APPENDIX A
SOILS CLASSIFICATION CHART AND KEY TO TEST DATA

BORING LOGS

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	SM	SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

	Modified California	RV	R-Value
	Split Spoon	SA	Sieve Analysis
	Pushed Shelby Tube	SW	Swell Test
	Auger Cuttings	TC	Cyclic Triaxial
	Grab Sample	TX	Unconsolidated Undrained Triaxial
	Sample Attempt with No Recovery	TV	Torvane Shear
CA	Chemical Analysis	UC	Unconfined Compression
CN	Consolidation	(1.2)	(Shear Strength, ksf)
CP	Compaction	WA	Wash Analysis
DS	Direct Shear	(20)	(with % Passing No. 200 Sieve)
PM	Permeability		Water Level at Time of Drilling
PP	Pocket Penetrometer		Water Level after Drilling(with date measured)

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

Figure A-1

E3RA

E3RA, Inc.
PO Box 44840
Tacoma, WA 98448
Telephone: 253-537-9400
Fax: 253-537-9401

BORING NUMBER B-1

Figure A-2

CLIENT Sunset Chevrolet
PROJECT NAME Sunset Chevrolet New Shop Addition
PROJECT NUMBER T11012
PROJECT LOCATION Sumner, WA
DATE STARTED 3/7/11 COMPLETED 3/7/11
GROUND ELEVATION ____ HOLE SIZE ____
DRILLING CONTRACTOR Holocene
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ AT TIME OF DRILLING 15.50 ft water is perched
LOGGED BY FER CHECKED BY JEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY LENGTH (in)	N VALUE	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						1.5 inches Asphalt concrete pavement
				SM		(SM) Brown silty fine sand (loose to medium dense, damp)
	SS S-1	13	4-3-2 (5)	SM		(SM) Brown silty fine sand (loose, damp to moist)
5	SS S-2	7	5-5-4 (9)	SP-SM		(SP-SM) Gray-brown fine sand with some silt (loose, moist)
	SS S-3	12	5-5-4 (9)	SP-SM		(SP-SM) Gray-brown fine sand with some silt (loose, moist)
10	SS S-4	9	3-4-5 (9)	SP-SM		(SP-SM) Gray-brown fine sand with some silt (loose, moist)
15	SS S-5	12	3-2-3 (5)	SM		▽ (SM) Brown silty fine sand (loose, saturated)
20	SS S-6	16	0-0-0 (0)	ML		(ML) Gray silt with scattered fine organics (soft, moist to wet)
						Water at 16' likely perched, no heave Bottom of borehole at 21.5 feet.

1.0 2.5 5.5 7.5 10.0 15.0 20.0 21.5

E3RA, Inc.
PO Box 44840
Tacoma, WA 98448
Telephone: 253-537-9400
Fax: 253-537-9401

BORING NUMBER B-2

Figure A-3

CLIENT Sunset Chevrolet
PROJECT NAME Sunset Chevrolet New Shop Addition
PROJECT NUMBER T11012
PROJECT LOCATION Sumner, WA
DATE STARTED 3/7/11 COMPLETED 3/7/11
GROUND ELEVATION ____ HOLE SIZE ____
DRILLING CONTRACTOR Holocene
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY FER CHECKED BY JEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY LENGTH (in)	N VALUE	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						1.5 inches Asphalt concrete pavement
				SM		(SM) Brown silty fine sand (loose, damp to moist)
	SS S-1	14	2-1-2 (3)	SM		(SM) Brown, silty fine sand (very loose, damp to moist)
5						
	SS S-2	14	2-1-1 (2)	SM		(SM) Gray-brown fine sand with some silt inter-bedding with silt fine sand (very loose, damp to moist)
				SP-SM		(SP-SM)
	SS S-3	12	4-6-4 (10)	SP-SM		(SP-SM) Gray-brown fine sand with some silt and inter-beds of silty fine sand (medium dense, moist)
10				ML		(ML)
	SS S-4	16	1-0-1 (1)	ML		(ML) Gray-brown silt with some fine sand (very soft, wet)
				SP		(SP)
15						
	SS S-5	17	4-3-1 (4)	SP		(SP) Orange-brown and mottled, medium sand with trace silt (loose, moist)
				SP-SM		(SP-SM) Gray medium sand with some silt (loose, saturated)
				SP		(SP)
20						
	SS S-6	12	9-13-19 (32)	SP		(SP) Orange-brown medium to coarse sand with some gravel (dense, moist)
						Possible perched groundwater at 16.5'
						Bottom of borehole at 21.5 feet.

1.0 2.5 5.0 7.0 7.5 9.5 10.0 12.5 15.0 16.5 18.5 20.0 21.5

GENERAL BH / TP / WELL - GINT US.GDT - 3/9/11 14:58 - C:\DOCUMENTS AND SETTINGS\COMPAQ_ADMINISTRATOR\DESKTOP\T11012 SUNSEST CHEVROLET BORING LOGS.GPJ

E3RA, Inc.
PO Box 44840
Tacoma, WA 98448
Telephone: 253-537-9400
Fax: 253-537-9401

