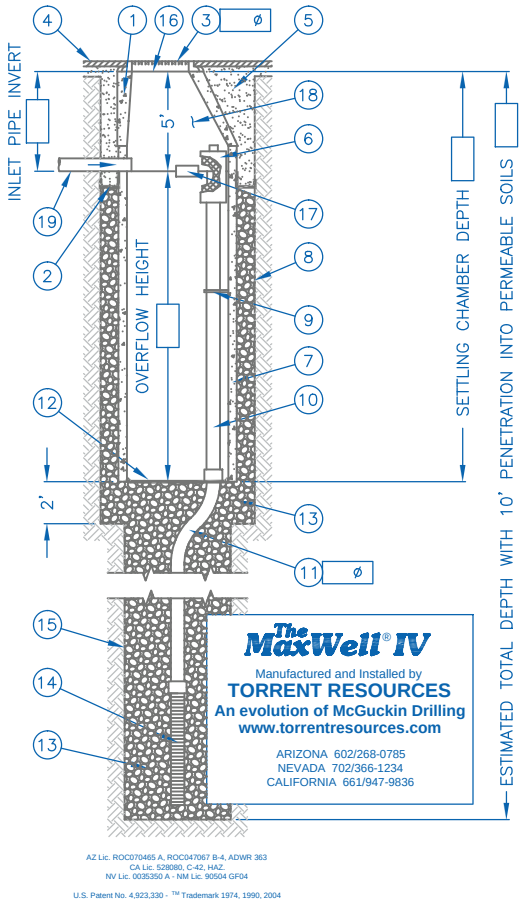
Please see reverse side for additional information

U.S. Patent No. 4,923,330

# MAXWELL® IV DRAINAGE SYSTEM DETAIL AND SPECIFICATIONS

## ITEM NUMBERS

1. **Manhole Cone** - Modified Flat Bottom.
2. **Moisture Membrane** - 6 Mil. Plastic. Applies only when native material is used for backfill. Place membrane securely against eccentric cone and hole sidewall.
3. **Bolted Ring & Grate** - Diameter as shown. Clean cast iron with wording **"Storm Water Only"** in raised letters. **Bolted in 2 locations** and secured to cone with mortar. Rim elevation ±0.02' of plans.
4. **Graded Basin or Paving** (by Others).
5. **Compacted Base Material** - 1-Sack Slurry except in landscaped installtions with no pipe connections.
6. **PureFlo® Debris Shield** - Rolled 16 ga. steel X 24" length with vented anti-siphon and Internal .265" Max. SWO flattened expanded steel screen X 12" length. **Fusion bonded epoxy coated.**
7. **Pre-cast Liner** - 4000 PSI concrete 48" ID. X 54" OD. **Center in hole** and align sections **to maximize bearing surface.**
8. **Min. 6' Ø Drilled Shaft.**
9. **Support Bracket** - Formed 12 Ga. steel. **Fusion bonded epoxy coated.**
10. **Overflow Pipe** - Sch. 40 PVC mated to drainage pipe at base seal.
11. **Drainage Pipe** - ADS highway grade with TRI-A coupler. **Suspend pipe** during backfill operations to prevent buckling or breakage. Diameter as noted.
12. **Base Seal** - Geotextile or concrete slurry.
13. **Rock** - Washed, sized between 3/8" and 1-1/2" to **best complement soil conditions.**
14. **FloFast® Drainage Screen** - Sch. 40 PVC 0.120" slotted well screen with 32 slots per row/ft.Diameter varies 120" overall length with TRI-B coupler.
15. **Min. 4' Ø Shaft** - Drilled to **maintain permeability** of drainage soils.
16. **Fabric Seal** - U.V. resistant geotextile - **to be removed by customer** at project completion.
17. **Absorbent** – Hydrophobic Petrochemical Sponge. Min. to 128 oz. capacity.
18. **Freeboard Depth** Varies with inlet pipe elevation. Increase settling chamber depth as needed to maintain all inlet pipe elevations above overflow pipe inlet.
19. **Optional Inlet Pipe** (Maximum 4", by Others). Extend moisture membrane and compacted base material or 1 sack slurry backfill below pipe invert.




AZ Lic. ROC070465 A, ROC047067 B-4, ADWR 363
CA Lic. 528080, C-42, HAZ.
NV Lic. 0035350 A - NM Lic. 90504 GF04

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*The referenced drawing and specifications are available on CAD either through our office or web site. This detail is copyrighted (2004) but may be used as is in construction plans without further release. For information on product application, individual project specifications or site evaluation, contact our Design Staff for no-charge assistance in any phase of your planning.*

## CALCULATING MAXWELL IV REQUIREMENTS

The type of property, soil permeability, rainfall intensity and local drainage ordinances determine the number and design of MaxWell Systems. For general applications draining retained stormwater, use one standard **MaxWell IV** per the instructions below for up to 3 acres of landscaped contributory area, and up to 1 acre of paved surface. For larger paved surfaces, subdivision drainage, nuisance water drainage, connecting pipes larger than 4" Ø from catch basins or underground storage, or other demanding applications, refer to our **MaxWell® Plus** System. For industrial drainage, including gasoline service stations, our **Envibro® System** may be recommended. For additional considerations, please refer to **"Design Suggestions For Retention And Drainage Systems"** or consult our Design Staff.

## COMPLETING THE MAXWELL IV DRAWING

To apply the **MaxWell IV** drawing to your specific project, simply fill in the blue boxes per instructions below. For assistance, please consult our Design Staff.

### ESTIMATED TOTAL DEPTH

The Estimated Total Depth is the approximate depth required to achieve 10 continuous feet of penetration into permeable soils. Torrent utilizes specialized **"crowd"** equipped drill rigs to penetrate difficult, cemented soils and to reach permeable materials at depths up to **180 feet.** Our extensive database of drilling logs and soils information is available for use as a reference. Please contact our Design Staff for site-specific information on your project.

