Stormwater Management Manual

Bureau of Environmental Services

1120 S.W. Fifth Avenue, Room 613, Portland, OR 97204-3713
503-823-7740 • BESStormManual@portlandoregon.gov
portland.gov/bes/SWMM

Date: March 1, 2022

By: Henry Stevens

Maintenance Interval for Contech Catch Basin StormFilter Units on the Beaverton-Hillsdale Highway

---

SUMMARY

In late April 2019 BES completed construction of a retrofit project to treat stormwater runoff from the Beaverton-Hillsdale Highway (BHH) adjacent to SW Shattuck Road. The purpose of the *Beaverton-Hillsdale Hwy – Phase I Drainage Retrofits for Water Quality Project*, BES capital project E08675, is to improve water quality in Fanno Creek by removing TSS and associated pollutants from street runoff that drains from the project area. In addition to 3 green street facilities, the project includes 7 Contech Catch Basin StormFilter™ (CBSF) units. The CBSFs were the first units of their type in the City of Portland.

BES developed a monitoring program for the group of CBSF units to confirm how often maintenance is required, specifically whether maintenance is required more than once a year. Like other arterials in Portland, the edges of the BHH provide relatively little space for stormwater retrofits and a viable treatment facility with a small footprint could be an important alternative to green streets facilities. Important considerations in any evaluation of cost-effectiveness include the feasibility of maintenance logistics and the interval between required maintenance visits.

The monitoring program included quarterly site visits to record sediment accumulations and conduct flow tests providing instantaneous measurements of filtered flow rates. The program followed the approach developed by Seattle Public Utilities for similar testing it conducted on 15 Contech StormFilter CBSF units in Seattle in 2011. (See Appendix for those results.) BES staff selected four of the seven CBSFs for monitoring based on the logistical ease of staging equipment for the hydraulic tests. The tests were completed with a water truck and a flow meter, documenting the maximum flow rate filtered before bypassing. The units have 2, 3, and 4 cannisters, with four cannisters being the largest system available in the catch basin configuration of the device.

The design treatment capacity of each facility was based on a unit capacity of 15 gpm per 18" cartridge, consistent with the design requirements of the 2014 BES Stormwater Management Manual (SWMM) when the project was designed. BES has since changed the approved capacity of StormFilter cannisters based on the certifications of the Washington State TAPE program which are now the technical basis for Portland approvals of Manufactured Stormwater Treatment Technologies (MSTTs). The current approved design flow rate is 7.5 gpm per 18" cartridge.

The scope of the monitoring effort was constrained by the COVID-19 pandemic and problems with the performance of the curb inlets for the monitored facilities. The monitoring team completed three of the four scheduled quarterly visits in 2019-2020, starting immediately after the units were put into service. Unfortunately the pandemic precluded the fourth monitoring visit. In addition, the data from two of the four facilities were invalidated by field observations during fall 2019 suggesting the inlets for two facilities were clogged on a regular basis by sediment and debris. The hydraulic data from the remaining two facilities indicate the two systems were filtering at roughly their design flow at the end of the third quarter of operation. Sediment depths measured during the third visit equaled or exceeded the depths at which Contech recommends maintenance.

PROJECT TEAM

Table 1. Project Stakeholders

Staff / Stakeholder	BES Workgroup
Adrienne Aiona	Code, Rules, Manual (CRM) Group; Manager
Henry Stevens	CRM
Alex Bans	CRM
Joel Dewit	Private Property Retrofit Program
Tim Kurtz	Integrated Planning
Todd Gunter	Stormwater Operations & Maintenance
Rob Cozzi	Stormwater Operations & Maintenance
Mike Henrickson	Stormwater Operations & Maintenance
Amin Wahab	Watershed Operations & Maintenance
Lisa Huntington	Engineering Services, Design Manager

PROJECT DETAILS

The project area is shown below, including the locations of the 3 green street facilities and the 7 CBSF installations.

Figure 1. Project Area with green streets in green. Contech units are in blue.