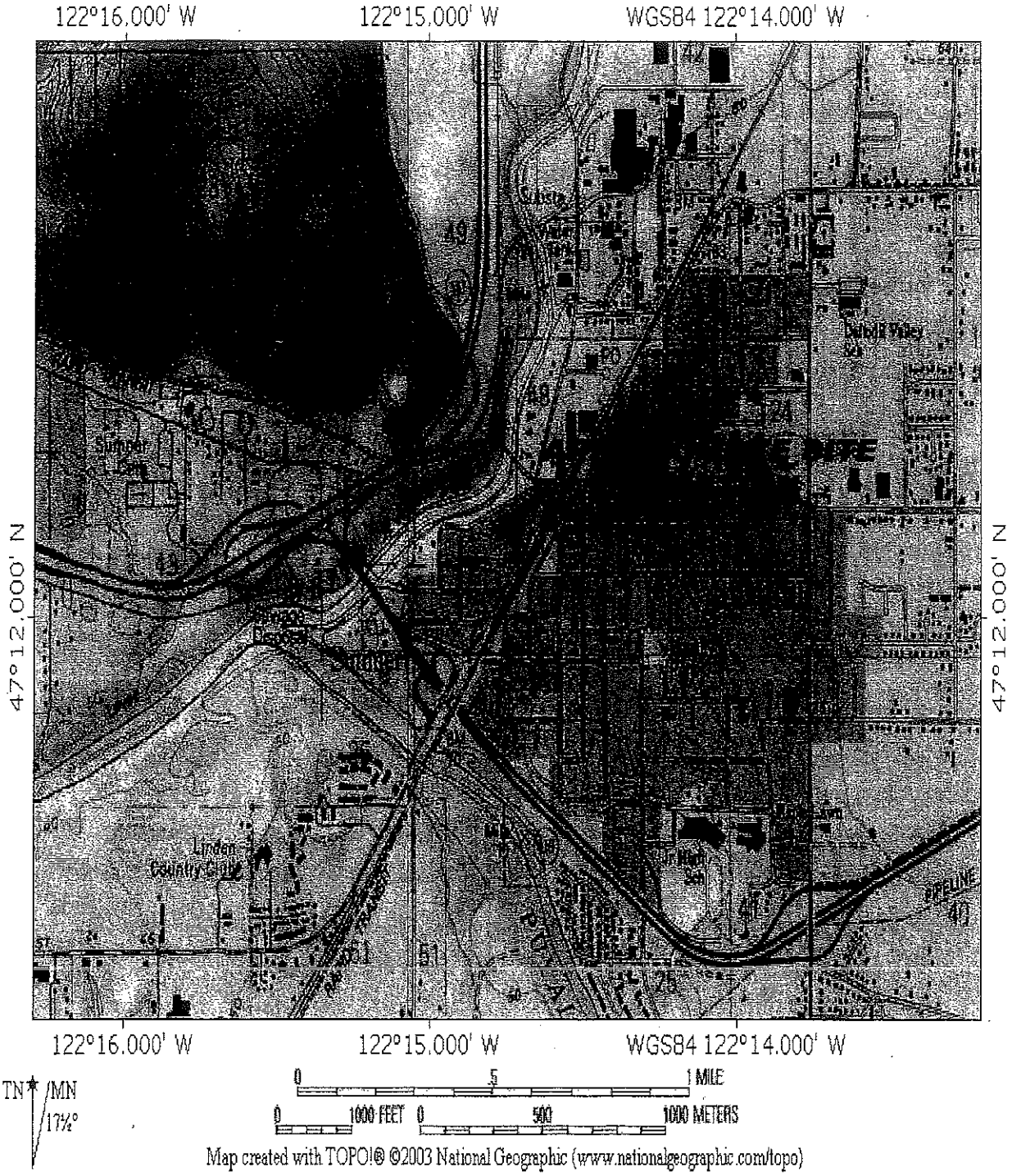
BORING NUMBER B-3

Figure A-4

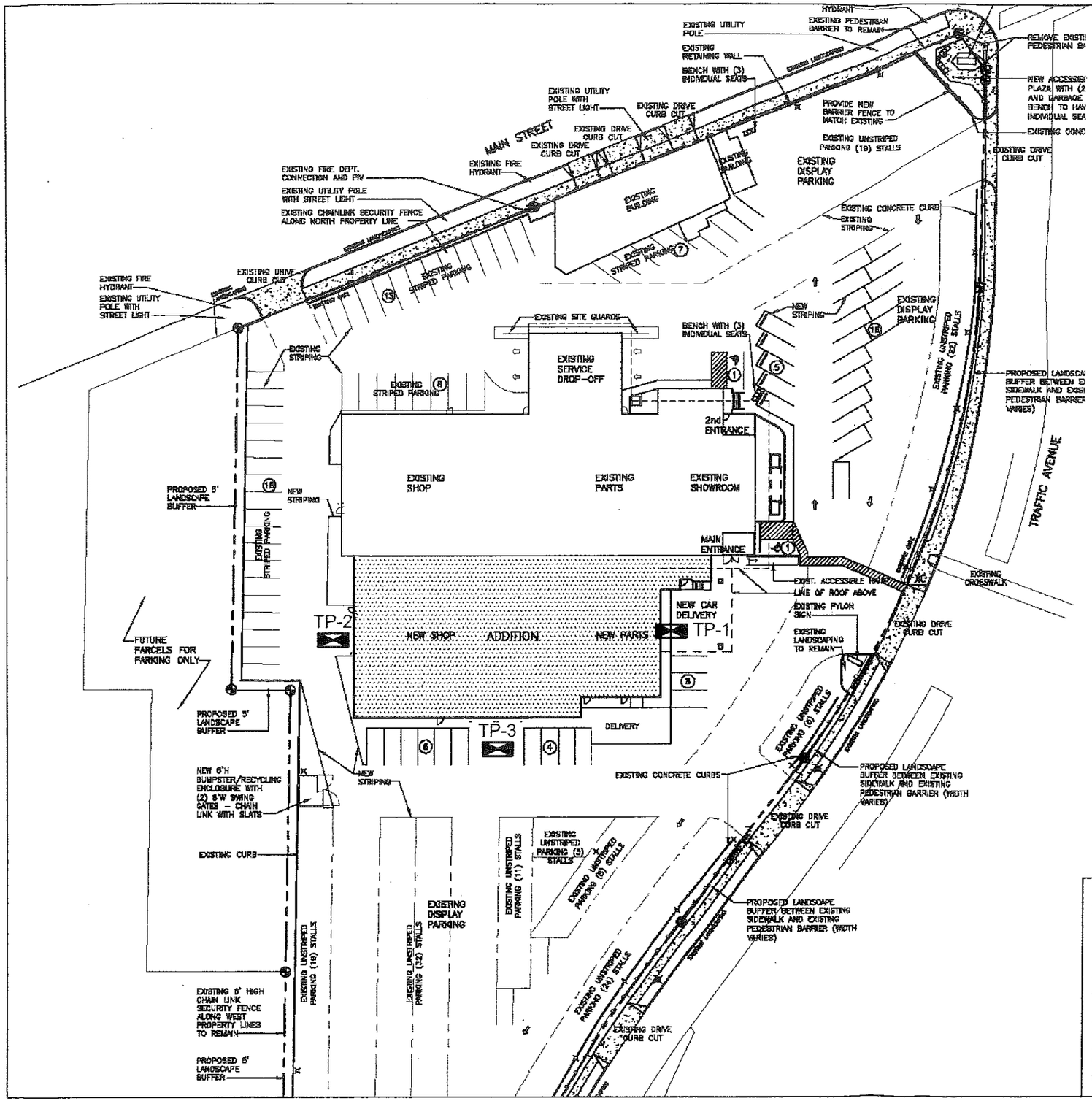
CLIENT Sunset Chevrolet
PROJECT NAME Sunset Chevrolet New Shop Addition
PROJECT NUMBER T11012
PROJECT LOCATION Sumner, WA
DATE STARTED 3/7/11 COMPLETED 3/7/11
GROUND ELEVATION ___ HOLE SIZE ___
DRILLING CONTRACTOR Holocene
GROUND WATER LEVELS:
DRILLING METHOD Hand Auger
AT TIME OF DRILLING ---
LOGGED BY FER CHECKED BY JEB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY LENGTH (in)	N VALUE	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						1.5" Asphalt concrete pavement
				SM		(SM) Brown silty fine sand (loose, damp to moist)
	SS S-1	8	4-2-2 (4)	SM		(SM) Brown silty fine sand (loose, damp to moist)
5	SS S-2	6	3-2-3 (5)	SM		(SM) Gray-brown silty fine sand (loose, moist)
	SS S-3	12	3-3-2 (5)	SM		(SM) Gray-brown silty fine sand with interbeds of fine sandy silt (loose, moist)
10	SS S-4	15	1-1-1 (2)	ML		(ML) Gray silt with some fine sand (soft, wet)
				SP-SM		(SP-SM)
15	SS S-5	14	3-4-5 (9)	SP-SM		(SP-SM) Orange-brown and mottled fine to coarse sand with some silt (loose, moist to wet)
						Firm Soils
20	SS S-6	12	18-20-21 (41)	SP		(SP) Orange-brown gravelly sand with trace silt (dense, damp to moist)
						No groundwater was encountered Bottom of borehole at 21.5 feet.

1.0
2.5
5.0
7.5
10.0
14.0
15.0
18.0
20.0
21.5



E3RA, Inc. **P.O Box 44840** **Tacoma, WA 98448**	SUNSET CHEVROLET TOPOGRAPHIC AND LOCATION MAP SUMNER, WASHINGTON	**FIGURE 1** **T11012**



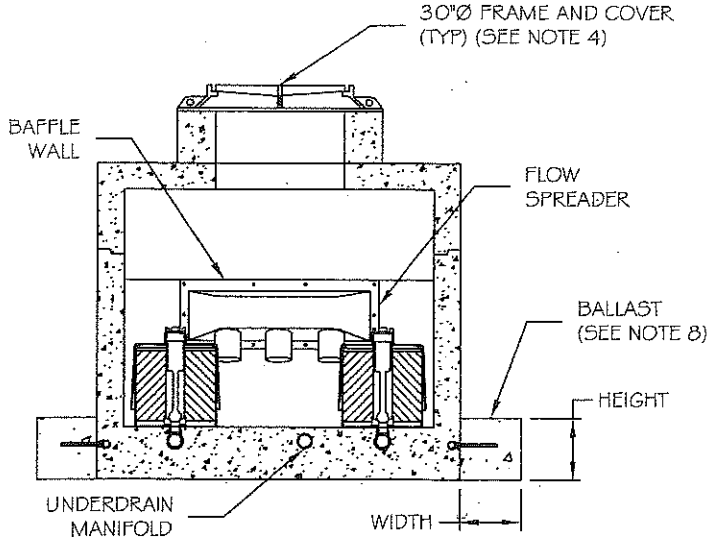
NOTE:
BOUNDARY AND TOPOGRAPHY ARE BASED ON MAPPING PROVIDED TO E3RA AND OBSERVATIONS MADE IN THE FIELD. THE INFORMATION SHOWN DOES NOT CONSTITUTE A FIELD SURVEY BY E3RA.

E3RA Inc.
201 - 160th St. S
Suite 401
Tacoma, WA 98444
253-537-9400
253-537-9401 fax
www.e3ra.com

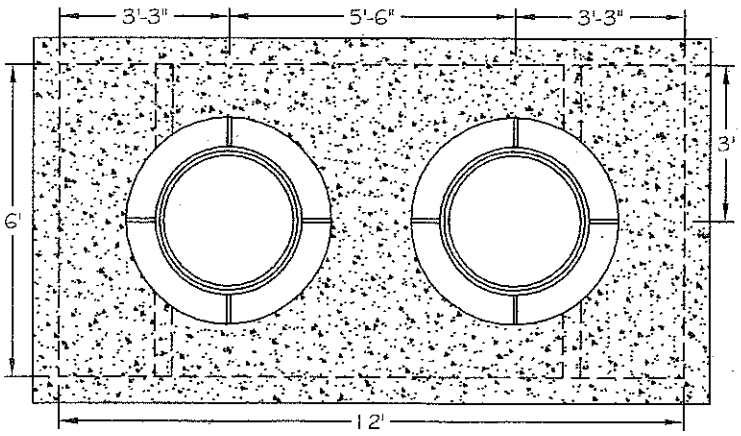
PROJECT: Sunset Chevrolet Sumner, Washington		
SHEET TITLE: Site and Exploration Plan		
DESIGNER: CRL	JOB NO.T11012	
DRAWN BY: CRL	SCALE:	
CHECKED BY: JEB	FIGURE:2	
DATE: Mar. 7, 2010	FILE: T11012.dwg	

GENERAL NOTES

1) STORMFILTER BY CONTECH STORMWATER SOLUTIONS; PORTLAND, OR (800) 548-4667; SCARBOROUGH, ME (877) 907-8676; ELKRIDGE, MD (866) 740-3318.
2) FILTER CARTRIDGE(S) TO BE SIPHON-ACTUATED AND SELF-CLEANING. STANDARD DETAIL DRAWING SHOWS MAXIMUM NUMBER OF CARTRIDGES. ACTUAL NUMBER REQUIRED TO BE SPECIFIED ON SITE PLANS OR IN DATA TABLE BELOW.
3) PRECAST VAULT TO BE CONSTRUCTED IN ACCORDANCE WITH ASTM C857 AND C858. DETAIL DRAWING REFLECTS DESIGN INTENT ONLY. ACTUAL DIMENSIONS AND CONFIGURATION OF STRUCTURE WILL BE SHOWN ON PRODUCTION SHOP DRAWING.
4) STRUCTURE AND ACCESS COVERS TO MEET AASHTO H-20 LOAD RATING.
5) STORMFILTER REQUIRES 2.3 FEET OF DROP FROM INLET TO OUTLET. IF LESS DROP IS AVAILABLE, CONTACT CONTECH STORMWATER SOLUTIONS.
6) INLET AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR. PRECAST STORMFILTER VAULT EQUIPPED WITH EITHER CORED OPENINGS OR KNOCKOUTS AT INLET AND OUTLET LOCATIONS.
7) PROVIDE MINIMUM CLEARANCE FOR MAINTENANCE ACCESS. IF A SHALLOWER SYSTEM IS REQUIRED, CONTACT CONTECH STORMWATER SOLUTIONS FOR OTHER OPTIONS.
8) ANTI-FLOTATION BALLAST TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR, IF REQUIRED. BALLAST TO BE SET ALONG ENTIRE LENGTH OF BOTH SIDES OF THE STRUCTURE.
9) ALL STORMFILTERS REQUIRE REGULAR MAINTENANCE. REFER TO OPERATION AND MAINTENANCE GUIDELINES FOR MORE INFORMATION.



