TATHAM ENGINEERING

Enhancing our communities

11283 Highway 26 – The Terrazzo

FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

1655570 Ontario Inc.

File 121075 | October 11, 2022

Document Control

File:

121075

Date:

October 11, 2022

Prepared by:

Tatham Engineering Limited
115 Sandford Fleming Drive, Suite 200
Collingwood, Ontario L9Y 5A6
T 705-444-2565
tathameng.com

Prepared for:

1655570 Ontario Inc.
30 Harding Boulevard
Richmond Hill, Ontario L4C 1S8

Authored by:	Reviewed by:
Michael Buske, C.E.T. Project Manager	Kevin Sansom, B.A.Sc., P.Eng. Senior Engineer

Disclaimer	Copyright
The information contained in this document is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and Tatham Engineering Limited undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.	This document may not be used for any purpose other than that provided in the contract between the Owner/Client and the Engineer nor may any section or element of this document be removed, reproduced, electronically stored or transmitted in any form without the express written consent of Tatham Engineering Limited.

Issue	Date	Description
0	October 11, 2022	FSR & SWM Report

Document Contents

1 Introduction

Tatham Engineering Limited has been retained by 1655570 Ontario Inc. to prepare a functional servicing (FSR) and Stormwater Management (SWM) report in support of the proposed 33-unit townhouse condominium development at 11283 Highway 26 in the Town of Collingwood.

1.1 OBJECTIVE

The primary objective of the report is to assess the feasibility of providing adequate servicing for the proposed development and provide recommendations for the improvements required. This report will also demonstrate that the proposed servicing and SWM plan conforms to applicable municipal and provincial guidelines.

1.2 BACKGROUND AND GUIDELINES

This report was prepared recognizing the pertinent background reports in support of the proposed development and municipal and provincial guidelines on water resources and the environment including the following publications.

- *Design Guidelines for Drinking-Water Systems*, Ministry of the Environment (2008);
- *Design Guidelines for Sewage Works*, Ministry of the Environment (2008);
- *Development Standards*, Town of Collingwood (July 2007); and
- *Stormwater Management Practices Planning and Design Manual,* Ministry of the Environment, Conservation and Parks (MECP) (2003).

2 Development Site

2.1 SITE DESCRIPTION AND LOCATION

The property is approximately 0.8 ha (2.0 ac) with the legal description being Registered Plan 51R-34205, Town of Collingwood, County of Simcoe. According to the Town's zoning bylaw, the land is currently zoned as R3 (residential third density).

2.2 EXISTING DEVELOPMENT

The existing lands consist mostly of mixed forest. There is foundation ruble from an old house in the northeast corner of the site with a driveway to Highway 26.

2.3 SURROUNDING DEVELOPMENT

The proposed development is bounded to the north by Highway 26 and by Dawson Drive to the south. There is an existing condominium (Glen III) to the southeast with an address of 25 Dawson Drive. A new condominium west of the proposed development was approved by the Town called "Waterstone" and will consist of 68 units. Site servicing for Waterstone was completed in late 2021. There is a 20 m un-opened road allowance (George Street, closed by By-Law 04-28) between a section of the proposed development and the Waterstone development on the south half of the west side of the site, adjacent to units 5 and 6.

2.4 PROPOSED DEVELOPMENT

The proposed development includes 33 townhouse condominiums in eight clusters ranging from two to eight units each. The units will range in size from 177.6 m^2 (1,912 ft^2) to 197.6 m^2 (2,127 ft^2) of living space (not including garages and terraces) and include 4 storeys. Two car garages will be provided for each unit. The fourth storey will include a terrace while balconies will be provided on the second floor of the interior units.

3 Water Distribution

Currently, there is an existing 300 mm diameter watermain on the northeast side of Dawson Drive which extends to Harbour Street West to the south and Cranberry Trail West to the north and services the “Cranberry Village” developments off Dawson Drive. There is a fire hydrant just north of the site at the corner of Dawson Drive and Fairway Crescent and another private fire hydrant within the condominium to the southeast (Glenn III).

There is also a 300 mm diameter water main on the northeast side of Highway 26.

It is proposed to extend a 200 mm diameter water main from the existing water main on Dawson Drive into the site through the main entrance (Street A) and loop the water main around the outside of the development using Street B and connecting to Street C along the south and north side of the site. A fire hydrant would be located centrally at the corner of Street A and Street C.

The proposed water main would be connected to the existing 300 mm diameter water main on Dawson Drive with a tap-sleeve & valve and a second valve would be located at the property line. Each townhouse unit will include a 25 mm diameter service and water meter. A separate water service for irrigation will be installed in the utility room at the end of unit 15 and will have its own water meter and backflow prevention.

Estimated water demand calculations are based on Town of Collingwood engineering standards and MECP guidelines and are summarized below (see appendix A for calculations):

Average day demand = 0.238 L/s (20.6 m^3/day)

Maximum day demand = 0.422 L/s (36.4 m^3/day)

Peak hour demand = 1.073 L/s (92.7 m^3/day)

The landscape areas within the site will be irrigated and the volume of water used will fluctuate depending on the watering schedule and summer rainfall. Based on using 38 L/min (10 gal/min) for one hour each day for irrigation over the season, we estimate the condominium will utilize on average 0.026 L/s (2.3 m^3/day) of water.

Based on the number of proposed townhouses (33) and the equivalent single development units (SDU’s) of 0.83 for townhouses as per Town of Collingwood Staff Report PW2022-18, we calculate the development will be equivalent to 27 Single Development Units (SDU’s).

In accordance with Town standards, the fire flow calculation is based on the Fire Underwriter’s study (FUS). We calculate the fire flow demand to be 83 L/s (See appendix A for calculations).

Refer to the Site Servicing (SS-1) and Water Distribution (WAT-1) plans for layout of the proposed water main including the 45-metre radius around the proposed and existing fire hydrants. Additional notes are included on the Notes and Details plan (DE-1), all included within the engineering design set.

4 Sanitary Sewers

Currently, there is a 200 mm diameter sanitary sewer on Dawson Drive flowing south towards Harbour Street West.

It is proposed to install a maintenance hole on the existing 200 mm diameter sewer main at the entrance to the site and to extend a 200 mm diameter sanitary sewer to service the 33 townhouse units with a minimum slope of 0.5%. Each unit will also include a 125 mm diameter service connected to the main. The townhouse units will not have basements; therefore, the depth of the sanitary sewer will range between 1.81 m (at Dawson Drive), 1.88 m at the west end of Street C and 2.57 m deep at the intersection of Streets A and B.

A sanitary sewer design sheet is included in Appendix B.

5 Storm Sewers

There is an existing 675 mm diameter concrete storm sewer on the north side of Dawson Drive which inlets immediately west of the driveway for the Glenn III condominium and continues west and outlets into Cranberry Creek.

It is proposed to provide storm sewers along the private roads and individual storm laterals to each townhouse unit for draining the flat roofs. A 375 mm diameter storm pipe will outlet to the north into the existing ditch on the south side of Highway 26 and include drainage areas 203 to 208 (0.39 ha). There will also be two small drainage areas directed to the existing storm sewer on Dawson Drive via catch basins on the entrance road at the property line (area 201 = 0.06 ha) and also a ditch inlet along the west side of the site (area 202 = 0.07 ha). Drainage area 209 (0.12 ha) along the north side of the site will be directed as sheet flow north to the ditch on Highway 26.

A storm sewer design sheet is included in Appendix B.

6 Stormwater Management

The stormwater management (SWM) plan has been prepared in accordance with the MOE Stormwater Management Planning and Design Manual, Town of Collingwood Development Standards and NVCA Stormwater Technical Guide as presented in the following sections.

6.1 DESIGN CRITERIA

Based on previous reports, the background information collected and our analysis of this information, a clear understanding of the potential impacts was gained. In summary, the following design criteria are to be satisfied in the proposed SWM plan:

- Due to the proximity of the site to Georgian Bay, peak flow rate attenuation will not be required on this site;
- the stormwater management plan must achieve the required Level 1 “Enhanced” water quality treatment to Provincial standards in the form of 80% total suspended solids (TSS) removal for the site effluent; and
- safe conveyance of the Regulatory storm event peak flows through the site to the downstream drainage system must be provided for surface runoff generated within the development.

6.2 PROPOSED SWM PLAN

A Storm Drainage Plan (STM-1) illustrates the proposed drainage conditions for the development and is enclosed as part of the engineering drawings and should be referenced when reviewing Section 6 of this report.

Under proposed conditions, the existing drainage patterns will generally be maintained as most of the site will continue to drain to the northeast to the Highway 26 ditch. Drainage from the site will be collected via private storm sewers and treated by an oil grit separator (OGS) unit (Stormceptor EF6 or approved equal) before outletting to the Highway 26 ditch.

6.3 WATER QUALITY CONTROL

A treatment train approach will provide the required 80% TSS removal across the site. Each catch basin (CB) on site will include a CB Shield insert to provide a pretreatment for the stormwater runoff generated on site. Runoff from catchments 203, 204, 205, 206, 207 and 208 will then be directed to the OGS unit for further treatment, while catchments 201 will be treated by the CB Shields. With the CB Shields for catchments 201 and the CB Shields and OGS unit for catchments

203 through 208, the weighted average for TSS removal for the combined area will be above the required 80% (80.2%).

Catchments 202 and 209 will only capture clean runoff from the landscaped areas and was therefore not included in the treatment train calculations.

Information on the CB Shields and OGS unit as well as removal efficiency calculations is included in Appendix C.

6.4 WATER QUANTITY CONTROL

Due to the site proximity to Georgian Bay, the development will utilize the "beat the peak" methodology, where stormwater peak flow rates will be conveyed directly to Georgian Bay through the existing ditch on Highway 26 and the existing 675 mm diameter storm sewer on Dawson Drive. Through this methodology, the peak flow rates generated on this site will be conveyed and passed to Georgian Bay via Cranberry Creek prior to the larger peak flow rates generated in the upstream catchment areas and therefore, peak flow rate attenuation will not be required on this site. An overland flow route through the visitor parking lot and amenity area towards the ditch on Highway 26 will convey the 100-year flow from the site.

The overland flow route (emergency spillway) calculation is included in Appendix C.

7 Roads and Parking

The proposed site will be serviced with a private road extending off Dawson Drive between Fairway Crescent and Oxbow Crescent and include internal drive aisle roads (Streets B & C). The entrance road (Street A) will be 7.5 m wide at the property line and 7.2 m wide internally and include barrier concrete curbs and a 1.5 m wide sidewalk on the east side of the road. The drive isles off Street A will consist of a 7.2 m wide road (centre of mountable curb to centre of mountable curb) and provide access to the garages for each townhouse unit.

Emergency vehicles and garbage truck access will be provided via the main entrance road along with a three-point turn at the north end of the road. See the architect's Site Plan for the fire route location.

Each townhouse unit will include a double car garage and there will be 8 visitor parking spaces, including one barrier free space (total of 9 visitor spaces).

Sidewalks will be provided in front of all townhouse units and there will be two access points to Cranberry Trail along Highway 26. A sidewalk will also be extended along the frontage of the site on Dawson Drive from the Waterstone development to the driveway of the Glenn III condominium.

Snow storage areas are shown on the Site Plan at both ends of Street B and Street C.

With respect to road structure, it will consist of the following as recommended by the geotechnical report and shown on the Details & Notes drawing (DE-1) of the engineering drawing set:

- 300 mm Granular B
- 150 mm Granular A
- 50 mm HL-8 Asphalt
- 40 mm HL-3 Asphalt

A traffic brief has been completed by Tatham Engineering Limited under separate cover and concluded the existing surrounding roads will not be impacted or require any upgrades due to the proposed development.

8 Utilities

The development will be serviced with gas, cable, telephone, and hydro. The applicable service suppliers will be contacted to confirm capacity to service the development, but it is expected the existing infrastructure is sufficient to support the 33-unit development. Final design from the applicable utilities will be included in a future submission.

Included in the engineering design drawings is a photometric design for the lighting which includes streetlights and lighting wall packs on townhouse units. Preliminary locations for pad mounted transformers are also shown on the photometric drawings (E-1 & E-2).

9 Summary

Based on the preceding analysis, the proposed 33-unit townhouse development located off Dawson Drive can be appropriately serviced. Specifically, the proposed strategy for servicing includes:

- Extending a 200 mm diameter water main from the existing 300 mm diameter water main on Dawson Drive to provide both fire protection and domestic demands to the 33 townhouse units. Individual services and water meters will be provided to each townhouse.
- A 200 mm diameter sanitary sewer will be extended into the development to service all townhouse units. Individual services will be provided to each townhouse.
- Drainage from the site will be split to the north and south, with a 375 mm storm pipe out-letting to the existing Highway 26 ditch. Three seperate 300 mm diameter storm pipes will be connected to the existing 675 mm diameter concrete storm pipe on Dawson Drive.
- Based on the proximity of Georgian Bay, only water quality controls are required and will consist of CB Shields in all catch basins and an EF6 oil grit separator by Stormceptor or approved equal.
- An entrance road off Dawson Drive will be extended into the development and include drive aisle roads to provide access to the garage of each townhouse unit. Visitor parking and a barrier free parking space will be provided. Emergency vehicle access will be provided via the main entrance road along with a three-point turn at the north end of the road.
- The development will include hydro, gas, cable and telephone services via extensions of the existing infrastructure (to be completed by the respective service providers) from Dawson Drive.

Appendix A:
Water Demands

TATHAM ENGINEERING	Project: The Terrazzo	Date: 2022-09-26
	File No.: 121075	Designed: MAB
	Subject: Water Demands	Checked KRS

Design Criteria

Person per Unit (average) =	2.4		(Collingwood Development Standards-Revised as per Staff Report PW2022-18)
Units =	33		
Per Capita Flow =	260.0	L/day	(Collingwood Development Standards-Revised as per Staff Report PW2022-18)
Peaking Factors =	1.77	Maximum Day	(Collingwood Development Standards-Revised as per Staff Report PW2022-18)
	4.5	Peak Hour	(Collingwood Development Standards)
Equivalent SDU's =	0.83	m3/unit/day for Townhouse Development	

Design Flows

Average Daily Flow =	20,592.00	L/day			
=	0.238	L/s	or	20.6	m3/day
Maximum Day Demand =	Average Flow	x	Peaking Factor		
=	0.422	L/s	or	36.4	m3/day
Peak Hour Demand =	Average Flow	x	Peaking Factor		
=	1.073	L/s	or	92.7	m3/day

Equivalent Single Development =	Number of units	x	equivalent SDU's	
Units (SDU's) =	33	x	0.83	(As per Town of Collingwood Staff Report PW2022-18)
=	27.39			
=	**27**			

Project:	11283 Highway 26 - The Terrazzo	Date:	September 22, 2022
File No.:	121075	Designed:	MAB
Subject:	Fire Underwriters Survey - Fire Flow Calculations	Checked	ANM
Revisions:			

Fire Underwriters Survey Fire Flow Calculations
Long Method

Calculation Based on 1999 Publication "Water Supply for Public Fire Protection" by Fire Underwriters Survey (FUS).