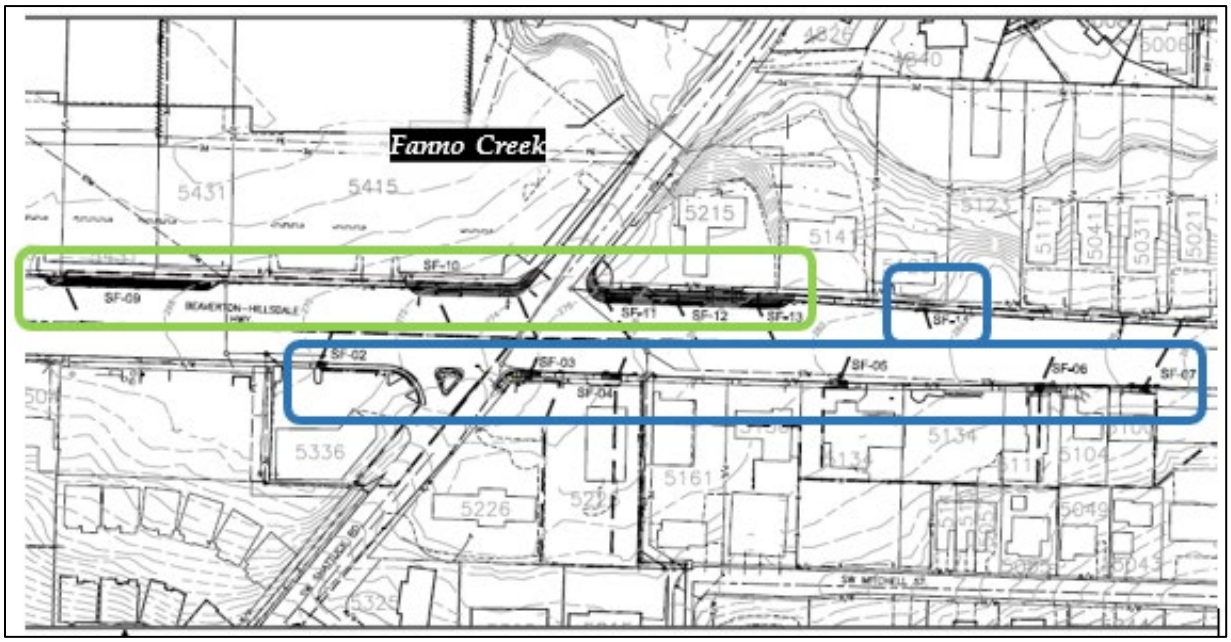


Table 2 is from the BES design report for the project. It summarizes the hydrologic design for the basins. Per the requirements of the 2014 Stormwater Management Manual, the designer used the Rational Method to determine the rate for the pollution reduction storm assuming a rainfall intensity of 0.19 in/hr with a time of concentration of 5 minutes. The number of cartridges in each catch basin unit was determined using a design flow rate of 15 gpm per cartridge and rounding up to the nearest whole cartridge.

Table 2. Sizing table from the BES design report. Catchment areas include pervious areas.

Facility ID	Catchment Area (sf)	c	Q_{PR} (cfs)	Calculated # of Filter Cartridges	Treat Pollution Reduction?	Q_{10} (cfs)	External bypass req'd?
SF-01	22,066	0.79	0.08	2.3	Y	1.15	Y
SF-02	13,373	0.90	0.05	1.6	Y	0.79	N
SF-03	18,245	0.90	0.07	2.1	Y	1.08	Y
SF-04	25,775	0.87	0.10	2.9	Y	1.47	Y
SF-05	32,816	0.90	0.13	3.8	Y	1.93	Y
SF-06	19,393	0.72	0.06	1.8	Y	0.92	N
SF-07	16,236	0.80	0.06	1.7	Y	-	
SF-07 (with roof)	20,306	0.82	-	-	-	1.09	Y
SF-14	74,31	0.68	0.02	0.7	Y	0.33	N

The CBSF units are located behind the curb and under the sidewalk. Each unit has a standard City of Portland P-305 curb inlet with an opening 2 feet wide and 6 inches tall, depressed 2" at the opening. The units contain 2, 3, or 4 filter cartridges depending on the catchment size. The steel vault for each of the facilities was custom-fabricated by a local metal shop. Each unit includes a forebay. The cartridges are loaded with Contech's Zeolite/Perlite/Granular activated carbon (ZPG) media. The following photos show the typical setup for the entrance and the forebay in relation to the adjacent cartridge vault.

METHODS

In 2019 BES staff completed initial site visits and concluded it was logistically feasible to test 4 of the 8 CBSFs using a water truck positioned on private property. The adjacent property owners partnered with BES, providing parking space for the water truck for the short time periods required for the testing.

The monitoring plan called for quarterly inspections and flow tests for each of the facilities during the first 12 months of operation. Prior to starting the individual hydraulic tests, staff measured sediment levels on the vault floor (at least one location), on the cartridges, and on the floor of the forebay. The results were noted and later compared with the observations and decision tree from the 2020 Contech maintenance guide (see below). The guide states maintenance is required if:

- There is >4 inches of sediment on the vault floor or
- There is >1/4 inch of sediment on the top of the cartridges or
- There is >4 inches of water above the bottom of the cartridges for more than 24 hours after the end of a rain event.

Staff documented the maximum flow rate being captured and filtered, just prior to bypass, for each installation. The field rate was compared with the design flow rate for each installation at the design standard of 15 GPM per canister.