### SETTLING CHAMBER DEPTH

On MaxWell IV Systems of over 30 feet overall depth and up to 0.25cfs design rate, the **standard** Settling Chamber Depth is **18 feet.** For systems exposed to greater contributory area than noted above, extreme service conditions, or that require higher design rates, chamber depths up to 25 feet are recommended.

### OVERFLOW HEIGHT

The Overflow Height and Settling Chamber Depth determine the effectiveness of the settling process. The higher the overflow pipe, the deeper the chamber, the greater the settling capacity. For normal drainage applications, an overflow height of **13 feet** is used with the standard settling chamber depth of **18 feet**. Sites with higher design rates than noted above, heavy debris loading or unusual service conditions require greater settling capacities

### DRAINAGE PIPE

This dimension also applies to the **PureFlo®** Debris Shield, the **FloFast®** Drainage Screen, and fittings. The size selected is based upon system design rates, soil conditions, and the need for adequate venting. Choices are 6", 8", or 12" diameter. Refer to "Design Suggestions for Retention and Drainage Systems" for recommendations on which size best matches your application.

### BOLTED RING & GRATE

Standard models are quality cast iron and available to fit 24" Ø or 30" Ø manhole openings. All units are bolted in two locations with wording "Storm Water Only" in raised letters. For other surface treatments, please refer to "Design Suggestions for Retention and Drainage Systems."

### INLET PIPE INVERT

Pipes up to 4" in diameter from catch basins, underground storage, etc. may be connected into the settling chamber. Inverts deeper than 5 feet will require additional settling chamber depth to maintain effective overflow height.


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WATERTIGHT SOLUTIONS 35 YEARS

## DRAINAGE MAINTENANCE

With over thirty years of experience to draw on, Torrent Resources records clearly show that utilizing regular inspection and cleaning procedures can significantly enhance the service-life and performance of the drainage systems it installs. *Maintenance Data Sheets* accompany all MaxWell and Envibro Systems at the time of completion that provide operational information and instructions for inspection and service.

As a benefit to all MaxWell and Envibro owners, Torrent offers a full range of maintenance programs to protect the investment made in its drainage systems. With thorough knowledge and experience to analyze the operational and structural aspects of our patented products, we can effectively accomplish these basic, yet important services.

Torrent can provide Preventive Maintenance Programs that are tailored for your site including full service contracts. These services would include a preliminary inspection of the settling chambers and internal components and an assessment of the site drainage to insure that the system meets operational guidelines. A written report is provided at the completion of each inspection.

MaxWell system cleaning is accomplished with truck mounted hydro-vactor equipment, utilizing water and air to dislodge and remove debris and sediment deposits. All chambers, inlets, connecting piping and catch basins are cleaned with the contents evacuated and transported off-site for disposal. Geotextile fabric base seals and hydrophobic petrochemical sponges are removed and replaced in each chamber. Inlet grates and covers are then re-installed and re-secured with existing locking devices.

Envibro system cleaning utilizes similar maintenance equipment. Servicing includes removal of debris from the trash basket under the collector grate inlet, hydro-vactoring all chambers and cleaning of silt filters. All, inlets, connecting piping and catch basins are cleaned as well with the contents evacuated and transported off-site for disposal. Inspection of the Imbiber Beads® Drain Field assembly is also included in standard maintenance. All hydrophobic absorbents blankets are replaced and inlet grates and covers are re-installed and re-secured with existing locking devices.

Under normal operation, Envibro cleaning is recommended annually or following heavy rainfalls and high loading of the system with foreign trash and debris. Should a spill or other discharge occur, complete service of the systems and replacement of activated Imbiber Beads® Drain Field assembly is normally required.

Below is a list of our Drainage Maintenance services:
Preventative Maintenance
Service Contracts
Drywell Cleaning

Imbiber Beads® is a registered Trademark of Imbibitive Technologies Corporation

*"Sun State Builders has had the privilege of working with Torrent Resources for several years. We find their work to be of excellent quality and their customer service is superior. We look forward to utilizing their services in all of our projects in the future."*

Andrea Vallas
Assistant Project Manager
Sun State Builders

# MaxWell IV Drywell

The Operation and Maintenance Program will include the following key components:

1. **Inspection Procedures:**

   The settling chambers and internal components of the unit will be inspected regularly. Additionally, an assessment of the site drainage will be conducted to insure that the system meets operation guidelines. The visual inspection will ascertain that the unit is functioning properly (no blockages or obstructions to inlet and/or infiltration chamber), measuring the amount of solid materials, fine sediment, and floating trash and debris within the chamber. Schedules for inspections and cleanout will be based on storm events and pollutant accumulation due to failure of upstream pre-treatment device. During the rainfall season, the unit will be inspected at least once every 30 days. Accumulation of sediment and floatable material captured by the MaxWell IV will be recorded in a maintenance log.

2. **Cleanout Procedures:**

   Truck mounted hydro-vactor equipment will be used to clean the system utilizing water and air to dislodge and remove debris and sediment deposits. All chambers, inlets, connecting piping and catch basis are cleaned and the contents discharged. The accumulated contents are transported off-site for disposal. Within each chamber, geotextile fabric base seals and hydrophobic petrochemical sponges are removed and replaced. Inlet grates and covers are re-installed and then re-secured with the existing locking devices.

3. **Stenciling:**

   Legibility of stencils and/or signs at all storm drain inlets and catch basins within the project area must be maintained at all time.

4. **Maintenance Log:**

   Keep on-site a log of all inspections and maintenance performed on the MaxWell IV.