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STORMWATER MANAGEMENT

AT

123 REGIONAL HIGHWAY 47, UXBRIDGE, ON

PREPARED FOR:

123 Highway 47 Inc.

December 14th, 2023

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1. Site Background

King EPCM (the Engineer) was retained by 123 Highway 47 Inc. (the Client) for geotechnical and environmental engineering services, including the creation of a Stormwater Management Plan (SWM). The property was located at 123 Regional Highway 47, Uxbridge, Ontario (the Site). It is understood that the SWM is for the sole purpose of the application and to develop a 14-lot industrial plan of subdivision on municipal water and private septic along with an access road (24.1ha or 59.5ac). This report is to be submitted to the Township of Uxbridge, Toronto and Region Conservation Authority (TRCA), and Regional Municipality of Durham (Durham Region).

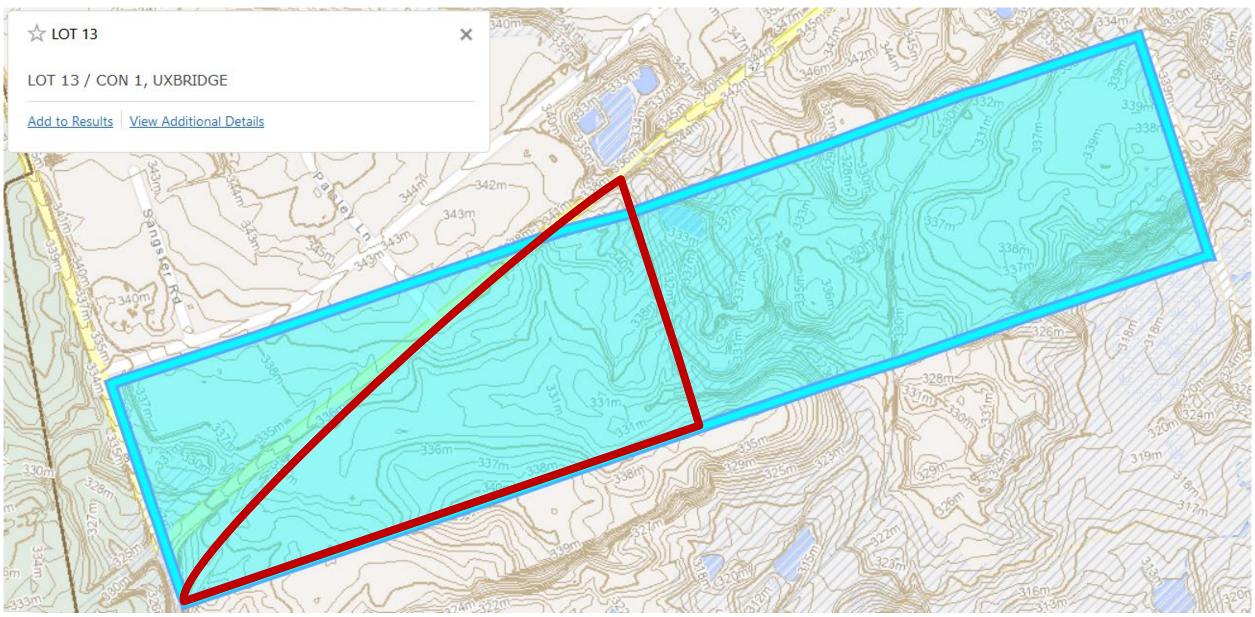

Figure 1 – Topographic map of 123 Regional Highway 47, Uxbridge, ON

The site property is considered triangular in shape and is located at the southeast corner of the intersection of Durham Regional Highway 47 and York/Durham Line, within the Town of Uxbridge. The proposed project is composed of a 14-lot industrial plan, including new roadways and a pond, post-development TIMP = 192,199m^2 = 80%. There would be a block for a storm-water management pond and the woodland. The site property is located on the south side of the Anderson Industrial Complex, in Lots 13 & 14, Con 1, Uxbridge.

The site is approximately 60 acres according to the Geowarehouse Property Reports. It is along the western boundary of the Durham Region, with agricultural fields to the south and east, while there is a relatively recently built industrial complex to the north.

This site is located within the Hummocky Halton Till Plain physiographic region and Reesor Creek Subwatershed, it was a net recharge zone, and it was located on a low-lying land south of Durham Regional Highway 47 with shallow slope from northeast to southwest and southeast. The site is under agricultural cultivation. There is a Key Natural Heritage Feature (woodland) on the eastern portion of the site. The site is also located within the CTC Source Protection Plan Area, and within an area of significant groundwater recharge. Portions of the site are within the TRCA-regulated area for the Duffins Creek Watershed. The Duffins watershed is situated on the south flank of the Oak Ridges Moraine and drains southward towards Lake Ontario.

The material of the site is mainly sandy clay with a medium permeability, except in the east portion, in front of the woodland area, with a low permeability. The subject land is currently vacant, and it was used as farmland, with only three buildings in the north portion, with around 1% TIMP.