6' x 12' STORMFILTER - SECTION VIEW (B/2)



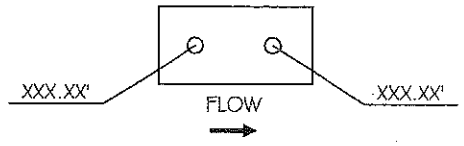
6' x 12' STORMFILTER - TOP VIEW (1/2)

6' x 12' PRECAST STORMFILTER DATA

STRUCTURE ID	XXX
WATER QUALITY FLOW RATE (cfs)	X.XX
PEAK FLOW RATE (cfs)	X.XX
RETURN PERIOD OF PEAK FLOW (yrs)	XXX
# OF CARTRIDGES REQUIRED	XX
CARTRIDGE FLOW RATE (15 OR 7.5 gpm)	XX
MEDIA TYPE (CSF, PERLITE, ZPG)	XXXXX

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	XXX.XX'	XXX	XX"
INLET PIPE #2	XXX.XX'	XXX	XX"
OUTLET PIPE	XXX.XX'	XXX	XX"

RIM



LADDER		YES/NO
ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	XX"	XX"

NOTES/SPECIAL REQUIREMENTS:

THE STORMWATER MANAGEMENT StormFilter® U.S. PATENT No. 5,322,629, No. 5,707,527, No. 6,027,639 No. 6,649,048, No. 5,624,576, AND OTHER U.S. AND FOREIGN PATENTS PENDING

CONTECH® STORMWATER SOLUTIONS™
contechstormwater.com

6' x 12' PRECAST STORMFILTER TOP VIEW, SECTION VIEW AND NOTES STANDARD DETAIL

DRAWING 2

FIGURE C6 2/2

DATE: 09/28/05 | SCALE: NONE | FILE NAME: SF612-PC-DTL | DRAWN: MJW | CHECKED: ARG

WASHINGTON STATE DEPARTMENT OF ECOLOGY

January 2005
(Updated December 2007)

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) TREATMENT

For

CONTECH Stormwater Solutions Inc.
Stormwater Management StormFilter®

Ecology's Decision:

Based on the CONTECH Stormwater Solution Inc. (CONTECH) application submissions and recommendations by the Technical Review Committee (TRC), Ecology hereby issues a General Use Level Designation (GULD) for the Stormwater Management StormFilter®:

- **As a basic stormwater treatment practice for total suspended solids (TSS) removal,**
- **Using ZPG™ media (zeolite/perlite/granular activated carbon), with the size distribution described below,**
- **Sized at a hydraulic loading rate of 1 gpm/ft^2 of media surface area, per Table 1, and**
- **Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.**

Table 1. StormFilter Design Flow Rates per Cartridge

Effective Cartridge Height (inches)	12	18	27
Cartridge Flow Rate (gpm/cartridge)	5	7.5	11.3

This designation has no expiration date, but it may be amended or revoked by Ecology, and is subject to the conditions specified below.

Ecology's Conditions of Use:

The StormFilter shall be designed, installed, and maintained to comply with these conditions:

1. **StormFilter systems containing ZPG (zeolite/perlite/granular activated carbon) media are approved for basic treatment at the hydraulic loading rate of 1 gpm/ft^2 of media surface area, per Table 1, at the 15-minute water quality design flow rate (as specified in Ecology's most recent Stormwater Manual), as**

FIGURE 7

REQUIRED ACTIONS: The following actions shall be taken to ensure that pollution generated on site shall be minimized:

1. Warning signs (e.g., "Dump No Waste--Drains to Stream") shall be painted or embossed on or adjacent to all storm drain inlets. They shall be repainted as needed.

2. Parking lots shall be swept when necessary to remove debris and, at a minimum, twice a year. Use of newer model high-velocity vacuum sweepers is recommended as they are more effective in removing the more harmful smaller particles from paved surfaces.

3. Sediment removed from ponds/catch basins shall be disposed of in a proper manner. Contact the City for instruction prior to completing this task.

4. No activities shall be conducted on site that are likely to result in short-term high-concentration discharge of pollution to the stormwater system. Such activities may include, but are not limited to, vehicle washing, vehicle maintenance, and cleaning of equipment used in the periodic maintenance of buildings and paved surfaces.

5. Employees shall receive basic instruction regarding the control of pollution from commercial operations. Contact the Public Works Department at (253) 863-8300.

6. Medical offices with high volume customer contacts have potential to influence individuals' water quality practices. Owners are encouraged to have informational brochures provided by the City (see Item 5 above) available in waiting rooms.

EXHIBIT 2

POLLUTION SOURCE CONTROL PROGRAM

WHAT ARE POLLUTION SOURCE CONTROLS, AND WHY ARE THEY NEEDED?

Pollution source controls are actions taken by a person or business to reduce the amount of pollution reaching surface and ground waters. Controls, also called "best management practices" (BMPs), include:

- Altering the activity (e.g., substitute non-toxic products, recycle used oil, reroute floor drains to sanitary sewer from storm sewer).
- Enclosing or covering the activity (e.g., building a roof)
- Segregating the activity (e.g., diverting runoff away from an area that is contaminated)
- Routing runoff from the activity to a treatment alternative (e.g., to a wastewater treatment facility, sanitary sewer, or stormwater treatment area).

Pollution source controls are needed because of the contamination found in runoff from commercial areas and the effect of this contamination on aquatic life and human health. Research on urban runoff in the Puget Sound area and elsewhere has found oil and grease, nutrients, organic substances, toxic metals, bacteria, viruses, and sediments at unacceptable levels. Effects of contaminated runoff include closure of shellfish harvesting areas and swimming areas, mortality of young fish and other aquatic organisms, tumors on fish, and impairment of fish reproduction.

PROFESSIONAL SERVICES

DESCRIPTION: Presented here are the remaining service businesses including theaters; hotels/motels; finance, banking, hospitals and medical services; nursing homes, schools and universities, and legal, financial and engineering services.

MATERIALS USED AND WASTES GENERATED: The primary concern is runoff from parking areas. Stormwater from parking lots will contain undesirable concentrations of oil and grease, suspended particulates, and metals such as lead, cadmium, and zinc. It will also contain the organic byproducts of engine combustion. Some also produce Dangerous Wastes, for example, hospitals, nursing homes, and other medical services. These materials are stored within the building until disposal.

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service:

Oil in Forebay: Yes ☐ No ☐

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Related Maintenance Activities -

Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

CONTECH CONSTRUCTION PRODUCTS INC.
800.338.1122
www.contech-cpi.com

Support

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

CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

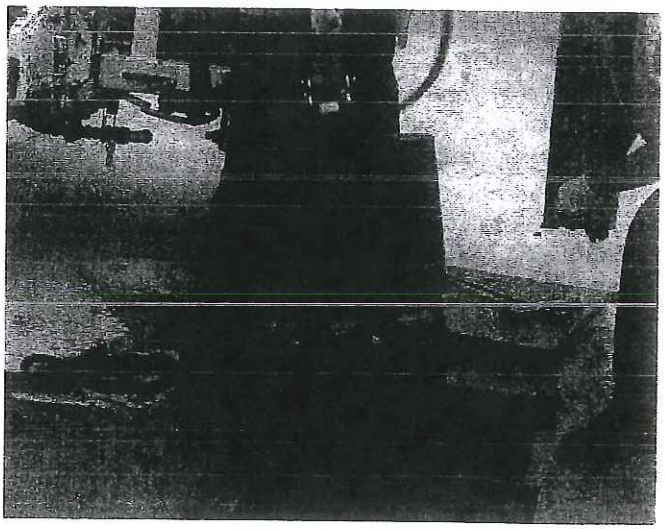
Nothing in this catalog should be construed as an expressed warranty or an implied warranty of merchantability or fitness for any particular purpose. See the CONTECH standard quotation or acknowledgement for applicable warranties and other terms and conditions of sale.

Important: Note that cartridges containing media other than the leaf media require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

D. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

E. Set the empty, used cartridge aside or load onto the hauling truck.

F. Continue steps a through e until all cartridges have been removed.



8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors. The connectors are short sections of 2-inch schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 1" above the floor of the vault. Lightly wash down the vault interior.
   a. Replace any damaged connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to CONTECH Construction Products.

Assumptions

- No rainfall for 24 hours or more
- No upstream detention (at least not draining into StormFilter)
- Structure is online
- Outlet pipe is clear of obstruction
- Construction bypass is plugged

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from CONTECH Construction Products.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Construction Products immediately.

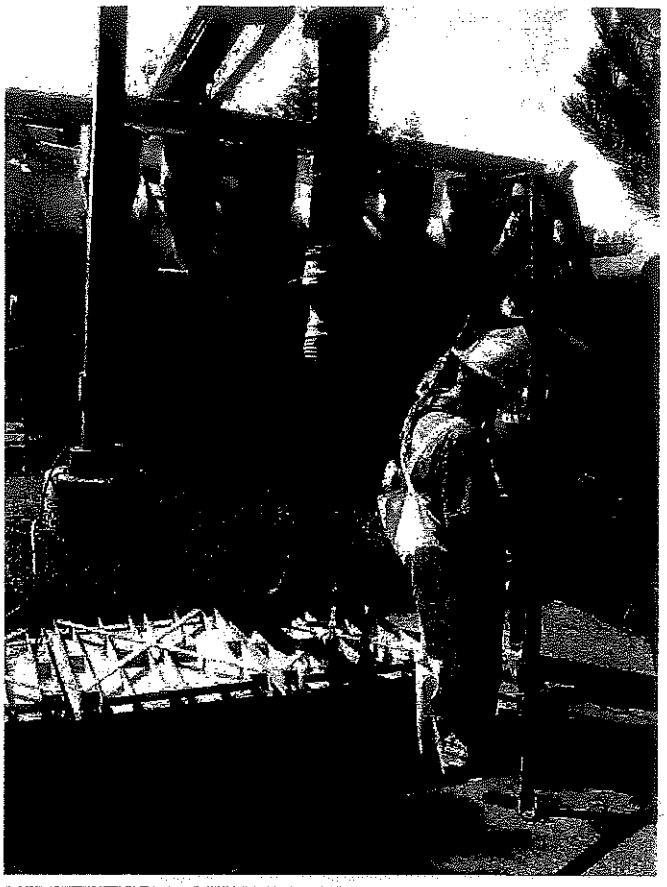
To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact CONTECH Construction Products for suggested attachment devices.



Important: Note that cartridges containing leaf media (CSF) do not require unscrewing from their connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and could be capped during the maintenance activity to prevent sediments from entering the underdrain manifold.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless CONTECH Construction Products performs the maintenance activities and damage is not related to discharges to the system.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. Enter the vault using appropriate confined space protocols.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood screws (3) hood and float.