Calculations based on 8 townhouse block (Units 15 to 22) on Street C

Step	Description	Term	Options	Multiplier Associated with Option	Choose	Value used	Unit	Total Fire Flow (L/min)
			Framing Material					
1	Frame Use for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	**0.8**	-	N/A
			Ordinary Construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (< 2 hrs)	0.7				
			Fire resistive construction (> 2 hrs)	0.6				
			Floor Space Area					
2	Type of Housing (if Townhouse, enter number of units per TH block)	Type of Housing	Single Family	1		**0**	Units	N/A
			Townhouse - Number of units	1		**8**		
			Other (Comm. Ind., etc.)	1				
			2 hour Fire Separation Between Units	1	No	**8**		
2.1	Number of Storeys	Number of Floors / Storeys in the unit (do not include basement)				**4**	Storeys	N/A
3	Floor Area (exclude basements, per unit for townhouses, per single family dwelling or per building for apartments, commercial or institutional)	Ground Floor Area				**45.2**	Square Metres (m2)	N/A
		Total Floor Area - One Storey of Townhouse/Apartment Block				**362**		
		Total Floor Area - All Storeys				**1446**		
		Does the building have fire-resistive design?			No	**1446**		
		Are vertical openings/communications properly protected (1 hour rating)?			No	**1446**		
		Total Floor Area (A) - for all storeys excluding basement - Single Family				**1446**		
		Measurement Unis	Square Feet (ft^2)	0.093		**1446**	m^2	
			Square Metres (m^2)	1				
			Hectares (ha)	10000				
4	Required Fire Flow without Reductions or Increases	Required Fire Flows without Reductions or Increases per FUS): ($FF= 220 \times C \times A^{0.5}$)					L/min	7,000
5	Factors Affecting Burning		**Reductions / Increases Due to Factors Affecting Burning**					
5.1	Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Non-combustible	-0.25	N/A	(1,750) 5,250
			Limited combustible	-0.15				
			Combustible	0.00				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Reduction Due to Presence of Sprinklers	Sprinkler reduction	Fully supervised system	-0.5	Water supply system/hose connections	-0.4	N/A	(2,100) 3,150
			Water supply system/hose connections	-0.4				
			Automatic sprinkler protection	-0.3				
			None	0				
5.3	Separation Distance Between Units (Use 10% for 2 hour Fire Separation between adjacent units)	Exposure distance between units	North Side	3.1 to 10.0 m	0.20	0.7	%	2,205 5,355
			East Side	10.1 to 20.0 m	0.15			
			South Side	3.1 to 10.0 m	0.20			
			West Side	10.1 to 20.0 m	0.15			
5.4	Combustibility of Wood Shingle or Shake Roof Material	Surcharge for potential to spread fire	Non-combustible roofing material	0	Non-combustible roofing material	0	L/min	0 5,355
			Low risk of fire spread	2000				
			Moderate risk of fire spread	3000				
			High risk of fire spread	4000				
		Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:						5,000
6	Required Fire Flow, Duration and Volume	Total Required Fire Flow (above) in L/s:						83
		Required Duration of Fire Flow of 5,000 L/min (hrs):						1.75
		Required volume for Fire Flow of 5,000 L/min (m^3):						525

Appendix B:
Sanitary & Storm Sewer Design Sheets

TATHAM ENGINEERING

Sanitary Sewer Design Sheet

Version Number: 1 Version Date: October 3, 2022

Project Information

The Terrazzo	121075

Drawing Reference

Sanitary Drainage Plan	September 15-22

Prepared By

Michael Buske	September 15-22

Reviewed By

Kevin Sansom	September 29-22

Municipality

Town of Collingwood

Population Density

	Low	Medium	High
Capita per Unit	2.40	0.00	-

Infiltration

Infiltration (L/s/ha)	0.23

Flow

Development Type	Average (L/cap/day)	Peaking Factor
Residential	450	Harmon
Development Type	**Average (L/ha/day)**	**Peaking Factor**
Institution	-	-
Commercial	-	-
Industrial High Intensity	-	-
Industrial Low Intensity	-	-

Manning's Coefficient

Pipe Material	Value
Concrete	0.013
PVC	0.013
Applied	0.013

Engineer Stamp

Street Name	Area Label/ID	Upstream Maintenance Hole	Downstream Maintenance Hole	Development Type	Population Density	Number of Units	Population (cap)	Accumulated Population (cap)	Peaking Factor	Area (ha)	Cumulative Area (ha)	Average Flow (L/s) Development	Average Flow (L/s) Infiltration	Average Flow (L/s) Total	Peak Flow (L/s) Development	Peak Flow (L/s) Infiltration	Peak Flow (L/s) Total	Proposed Sanitary Sewer Sewer Length (m)	Sewer Slope (%)	Actual Sewer Diameter (mm)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Actual Velocity (m/s)	Calculated Sewer Diameter (mm)	Percentage of Full Flow Capacity (%)
Street C	S106	MH9	MH8	Residential	Low	10	24.0	24.0	4.37	0.16	0.16	0.13	0.04	0.16	0.55	0.04	0.58	33.6	0.5%	200	0.74	23.19	0.31	50	2.5%
Street C	S107	MH8	MH7	Residential	Low	0	0.0	24.0	4.37	0.03	0.19	0.13	0.04	0.17	0.55	0.04	0.59	9.9	0.5%	200	0.74	23.19	0.32	50	2.5%
Street C	S108	MH10	MH7	Residential	Low	13	31.2	31.2	4.35	0.21	0.21	0.16	0.05	0.21	0.71	0.05	0.76	57.8	0.5%	200	0.74	23.19	0.34	55	3.3%
Street A	S105	MH7	MH6	Residential	Low	0	0.0	55.2	4.31	0.03	0.43	0.29	0.10	0.39	1.25	0.10	1.35	25.6	0.5%	200	0.74	23.19	0.39	69	5.8%
Street A	S103	MH6	MH3	Residential	Low	0	0.0	55.2	4.31	0.02	0.45	0.29	0.10	0.39	1.25	0.10	1.36	20.1	0.5%	200	0.74	23.19	0.39	69	5.9%
Street B	S104	MH4	MH3	Residential	Low	6	14.4	14.4	4.40	0.11	0.11	0.08	0.03	0.10	0.33	0.03	0.36	25.5	0.5%	200	0.74	23.19	0.27	42	1.5%
Street B	S102	MH5	MH3	Residential	Low	4	9.6	9.6	4.42	0.08	0.08	0.05	0.02	0.07	0.22	0.02	0.24	19.7	0.5%	200	0.74	23.19	0.25	36	1.0%
Street A	S101	MH3	MH2	Residential	Low	0	0.0	79.2	4.27	0.02	0.66	0.41	0.15	0.56	1.80	0.15	1.96	21.5	0.5%	200	0.74	23.19	0.44	79	8.4%
Street A		MH2	MH1	Residential	Low	0	0.0	79.2	4.27	0.00	0.66	0.41	0.15	0.56	1.80	0.15	1.96	14.0	0.5%	200	0.74	23.19	0.44	79	8.4%

TATHAM ENGINEERING

Storm Sewer Design Sheet

Version Number: 1 Version Date: October 3, 2022

Project Information

Terrazzo	121075

Drawing Reference

Storm Drainage Plan, STM-1	September 15-22

Prepared By

Adrian van Niekerk	May 12-22

Reviewed By

Michael A. Buske	September 29-22

Municipality

Town of Collingwood

Runoff Coefficient Adjustment

Year	A	B
10	1.00	0.00
25	1.10	0.00
50	1.20	0.00
100	1.25	0.00

Manning's Coefficient

Pipe	Value
CSP	0.024
Concrete	0.013
PVC	0.013

Time of Concentration

10 mins

IDF Curve Coefficients

Year	A	B	C
2	807.44	6.75	0.83
5	1135.40	7.50	0.84
10	1387.00	7.97	0.85
25	1676.20	8.30	0.86
50	1973.10	9.00	0.87
100	2193.10	9.04	0.87

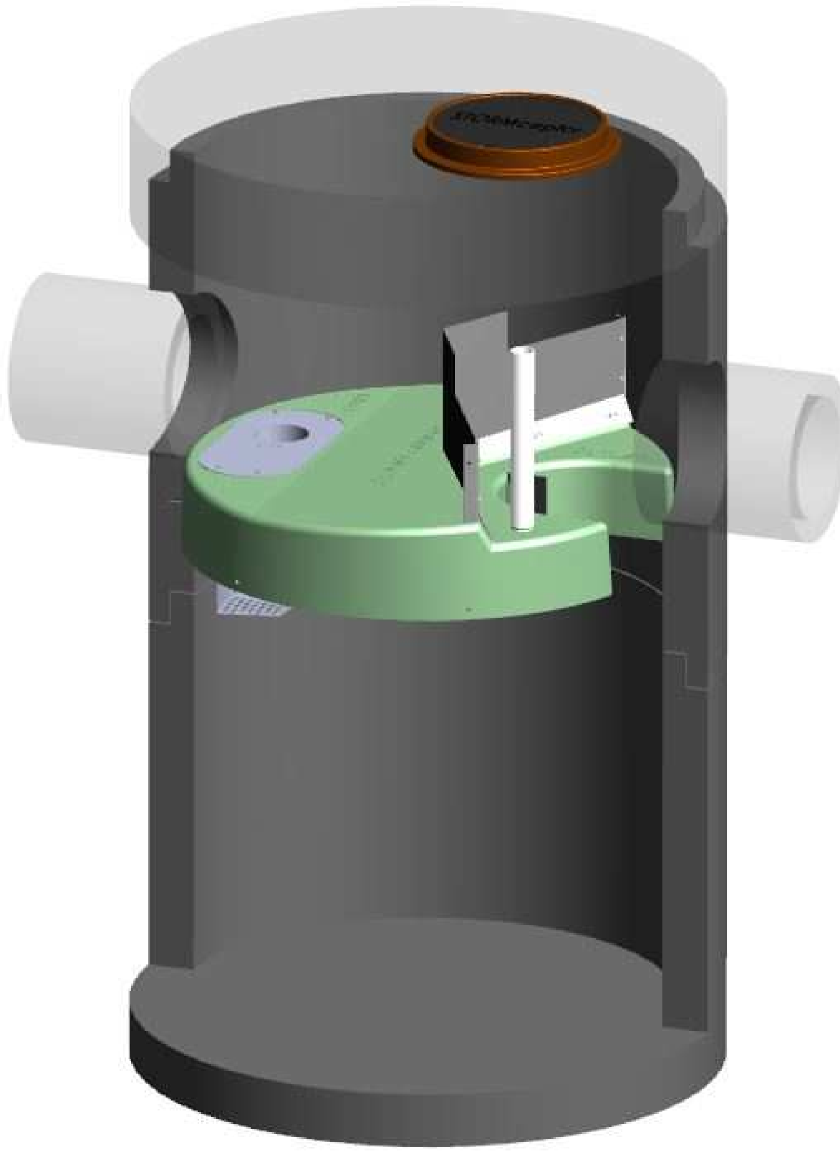
Engineer Stamp

Street Name	Area ID / Label	Upstream Maintenance Hole	Downstream Maintenance Hole	Area (ha)	5 Year Runoff Coefficient (C)	Design Storm (Year)	Adjusted Runoff Coefficient (C)	Area × Runoff Coefficient	Cumulative Area (ha)	Cumulative Area × Adjusted Runoff Coefficient	Time of Concentration (min)	Rainfall Intensity (mm/hr)	Peak Flow (m^3/s)	Manning's Roughness Coefficient	Sewer Length (m)	Sewer Slope (%)	Actual Sewer Diameter (mm)	Full Flow Velocity (m/s)	Full Flow Capacity (m^3/s)	Actual Velocity (m/s)	Travel Time (min)	Calculated Sewer Diameter (mm)	Percentage of Full Flow Capacity (%)	Total Time of Travel (min)
Street B (Units 1-3, 8-10)	C203	STM MH1	STM MH2	0.08	0.75	5	0.75	0.06	0.08	0.06	10.00	102.27	0.017	0.013	29.2	0.5%	300	0.97	0.068	0.75	0.65	178	24.9%	10.65
Street B (Units 4-7)	C204	STM MH4	STM MH2	0.05	0.75	5	0.75	0.04	0.05	0.04	10.00	102.27	0.011	0.013	11.8	0.5%	300	0.97	0.068	0.66	0.30	149	15.6%	10.30
Street A	-	STM MH2	STM MH3	-	0.75	5	0.75	-	0.13	0.10	10.65	99.18	0.027	0.013	18.8	0.5%	300	0.97	0.068	0.84	0.37	211	39.3%	11.02
Street B (Units 11-14)	C205	STM MH3	CBMH1	0.15	0.75	5	0.75	0.11	0.28	0.21	11.02	97.50	0.057	0.013	26.8	0.5%	300	0.97	0.068	0.97	0.46	280	83.2%	11.48
Street C (Units 28-33)	C206	STM MH6	STM MH5	0.06	0.75	5	0.75	0.05	0.06	0.05	10.00	102.27	0.013	0.013	30.0	0.5%	300	0.97	0.068	0.69	0.72	160	18.7%	10.72
Street C	-	STM MH5	CBMH1	-	0.75	5	0.75	-	0.06	0.05	10.72	98.85	0.012	0.013	11.2	0.5%	300	0.97	0.068	0.69	0.27	158	18.1%	11.00
Street C (Units 15-27)	C207	STM MH7	CBMH1	0.15	0.75	5	0.75	0.11	0.15	0.11	10.00	102.27	0.032	0.013	53.5	0.5%	300	0.97	0.068	0.89	1.01	225	46.7%	11.01
Street C (Parking Area)	C208	CBMH1	OGS1	0.05	0.75	5	0.75	0.04	0.54	0.41	11.48	95.51	0.107	0.013	4.5	0.5%	375	1.12	0.124	1.12	0.07	355	86.7%	11.55
Overland Flow Route	-	OGS1	HW1	-	0.75	5	0.75	-	0.54	0.41	11.55	95.22	0.107	0.013	38.4	0.5%	375	1.12	0.124	1.12	0.57	355	86.4%	12.12
Street A	C201	CB10/CB11	Ex.675 Stm	0.06	0.75	5	0.75	0.05	0.06	0.05	10.00	102.27	0.013	0.013	4.0	2.0%	300	1.93	0.137	1.15	0.06	123	9.3%	10.06
Dawson Drive	C202	CB12	Ex.675 Stm	0.07	0.75	5	0.75	0.05	0.07	0.05	10.00	102.27	0.015	0.013	5.2	0.5%	300	0.97	0.068	0.72	0.12	169	21.8%	10.12

Appendix C: Stormwater Management Calculations

Stormceptor® EF

Owner's Manual



Stormceptor is protected by one or more of the following patents:

Canadian Patent No. 2,137,942
Canadian Patent No. 2,180,305
Canadian Patent No. 2,327,768
Canadian Patent No. 2,694,159
Canadian Patent No. 2,697,287
U.S. Patent No. 6,068,765
U.S. Patent No. 6,371,690
U.S. Patent No. 7,582,216
U.S. Patent No. 7,666,303
Australia Patent No. 693.164
Australia Patent No. 729,096
Australia Patent No. 2008,279,378
Australia Patent No. 2008,288,900
Japanese Patent No. 5,997,750
Japanese Patent No. 5,555,160
Korean Patent No. 0519212
Korean Patent No. 1451593
New Zealand Patent No. 583,008
New Zealand Patent No. 583,583
South African Patent No. 2010/00682
South African Patent No. 2010/01796
Patent pending

Table of Contents:

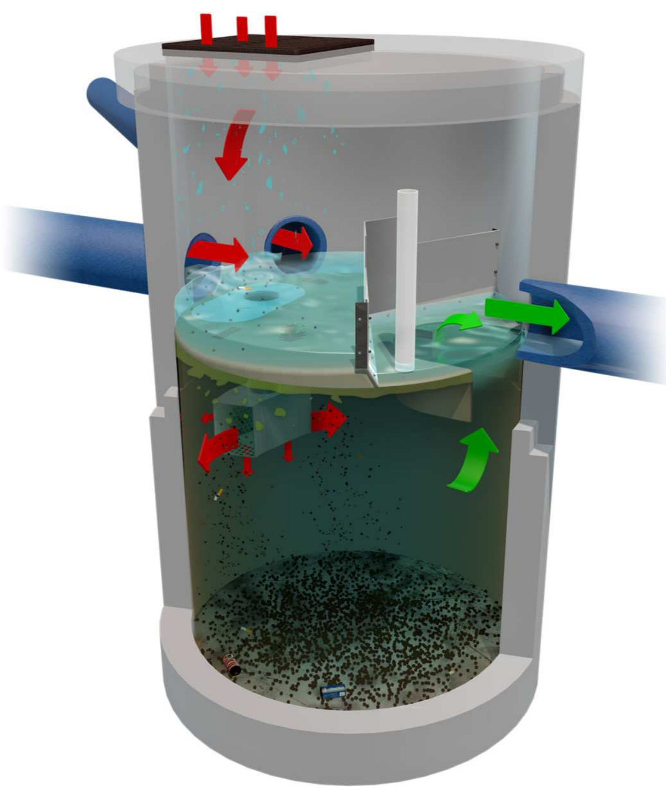
OVERVIEW

Stormceptor® EF is a continuation and evolution of the most globally recognized oil grit separator (OGS) stormwater treatment technology - ***Stormceptor®***. Also known as a hydrodynamic separator, the enhanced flow Stormceptor EF is a high performing oil grit separator that effectively removes a wide variety of pollutants from stormwater and snowmelt runoff at flow rates higher than the original Stormceptor. Stormceptor EF captures and retains sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's patent-pending treatment and scour prevention platform ensures sediment is retained during all rainfall events.

Stormceptor EF offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe, multiple inlet pipes, and/or from the surface through an inlet grate. Stormceptor EF can also serve as a junction structure, accommodate a 90-degree inlet to outlet bend angle, and be modified to ensure performance in submerged conditions. With its scour prevention and internal bypass, Stormceptor EF can be installed online, eliminating the need for costly additional bypass structures.

OPERATION

- Stormwater enters the Stormceptor upper chamber through the inlet pipe(s) or a surface inlet grate. A specially designed insert reduces the influent velocity by creating a pond upstream of the insert's weir. Sediment particles immediately begin to settle. Swirling flow sweeps water, sediment, and floatables across the sloped surface of the insert to the inlet opening of the drop pipe, where a strong vortex draws water, sediment, oil, and debris down the drop pipe cone.
- Influent exits the cone into the drop pipe duct. The duct has two large rectangular outlet openings as well as perforations in the backside and floor of the duct. Influent is diffused through these various opening in multiple directions and at low velocity into the lower chamber.
- Free oils and other floatables rise up within the channel surrounding the central riser pipe and are trapped beneath the insert, while sediment settles to the sump. Pollutants are retained for later removal during maintenance cleaning.
- Treated effluent enters the outlet riser, moves upward, and discharges to the top side of the insert downstream of the weir, where it flows out the outlet pipe.
- During intense storm events with very high influent flow rates, the pond height on the upstream side of the weir may exceed the height of the weir, and the excess flow passes over the top of the weir to the downstream side of the insert, and exits through the outlet pipe. This internal bypass feature allows for in-line installation, avoiding the cost of additional bypass structures. During bypass, the pond separates sediment from all incoming flows, while full treatment in the lower chamber continues at the maximum flow rate.
- Stormceptor EF's patent-pending enhanced flow and scour prevention technology ensures pollutants are captured and retained, allowing excess flows to bypass during infrequent, high intensity storms.