BES hired a 3,500 gallon water truck and used BES' SENSUS 1250 closed-channel water meter to test the units. Flow from the hose exiting the meter was directed into the forebay of the tested unit, using a diffuser and a bucket as needed to disperse incoming flows and to avoid suspending existing sediment. Staff slowly increased the flow rate until bypass occurred and slowly reduced the flow to the point where the flow stabilized at the level of the bypass bar for at least a minute. This stabilized flow rate was documented as the treated flow rate for the unit and compared with the design flow rate for the individual units.



RESULTS

Test Schedule and Rainfall

BES contractors completed construction in April 2019 and the curb inlets, which had been completely blocked so as not to allow entrance of runoff during the construction period, were opened the last week of April. Staff measured sediment depths and conducted hydraulic tests on the following dates.

- May 21, 2019
- August 28, 2019
- February 14, 2020
- (Testing was not performed during the fourth quarter due to the pandemic.)

More than nine months passed between the time the units first received runoff in late April 2019 and the third and final tests in mid-February of 2020. The HYDRA rain gage at Maplewood Elementary School reported a total of 23.1 inches of rainfall during this period.

Inlet Performance

Staff visited the project site twice in December 2019 to verify the curb inlets were functioning properly. The inlets for SF02 and SF04 were free of sediment and debris during both visits, but the inlets for units SF03 and SF05 were clogged with sediment and debris on both occasions. Staff cleared the entrances for the clogged inlets during the first visit but found them

significantly blocked, with bypass occurring, during a visit during a rain event a couple of weeks later. Staff concluded units SF03 and SF05 were clogging regularly in the fall and that it's unlikely the results for these two facilities are representative. There are two related observations about the inlets.

- The slope of the entrance (curb inlet) for SF05 is shallower than called for in the plan set. This stems from the fact that the top (lip) of the metal vault at the inlet is higher than shown in the plans. On February 20, 2020, staff hydraulically tested the curb inlet for SF05 after cleaning it and confirmed there was significant bypass at the design flow rate. This was not the case for the other curb inlets when staff tested them.

- In 2021 a maintenance supervisor with the PBOT street cleaning program reported that the Beaverton-Hillsdale Highway is swept regularly and that street sweepers occasionally clog curb inlets since the brushes push debris to the curb and can't reach inside a curb inlet1.

Sediment Depths and Flow Rates

Table 3 shows the sediment depths staff documented on February 14, 2022, the day of the third and final quarterly flow tests. Vault water depths are not presented here since it had rained less than 24 hours before the site visit and Contech's maintenance guide recommends assessing the water depths only after 24 hours have passed after the end of an event.

Table 3. Sediment depths after 3 quarters

	Sediment Depths; February 14, 2022		
Facility	Vault Floor	Cartridge Tops	Forebay
SF02	3"	.5"	4-9"
SF03*	Not Recorded	0"	10"
SF04	7"	.5-1"	2.5"
SF05*	5"	0"	2"

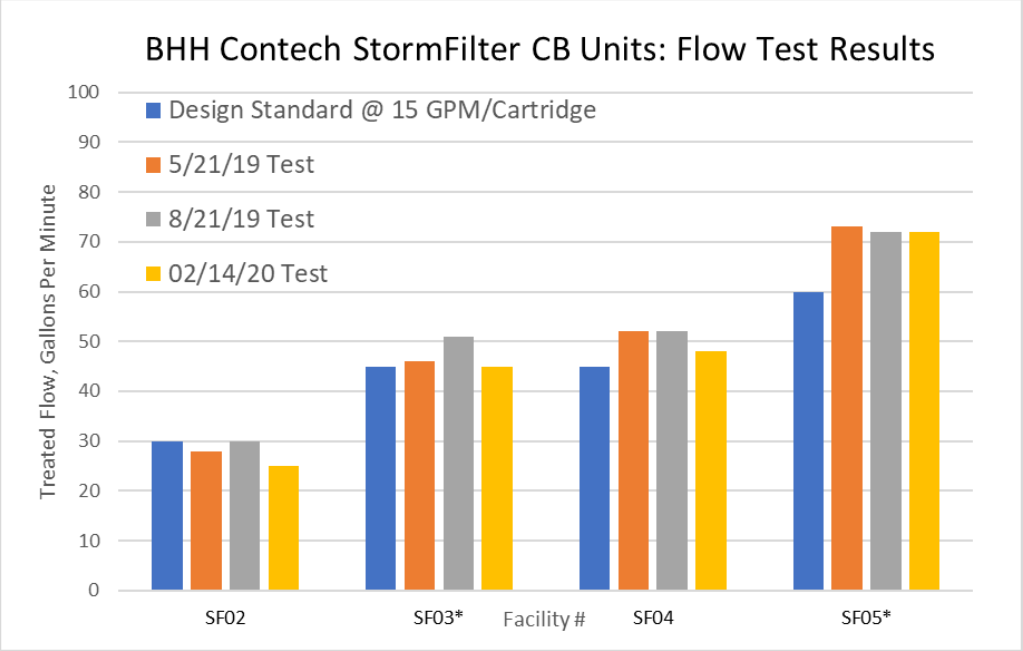
* The data for SF03 and SF05 likely aren't representative given the repeated inlet clogging and bypass observed during December 2019.