D. At location under structure access, tip the cartridge on its side.

11 of 17

Sediment removal and cartridge replacement on an as needed basis is recommended unless site conditions warrant.

Once an understanding of site characteristics has been established, maintenance may not be needed for one to three years, but inspection is warranted and recommended annually.

Inspection Procedures

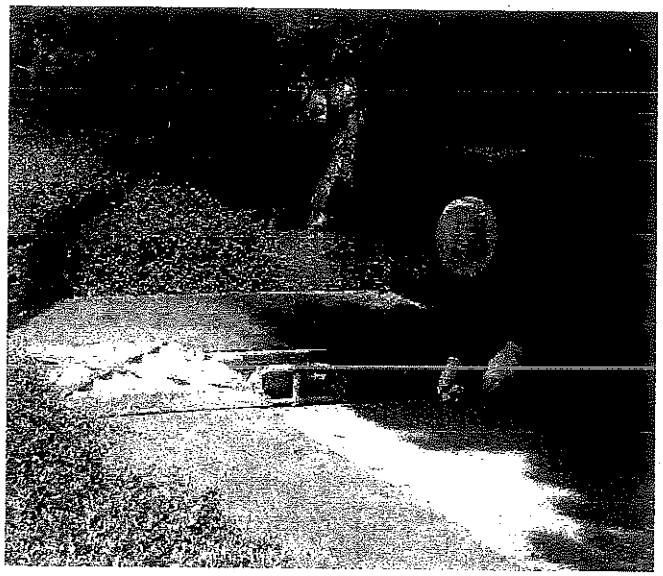
The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Construction Products immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

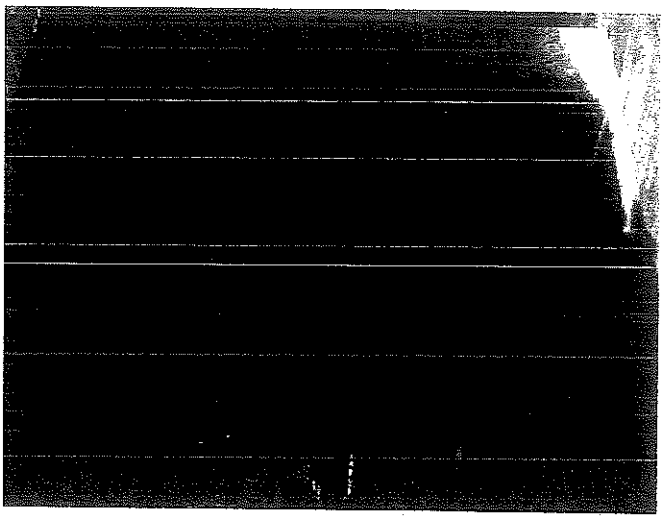
1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.



3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)



1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water in the cartridge bay for more that 24 hours after end of rain event, maintenance is required.
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.
8. Calendar Lifecycle.
   a. If system has not been maintained for 3 years maintenance is required.

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are likely many effective maintenance options, we believe the following procedure is efficient and can be implemented using common equipment and existing maintenance protocols. A two step procedure is recommended as follows:

1. Inspection

Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

Cartridge replacement

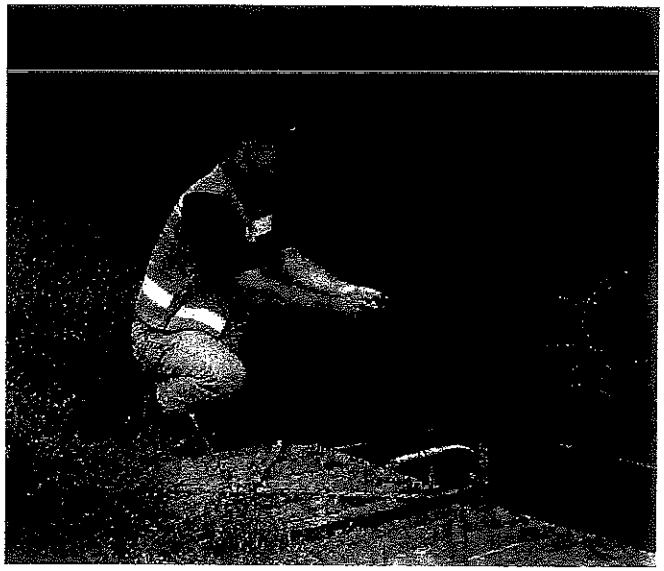
Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.



In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, in late summer to early fall when flows into the system are not likely to be present.

Maintenance Frequency

The primary factor controlling timing of maintenance of the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs.

Prior to the development of the maintenance database, the following maintenance frequencies should be followed:

Inspection

One time per year

After major storms

Maintenance

As needed, based on results of inspection (The average maintenance lifecycle is approximately 1-3 years)

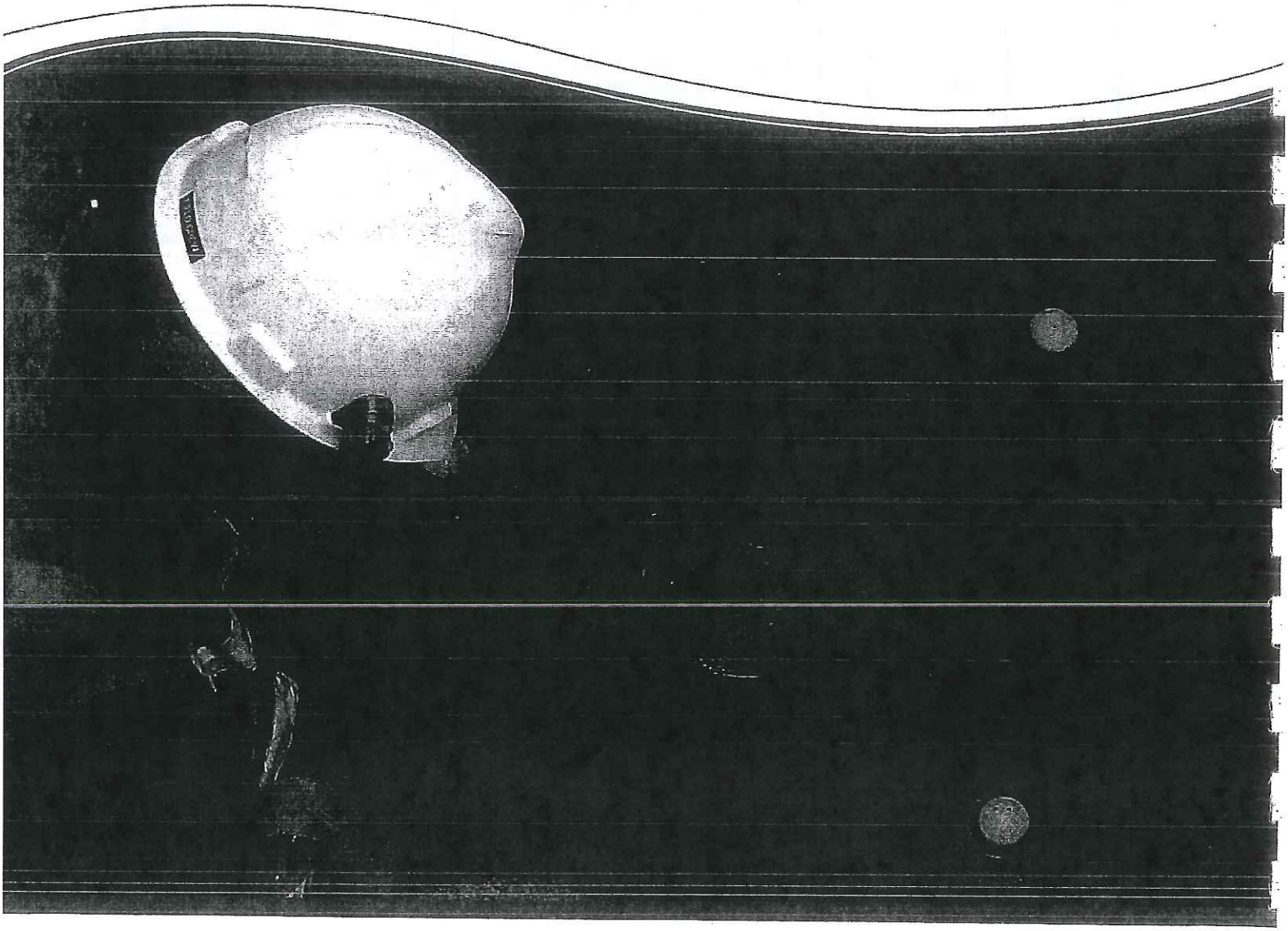
Per Regulatory requirement

In the event of a chemical spill

Frequencies should be updated as required. The recommended initial frequency for inspection is one time per year. StormFilter units should be inspected after major storms.

CONTECH
CONSTRUCTION PRODUCTS INC.

StormFilter Inspection and Maintenance Procedures



The Stormwater Management StormFilter

10. Maintenance Checklist for Grounds (Landscaping)

Frequency	Drainage System Feature	X	Problem	Conditions to Checks For	Conditions That Should Exist
M	General		Weeds (nonpoisonous)	Weeds growing in more that 20% of the landscaped area (trees and shrubs only).	Weeds present in less than 5% of the landscaped area.
M			Safety hazard	Any presence of poison ivy or other poisonous vegetation or insect nests.	No poisonous vegetation or insect nests present in landscaped area.
M,S			Trash or litter	See Ponds Checklist	See Ponds Checklist
M, S			Erosion of Ground Surface	Noticeable rills are seen in landscaped areas.	Causes of erosion are identified and steps taken to slow down/spread out the water. Eroded areas are filled, contoured, and seeded.
A	Trees and shrubs		Damage	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trim trees/shrubs to restore shape. Replace trees/shrubs with severe damage.
M				Trees or shrubs that have been blown down or knocked over.	Replant tree, inspecting for injury to stem or roots. Replace if severely damaged.
A				Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Place stakes and rubber-coated ties around young trees/shrubs for support.

Key:

A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms.