COMPONENTS

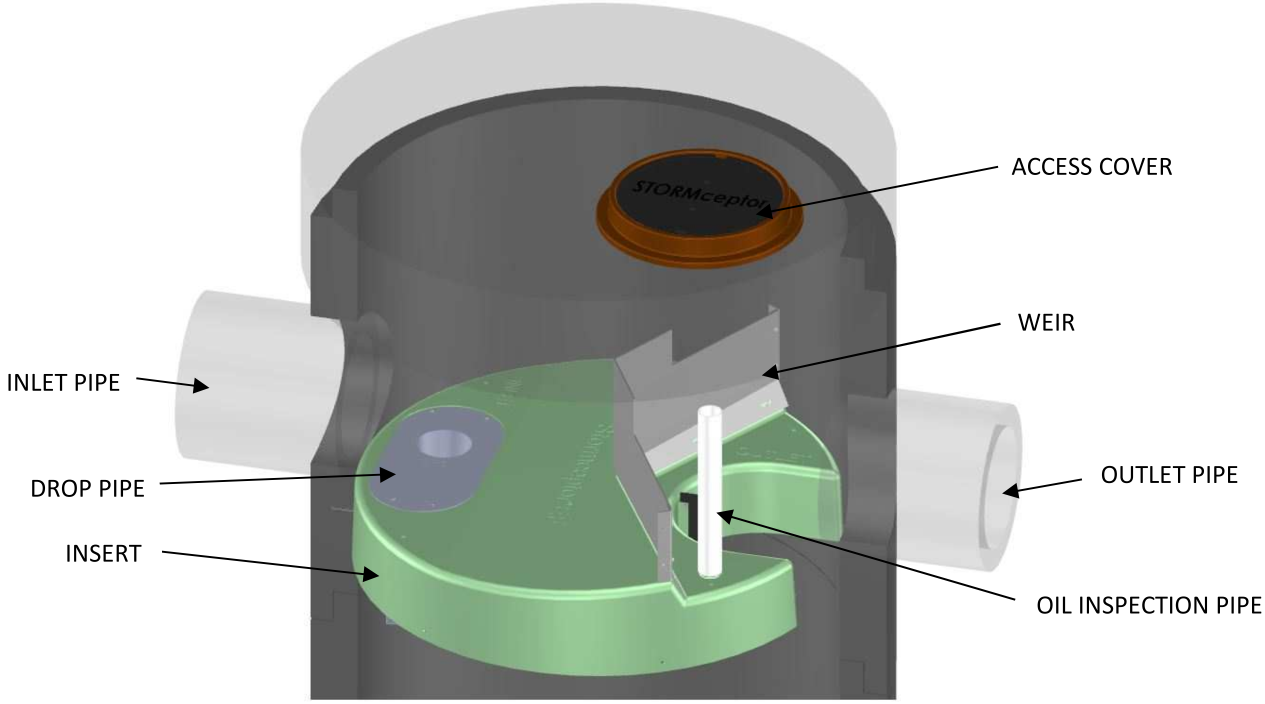


Figure 1

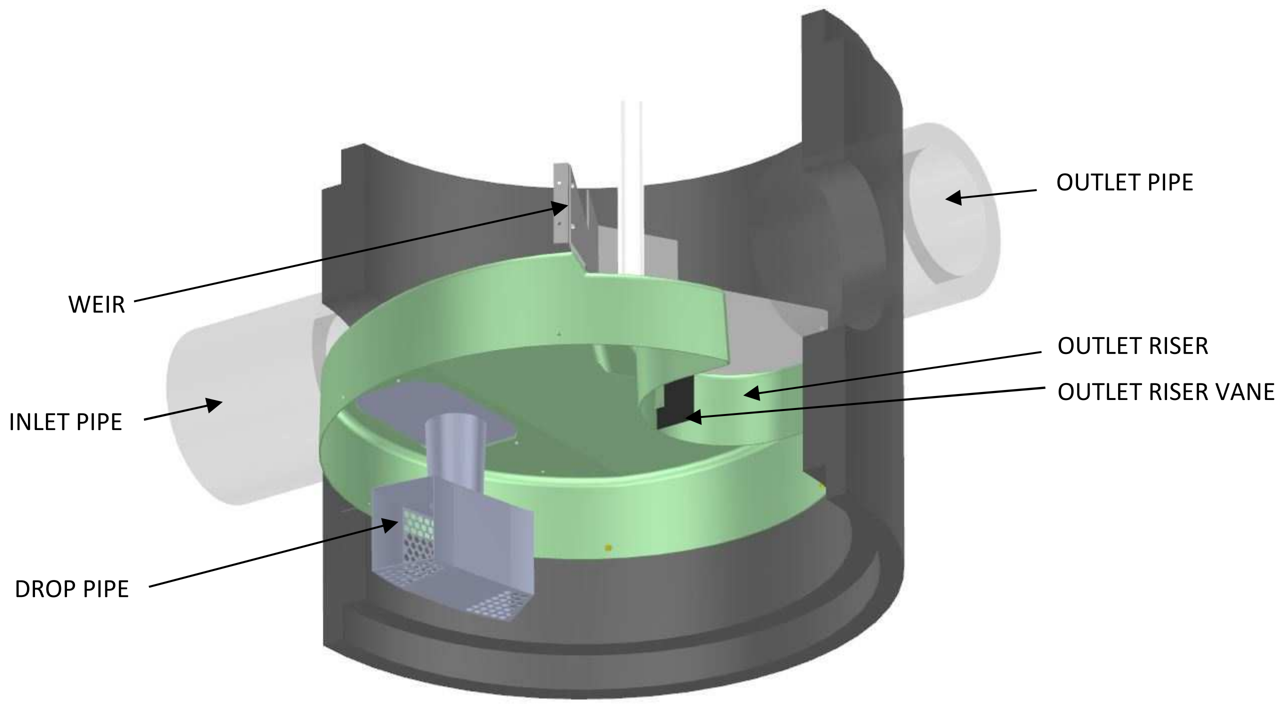


Figure 2

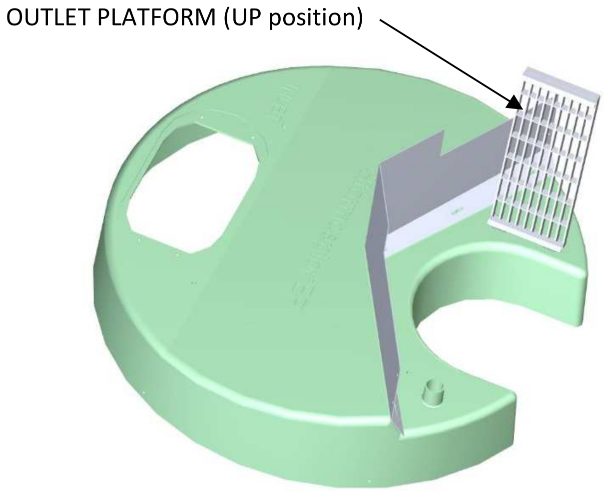


Figure 3A

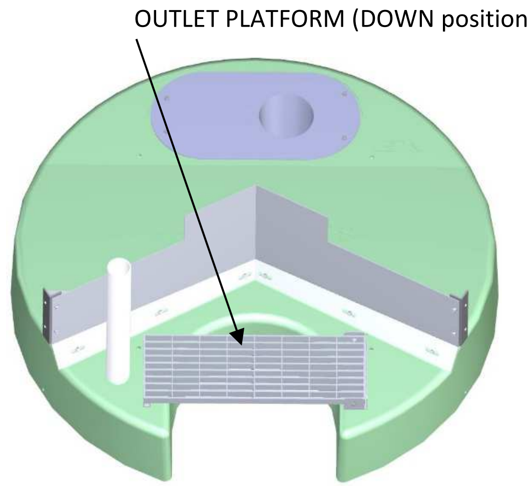


Figure 3B

- **Insert** – separates vessel into upper and lower chambers, and provides double-wall containment of hydrocarbons
- **Weir** – creates stormwater ponding and driving head on top side of insert
- **Drop pipe** – conveys stormwater and pollutants into the lower chamber
- **Outlet riser** – conveys treated stormwater from the lower chamber to the outlet pipe, and provides primary inspection and maintenance access into the lower chamber
- **Outlet riser vane** – prevents formation of a vortex in the outlet riser during high flow rate conditions
- **Outlet platform (optional)** – safety platform in the event of manned entry into the unit
- **Oil inspection pipe** – primary access for measuring oil depth

PRODUCT DETAILS

METRIC DIMENSIONS AND CAPACITIES

Table 1

Stormceptor Model	Inside Diameter (m)	Minimum Surface to Outlet Invert Depth (mm)	Depth Below Outlet Pipe Invert (mm)	Wet Volume (L)	Sediment Capacity [1] (m^3)	Hydrocarbon Storage Capacity [2] (L)	Maximum Flow Rate into Lower Chamber [3] (L/s)	Peak Conveyance Flow Rate [4] (L/s)
EF4 / EFO4	1.22	915	1524	1780	1.19	265	22.1 / 10.4	425
EF6 / EFO6	1.83	915	1930	5070	3.47	610	49.6 / 23.4	990
EF8 / EFO8	2.44	1219	2591	12090	8.78	1070	88.3 / 41.6	1700
EF10 / EFO10	3.05	1219	3251	23700	17.79	1670	138 / 65	2830
EF12 / EFO12	3.66	1524	3886	40800	31.22	2475	198.7 / 93.7	2830

[1] Sediment Capacity is measured from the floor to the bottom of the drop pipe cone. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[2] Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[3] EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 1135 L/min/m^2.
EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 535 L/min/m^2.
[4] Peak Conveyance Flow Rate is limited by a maximum velocity of 1.5 m/s.

U.S. DIMENSIONS AND CAPACITIES

Table 2

Stormceptor Model	Inside Diameter (ft)	Minimum Surface to Outlet Invert Depth (in)	Depth Below Outlet Pipe Invert (in)	Wet Volume (gal)	Sediment Capacity [1] (ft^3)	Hydrocarbon Storage Capacity [2] (gal)	Maximum Flow Rate into Lower Chamber [3] (cfs)	Peak Conveyance Flow Rate [4] (cfs)
EF4 / EFO4	4	36	60	471	42	70	0.78 / 0.37	15
EF6 / EFO6	6	36	76	1339	123	160	1.75 / 0.83	35
EF8 / EFO8	8	48	102	3194	310	280	3.12 / 1.47	60
EF10 / EFO10	10	48	128	6261	628	440	4.87 / 2.30	100
EF12 / EFO12	12	60	153	10779	1103	655	7.02 / 3.31	100

[1] Sediment Capacity is measured from the floor to the bottom of the drop pipe cone. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[2] Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[3] EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 27.9 gpm/ft^2.
EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 13.1 gpm/ft^2.
[4] Peak Conveyance Flow Rate is limited by a maximum velocity of 5 fps.

IDENTIFICATION

Each Stormceptor EF/EFO unit is easily identifiable by the trade name ***Stormceptor®*** embossed on the access cover at grade as shown in **Figure 3**. The tradename ***Stormceptor®*** is also embossed on the top of the insert upstream of the weir as shown in **Figure 3**.

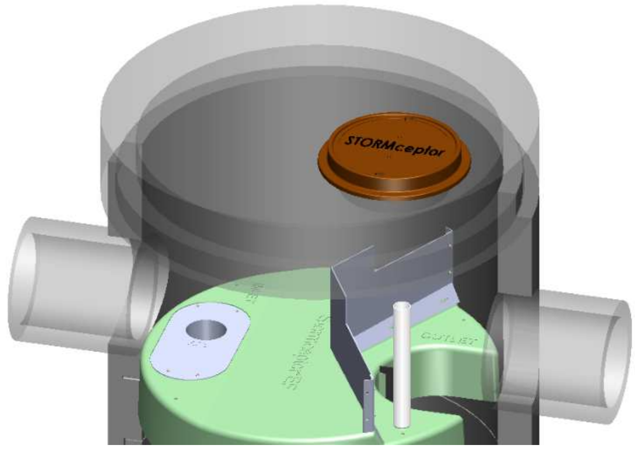


Figure 4

The specific Stormceptor EF/EFO model number is identified on the top of the aluminum Drop Pipe as shown in **Figure 4**. The unit serial number is identified on the top of the insert upstream of the weir as shown in **Figure 4**.

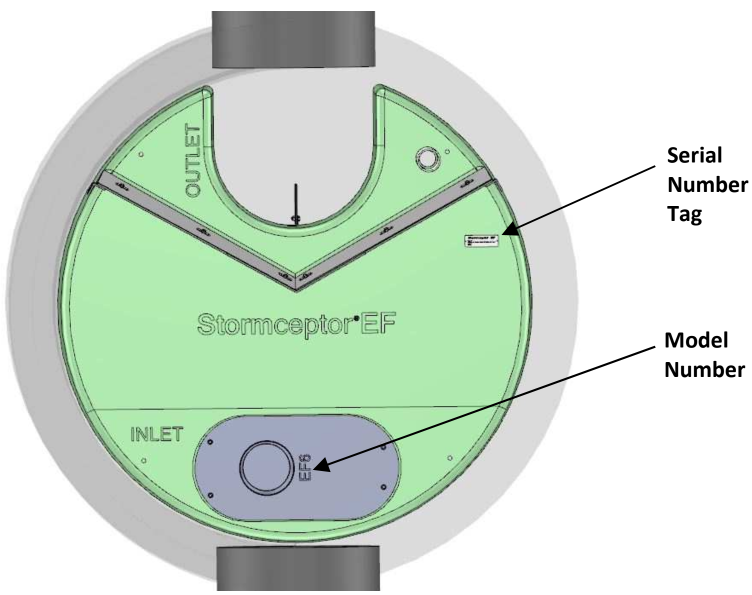


Figure 5

INSPECTION AND MAINTENANCE

It is very important to perform regular inspection and maintenance. Regular inspection and maintenance ensures maximum operation efficiency, keeps maintenance costs low, and provides continued of natural waterways.

Quick Reference

- Typical inspection and maintenance is performed from grade
- Remove manhole **cover(s)** or **inlet grate** to access insert and lower chamber
  NOTE: EF4/EFO4 requires the removal of a **flow deflector** beneath inlet grate
- Use Sludge Judge® or similar sediment probe to check sediment depth through the **outlet riser**
- Oil dipstick can be inserted through the **oil inspection pipe**
- Visually inspect the **insert** for debris, remove debris if present
- Visually inspect the **drop pipe** opening for blockage, remove blockage if present
- Visually inspect **insert** and **weir** for damage, schedule repair if needed
- Insert vacuum hose and jetting wand through the outlet riser and extract sediment and floatables
- Replace flow deflector (EF4/EFO4), inlet grate, and cover(s)
- **NOTE:** If the unit has an **outlet platform**, the outlet platform is typically in the UP position (see Figure 3A) for normal treatment conditions, and for inspection and maintenance. If manned entry into the unit is required, the outlet platform must first be placed in the DOWN position (see Figure 3B). After manned entry is completed, return the outlet platform to the UP position for treatment.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess pollutant accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

What equipment is typically required for inspection?

- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

When is maintenance cleaning needed?

- If the post-construction inspection indicates presence of construction sediment of a depth greater than a few inches, maintenance is recommended at that time.
- For optimum performance and normal operation the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, see **Table 3**.
- Maintain immediately after an oil, fuel, or other chemical spill.

Table 3

Recommended Sediment Depths for Maintenance Service*	
MODEL	Sediment Depth (in/mm)
EF4 / EFO4	8 / 203
EF6 / EFO6	12 /305
EF8 / EFO8	24 / 610
EF10 / EFO10	24 / 610
EF12 / EFO12	24 / 610

* Based on a minimum distance of 40 inches (1,016 mm) from bottom of outlet riser to top of sediment bed

The frequency of inspection and maintenance may need to be adjusted based on site conditions to ensure the unit is operating and performing as intended. Maintenance costs will vary based on the size of the unit, site conditions, local requirements, disposal costs, and transportation distance.

What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required (adhere to all OSHA / CCOSH standards)

What conditions can compromise Stormceptor performance?

- Presence of construction sediment and debris in the unit prior to activation
- Excessive sediment depth beyond the recommended maintenance depth
- Oil spill in excess of the oil storage capacity
- Clogging or restriction of the drop pipe inlet opening with debris
- Downstream blockage that results in a backwater condition

Maintenance Procedures

- Maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is maintained from grade through a standard surface manhole access cover or inlet grate.
- In the case of submerged or tailwater conditions, extra measures are likely required, such as plugging the inlet and outlet pipes prior to conducting maintenance.
- Inspection and maintenance of upstream catch basins and other stormwater conveyance structures is also recommended to extend the time between future maintenance cycles.