The sediment depths on the vault floor and cartridge tops for SF02 and SF04 are close to or meet and exceed the Contech thresholds indicating maintenance is needed. The lack of sediment on the cartridge tops for SF03 and SF05, compared with observations from the other two facilities, supports the observation that some runoff was bypassing the facilities and that they weren't being loaded consistently with stormwater.

[1] Email from Ryan Hughes, PBOT Maintenance Supervisor, to Henry Stevens; February 9, 2021.

Figure 2 displays results from the hydraulic testing completed by BES staff. The graph includes the design flow rate (in blue) for reference.

Figure 2. Facility design standards and hydraulic test results*



* The data for SF03 and SF05 likely aren't representative given the repeated inlet clogging and bypass observed during December 2019.

On February 14, 2020 the flow rate for SF04 is still slightly higher than the design rate, while the flow rate for SF02 is slightly lower than the design rate. The evidence suggests the two systems were performing close to their design flow rates after more than 9 months and approximately 23 inches of rain. That said, the dip in the treated flow rate for SF02 may indicate the beginning of clogging. It's important to note that facilities SF02 and SF04 both met CONTECH guidance thresholds for triggering maintenance based on sediment depths on February 14, 2020. As previously noted the results for SF03 and SF05 are being discounted due to evidence the inlets for those facilities are susceptible to clogging.

The project provided a unique opportunity to test the performance and maintenance requirements of a group of Contech StormFilter catch basin units on a busy arterial. Unfortunately the results are less than authoritative as a reference for BES when it comes to making decisions about the use of these catch basin systems. The study points to the important role played by curb inlets and the potential for inlet clogging in the fall, perhaps partly as a result of street sweeping.

REFERENCES

Contech, 2010. *The Stormwater Management StormFilter® Specification CatchBasin StormFilter™*. March 2010.

Seattle Public Utilities (SPU), 2012. *CatchBasin StormFilter Performance Evaluation Report.* March 2012. Web link: https://www.seattle.gov/util/cs/groups/public/@spu/@drainsew/documents/webcontent/01_016486.pdf.

Seattle Public Utilities (SPU), 2013. *CatchBasin StormFilter Hydrologic Performance and Sizing Study.* June 2013.

Washington Department of Ecology (WDOE), 2016a. "GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) TREATMENT For CONTECH Engineered Solutions Stormwater Management StormFilter® With ZPG Media at 1 gpm/sq ft media surface area." November 2016.http://www.ecy.wa.gov/programs/wq/stormwater/newtech/use_designations/STORMFILTERzpg1GPMCONTECHguld.pdf

Washington Department of Ecology (WDOE), 2016b. "GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) AND PHOSPHORUS TREATMENT For CONTECH Engineered Solutions Stormwater Management StormFilter® with PhosphoSorb® media." November 2016. http://www.ecy.wa.gov/programs/wq/stormwater/newtech/use_designations/STORMFILTERphosphosorbCONTECHguld.pdf

Appendix

					% of Target Flowrate	
Unit No.	Corrected Catchment	Catchment % Impervious	18" Canisters Installed	18" Canisters Req'd by BES (New Sizing)	After 3 Months	After 10 months
1	5,405	100	3	2	93	88
2	15,749	100	4	4	34	12
3	4,494	100	1	2	43	7
4	6,171	100	2	2	116	117
5	6,525	100	2	2	127	127
6	6,769	100	2	2	114	115
7	4,988	100	2	2	117	74
8	5,333	100	3	2	109	55
9	33,411	77	2	8	92	96
10	31,029	67	3	8	38	16
11	52,571	75	3	13	32	0
12	29,287	100	2	7	37	0
13	13,147	100	2	4	59	0
14	31,163	50	2	8	59	2
15	17,463	88	3	5	67	63

- S

Summary of data from Seattle SPU 2013 flow-tests of Contech CBSFs installations. The grey highlights facilities that meet or exceed Portland's sizing standard using 7.5 gpm/ 18"cartridge. 2013 SPU report: “StormFilter Hydrologic Performance and Sizing Study”.