Comments:

9. Maintenance Checklist for Fencing/Shrubbery Screen/Other Landscaping

Frequency	Drainage System Feature	X	Problem	Conditions to Checks For	Conditions That Should Exist
M	General		Missing or broken parts/dead shrubbery	Any debris in the fence or screen that permits easy entry to a facility.	Fence is mended or shrubs replaced to form a solid barrier to entry.
M, S			Erosion	Erosion has resulted in an opening under a fence that allows entry by people or pets.	Replace soil under fence so that no opening exceeds 4 inches in height.
M			Unruly vegetation	Shrubbery is growing out of control or is infested with weeds.	Shrubbery is trimmed and weeded to provide appealing aesthetics. Do not use chemicals to control weeds.
A	Wire fences		Damaged parts	Posts out of plumb more than 6 inches.	Posts plumb to within 1 ½ inches of plumb.
A				Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
A				Any part of fence (including posts, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
A				Missing or loose tension wire.	Tension wire in place and holding fabric.
A				Missing or loose barbed wire that is sagging more than 2 ½ inches between posts.	Barbed wire in place with less than ¾-inch sag between posts.
A				Extension arm missing, broken, or bent out of shape more than 1 ½ inches.	Extension arm in place with no bends larger than ¾ inch.
A			Deteriorated paint or protective coating.	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
M			Opening in fabric.	Openings in fabric are such that an 8-inch diameter ball could fit through.	No openings in fabric.

Key:

A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms.

Comments:

EXHIBIT 1 (Continued)

2. Maintenance Checklist for Conveyance Systems

M			Conversion by homeowner to imcompatible use	Swale has been filled in or blocked by shed, woodpile, shrubbery, etc.	If possible, speak with homeowner and request that swale area be restored. Contact City to report problem if not rectified voluntarily.
A			Swale does not drain.	Water stands in swale or flow velocity is very slow. Stagnation occurs.	A survey may be needed to check grades. Grades need to be in 1 - 5% range if possible. If grade is less than 1%, underdrains may need to be installed.

Key:
A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms.
Comments:

2. Maintenance Checklist for Conveyance Systems

Frequency	Drainage System Feature	X	Problem	Conditions to Check For	Conditions That Should Exist
M, S	Pipes		Sediment & debris	Accumulated sediment that exceeds 20% of the diameter of the pipe.	Pipe cleaned of all sediment and debris.
M			Vegetation	Vegetation that reduces free movement of water through pipes.	All vegetation removed so water flows freely through pipes.
A			Damaged (rusted, bent, or crushed)	Protective coating is damaged; rust is causing more than 50% deterioration to any part of pipe.	Pipe repaired or replaced.
M				Any dent that significantly impedes flow (i.e., decreases the cross section area of pipe by more than 20%)	Pipe repaired or replaced.
M				Pipe has major cracks or tears allowing groundwater leakage.	Pipe repaired or replaced.
M, S	Open ditches		Trash & debris	Dumping of yard waste such as grass clippings and branches into basin. Unsightly accumulation of nondegradable materials such as glass, plastic, metal, foam, and coated paper.	Remove trash and debris and dispose as prescribed by city Waste Management Section.
M			Sediment buildup	Accumulated sediment that exceeds 20% of the design depth	Ditch cleaned of all sediment and debris so that it matches design.
A			Vegetation	Vegetation (e.g., weedy shrubs or saplings) that reduces free movement of water through ditches.	Water flows freely through ditches. Grassy vegetation should be left alone.
M			Erosion damage to slopes	See "Ponds" Checklist	See "Ponds" Checklist
A			Rock lining out of place or missing (if applicable)	Maintenance person can see native soil beneath the rock lining.	Replace rocks to design standard.
Varies	Catch Basins			See "Catch Basins" Checklist	See "Catch Basins" Checklist
M, S	Swales		Trash & debris	See above for "Ditches"	See above for "Ditches"
M			Sediment Buildup	See above for "Ditches"	Vegetation may need to be replanted after cleaning.
M			Vegetation not growing or overgrown	Grass cover is sparse and weedy or areas are overgrown with woody vegetation.	Aerate soils and reseed and mulch bare areas. Maintain grass height at a minimum of 6 inches for best stormwater treatment or a minimum of 2 inches above the design flow depth. Remove woody growth, recontour, and reseed as necessary.
M, S			Erosion damage to slopes	See Ponds Checklist	See Ponds Checklist

EXHIBIT 1 (Continued)

1. Maintenance checklist for Catch Basins and Inlets (continued)

Frequency	Drainage System Feature	X	Problem	Conditions to Check For	Conditions That Should Exist
M, S			Outlet pipe is clogged with vegetation.	Vegetation or roots growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
M, S			Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
M, S			Pollution	Non-flammable chemicals of more than ½ cubic foot per three feet of basin length.	No pollution present other than surface film.
M, S	Catch Basin Cover		Cover not in place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
A			Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than ½ inch of thread.	Mechanism opens with proper tools.
A			Cover Difficult to Remove	One maintenance person cannot remove lid after applying 80 lbs of lift; intent is to keep cover from sealing off access to maintenance.	Cover can be removed by one maintenance person.
A	Ladder		Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
M, S	Metal Grates (if applicable)		Trash and Debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris.
M, S			Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Key:
A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms.

Comments:

EXHIBIT 1 MAINTENANCE PROGRAM

1. Maintenance checklist for Catch Basins and Inlets

Frequency	Drainage System Feature	X	Problem	Conditions to Check For	Conditions That Should Exist
M, S	General		Trash, debris and sediment in or on basin	Trash or debris in front of the catch basin opening is blocking capacity by more than 10%.	No trash or debris located immediately in front of catch basin opening. Grate is kept clean and allows water to enter.
M				Sediment or debris (in the basin) that exceeds 1/3 depth from the bottom of basin to invert of the lowest pipe into or out of the basin.	No sediment or debris in the catch basin. Catch basin is dug out and clean.
M, S				Trash or debris in any inlet or pipe blocking more than 1/3 of height.	Inlet and outlet pipes free of trash or debris.
M, S				Dead animals or vegetation that could generate odors that would cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
M, S				Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
M			Structural damage to frame and/or top slab.	Corner of frame extends more than ¾ inch past curb face into the street (if applicable)	Frame is even with curb.
M				Top slab has holes larger than 2 square inches or cracks wider than ¼ inch (intent is to make sure all material is running into the basin)	Top slab is free of holes and cracks.
M				Frame is not sitting flush on top slab i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
A			Cracks in basin walls/bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks or maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards. Contact a professional engineer for evaluation.
A				Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipe.
A			Settlement/ Misalignment	Basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards. Contact a professional engineer for evaluation.
M, S			Fire hazard or other pollution	Presence of chemicals such as natural gas, oil, or gasoline. Obnoxious color, odor, or sludge noted.	No color, odor, or sludge. Basin is dug out and clean.

EXHIBIT 1: MAINTENANCE PROGRAM - COVER SHEET

TYPE OF DOCUMENT:	Agreement to Maintain Stormwater Facilities
GRANTOR(S):	**Sunset Chevrolet**
ASSESSOR TAXPARCEL I.D. No.:	**042024-3019, -3023, -3046, -3130, and -3132** **042024-3018, -3070, -3139, -3140, and -3141**
NAME OF PROJECT	**Sunset Chevrolet Remodel / Addition**
ADDRESS OF PROJECT	**910 Traffic Avenue** **SUMNER, WA 98390**
PROJECT No.:	**PRJ2010-00012**

Inspection Period:	ANNUALLY by May 15
Number of Sheets Attached:	9 (including this sheet)
Inspection Period:	May 16th – May 15th Anually
Date Inspected:	
Name of Firm responsible for implementation:	Sunset Chevrolet
Name of Inspector: (print)	
Inspector's Signature:	
Site Contact Mailing Address:	Sunset Chevrolet 910 Traffic Avenue, Sumner, WA 98390
Site Contact telephone number:	
Site Contact email address:	

Appendix D

Operations and Maintenance Manual

bubbling between the inner surface of the hood and the outer surface of the filter. This bubbling agitates and cleans the surface of the filter, releasing accumulated sediments on the surface, flushing them from beneath the hood, and allowing them to settle to the vault floor.

Adjustable cartridge flow rate:

Inherent to the design of the StormFilter is the ability to control the individual cartridge flow rate with an orifice-control disc placed at the base of the cartridge. Depending on the treatment requirements and on the pollutant characteristics of the influent stream as specified in the CONTECH *Product Design Manual*, the flow rate may be adjusted through the filter cartridges. By decreasing the flow rate through the filter cartridges, the influent contact time with the media is increased and the water velocity through the system is decreased, thus increasing both the level of treatment and the solids removal efficiencies of the filters, respectively (de Ridder, 2002).

Recommended research and development:

Ecology encourages CONTECH to pursue continuous improvements to the StormFilter. To that end, the following actions are recommended:

- Determine, through laboratory testing, the relationship between accumulated solids and flow rate through the cartridge containing the ZPG™ media. **Completed 11/05.**
- Determine the system's capabilities to meet Ecology's enhanced, phosphorus, and oil treatment goals.
- Develop easy-to-implement methods of determining that a StormFilter facility requires maintenance (cleaning and filter replacement).

Contact Information:

Applicant Contact: Sean Darcy, darcys@contech-cpi.com
(800) 548-4667

Applicant Web link: www.contechstormwater.com

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology Contact: Mieke Hoppin
Water Quality Program
(360) 407-6435
mhop461@ecy.wa.gov

Technical Review Committee: Dave Tucker, P.E.
Kitsap County
(360) 337-7292
dtucker@co.kitsap.wa.us

The typical precast StormFilter unit is composed of three sections: the energy dissipater, the filtration bay, and the outlet sump. As Stormwater enters the inlet of the StormFilter vault through the inlet pipe, stormwater is directed through the energy dissipater into the filtration bay where treatment will take place. Once in the filtration bay, the stormwater begins to pond and percolate horizontally through the media contained in the StormFilter cartridges. After passing through the media, the treated water in each cartridge collects in the cartridge's center tube from where it is directed into the outlet sump by a High Flow Conduit under-drain manifold. The treated water in the outlet sump is then discharged through the single outlet pipe to a collection pipe or to an open channel drainage way. In some applications where heavy grit loads are anticipated, pretreatment by settling may be necessary.