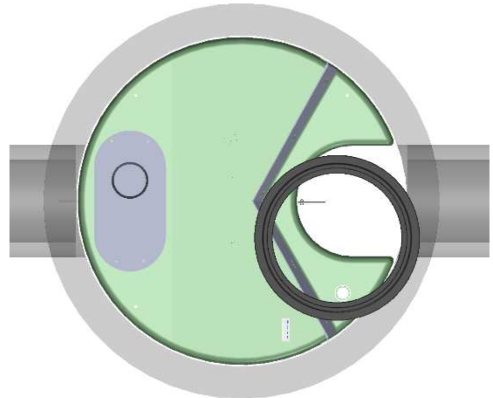
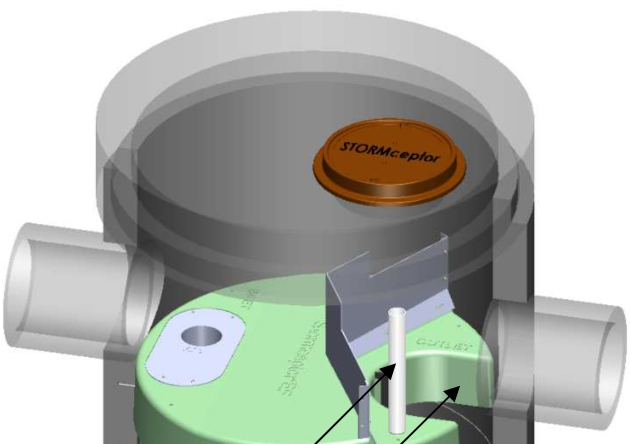


Figure 6

- Sediment depth inspections are performed through the **Outlet Riser** and oil presence can be determined through the **Oil Inspection Pipe**.
- Oil presence and sediment depth are determined by inserting a Sludge Judge® or measuring stick to quantify the pollutant depths.



Oil Inspection Pipe

Outlet Riser

Figure 7

Sludge Judge®

Figure 8

- Visually inspect the insert, weir, and drop pipe inlet opening to ensure there is no damage or blockage.
- **NOTE:** If the unit has an **outlet platform**, the outlet platform is typically in the UP position (see Figure 3A) for normal treatment conditions, and for inspection and maintenance. If manned entry into the unit is required, the outlet platform must first be placed in the DOWN position (see Figure 3B). After manned entry is completed, return the outlet platform to the UP position for treatment.

- When maintenance is required, a standard vacuum truck is used to remove the pollutants from the lower chamber of the unit through the **Outlet Riser**.

Figure 9

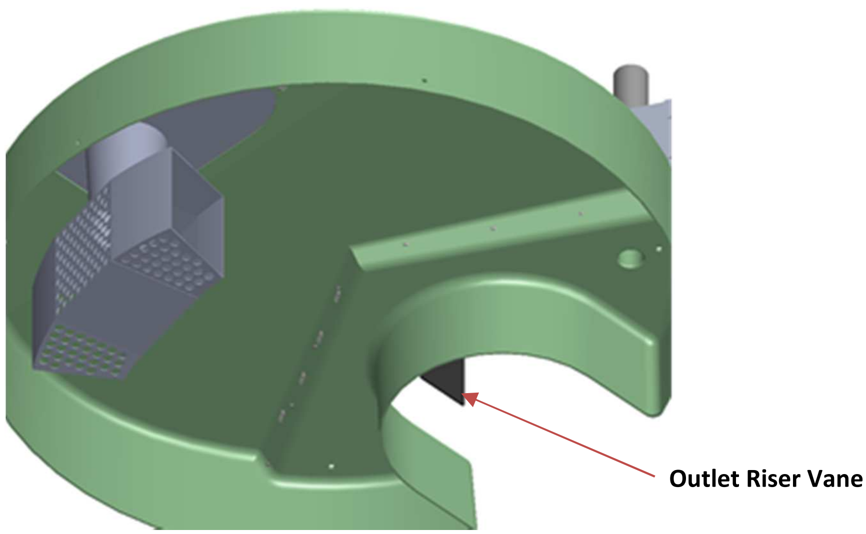


Figure 10

NOTE: The Outlet Riser Vane is durable and flexible and designed to allow maintenance activities with minimal, if any, interference.

Removable Flow Deflector

- Top grated inlets for the Stormceptor EF4/EFO4 model requires a removable flow deflector staged underneath a 24-inch x 24-inch (600 mm x 600 mm) square inlet grate to direct flow towards the inlet side of the insert, and avoid flow and pollutants from entering the outlet side of the insert from grade. The EF6/EFO6 and larger models do not require the flow deflector.

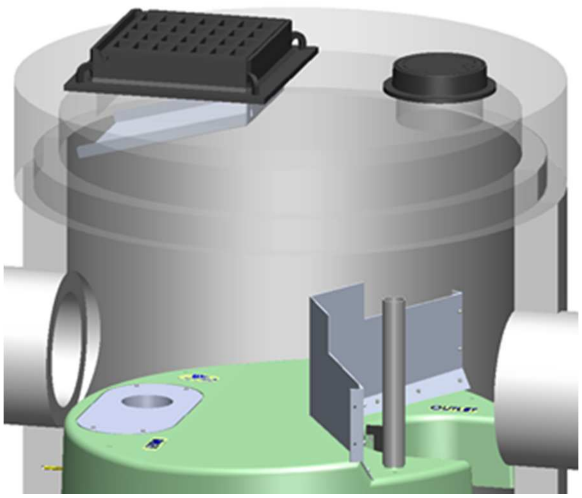
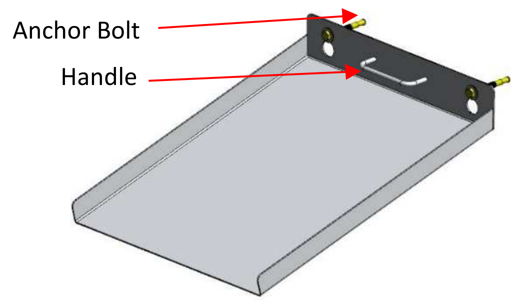


Figure 11

How to Remove:

1. Loosen anchor bolts
2. Pull up and out using the handle



Removable Flow Deflector

Hydrocarbon Spills

Stormceptor is often installed on high pollutant load hotspot sites with vehicular traffic where hydrocarbon spill potential exists. Should a spill occur, or presence of oil be identified within a Stormceptor EF/EFO, it should be cleaned immediately by a licensed liquid waste hauler.

Disposal

Maintenance providers are to follow all federal, state/ provincial, and local requirements for disposal of material.

Oil Sheens

When oil is present in stormwater runoff, a sheen may be noticeable at the Stormceptor outlet. An oil rainbow or sheen can be noticeable at very low oil concentrations (< 10 mg/L). Despite the appearance of a sheen, Stormceptor EF/EFO may still be functioning as intended.

Oil Level Alarm

To mitigate spill liability with 24/7 detection, an electronic monitoring system can be employed to trigger a visual and audible alarm when a pre-set level of oil is captured within the lower chamber or when an oil spill occurs. The oil level alarm is available as an optional feature to include with Stormceptor EF/EFO as shown in **Figure 11**. For additional details about the Oil Level Alarm please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-systems.

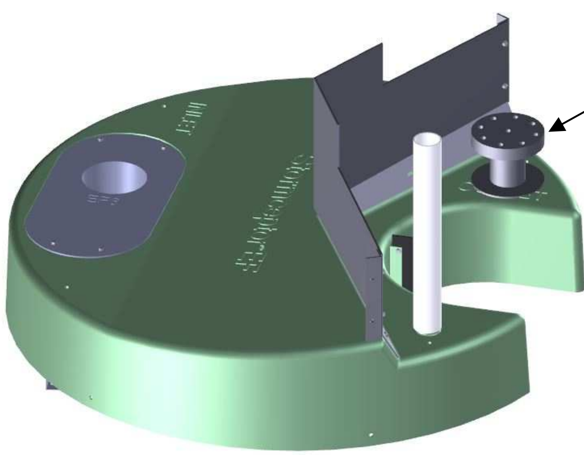


Figure 12

Replacement Parts

Stormceptor has no moving parts to wear out. Therefore inspection and maintenance activities are generally focused on pollutant removal. Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. However, if replacement parts are necessary, they may be purchased by contacting your local Stormceptor representative.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: ________________________

Serial Number: ________________________

Installation Date: ________________________

Location Description of Unit: ________________________

Recommended Sediment Maintenance Depth: ________________________

DATE	SEDIMENT DEPTH (inch or mm)	OIL DEPTH (inch or mm)	SERVICE REQUIRED (Yes / No)	MAINTENANCE PERFORMED	MAINTENANCE PROVIDER	COMMENTS

Other Comments:

Contact Information

Questions regarding Stormceptor EF/EFO can be addressed by contacting your local Stormceptor representative or by visiting our website at **www.stormceptor.com**.

Imbrium Systems Inc. & Imbrium Systems LLC

Canada	1-416-960-9900 / 1-800-565-4801
United States	1-301-279-8827 / 1-888-279-8826
International	+1-416-960-9900 / +1-301-279-8827

www.imbriumsystems.com
www.stormceptor.com
info@imbriumsystems.com

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Stormceptor® EF and EFO Oil-Grit Separators

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

Registration: GPS-ETV_VR2020-11-15_Imbrium-SC

In accordance with

ISO 14034:2016

Environmental management — Environmental technology verification (ETV)

GLOBE VERIFIED VÉRIFIÉ

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

November 15, 2020
Vancouver, BC, Canada

GLOBE PERFORMANCE SOLUTIONS

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

The Stormceptor® EF and EFO are treatment devices designed to remove oil, sediment, trash, debris, and pollutants attached to particulates from Stormwater and snowmelt runoff. The device takes the place of a conventional manhole within a storm drain system and offers design flexibility that works with various site constraints. The EFO is designed with a shorter bypass weir height, which accepts lower surface loading rate into the sump, thereby reducing re-entrainment of captured free floating light liquids.

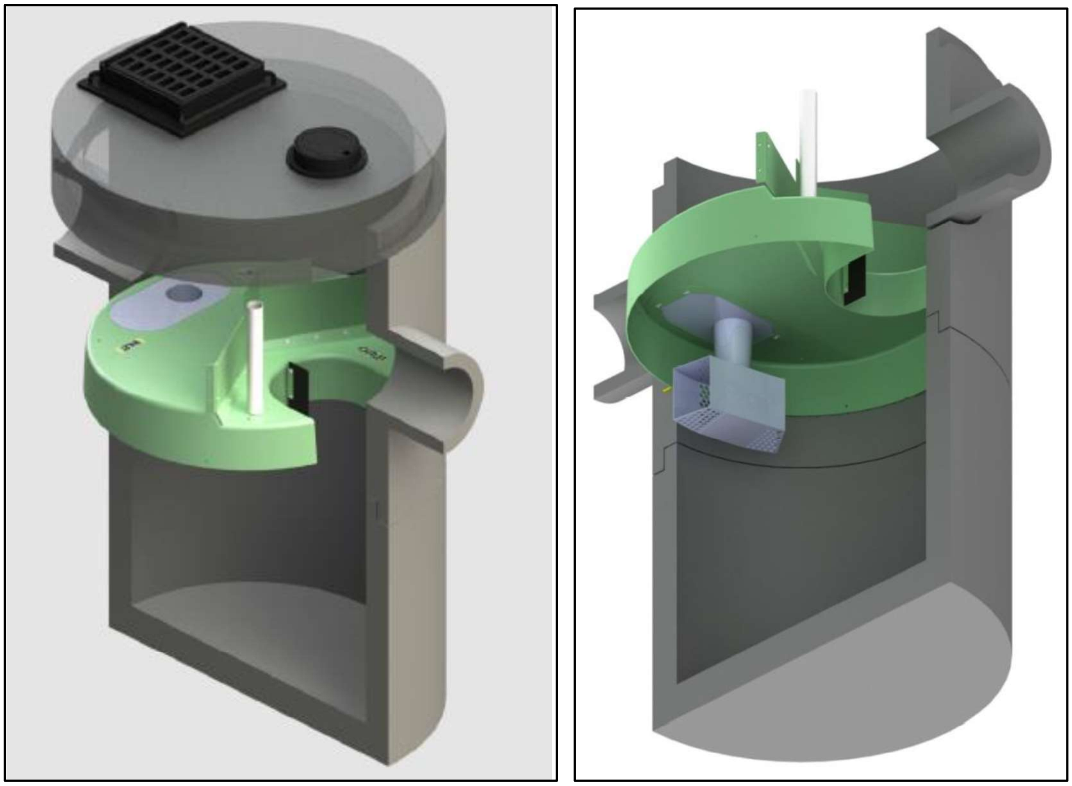


Figure 1. Graphic of typical inline Stormceptor® unit and core components.

Stormwater and snowmelt runoff enters the Stormceptor® EF/EFO's upper chamber through the inlet pipe(s) or a surface inlet grate. An insert divides the unit into lower and upper chambers and incorporates a weir to reduce influent velocity and separate influent (untreated) from effluent (treated) flows. Influent water ponds upstream of the insert's weir providing driving head for the water flowing downwards into the drop pipe where a vortex pulls the water into the lower chamber. The water diffuses at lower velocities in multiple directions through the drop pipe outlet openings. Oil and other floatables rise up and are trapped beneath the insert, while sediments undergo gravitational settling to the sump's bottom. Water from the sump can exit by flowing upward to the outlet riser onto the top side of the insert and downstream of the weir, where it discharges through the outlet pipe.

Maximum flow rate into the lower chamber is a function of weir height and drop pipe orifice diameter. The Stormceptor® EF and EFO are designed to allow a surface loading rate of 1135 L/min/m^2 (27.9 gal/min/ft^2) and 535 L/min/m^2 (13.1 gal/min/ft^2) into the lower chamber, respectively. When prescribed surface loading rates are exceeded, ponding water can overtop the weir height and bypass the lower treatment chamber, exiting directly through the outlet pipe. Hydraulic testing and scour testing demonstrate that the internal bypass effectively prevents scour at all bypass flow rates. Increasing the bypass flow rate does not increase the orifice-controlled flow rate into the lower treatment chamber where sediment is stored. This internal bypass feature allows for in-line installation, avoiding the cost of additional bypass structures. During bypass, treatment continues in the lower chamber at the maximum flow rate. The Stormceptor® EFO's lower design surface loading rate is favorable for minimizing re-entrainment and washout of captured light liquids. Inspection of Stormceptor® EF and EFO devices is performed from grade by inserting a sediment probe through the outlet riser and an oil dipstick through the oil inspection pipe. The unit can be maintained by using a vacuum hose through the outlet riser.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Imbrium Systems Inc.'s Stormceptor® EF4 and EFO4 Oil-Grit Separators, in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014). The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for Environment Canada's Environmental Technology Verification (ETV) Program. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test [a]:

During the capture test, the Stormceptor® EF4 OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 46, 44, and 49 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Stormceptor® EFO4, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 42, 40, and 34 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Scour test [a]:

During the scour test, the Stormceptor® EF4 and Stormceptor® EFO4 OGS devices, with 10.2 cm (4 inches) of test sediment pre-loaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment storage depth, generate corrected effluent concentrations of 4.6, 0.7, 0, 0.2, and 0.4 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test[a]:

During the light liquid re-entrainment test, the Stormceptor® EFO4 OGS device with surrogate low-density polyethylene beads preloaded within the lower chamber oil collection zone, representing a floating light liquid volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.5, 99.8, 99.8, and 99.9 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2.

[a] The claim can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)

Performance results

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure. The *Procedure for Laboratory Testing of Oil Grit Separators* requires that the three sample average of the test sediment particle size distribution (PSD) meet the specified PSD percent less than values within a boundary threshold of 6%. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 2 indicates that the test sediment used for the capture and scour tests met this condition.

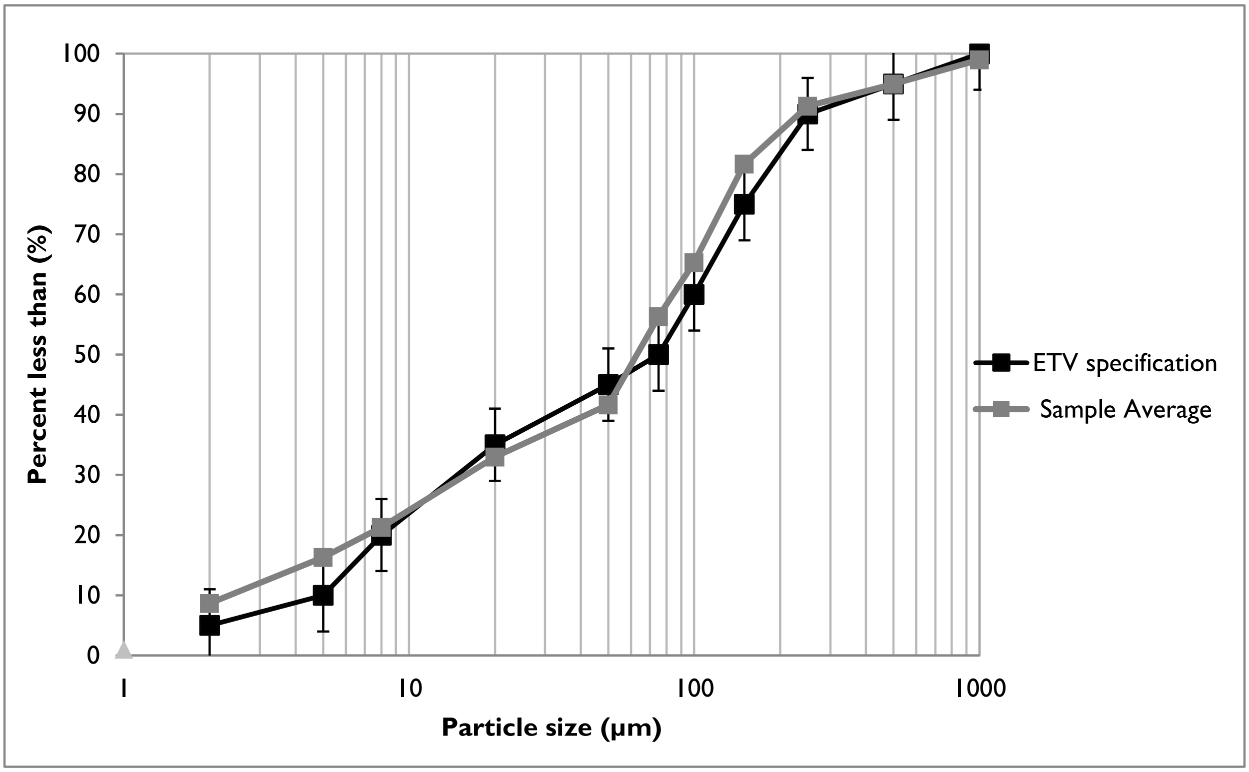


Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

The capacity of the device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1). Since the EF and EFO models are identical except for the weir height, which bypasses flows from the EFO model at a surface loading rate of 535 L/min/m^2 (13.1 gpm/ft^2), sediment capture tests at surface loading rates from 40 to 400 L/min/m^2 were only performed on the EF unit. Surface loading rates of 600, 1000, and 1400 L/min/m^2 were tested on both units separately. Results for the EFO model at these higher flow rates are presented in Table 2.

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and may be attributed to errors relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001). The results for "all particle sizes by mass balance" (see Table 1 and 2) are based on measurements of the total injected and retained sediment mass, and are therefore not subject to blending, sampling or PSD analysis errors.

Table 1. Removal efficiencies (%) of the EF4 at specified surface loading rates

Particle size fraction (µm)	Surface loading rate (L/min/m^2)						
	40	80	200	400	600	1000	1400
>500	90	58	58	100*	86	72	100*
250 - 500	100*	100*	100	100*	100*	100*	100*
150 - 250	90	82	26	100*	100*	67	90
105 - 150	100*	100*	100*	100*	100*	100*	100
75 - 105	100*	92	74	82	77	68	76
53 - 75	Undefined [a]	56	100*	72	69	50	80
20 - 53	54	100*	54	33	36	40	31
8 - 20	67	52	25	21	17	20	20
5 – 8	33	29	11	12	9	7	19
<5	13	0	0	0	0	0	4
All particle sizes by mass balance	**70.4**	**63.8**	**53.9**	**47.5**	**46.0**	**43.7**	**49.0**

[a] An outlier in the feed sample sieve data resulted in a negative removal efficiency for this size fraction.

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 171% (average 128%). See text and Bulletin # CETV 2016-11-0001 for more information.

Table 2. Removal efficiencies (%) of the EFO4 at surface loading rates above the bypass rate of 535 L/min/m^2

Particle size fraction (µm)	Surface loading rate (L/min/m^2)		
	600	1000	1400
>500	89	83	100*
250 - 500	90	100*	92
150 - 250	90	67	100*
105 - 150	85	92	77
75 - 105	80	71	65
53 - 75	60	31	36
20 - 53	33	43	23
8 - 20	17	23	15
5 – 8	10	3	3
<5	0	0	0
All particle sizes by mass balance	**41.7**	**39.7**	**34.2**

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 103 and 111% (average 107%). See text and Bulletin # CETV 2016-11-0001 for more information.

Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the sediment retained by the EF4 at each of the tested surface loading rates. Figure 4 shows the same graph for the EFO4 unit at surface loading rates above the bypass rate of 535 L/min/m^2.

As expected, the capture efficiency for fine particles in both units was generally found to decrease as surface loading rates increased.

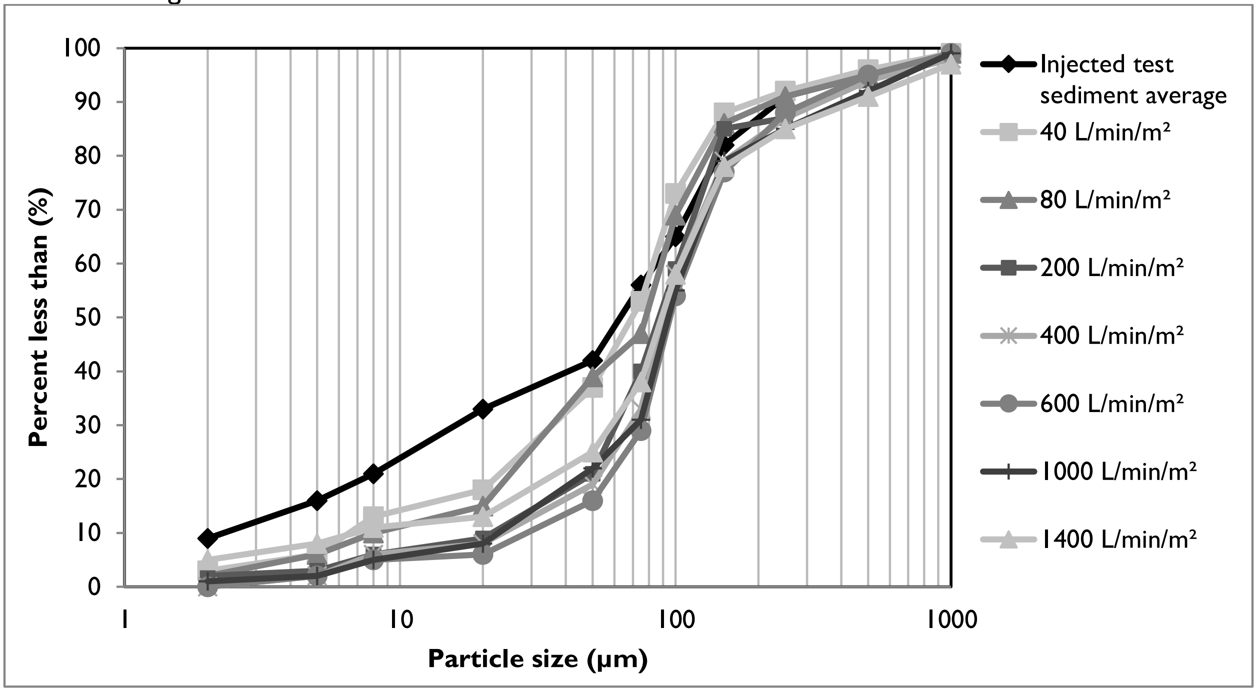


Figure 3. Particle size distribution of sediment retained in the EF4 in relation to the injected test sediment average.

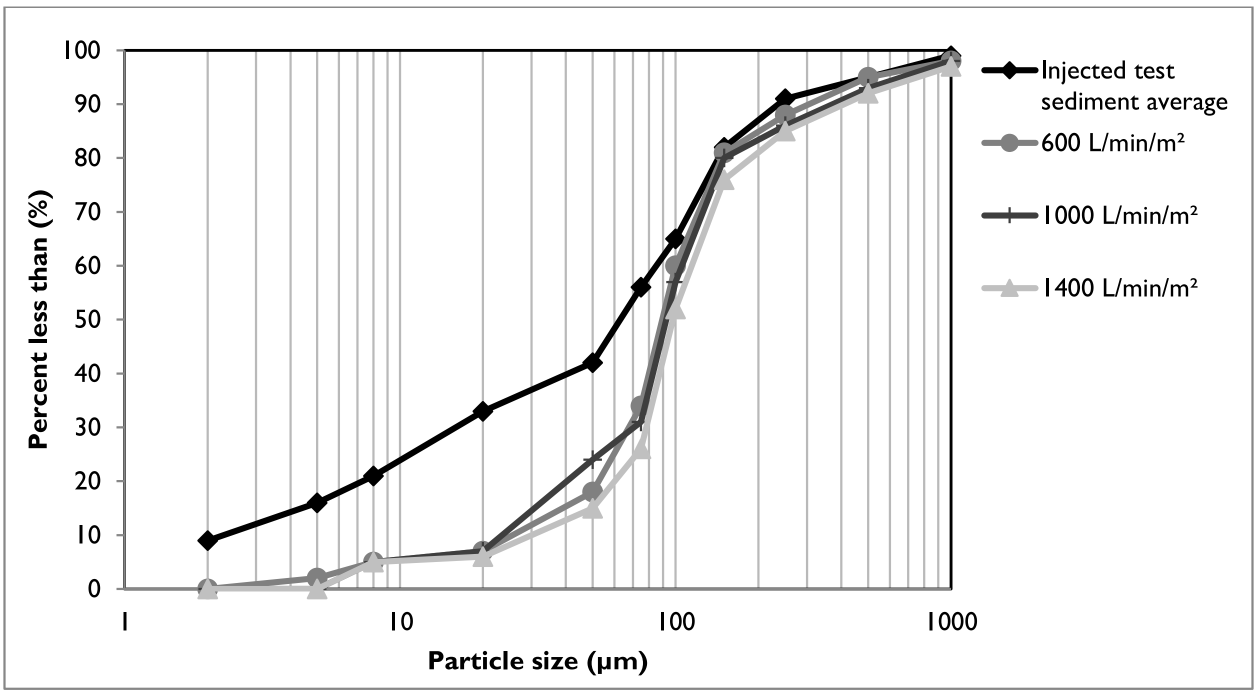


Figure 4. Particle size distribution of sediment retained in the EFO4 in relation to the injected test sediment average at surface loading rates above the bypass rate of 535 L/min/m²

Table 4 shows the results of the sediment scour and re-suspension test for the EF4 unit. The EFO4 was not tested as it was reasonably assumed that scour rates would be lower given that flow bypass occurs at a lower surface loading rate. The scour test involved preloading 10.2 cm of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Clean water was run through the device at five surface loading rates over a 30 minute period. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water. Typically, the smallest 5% of particles captured during the 40 L/min/m² sediment capture test is also used to adjust the concentration, as per the method described in Bulletin # CETV 2016-09-0001. However, since the composites of effluent concentrations were below the Reporting Detection Limit of the Laser Diffraction PSD methodology, this adjustment was not made. Results showed average adjusted effluent sediment concentrations below 5 mg/L at all tested surface loading rates.

It should be noted that the EF4 starts to internally bypass water at 1135 L/min/m², potentially resulting in the dilution of effluent concentrations, which would not normally occur under typical field conditions because the field influent concentration would contain a much higher sediment concentration than during the lab test. Recalculation of effluent concentrations to account for dilution at surface loading rates above the bypass rate showed sediment effluent concentrations to be below 1.6 mg/L.

Table 4. Scour test adjusted effluent sediment concentration.

Run	Surface loading rate (L/min/m²)	Run time (min)	Background sample concentration (mg/L)	Adjusted effluent suspended sediment concentration (mg/L) [a]	Average (mg/L)
1	200	1:00	<RDL	11.9	4.6
		2:00		7.0	
		3:00		4.4	
		4:00		2.2	
		5:00		1.0	
		6:00		1.2	
2	800	7:00	<RDL	1.1	0.7
		8:00		0.9	
		9:00		0.6	
		10:00		1.4	
		11:00		0.1	
		12:00		0	
3	1400	13:00	<RDL	0	0
		14:00		0.1	
		15:00		0	
		16:00		0	
		17:00		0	
		18:00		0	
4	2000	19:00	1.2	0.2	0.2
		20:00		0	
		21:00		0	
		22:00		0.7	
		23:00		0	
		24:00		0.4	

5	2600	25:00	1.6	0.3	0.4
		26:00		0.4	
		27:00		0.7	
		28:00		0.4	
		29:00		0.2	
		30:00		0.4	

[a] The adjusted effluent suspended sediment concentration represents the actual measured effluent concentration minus the background concentration. For more information see Bulletin # CETV 2016-09-0001.

The results of the light liquid re-entrainment test used to evaluate the unit's capacity to prevent re-entrainment of light liquids are reported in Table 5. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m^2) of surrogate low-density polyethylene beads within the oil collection skirt and running clean water through the device continuously at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m^2). Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates. The effluent flow was screened to capture all re-entrained pellets throughout the test.

Table 5. Light liquid re-entrainment test results for the EFO4.

Surface Loading Rate (L/min/m2)	Time Stamp	Amount of Beads Re-entrained			
		Mass (g)	Volume (L)[a]	% of Pre-loaded Mass Re-entrained	% of Pre-loaded Mass Retained
200	62	0	0	0.00	100
800	247	168.45	0.3	0.52	99.48
1400	432	51.88	0.09	0.16	99.83
2000	617	55.54	0.1	0.17	99.84
2600	802	19.73	0.035	0.06	99.94
Total Re-entrained		295.60	0.525	0.91	--
Total Retained		32403	57.78	--	99.09
Total Loaded		32699	58.3	--	--

[a] Determined from bead bulk density of 0.56074 g/cm^3

Variances from testing Procedure

The following minor deviations from the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014) have been noted:

1. During the capture test, the 40 L/min/m^2 and 80 L/min/m^2 surface loading rates were evaluated over 3 and 2 days respectively due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit at these lower flow rates. Pumps were shut down at the end of each intermediate day, and turned on again the following morning. The target flow rate was re-established within 30 seconds of switching on the pump. This procedure may have allowed sediments to be captured that otherwise may have exited the unit if the test was continuous. On the basis of practical considerations, this variance was approved by the verifier prior to testing.

2. During the scour test, the coefficient of variation (COV) for the lowest flow rate tested (200 L/min/m^2) was 0.07, which exceeded the specified limit of 0.04 target specified in the OGS Procedure. A pump capable of attaining the highest flow rate of 3036 L/min had difficulty maintaining the lowest flow of 234 L/min but still remained within +/- 10% of the target flow and is viewed as having very little impact on the observed results. Similarly, for the light liquid re-entrainment test the COV for the flow rate of the 200 L/min/m^2 run was 0.049, exceeding the limit of 0.04, but is believed to introduce negligible bias.

3. Due to pressure build up in the filters, the runs at 1000 L/min/m^2 for the Stormceptor® EF4 and 1000 and 1400 L/min/m^2 for the Stormceptor® EFO4 were slightly shorter than the target. The run times were 54, 59 and 43 minutes respectively, versus targets of 60 and 50 minutes. The final feed samples were timed to coincide with the end of the run. Since >25 lbs of sediment was fed, the shortened time did not invalidate the runs.

Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Imbrium Systems Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories, and dated September 8, 2017; the report is based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Stormceptor® EF and EFO OGS please contact:

Imbrium Systems, Inc.
407 Fairview Drive
Whitby, ON
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

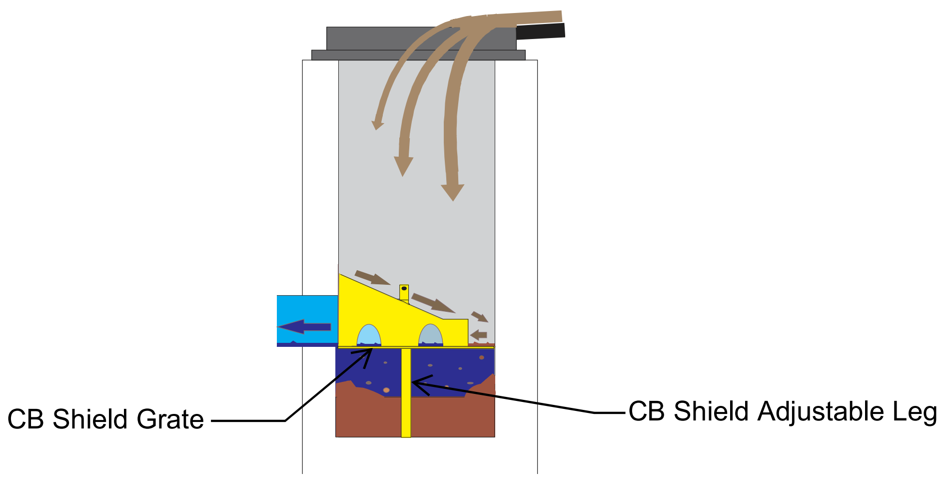
For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
World Trade Centre
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com

CB Shield Operations Manual

Installing CB Shield

It is important the catch basin frame and cover is aligned properly with the catch basin below
If it is misaligned it may be difficult to install the CB Shield insert
Determine the depth of the sump (i.e. the distance from the invert of the outlet pipe to the bottom of the catch basin). If the catch basin is in service the sump depth will be the depth of the water. The grate section of the CB Shield insert should be the same elevation as the water depth in the sump.