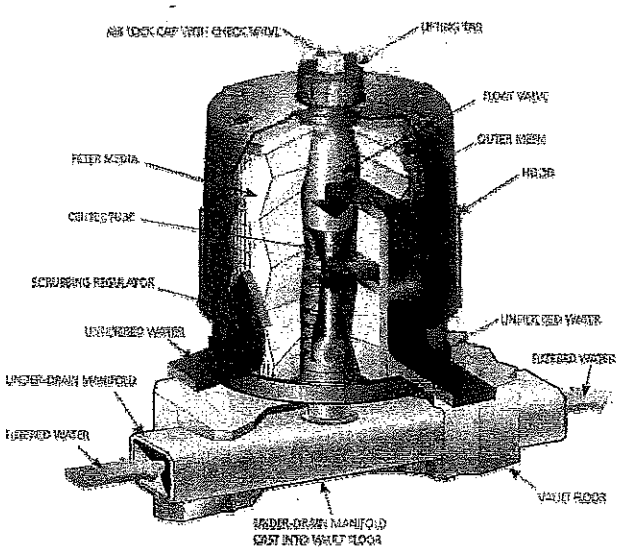


Figure 2. The StormFilter Cartridge

Cartridge Operation:

As the water level in the filtration bay begins to rise, stormwater enters the StormFilter cartridge. Stormwater in the cartridge percolates horizontally through the filter media and passes into the cartridge's center tube, where the float in the cartridge is in a closed (downward) position. As the water level in the filtration bay continues to rise, more water passes through the filter media and into the cartridge's center tube. The air in the cartridge is displaced by the water and purged from beneath the filter hood through the one-way check valve located in the cap. Once the center tube is filled with water there is enough buoyant force on the float to open the float valve and allow the treated water to flow into the underdrain manifold. As the treated water drains, it tries to pull in air behind it. This causes the check valve to close, initiating a siphon that draws polluted water throughout the full surface area and volume of the filter. Thus, the entire filter cartridge is used to filter water throughout the duration of the storm, regardless of the water surface elevation in the filtration bay. This continues until the water surface elevation drops to the elevation of the scrubbing regulators. At this point, the siphon begins to break and air is quickly drawn beneath the hood through the scrubbing regulators, causing energetic

- For the 8 qualifying events with peak discharge exceeding design flow (ranging from 120 to 257% of the design rate), results ranged from 52% to 96% TSS removal, with an average of 72%.
- Due to the characteristics of the hydrographs, generally the field results reflect flows below (ranging between 20 and 60 percent of) the tested facilities' design rate. During these sub-design flow rate periods, some of the cartridges operate at or near their *individual* full design flow rate (generally between 4 and 7.5 GPM for an 18" cartridge effective height) because their float valves have opened. Float valves remain closed on the remaining cartridges, which operate at their base "trickle" rate of 1 to 1.5 GPM.
- Laboratory testing using U.S. Silica's Sil-Co-Sil 106 fine silica product showed an average 87% TSS removal for testing at 7.5 GPM per cartridge (100% design flow rate).
- Other relevant testing at I-5 Lake Union, Greenville Yards (New Jersey), and Ski Run Marina (Lake Tahoe) facilities shows consistent TSS removals in the 75 to 85% range. *Note that I-5 Lake Union was operated at 50%, 100%, and 125% of design flow.*
- SMI's application included a satisfactory "Factors other than treatment performance" discussion.

Note: Ecology's 80% TSS removal goal applies to 100 mg/l and greater influent TSS. Below 100 mg/L influent TSS, the goal is 20 mg/L effluent TSS.

Technology Description:

The Stormwater Management StormFilter® (StormFilter), a flow-through stormwater filtration system, improves the quality of stormwater runoff from the urban environment by removing pollutants. The StormFilter is used to treat runoff from a wide variety of sites including, but not limited to: retail and commercial development, residential streets, urban roadways, freeways, and industrial sites such as shipyards, foundries, etc.

Operation:

The StormFilter is typically comprised of a vault that houses rechargeable, media-filled, filter cartridges. Various media may be used, but this designation covers only the zeolite-perlite-granulated activated carbon (ZPG™) medium. Stormwater from storm drains is percolated through these media-filled cartridges, which trap particulates and may remove pollutants such as dissolved metals, nutrients, and hydrocarbons. During the filtering process, the StormFilter system also removes surface scum and floating oil and grease. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged to an open channel drainage way.

A bypass schematic for flow rates exceeding the water quality design flow rate is shown on page 7.

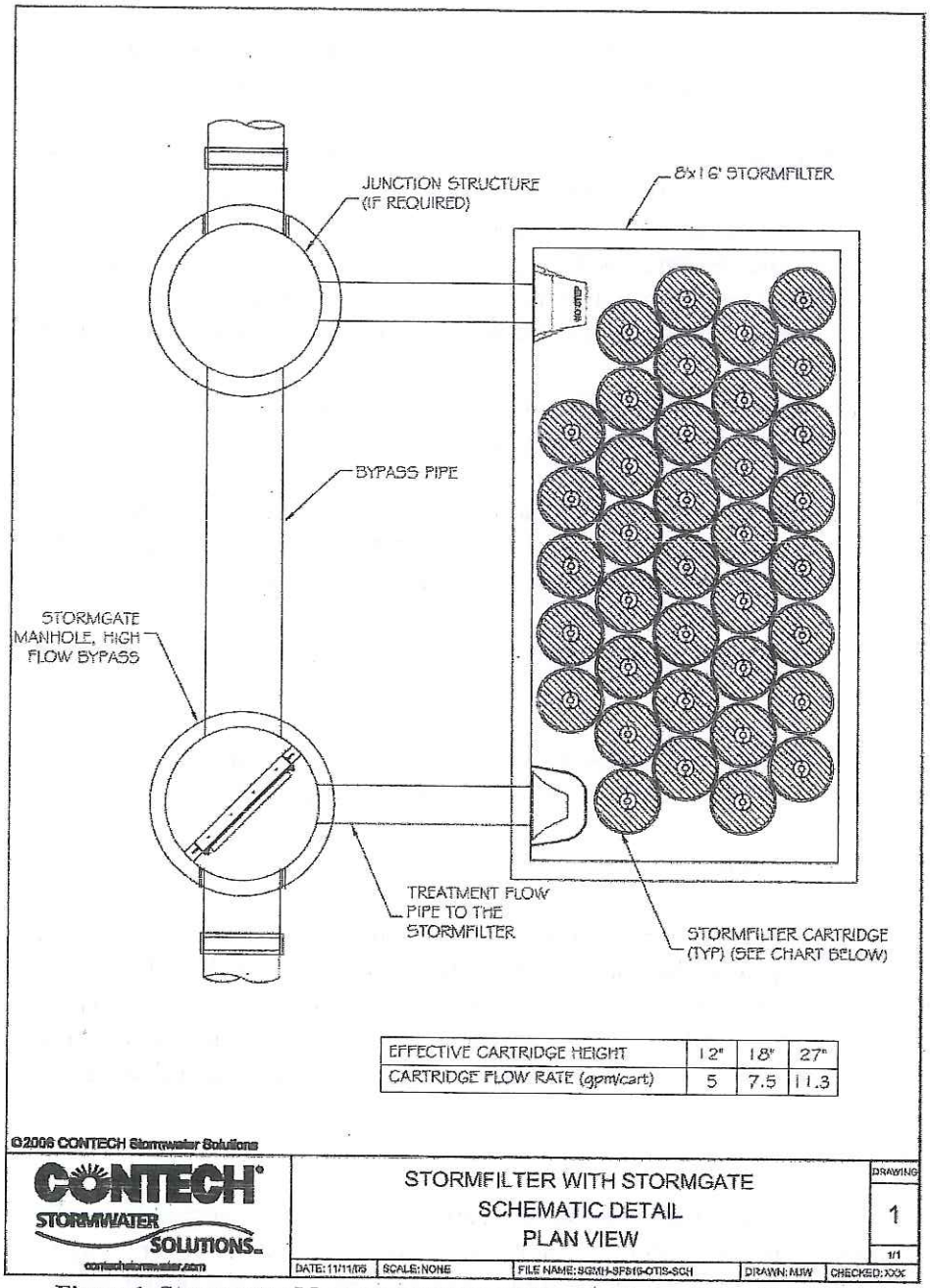


Figure 1. Stormwater Management StormFilter Configuration with Bypass

StormFilter Configurations:

The StormFilter is offered in multiple configurations: precast, high flow, catch basin, curb inlet, linear, volume, corrugated metal pipe, dry-well, and CON/Span form. Most configurations use pre-manufactured units to ease the design and installation process. Systems may be either uncovered or covered underground units.

The combined data from the two field sites reported in this TEER (Heritage Marketplace and Lake Stevens) indicate that the performance of a StormFilter system configured for inline bypass with ZPG media and a hydraulic loading rate of 1 gpm/ft^2 of media surface area meets Ecology performance goals for Basic Treatment.

Technical Review Committee Recommendations:

The TRC, based on the weight of the evidence and using its best professional judgment, finds that:

- StormFilter, using ZPG media and operating at no more than a hydraulic loading rate of 1 gpm/ft^2 of media surface area, is expected to provide effective stormwater treatment achieving Ecology's Basic Treatment TSS removal performance goals, as demonstrated by field and laboratory testing performed in accordance with the protocol; and, StormFilter® is deemed satisfactory with respect to factors other than treatment performance (e.g., maintenance; see the protocol's Appendix B for complete list).

Findings of Fact:

- Influent TSS concentrations and particle size distributions were generally within the range of what would be considered "typical" for western Washington (silt to silt loam).
- Thirty-two (32) storm events were sampled at two sites for storms from April 2003 to March 2004, of which twenty-two (22) were deemed "qualified" and were therefore included in the data analysis set.
- Statistical analysis of these 22 storm events verifies the data set's adequacy.
- Analyzing all 22 qualifying events, the average influent and effluent concentrations and aggregate pollutant load reduction are 114 mg/L, 25 mg/L, and 82%, respectively.
- Analyzing all 22 qualifying events based on the *estimated average* flow rate during the event (versus the *measured peak* flow rate), and more heavily weighting those events near the design rate (versus events either far above or well below the design rate) does not significantly affect the reported results.
- For the 7 qualifying events with influent TSS concentrations greater than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 241 mg/L, 34 mg/L, and 89%, respectively. If the 2 of 7 events that exceed the maximum 300 mg/L specified in Ecology's guidelines are excluded, the average influent and effluent concentrations and aggregate pollutant load reduction are 158 mg/L, 35 mg/L, and 78%, respectively.
- For the 15 qualifying events with influent TSS concentrations less than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 55 mg/L, 20 mg/L, and 61%, respectively. If the 6 of 15 events that fall below the minimum 33 mg/L TSS specified in Ecology's guidelines are excluded, the average influent and effluent concentrations and aggregate pollutant load reduction are 78 mg/L, 26 mg/L, and 67%, respectively.