Adjust the leg of the CB Shield to achieve the appropriate elevation
The CB Shield is lowered into place with the rope attached to the top of the leg. The high side of the sloped plate should face the wall with the outlet pipe. (The incoming water should be directed to the wall furthest from the outlet)
The flexible plastic skirt around the outer edges of the CB Shield insert may interfere with some misaligned frame and grates. If so a slice can be cut into the skirt with a utility knife at the point of interference.
Make sure the grate is at the desired level or remove CB Shield and re-adjust the leg length.

Inspecting a CB Shield Enhanced Catch Basin

Open grate
A lifting rope is attached to the top of the centered leg of the CB Shield insert. Lift and remove the insert.
Inspect CB Shield for any possible damage. Quite often leaves will accumulate on the grate. This can actually improve the Shield's ability to capture sediment and assist in preventing leave litter from being washed down stream.
Use a Sludge Judge to measure the sediment depth in 4 - 6 locations of the sump.
If the sediment depth is 300mm – 600mm deep it is recommended that the unit be cleaned.

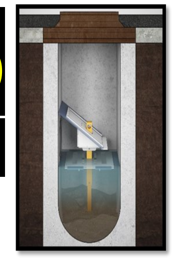
Cleaning a CB Shield Enhanced Catch Basin

Open grate and remove CB Shield with lift rope.
Clean catch basin as usual with a Vacuum truck.
Clean CB Shield (if needed) and re-install into catch basin.
If there is any significant damage to a CB Shield please send a picture and its location to CB Shield Inc. (info@cbshield.com).

CB SHIELD: OPERATIONS INFO

REMOVING AND INSTALLING A SHIELD

CBSHIELD.COM/MAINTENANCE OR 226-802-1749



CB Shield is a Canadian owned and operated company aimed at improving stormwater quality. CB shields are a catch basin insert used to maintain sediment and improve water quality. Shields are put to work as water flows off the “slope” and into the basin wall opposite to the outlet pipe; grates allow sediment from the slowed water to pass to the sump below. See below on steps for removing and installing these.

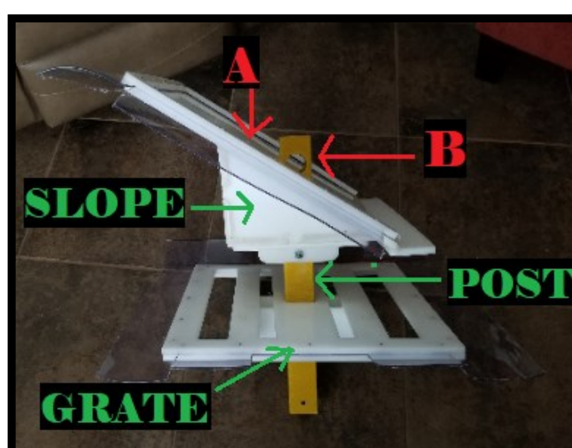
You open a catch basin and you see this device

What you need is one these specialized sticks we provide called a “Gandalf stick.” These can be provided beforehand or are sometimes left with cb shields after the unit has been installed. Please contact us if these are needed.

What you will need to do next depends on the type of shield you find. They have changed over time.

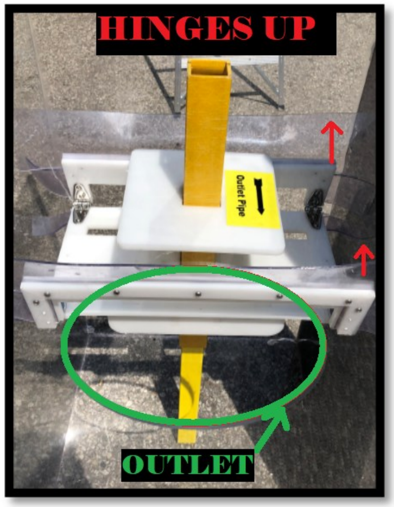
For a one piece unit: pull the unit up by the rope in the middle post

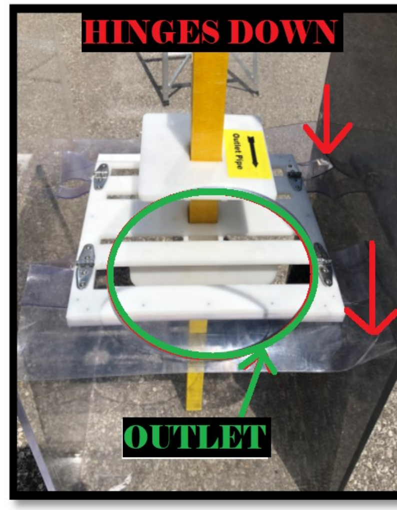
For a two piece unit, the top slope can slide off the post. The slope will have a rope (a), the post has an eye hole (b). Sometimes these will have to be removed separately.



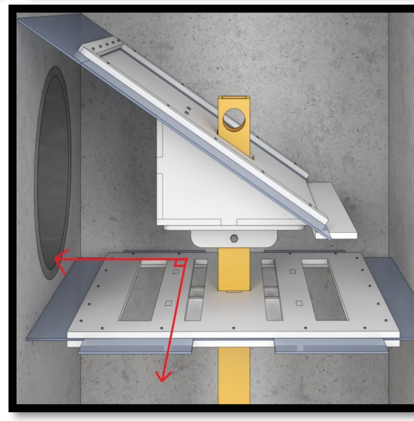
CB SHIELD: OPERATIONS INFO

Some two piece units have hinges. Follow the same steps a standard two piece unit, except pull up both hinges to remove unit, and fully extend them when reinstalling it.

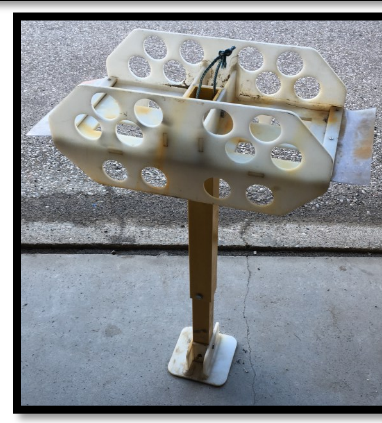




Once the unit is removed and the sediment is cleaned out, you can reinstall the unit. Clean off the grates of debris and ensure the grate slots are perpendicular to the lowest outlet pipe.



We have several variations of “spacers” used to keep shields propped in place for double catch basins. Reinstall these as you find



Tips and Facts:

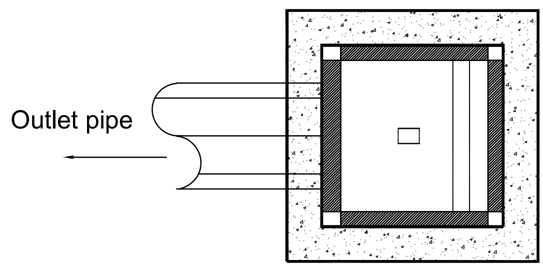
1) Try to reinstall units the way you found them. Taking a photo of how they were before you start can help save time and confusion.

2) When in doubt, use the lowest outlet pipe as the reference point: the grate should be at the same height as it, and the slope should be headed down from it.

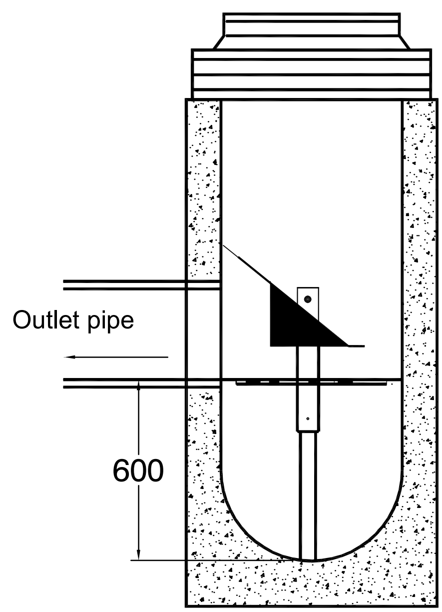
3) For videos and more information go to cbshield.com/maintenance

4) Let’s improve water quality together. Please call if you have any questions at 226-802-1749

Notes
1. CB Shield to be installed in non frozen conditions.
2. The frame and cover should be well aligned with the catchbasin for proper installation
3. The sump must be clean before installation
4. The grate is at the same elevation as pipe invert.
5. Pipes must be cut flush with inside walls



Top view



Profile view

600 x 600 CB
CB Shield (600mm Sump)

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

CB Shield® Stormwater Quality Device

Developed by CB Shield Inc.
Oakville, Ontario, Canada

Registration: GPS-ETV_VR2019-10-31

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

October 31, 2019
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

The CB Shield® technology provides an environmental benefit of controlling sediment wash off at upstream locations. A standard catch basin has a 1.2 m waterfall inflow that churns up sediment in the sump below causing a very poor rate of sediment retention. The CB Shield is a flow deflection device that is inserted into a standard catch basin. It contains a sloped plate to direct runoff to the back wall of the catch basin, thereby dissipating the energy of stormwater inflows. The dissipation of inflow energy allows time for settling of sediment in stormwater runoff, increasing capture and reducing scour/ re-suspension of previously deposited sediment. Installation involves lowering the unit into a standard sized catch basin, and adjusting the height of the unit to the height of the permanent pool in the sump. The unit is manufactured with durable fiberglass requiring little maintenance and is estimated to be operated on the same cleanout schedule set for the catch basin. Due to high rates of scour in a standard catch basin, they are seldom filled beyond 40% of sump capacity. Clean out routines and expenses are optimized when the CB Shield captures and retains more sediment within the sump.

In an urban setting, there are typically approximately 5 catch basins installed per hectare. Assuming an equal distribution of overland flow, the tested flow rates for the scour and capture tests are meaningful in the context of 78 L/s per hectare and 42 L/s per hectare, respectively. The CB Shield's scour prevention performance has been evaluated in a laboratory setting relative to a standard unshielded catch basin for flows of 1.2 to15.6 L/s. The device's sediment capture performance was evaluated for flows of 0.24 to 8.4 L/s. Hydraulically, the CB Shield has been tested to pass flows up to 60 L/s without any negative impacts (i.e., surcharging).

Performance conditions

Claim 1: Capture test

The capture test is carried out in a laboratory with a constructed simulated street scape (1 % slope along its 2.4 m (96 inch) length, 2 % slope along its 1.2 m (48 inch) width). The catch basin was clean of any litter or debris. Capture performance was tested by comparing the mass of retained sediment with the influent sediment mass for each of six inflow rates: 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s. The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the *Procedure for Laboratory Testing of Oil Grit Separators (TRCA, 2014)*. Sediment was injected onto the street scape at a point just upstream of the catch basin to allow mixing prior to discharge while avoiding excessive buildup of sediment on the street scape. The sediment feed rate was adjusted for each flow rate to keep the influent concentrations consistent at 200 mg/L. The tests were conducted with a false floor set at 300 mm below the outlet invert simulating a catch basin that is filled to 50% of the manufacturer's recommended maximum sediment storage.

Claim 2: Scour test

The scour test was carried out in a laboratory on catch basins with and without the CB Shield® insert with a constructed simulated street scape (1 % slope along its 2.4 m (96 inch) length, 2 % slope along its 1.2 m (48 inch) width) and the catch basins clean of any litter or debris. A false floor was set in the catch basins at 254 mm below the outlet invert and preloaded with the test sediment (1- 1000 micron silica blend) test up to 150 mm below the outlet invert simulating a catch basin that is ¾ full of sediment. Water was filled to the effluent pipe and sediments were allowed to settle for 12-24 hours. Flows of 1.2, 4.8, 8.4, 12, and 15.6 L/s were tested on a continuous run with flow rates maintained at 5 minutes and a one minute transition time between flow rates. A minimum effluent grab sample of 500 mL was collected in 1000 mL jars by holding it under the entire effluent stream. A sample was taken at 30 seconds during the flow transitions to account for scour during the transition. Background samples were also taken at least once every flow rate and effluent concentrations were corrected accordingly. Effluent flow was filtered using a 10µm filter and was recycled during the continuous 30 min test.

Performance claim(s)

Claim 1: Capture test

During the sediment capture test, for a catch basin with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent sediment concentration of 200 mg/L, the catch basin with a CB Shield® insert removed 64, 59.9, 52.4, 42.6, 25.2, and 26.7 percent of influent test sediment by mass at inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s, respectively.

Claim 2: Scour test

For a catch basin filled to three quarters of the manufacturer's recommended maximum sediment storage depth, with the CB Shield® insert, scouring of test sediment is at most 8% of the control catch basin during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

Performance results

The test sediment used to evaluate the CB Shield® technology was the same as that required by CETV for the evaluation of Oil Grit Separators. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 1 indicates that the test sediment was finer than the specified PSD, with a median particle size of approximately 50 microns.

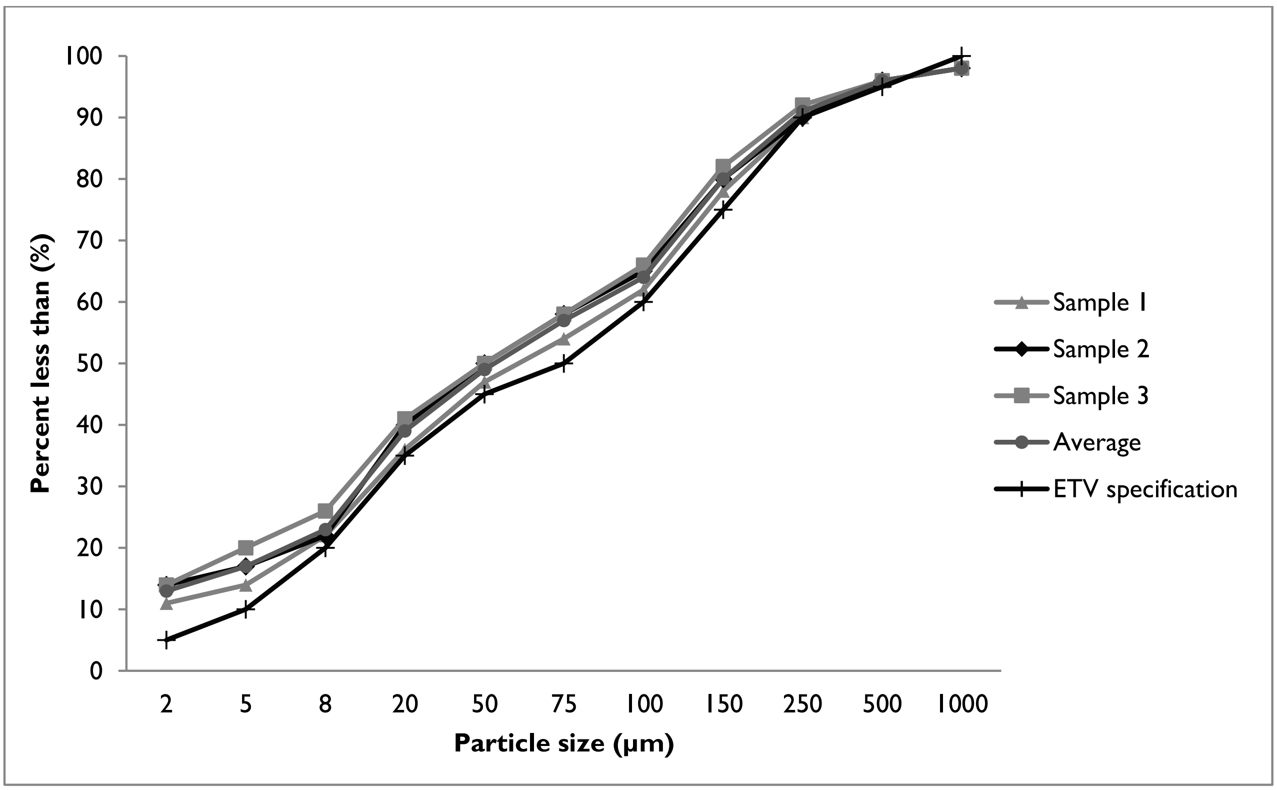


Figure 1. Test sediment particle size distribution (PSD) in relation to specified PSD.

The capacity of the device to retain sediment was determined at six surface loading rates using the modified mass balance method (see TRCA, 2014). During each of the tested flow rates, a known quantity of sediment was injected at a constant rate onto a simulated street scape just upstream of the catch basin containing the CB Shield® technology. Based on these results, removal efficiencies were determined for each of the tested surface loading rates (Table 1).

Table 1. Removal efficiencies (%) based on modified mass balance results at specified surface loading rates.

Flow rate	**(L/s)**	0.24	0.48	1.20	2.40	6.00	8.40
Surface loading rate	**(L/min/m^2)**	40	80	200	400	1000	1400
Total mass added	**(kg)**	1.217	2.302	5.072	5.150	4.921	4.812
Total mass captured	**(kg)**	0.778	1.378	2.659	2.196	1.238	1.287
Removal efficiency	**(%)**	64.0	59.9	52.4	42.6	25.2	26.7

Table 2 shows the results of the sediment scour and re-suspension test. This test involved preloading fresh test sediment into the sedimentation area of two catch basins with and without the CB Shield technology, as described in Performance Conditions section above. Effluent samples were collected at one-minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC). The mean sediment scour load of the catch basin with the CB shield insert was shown to be only 5% that of the control catch basin.

Table 2. Scour test effluent sediment concentration and loads.

Run	Flow rates (L/sec)	Surface loading rate (L/min/m²)	CB Shield® Run time (min)	CB Shield® Effluent suspended sediment concentration (mg/L)	CB Shield® Sediment load (g)	Control Run time (min)	Control Effluent suspended sediment concentration (mg/L)	Control Sediment load (g)
			1:00	17.7	1.3	1:00	129.2	9.7
			2:00	6.5	0.47	2:00	185.3	13.9
			3:00	2.7	0.19	3:00	206.0	15.5
			4:00	3.1	0.22	4:00	176.0	13.2
			5:00	4.6	0.33	5:00	523.6	39.4
			6:00	0.6	0.04	6:00	495.7	41.8
1	1.2	200	**Sum**		**2.6**	**Sum**		**133.5**
			7:00	8.2	2.4	7:00	7164.0	2069.0
			8:00	4	1.2	8:00	8094.0	2338.0
			9:00	0.6	0.2	9:00	6762.0	1950.0
			10:00	0.6	0.2	10:00	4842.0	1393.0
			11:00	1.7	0.5	11:00	5266.0	1517.0
			12:00	0.6	0.2	12:00	4768.0	1457.0
2	4.8	800	**Sum**		**4.7**	**Sum**		**10724.0**
			13:00	5.4	2.7	13:00	5429.0	2725.0
			14:00	10.0	5.0	14:00	6648.0	3332.0
			15:00	9.5	4.8	15:00	5025.0	2528.0
			16:00	10.0	5.0	16:00	5859.0	2939.0
			17:00	8.4	4.2	17:00	5019.0	2515.0
			18:00	8.2	4.1	18:00	3249.0	1628.0
3	8.4	1400	**Sum**		**25.8**	**Sum**		**15667.0**
			19:00	38.4	27.6	25:30	1886.0	1347.0
			20:00	79.4	57.2	26:30	1432.0	1027.0
			21:00	113.0	81.3	27:30	1167.0	844.0
			22:00	103.0	74.2	28:30	1508.0	1089.0
			23:00	114.0	82.1	29:30	1100.0	795.0
			24:00	92.3	66.5	30:30	708.0	512.0
4	12	2000	**Sum**		**388.9**	**Sum**		**5614.0**
			25:00	117.4	166.0	52:30	386.9	364.8
			26:00	211.6	198.1	53:30	252.7	237.8
			27:00	220.3	206.2	54:30	372.5	349.6
			28:00	187.8	175.8	55:30	332.4	311.7
			29:00	224.4	210.0	56:30	279.8	262.6
			30:00	199.2	186.5	57:30	310.2	290.9
5	15.6	2600	**Sum**		**1142.6**	**Sum**		**1817.4**
Total load					**1564.6**			**33956.0**

Potential sources of error

1. Background concentrations during the scour test were measured to be generally under 5 mg/L for both CB Shield® and Control treatments. However, background concentrations for the Control treatment at flow rates of 12.0 L/s and 15.6 L/s were substantially higher than the expected threshold of 20 mg/L as a result of inefficient recycling of water in the laboratory. Effluent samples were corrected based on the measured background concentrations since it was assumed that background sediments consisted of fine particles that were not captured in the device and flowed through as effluent concentration. If instead, some of the background sediments settled, the correction for all background sediments would bias against the relative performance of the CB Shield and therefore result in a more conservative evaluation of the CB Shield technology performance.

2. The reduction in scour at higher flow rates for the Control treatment suggested that the amount of preloaded sediment (10.2 cm depth) may have been insufficient to provide a continuous supply of fine particles for scour throughout the test. A similar decrease in scour at high flow rates was not observed for the CB Shield® treatment. This interpretation of the data implies that preloading both catch basins with additional sediment would likely have shown increased relative scour for the Control treatment, particularly at high flow rates. Although further testing would be required to verify this interpretation, it is reasonable to suggest that the test as conducted may have produced a smaller relative difference, resulting in a more conservative claim for the CB Shield technology.

Verification

This verification was first completed in October, 2016 and is considered valid for subsequent renewal periods every three (3) years thereafter. Data and information provided by CB Shield Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories of Mississauga, Ontario, dated 24 August 2016; the report was based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

The original verification was completed by the Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the Canadian ETV Program's General Verification Protocol (June 2012) and taking into account ISO/FDIS 14034:2015(E). This ETV renewal is considered to meet the equivalency of an ETV verification completed using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***.

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV) and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the CB Shield® Stormwater Quality Device please contact:

CB Shield Inc.
39 Uplands Drive
Brantford, ON
N3R 6H5 Canada
Tel: 519-212-9161
info@cbshield.com
www.cbshield.com

For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com
www.globeperformance.com

TATHAM ENGINEERING

PROJECT	The Terrazzo	FILE	121075
		DATE	October 6, 2022
SUBJECT	25 mm Storm Peak Flow Rate Calculation	NAME	AVN
		PAGE	1 OF 1

Taken from Section 4.6 Wet Ponds, Stormwater Management Plan and SWMP Design
Equation 4.8 (Rational Method) and 4.9 (25 mm Storm Intensity)

$Q = \frac{C*i*A}{360}$

Q = Peak Flow Rate (m^3/s)
C = 5 Year Runoff Coefficient
A = Area (ha)
i = Rainfall Intensity (mm/h)

i = 43*C+5.9 C = 5 Year Runoff Coefficient

Catchments to OGS

Catchment 203

i = 43*(0.75)+5.9 = 38.15 mm/h

$Q = \frac{(0.75)*(38.15)*(0.08)}{360}$

Q = 0.0064 m^3/s = **6.4** L/s

Catchment 204

i = 43*(0.75)+5.9 = 38.15 mm/h

$Q = \frac{(0.75)*(38.15)*(0.05)}{360}$

Q = 0.0040 m^3/s = **4.0** L/s

Catchment 205

i = 43*(0.75)+5.9 = 38.15 mm/h

$Q = \frac{(0.75)*(38.15)*(0.15)}{360}$

Q = 0.0119 m^3/s = **11.9** L/s

Catchment 206

i = 43*(0.75)+5.9 = 38.15 mm/h

$Q = \frac{(0.75)*(38.15)*(0.06)}{360}$

Q = 0.0048 m^3/s = **4.8** L/s

Catchment 207

i = 43*(0.75)+5.9 = 38.15 mm/h

$Q = \frac{(0.75)*(38.15)*(0.15)}{360}$

Q = 0.0119 m^3/s = **11.9** L/s

Catchment 208

i = 43*(0.75)+5.9 = 38.15 mm/h

$Q = \frac{(0.75)*(38.15)*(0.05)}{360}$

Q = 0.0048 m^3/s = **4.8** L/s

Q_{total} = **43.7** L/s to OGS Unit

Catchments not to OGS

Catchment 201

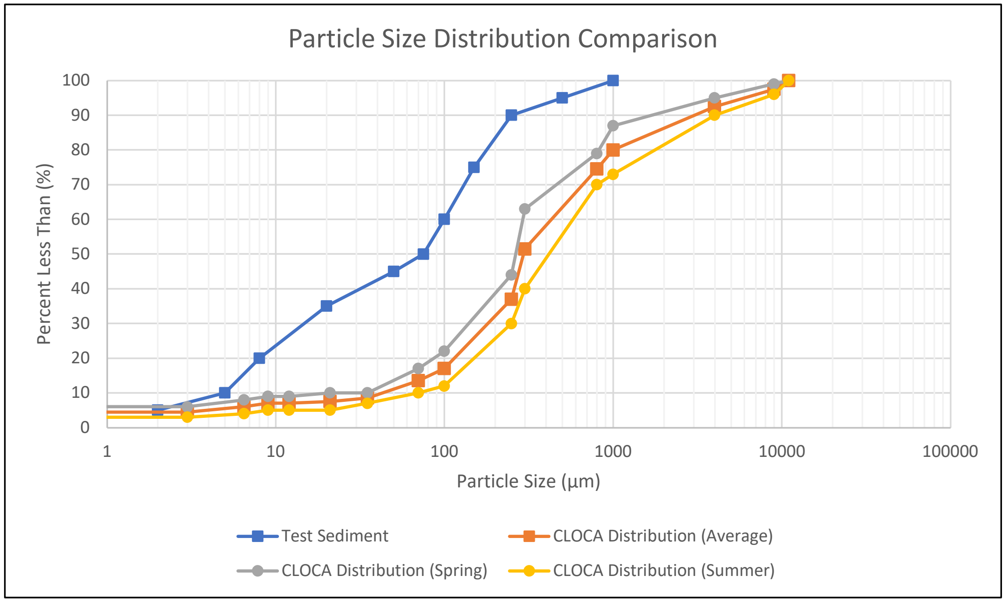
i = 43*(0.75)+5.9 = 38.15 mm/h

$Q = \frac{(0.75)*(38.15)*(0.06)}{360}$

Q = 0.0048 m^3/s = **4.8** L/s

PARTICLE SIZE DISTRIBUTION COMPARISION
LABORATORY TESTING VERSUS CLOCA
SEPTEMBER 15, 2022

Laboratory Testing		CLOCA			
			Percent Less Than		
Particle Size (µm)	Percent Less Than	Particle Size (µm)	Average Sample	Spring Sample	Summer Sample
1000	100	11000	100	100	100
500	95	9000	97.5	99	96
250	90	4000	92.5	95	90
150	75	1000	80	87	73
100	60	800	74.5	79	70
75	50	300	51.5	63	40
50	45	250	37	44	30
20	35	100	17	22	12
8	20	70	13.5	17	10
5	10	35	8.5	10	7
2	5	21	7.5	10	5
		12	7	9	5
		9	7	9	5
		6.5	6	8	4
		3	4.5	6	3
		0.5	4.5	6	3



OIL GRIT SEPARATOR TREATMENT EFFICIENCY
IMBRIUM SYSTEMS STORMCEPTOR
SEPTEMBER 15, 2022

Mass Surface Loading Rate

25 mm Design Storm Peak Flow Rate =	43.7	L/s
	2623	L/min
Stormceptor EF6 (EF6)	1.83	m
EF6 Treatment Area =	2.6	m^2
Mass Surface Loading Rate =	997	$L/min/m^2$

Lower	Upper
600	1000

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 600 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	86.0%	33.8%
250	37.0%	23.7%	100.0%	23.7%
150	23.7%	13.3%	100.0%	13.3%
105	17.7%	6.0%	100.0%	6.0%
75	14.1%	3.6%	77.0%	2.8%
53	11.1%	3.0%	69.0%	2.1%
20	7.4%	3.7%	36.0%	1.3%
8	6.6%	0.8%	17.0%	0.1%
5	5.0%	1.6%	9.0%	0.1%
0	0.0%	5.0%	0.0%	0.0%
Total		**100.0%**		**83.3%**

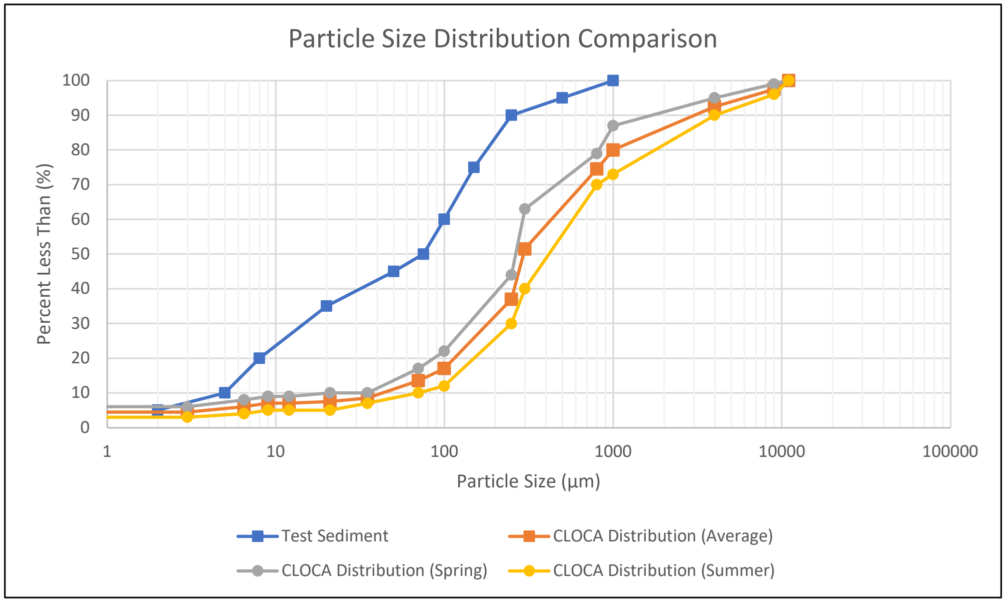
Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 997 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	72.1%	28.3%
250	37.0%	23.7%	100.0%	23.7%
150	23.7%	13.3%	67.2%	8.9%
105	17.7%	6.0%	100.0%	6.0%
75	14.1%	3.6%	68.1%	2.5%
53	11.1%	3.0%	50.1%	1.5%
20	7.4%	3.7%	40.0%	1.5%
8	6.6%	0.8%	20.0%	0.2%
5	5.0%	1.6%	7.0%	0.1%
0	0.0%	5.0%	0.0%	0.0%
Total		**100.0%**		**72.7%**

Therefore, OGS removal efficiency is : **72.7%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 1000 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	72.0%	28.3%
250	37.0%	23.7%	100.0%	23.7%
150	23.7%	13.3%	67.0%	8.9%
105	17.7%	6.0%	100.0%	6.0%
75	14.1%	3.6%	68.0%	2.4%
53	11.1%	3.0%	50.0%	1.5%
20	7.4%	3.7%	40.0%	1.5%
8	6.6%	0.8%	20.0%	0.2%
5	5.0%	1.6%	7.0%	0.1%
0	0.0%	5.0%	0.0%	0.0%
Total		**100.0%**		**72.6%**

PARTICLE SIZE DISTRIBUTION COMPARISION
LABORATORY TESTING VERSUS CLOCA
SEPTEMBER 15, 2022

Laboratory Testing		CLOCA			
			Percent Less Than		
Particle Size (µm)	Percent Less Than	Particle Size (µm)	Average Sample	Spring Sample	Summer Sample
1000	100	11000	100	100	100
500	95	9000	97.5	99	96
250	90	4000	92.5	95	90
150	75	1000	80	87	73
100	60	800	74.5	79	70
75	50	300	51.5	63	40
50	45	250	37	44	30
20	35	100	17	22	12
8	20	70	13.5	17	10
5	10	35	8.5	10	7
2	5	21	7.5	10	5
		12	7	9	5
		9	7	9	5
		6.5	6	8	4
		3	4.5	6	3
		0.5	4.5	6	3



CB SHIELD TREATMENT EFFICIENCY

SEPTEMBER 15, 2022

Catchment 203 - Mass Surface Loading Rate

25 mm Design Storm Peak Flow Rate =	3.2	L/s	(2 catchbasins in catchment, therefore 25mm flow divided by 2)
Mass Surface Loading Rate =	191	L/min	
CB Insert (CB)	0.6x0.6	m	
FD Treatment Area =	0.36	m^2	Lower: 400 / Upper: 1000
Mass Surface Loading Rate =	530	$L/min/m^2$	

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 400 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	42.6%	16.7%
250	37.0%	23.7%	42.6%	10.1%
150	23.7%	13.3%	42.6%	5.7%
105	17.7%	6.0%	42.6%	2.6%
75	14.1%	3.6%	42.6%	1.5%
53	11.1%	3.0%	42.6%	1.3%
20	7.4%	3.7%	42.6%	1.6%
8	6.6%	0.8%	42.6%	0.3%
5	5.0%	1.6%	42.6%	0.7%
0	0.0%	5.0%	42.6%	2.1%
Total		**100.0%**		**42.6%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 530 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	38.8%	15.3%
250	37.0%	23.7%	38.8%	9.2%
150	23.7%	13.3%	38.8%	5.2%
105	17.7%	6.0%	38.8%	2.3%
75	14.1%	3.6%	38.8%	1.4%
53	11.1%	3.0%	38.8%	1.2%
20	7.4%	3.7%	38.8%	1.4%
8	6.6%	0.8%	38.8%	0.3%
5	5.0%	1.6%	38.8%	0.6%
0	0.0%	5.0%	38.8%	1.9%
Total		**100.0%**		**38.8%**

Therefore, CB Shield removal efficiency is : **38.8%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 1000 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	25.2%	9.9%
250	37.0%	23.7%	25.2%	6.0%
150	23.7%	13.3%	25.2%	3.4%
105	17.7%	6.0%	25.2%	1.5%
75	14.1%	3.6%	25.2%	0.9%
53	11.1%	3.0%	25.2%	0.8%
20	7.4%	3.7%	25.2%	0.9%
8	6.6%	0.8%	25.2%	0.2%
5	5.0%	1.6%	25.2%	0.4%
0	0.0%	5.0%	25.2%	1.3%
Total		**100.0%**		**25.2%**

CB SHIELD TREATMENT EFFICIENCY

SEPTEMBER 15, 2022

Catchment 204 - Mass Surface Loading Rate

25 mm Design Storm Peak Flow Rate =	2.0	L/s	(2 catchbasins in catchment, therefore 25mm flow divided by 2)
Mass Surface Loading Rate =	60	L/min	
CB Insert (CB)	0.6x0.6	m	
FD Treatment Area =	0.36	m^2	Lower: 80
Mass Surface Loading Rate =	166	$L/min/m^2$	Upper: 200