Report (TEER) by Stormwater Management Inc., October 29, 2004" Ecology's technology assessment protocol requires the applicant to hire an independent consultant to complete the following work:

1. Complete the data validation report.
2. Prepare a TEER summary, including a testing summary and conclusions compared with the supplier's performance claims.
3. Provide a recommendation of the appropriate technology use level.
4. Recommend relevant information to be posted on Ecology's website.
5. Provide additional testing recommendations, if needed."

This report, authored by Dr. Gary Minton, Ph. D., P.E., Resource Planning Associates, satisfies the Ecology requirement.

- (Public) "Performance of the Stormwater Management StormFilter Relative to the Washington State Department of Ecology Performance Goals for Basic Treatment," is a summary of StormFilter performance that strictly adheres to the criteria listed in the Guidance for Evaluating Emerging Stormwater Treatment Technologies, Technology Assessment Protocol – Ecology (TAPE).
- "Heritage Marketplace Field Evaluation: Stormwater Management StormFilter with ZPG Media," is a report showing all of the information collected at Site A as stated in the SMI Quality Assurance Project Plan (QAPP). This document contains detailed information regarding each storm event collected at this site, and it provided a detailed overview of the data and project.
- "Lake Stevens Field Evaluation: Stormwater Management StormFilter with ZPG Media," is a report that corresponds to Site E as stated in the SMI QAPP. This document contains detailed information regarding each storm collected at this site, and includes a detailed overview of the data and project.
- (Public) "Evaluation of the Stormwater Management StormFilter for the removal of SIL-CO-SIL 106, a standardized silica product: ZPG at 7.5 GPM" is a report that describes laboratory testing at full design flow.
- "Factors Other Than Treatment Performance."
- "State of Washington Installations."

Above-listed documents noted as "public" are available by contacting CONTECH.

Applicant's Use Level Request:

That Ecology grant a General Use Level Designation for Basic Treatment for the StormFilter using ZPG™ media (zeolite/perlite/granular activated carbon) at a hydraulic loading rate of 1 gpm/ft^2 of media surface area in accordance with Ecology's 2005 Stormwater Manuals.

Applicant's Performance Claim:

Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.

6. **CONTECH shall maintain readily available those reports listed under "Application Documents" (above) as public, as well as the documentation submitted with its previous conditional use designation application. CONTECH shall provide links to this information from its corporate website, and make this information available upon request, at no cost and in a timely manner.**

7. **ZPG™ media used shall conform with the following specifications:**

   Each cartridge contains a total of approximately 2.6 cubic feet of media. The ZPG™ cartridge consists of an outer layer of perlite that is approximately 1.3 cubic feet in volume and an inner layer, consisting of a mixture of 90% zeolite and 10% granular activated carbon, which is approximately 1.3 cubic feet in volume.

   Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The expanded perlite shall have a bulk density ranging from 6.5 to 8.5 lbs per cubic foot and particle sizes ranging from 0.09" (#8 mesh) to 0.38" (3/8" mesh).

   Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite. The zeolite media shall have a bulk density ranging from 44 to 50 lbs per cubic foot and particle sizes ranging from 0.13" (#6 mesh) to 0.19" (#4 mesh). Additionally, the cation exchange capacity (CEC) of zeolite shall range from approximately 1.0 to 2.2 meq/g.

   Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam-activated. The GAC media shall have a bulk density ranging from 28 to 31 lbs per cubic foot and particle sizes ranging from a 0.09" (#8 mesh) to 0.19" (#4 mesh).

Applicant: CONTECH Stormwater Solutions Inc., Manufacturer and Vendor

Applicant's Address: 11835 NE Glenn Widing Dr.
Portland, OR 97220

Application Documents:

The applicant's master report, titled, "The Stormwater Management StormFilter Basic Treatment Application for General Use Level Designation in Washington", Stormwater Management, Inc., November 1, 2004, includes the following reports:

- (Public) "Evaluation of the Stormwater Management StormFilter Treatment System: Data Validation Report and Summary of the Technical Evaluation Engineering

calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model (e.g. MGS Flood). Note that if single event methods are used to estimate runoff flowrates, Figures 9.6a and 9.6b in Volume V of the 2005 Stormwater Management Manual for Western Washington should be used to adjust the peak single event flow rate for calculation purposes. This is done by dividing the peak 10 minute flow rate predicted by the single event method by the ratio indicated in Figure 9.6a for on-line designs, or Figure 9.6b for off-line designs. The 6-month, 24-hour rainfall amount for the project site must be known to identify the appropriate ratio. The adjusted flow rate is then divided by the approved cartridge flow rate (Table 1) to compute the number of cartridges necessary. Note: This method is not applicable for Eastern Washington.

2. For StormFilter systems to be located downstream of a stormwater detention facility, the StormFilter size shall be calculated using both the flow-based and mass-based methods as described in the CONTECH *Product Design Manual Version 4.1 (April 2006)*, or most current version, and the designer shall select the result yielding the larger number of cartridges.

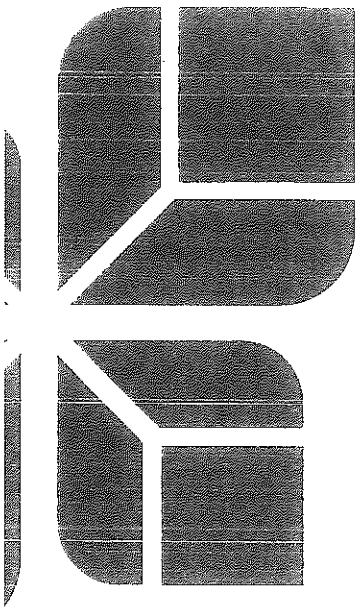
3. StormFilter systems shall be installed in such a manner that flows exceeding the water quality treatment rate are bypassed or will not resuspend captured sediments. StormFilter systems shall be designed in accordance with the performance goals in Ecology's most recent Stormwater Manual and CONTECH's *Product Design Manual Version 4.1 (April 2006)*, or most current version, unless otherwise specified. The design, pretreatment, land use application, and maintenance criteria in CONTECH's Design Manual must be closely followed.

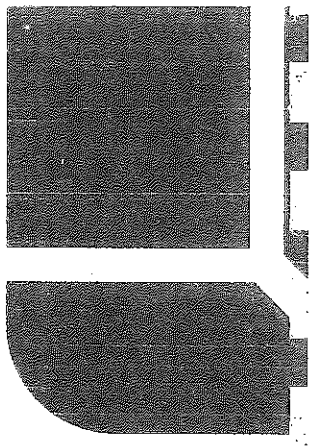
4. Pretreatment of TSS and oil and grease may be necessary, and shall be provided in accordance with the most current versions of the CONTECH's *Product Design Manual (April 2006)* or the applicable Ecology Stormwater Manual, and using the performance criteria and pretreatment practices provided on Ecology's "Evaluation of Emerging Stormwater Treatment Technologies" website.

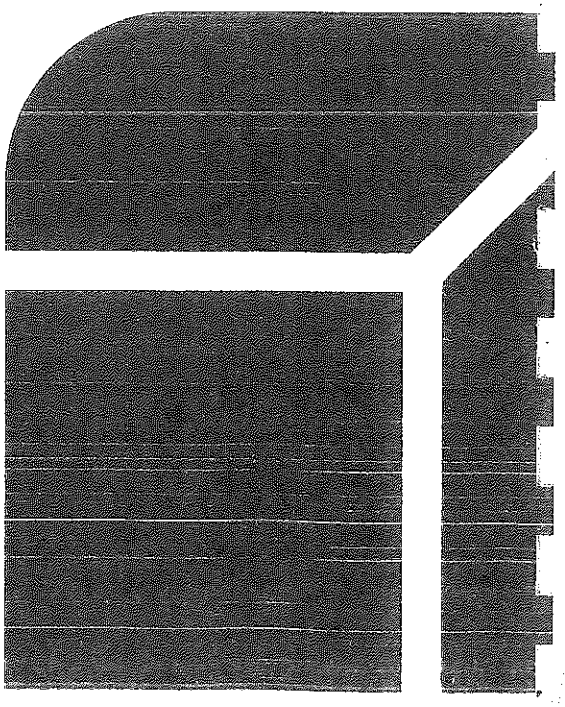
5. StormFilter systems are typically designed to be maintained on an annual basis, which shall serve as the default maintenance frequency. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.

   In lieu of annual maintenance, inspections can be used to determine a site-specific maintenance schedule and/or requirements. When inspections are performed, the following findings shall serve as maintenance triggers:

   a) Accumulated vault sediment depths exceed an average of 2 inches, or
   b) Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or
   c) Standing water remains in the vault between rain events.