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 80 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	59.9%	23.5%
250	37.0%	23.7%	59.9%	14.2%
150	23.7%	13.3%	59.9%	8.0%
105	17.7%	6.0%	59.9%	3.6%
75	14.1%	3.6%	59.9%	2.2%
53	11.1%	3.0%	59.9%	1.8%
20	7.4%	3.7%	59.9%	2.2%
8	6.6%	0.8%	59.9%	0.5%
5	5.0%	1.6%	59.9%	1.0%
0	0.0%	5.0%	59.9%	3.0%
Total		**100.0%**		**59.9%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 166 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	54.6%	21.4%
250	37.0%	23.7%	54.6%	12.9%
150	23.7%	13.3%	54.6%	7.3%
105	17.7%	6.0%	54.6%	3.3%
75	14.1%	3.6%	54.6%	2.0%
53	11.1%	3.0%	54.6%	1.6%
20	7.4%	3.7%	54.6%	2.0%
8	6.6%	0.8%	54.6%	0.4%
5	5.0%	1.6%	54.6%	0.9%
0	0.0%	5.0%	54.6%	2.7%
Total		**100.0%**		**54.6%**

Therefore, CB Shield removal efficiency is : **54.6%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 200 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	52.4%	20.6%
250	37.0%	23.7%	52.4%	12.4%
150	23.7%	13.3%	52.4%	7.0%
105	17.7%	6.0%	52.4%	3.1%
75	14.1%	3.6%	52.4%	1.9%
53	11.1%	3.0%	52.4%	1.6%
20	7.4%	3.7%	52.4%	1.9%
8	6.6%	0.8%	52.4%	0.4%
5	5.0%	1.6%	52.4%	0.8%
0	0.0%	5.0%	52.4%	2.6%
Total		**100.0%**		**52.4%**

CB SHIELD TREATMENT EFFICIENCY

SEPTEMBER 15, 2022

Catchment 205 - Mass Surface Loading Rate

25 mm Design Storm Peak Flow Rate =	4.0 L/s	(3 catchbasins in catchment, therefore 25mm flow divided by 3)
Mass Surface Loading Rate =	238 L/min	
CB Insert (CB)	0.6x0.6 m	
FD Treatment Area =	0.36 m^2	Lower / Upper
Mass Surface Loading Rate =	662 L/min/m^2	400 / 1000

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 400 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	42.6%	16.7%
250	37.0%	23.7%	42.6%	10.1%
150	23.7%	13.3%	42.6%	5.7%
105	17.7%	6.0%	42.6%	2.6%
75	14.1%	3.6%	42.6%	1.5%
53	11.1%	3.0%	42.6%	1.3%
20	7.4%	3.7%	42.6%	1.6%
8	6.6%	0.8%	42.6%	0.3%
5	5.0%	1.6%	42.6%	0.7%
0	0.0%	5.0%	42.6%	2.1%
Total		**100.0%**		**42.6%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 662 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	35.0%	13.8%
250	37.0%	23.7%	35.0%	8.3%
150	23.7%	13.3%	35.0%	4.7%
105	17.7%	6.0%	35.0%	2.1%
75	14.1%	3.6%	35.0%	1.3%
53	11.1%	3.0%	35.0%	1.0%
20	7.4%	3.7%	35.0%	1.3%
8	6.6%	0.8%	35.0%	0.3%
5	5.0%	1.6%	35.0%	0.6%
0	0.0%	5.0%	35.0%	1.7%
Total		**100.0%**		**35.0%**

Therefore, CB Shield removal efficiency is : **35.0%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 1000 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	25.2%	9.9%
250	37.0%	23.7%	25.2%	6.0%
150	23.7%	13.3%	25.2%	3.4%
105	17.7%	6.0%	25.2%	1.5%
75	14.1%	3.6%	25.2%	0.9%
53	11.1%	3.0%	25.2%	0.8%
20	7.4%	3.7%	25.2%	0.9%
8	6.6%	0.8%	25.2%	0.2%
5	5.0%	1.6%	25.2%	0.4%
0	0.0%	5.0%	25.2%	1.3%
Total		**100.0%**		**25.2%**

CB SHIELD TREATMENT EFFICIENCY

SEPTEMBER 15, 2022

Catchment 206 - Mass Surface Loading Rate

25 mm Design Storm Peak Flow Rate =	4.8	L/s
Mass Surface Loading Rate =	286	L/min
CB Insert (CB)	0.6x0.6	m
FD Treatment Area =	0.36	m^2
Mass Surface Loading Rate =	795	$L/min/m^2$

Lower	Upper
400	1000

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 400 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	42.6%	16.7%
250	37.0%	23.7%	42.6%	10.1%
150	23.7%	13.3%	42.6%	5.7%
105	17.7%	6.0%	42.6%	2.6%
75	14.1%	3.6%	42.6%	1.5%
53	11.1%	3.0%	42.6%	1.3%
20	7.4%	3.7%	42.6%	1.6%
8	6.6%	0.8%	42.6%	0.3%
5	5.0%	1.6%	42.6%	0.7%
0	0.0%	5.0%	42.6%	2.1%
Total		**100.0%**		**42.6%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 795 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	31.2%	12.2%
250	37.0%	23.7%	31.2%	7.4%
150	23.7%	13.3%	31.2%	4.1%
105	17.7%	6.0%	31.2%	1.9%
75	14.1%	3.6%	31.2%	1.1%
53	11.1%	3.0%	31.2%	0.9%
20	7.4%	3.7%	31.2%	1.2%
8	6.6%	0.8%	31.2%	0.2%
5	5.0%	1.6%	31.2%	0.5%
0	0.0%	5.0%	31.2%	1.6%
Total		**100.0%**		**31.2%**

Therefore, CB Shield removal efficiency is : **31.2%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 1000 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	25.2%	9.9%
250	37.0%	23.7%	25.2%	6.0%
150	23.7%	13.3%	25.2%	3.4%
105	17.7%	6.0%	25.2%	1.5%
75	14.1%	3.6%	25.2%	0.9%
53	11.1%	3.0%	25.2%	0.8%
20	7.4%	3.7%	25.2%	0.9%
8	6.6%	0.8%	25.2%	0.2%
5	5.0%	1.6%	25.2%	0.4%
0	0.0%	5.0%	25.2%	1.3%
Total		**100.0%**		**25.2%**

CB SHIELD TREATMENT EFFICIENCY

SEPTEMBER 15, 2022

Catchment 207 - Mass Surface Loading Rate

25 mm Design Storm Peak Flow Rate =	4.0	L/s	(3 catchbasins in catchment, therefore 25mm flow divided by 3)	
Mass Surface Loading Rate =	238	L/min		
CB Insert (CB)	0.6x0.6	m		
FD Treatment Area =	0.36	m^2	Lower	Upper
Mass Surface Loading Rate =	662	$L/min/m^2$	400	1000

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 400 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	42.6%	16.7%
250	37.0%	23.7%	42.6%	10.1%
150	23.7%	13.3%	42.6%	5.7%
105	17.7%	6.0%	42.6%	2.6%
75	14.1%	3.6%	42.6%	1.5%
53	11.1%	3.0%	42.6%	1.3%
20	7.4%	3.7%	42.6%	1.6%
8	6.6%	0.8%	42.6%	0.3%
5	5.0%	1.6%	42.6%	0.7%
0	0.0%	5.0%	42.6%	2.1%
Total		**100.0%**		**42.6%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 662 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	35.0%	13.8%
250	37.0%	23.7%	35.0%	8.3%
150	23.7%	13.3%	35.0%	4.7%
105	17.7%	6.0%	35.0%	2.1%
75	14.1%	3.6%	35.0%	1.3%
53	11.1%	3.0%	35.0%	1.0%
20	7.4%	3.7%	35.0%	1.3%
8	6.6%	0.8%	35.0%	0.3%
5	5.0%	1.6%	35.0%	0.6%
0	0.0%	5.0%	35.0%	1.7%
Total		**100.0%**		**35.0%**

Therefore, CB Shield removal efficiency is : **35.0%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 1000 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	25.2%	9.9%
250	37.0%	23.7%	25.2%	6.0%
150	23.7%	13.3%	25.2%	3.4%
105	17.7%	6.0%	25.2%	1.5%
75	14.1%	3.6%	25.2%	0.9%
53	11.1%	3.0%	25.2%	0.8%
20	7.4%	3.7%	25.2%	0.9%
8	6.6%	0.8%	25.2%	0.2%
5	5.0%	1.6%	25.2%	0.4%
0	0.0%	5.0%	25.2%	1.3%
Total		**100.0%**		**25.2%**

CB SHIELD TREATMENT EFFICIENCY

SEPTEMBER 15, 2022

Catchment 208 - Mass Surface Loading Rate

25 mm Design Storm Peak Flow Rate =	2.4	L/s	(2 catchbasins in catchment, therefore 25mm flow divided by 2)
Mass Surface Loading Rate =	143	L/min	
CB Insert (CB)	0.6x0.6	m	
FD Treatment Area =	0.36	m^2	Lower 200, Upper 400
Mass Surface Loading Rate =	397	$L/min/m^2$	

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 200 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	52.4%	20.6%
250	37.0%	23.7%	52.4%	12.4%
150	23.7%	13.3%	52.4%	7.0%
105	17.7%	6.0%	52.4%	3.1%
75	14.1%	3.6%	52.4%	1.9%
53	11.1%	3.0%	52.4%	1.6%
20	7.4%	3.7%	52.4%	1.9%
8	6.6%	0.8%	52.4%	0.4%
5	5.0%	1.6%	52.4%	0.8%
0	0.0%	5.0%	52.4%	2.6%
Total		**100.0%**		**52.4%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 397 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	42.7%	16.8%
250	37.0%	23.7%	42.7%	10.1%
150	23.7%	13.3%	42.7%	5.7%
105	17.7%	6.0%	42.7%	2.6%
75	14.1%	3.6%	42.7%	1.5%
53	11.1%	3.0%	42.7%	1.3%
20	7.4%	3.7%	42.7%	1.6%
8	6.6%	0.8%	42.7%	0.3%
5	5.0%	1.6%	42.7%	0.7%
0	0.0%	5.0%	42.7%	2.1%
Total		**100.0%**		**42.7%**

Therefore, CB Shield removal efficiency is : **42.7%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 400 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	42.6%	16.7%
250	37.0%	23.7%	42.6%	10.1%
150	23.7%	13.3%	42.6%	5.7%
105	17.7%	6.0%	42.6%	2.6%
75	14.1%	3.6%	42.6%	1.5%
53	11.1%	3.0%	42.6%	1.3%
20	7.4%	3.7%	42.6%	1.6%
8	6.6%	0.8%	42.6%	0.3%
5	5.0%	1.6%	42.6%	0.7%
0	0.0%	5.0%	42.6%	2.1%
Total		**100.0%**		**42.6%**

CB SHIELD TREATMENT EFFICIENCY

SEPTEMBER 15, 2022

Catchment 201 - Mass Surface Loading Rate

25 mm Design Storm Peak Flow Rate =	2.4	L/s	(2 catchbasins in catchment, therefore 25mm flow divided by 2)
Mass Surface Loading Rate =	143	L/min	
CB Insert (CB)	0.6x0.6	m	
FD Treatment Area =	0.36	m^2	Lower: 200, Upper: 400
Mass Surface Loading Rate =	397	$L/min/m^2$	

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 200 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	52.4%	20.6%
250	37.0%	23.7%	52.4%	12.4%
150	23.7%	13.3%	52.4%	7.0%
105	17.7%	6.0%	52.4%	3.1%
75	14.1%	3.6%	52.4%	1.9%
53	11.1%	3.0%	52.4%	1.6%
20	7.4%	3.7%	52.4%	1.9%
8	6.6%	0.8%	52.4%	0.4%
5	5.0%	1.6%	52.4%	0.8%
0	0.0%	5.0%	52.4%	2.6%
Total		**100.0%**		**52.4%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 400 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	42.7%	16.8%
250	37.0%	23.7%	42.7%	10.1%
150	23.7%	13.3%	42.7%	5.7%
105	17.7%	6.0%	42.7%	2.6%
75	14.1%	3.6%	42.7%	1.5%
53	11.1%	3.0%	42.7%	1.3%
20	7.4%	3.7%	42.7%	1.6%
8	6.6%	0.8%	42.7%	0.3%
5	5.0%	1.6%	42.7%	0.7%
0	0.0%	5.0%	42.7%	2.1%
Total		**100.0%**		**42.7%**

Therefore, CB Shield removal efficiency is : **42.7%**

Particle Size (µm)	Percent Less Than (CLOCA Average)	Particle Size Fraction	Treatment Efficiency - ETV 400 (%)	Sediment Removal (%)
11000	100.0%			
500	60.7%	39.3%	42.6%	16.7%
250	37.0%	23.7%	42.6%	10.1%
150	23.7%	13.3%	42.6%	5.7%
105	17.7%	6.0%	42.6%	2.6%
75	14.1%	3.6%	42.6%	1.5%
53	11.1%	3.0%	42.6%	1.3%
20	7.4%	3.7%	42.6%	1.6%
8	6.6%	0.8%	42.6%	0.3%
5	5.0%	1.6%	42.6%	0.7%
0	0.0%	5.0%	42.6%	2.1%
Total		**100.0%**		**42.6%**

Water Quality Treatment Train Calculation

Catchment 203
Drainage Area to Controls = 0.08 ha

Device		Target Total Suspended Solids (TSS) Removal
Primary Treatment	OGS	72.7%
Secondary Treatment	CB Insert	38.8%

$$TSS\ Removal = (R_P + R_S) - [(R_P \times R_S)/100]$$

where:

R_P = % TSS Removal provided by Primary Treatment Strategy
R_S = % TSS Removal provided by Secondary Treatment Strategy

TSS Removal Provided By Controls = 83.3%

Catchment 204
Drainage Area to Controls = 0.15 ha

Device		Target Total Suspended Solids (TSS) Removal
Primary Treatment	OGS	72.7%
Secondary Treatment	CB Insert	54.6%

TSS Removal Provided By Controls = 87.6%

Catchment 205
Drainage Area to Controls = 0.15 ha

Device		Target Total Suspended Solids (TSS) Removal
Primary Treatment	OGS	72.7%
Secondary Treatment	CB Insert	35.0%

TSS Removal Provided By Controls = 82.2%

Catchment 206
Drainage Area to Controls = 0.06 ha

Device		Target Total Suspended Solids (TSS) Removal
Primary Treatment	OGS	72.7%
Secondary Treatment	CB Insert	31.2%

TSS Removal Provided By Controls = 81.2%

TATHAM ENGINEERING

PROJECT	The Terrazzo	FILE	121075
		DATE	October 12, 2022
SUBJECT	Water Quality - Treatment Train Calculation	NAME	AVN
		PAGE	2 OF 2

Catchment 207

Drainage Area to Controls = 0.15 ha

Device		Target Total Suspended Solids (TSS) Removal
Primary Treatment	OGS	72.7%
Secondary Treatment	CB Insert	35.0%

TSS Removal Provided By Controls = 82.2%

Catchment 208

Drainage Area to Controls = 0.06 ha

Device		Target Total Suspended Solids (TSS) Removal
Primary Treatment	OGS	72.7%
Secondary Treatment	CB Insert	42.7%

TSS Removal Provided By Controls = 84.4%

Overall removal efficiency for catchments (weighted average) **83.7%**

Areas Treated by OGS and CB Inserts

Catchment 201

Drainage Area to Controls = 0.06 ha

Device		Target Total Suspended Solids (TSS) Removal
Primary Treatment	CB Insert	42.7%

TSS Removal Provided By Controls = 42.7%

Overall removal efficiency for entire site (weighted average) **80.2%**

Catchments 202 and 209 have been excluded from the treatment train calculations and are considered clean runoff (no road drainage)

TATHAM ENGINEERING

PROJECT	The Terrazzo	FILE	121075
		DATE	September 15, 2022
SUBJECT	Emergency Spillway	NAME	AVN
		PAGE	OF

Trapezoidal Broad Crested Weir

Source: Hydraulic Structures, C.D.Smith, University of Saskatchewan

Trapezoidal Weir

The trapezoidal weir is a combination of the rectangular weir and the triangular weir

Enter

W	Weir Bottom Width (m)	5.6
H	Head (m)	0.18
L	Weir Downstream Length	10
S	Side Slope (horizontal):1	10

Rectangular Weir

$$Q = CWH^{3/2}$$

H/L 0.018

C 1.4

Result

Q Rectangular Weir Flow (m^3/s) **0.5987**

Triangular Weir

$$Q = CH^{5/2}\tan(\theta/2)$$

Notch Angle (one side) 84.289 degrees

Notch Angle (one side) 1.4711 radians

$\tan(\theta/2)$ 10.00

Triangular H/L 0.018

C 1.05

Result

Q Triangular Weir Flow (m^3/s) **0.1443**

Total Rectangular + Triangular Weir

Q Total Flow (m^3/s) 0.7431

100 Year Flow Uncontrolled (m^3/s) 0.2282