AHBL

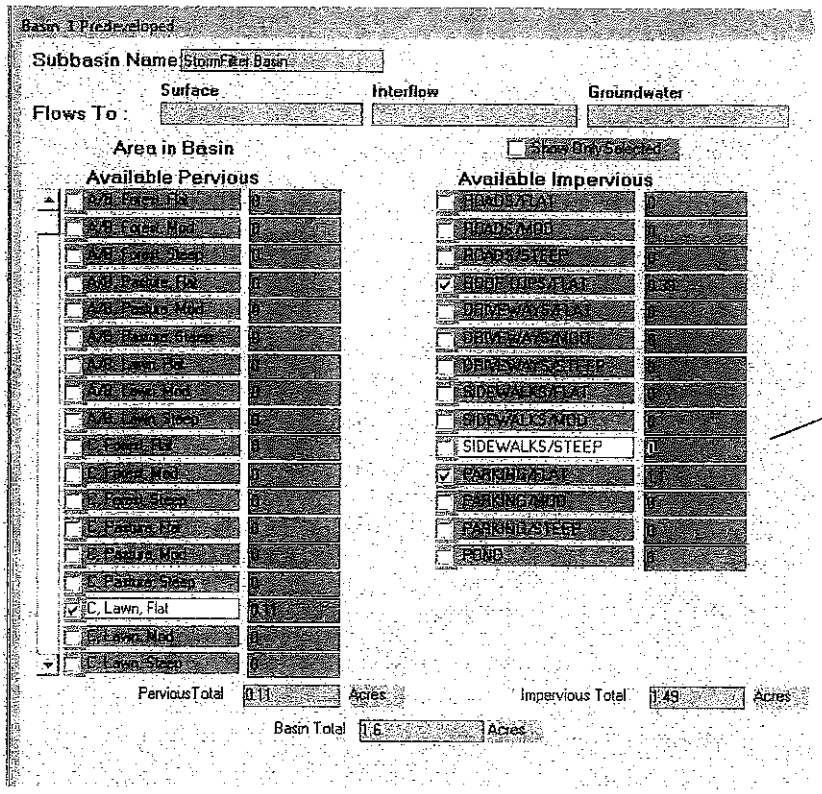
TACOMA

2215 North 30th Street
Suite 300
Tacoma, WA 98403-3350
253.383.2422 TEL
253.383.2572 FAX

SEATTLE

1200 6th Avenue
Suite 1620
Seattle, WA 98101-3123
206.267.2425 TEL
206.267.2429 FAX

www.ahbl.com

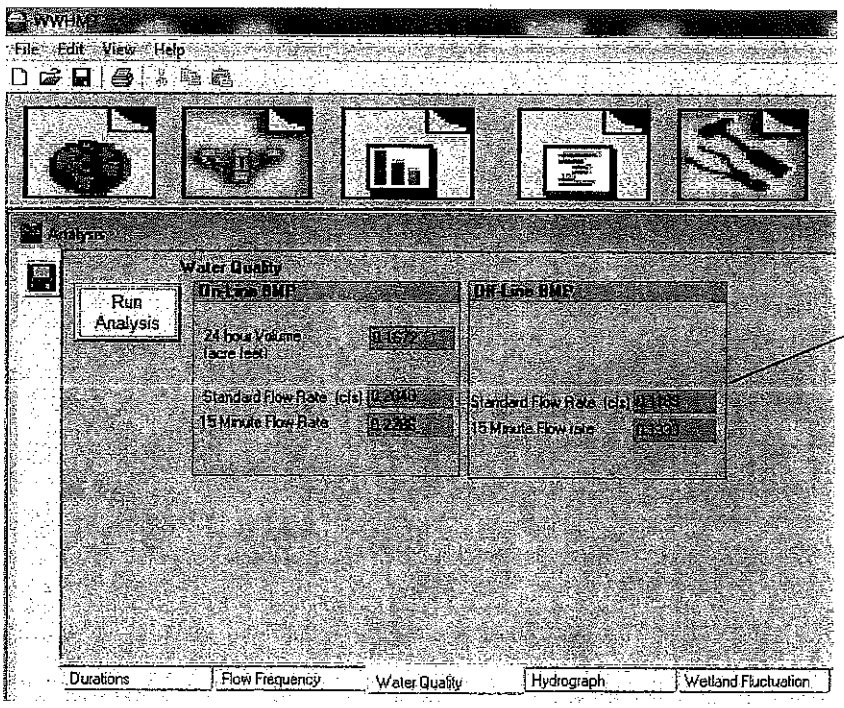


BASIN AREA:

Lawn = 0.11 acre

Roof = 0.39 acre

Parking/Flat = 1.10 acres



15-Minute Flow
0.1333cfs

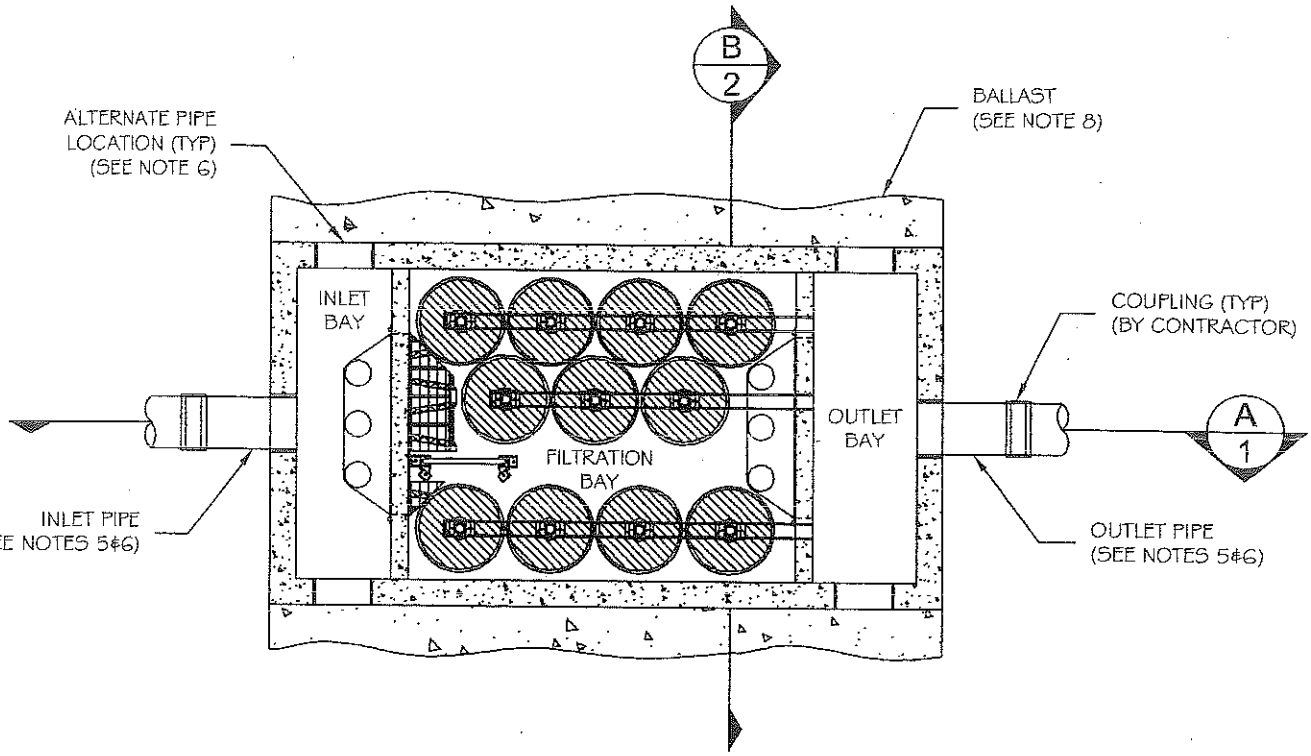
0.133x449gpm/7.5
= 7.97 cart.
Use 8 18-inch cart.

449 GPM / CFS

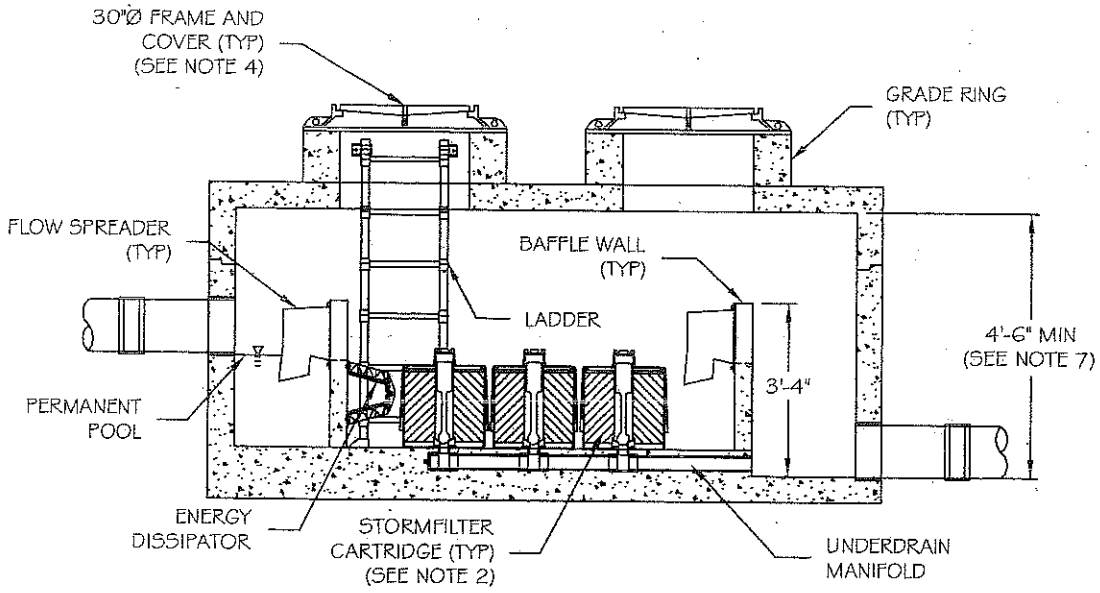
7.5 GPM / CARTRIDGE

STANDARD 18-INCH

OFF-LINE FLOW USED SINCE STORMFILTER WAS BUILT-IN BYPASS FOR HIGH FLOWS. (BAFFLE WALL)



6' x 12' STORMFILTER - PLAN VIEW 1/1



6' x 12' STORMFILTER - SECTION VIEW A/1

THE STORMWATER MANAGEMENT StormFilter® U.S. PATENT No. 5,322,629, No. 5,707,527, No. 6,027,639 No. 6,649,048, No. 5,624,576, AND OTHER U.S. AND FOREIGN PATENTS PENDING

CONTECH® STORMWATER SOLUTIONS™
contechstormwater.com

6' x 12' PRECAST STORMFILTER PLAN AND SECTION VIEWS STANDARD DETAIL

FIGURE 6

DRAWING 1 1/2

DATE: 09/28/05 | SCALE: NONE | FILE NAME: SF612-PC-DTL | DRAWN: MJW | CHECKED: ARG