There are no waterbodies within the site property, except the proposed dry pond located on the southeast corner which collects stormwater through open ditches and culverts. The site is situated within the Reesor Creek subwatershed and Duffins Creek watershed. In the northwestern corner of the Duffins Creek watershed is the Reesor Creek subwatershed that discharges into the Duffins Creek west river system. Duffins Creek is in the eastern part of Toronto and Region Conservation's (TRCA) jurisdiction. The Duffins Creek watershed has been divided into six subwatersheds (Appendix VII). The headwaters originated in the northern regions of the watershed in the Oak Ridges Moraine where sub-surface drainage predominates.

Figure 2 –Site Location Plan

In the above figure, the proposed developments are displayed which are:
#1: Building (TIMP = 77,861.7 m^2)
#2: Roadway (TIMP = 81,091.9m^2)
#3: Parking lot (TIMP = 16,934.8m^2)
#4: Walkway (TIMP = 9972.6m^2)
#5: Pond (Total area= 6,338.3m^2)

and the proposed pervious areas which are located outside of the new proposed development in each lot, in addition to the woodland area along the eastern strip of the site boundary:

#6: Ditch (Total area= 7952m^2)
#7: Grass (Total area =22,666.1m^2)
#8: Woodland (Total area= 18,422m^2)

2. Site Investigation & In-Situ Permeameter Testing

2.1. Monitoring Wells

Eight (8) boreholes were drilled at the site property by King EPCM (O.Reg 903 License C-7691) in May, June, and July 2023. Detailed borehole drill logs are in Appendix III, while Table 1 below shows the summary. Shallow groundwater has been observed in the boreholes located in the northwest portion of the site, since drilling in May 2023. In general, the soil stratigraphy can be described in Table 3, which confirms the presence of a sandy clay material layer under the topsoil layer.

Table 1 - Borehole Summary

Borehole #	Date	Northing (UTM)	Easting (UTM)	Surface Elev. (masl)	Hole Depth (m)	Screen Elevations (m)	Surface Soil type	Groundwater
101	10-July, 2023	4,875,221	641,617	336.88	6.1	330.34-332.28	Sandy Clay	no
102	6-June, 2023	4,881,934	621,133	337.56	4.6	333-334.45	Sandy Clay	yes
103	7-July, 2023	4,875,173	641,652	334.48	4.6	329.58-331.07	Sandy Clay	no
104	18-May, 2023	4,875,068	641,513	334.67	4.5	330.16-331.66	Sandy Clay	yes
105	25-May, 2023	4,874,952	641,434	329.93	4.5	325.44-326.93	Sandy Clay	no
106	24-May, 2023	4,875,101	641,754	336.04	4.5	331.54-333.03	Sandy Clay	yes
107	30-May, 2023	4,875,218	641,944	332.95	7.6	325.55-326.84	Sandy clay	yes
108	5-June, 2023	4,875,430	641,986	339.34	4.5	334.84-336.34	Clayey sand	no

Table 2 – Water-level measurements(m) in monitoring wells, May to November, 2023

Borehole #	Date				Max GW (mbgl.)
	Drilling day (May-July 2023)	23-Aug., 2023	04-Oct., 2023	07-Nov., 2023	
101	Dry	Dry	Dry	Dry	-
102	333.6	333.76	Dry	Dry	3.8
103	Dry	330.58	Dry	Dry	3.9
104	330.37	331.54	Dry	Dry	3.1
105	Dry	Dry	Dry	Dry	-
106	335.14	334.79	333.79	333.62	0.9
107	327.12	Dry	Dry	Dry	5.8
108	Dry	Dry	Dry	Dry	-

Table 1 - Soil Stratigraphy Summary

	Top Layer	Middle Layer	Bottom Layer
From (m)	0 m	0.35	1.5
To (m)	0.35 m	1.5 – 5.8	4.5 – 7.6
Description	Topsoil	Sandy Clay	Silt
Primary Soil	-	Clay	Silt
Secondary Soil	-	Sand	-
Debris/Others	-	-	-
Cone Penetrometer Test	n/a	700 -1400 kPa resistance with less than 0.5cm of movement @ 1.5 m	700 -1400 kPa resistance with less than 0.5cm of movement @ 3.0 m
Shear Vane Test	n/a	110 - 240 kPa @ 1.5m	130 - 240 kPa @ 3.0m
Comments		BH#108: Clayey Sand (dry) and/or Sand (moist)	BH#108: Clayey Sand mixed with Gravel (moist)
			Perched groundwater at around 0.9 – 5.8 m since drilling

2.2. In-Situ Permeameter Testing

Based on a field visit dated June 16, 2023, "field-saturated" hydraulic conductivity, K_{fs}, was achieved using the "Constant Head Well Permeameter" (CHWP) method. K_{fs101} and K_{fs102} were conducted southeast corner near the natural heritage, near BH107 while K_{fs103} at a central portion near the existing dwelling (near BH106) and K_{fs104} at the southwest corner near the BH105 using ETC both Standard and Slow Soils Pask Permeameter Apparatuses. The "Constant Head Well Permeameter" (CHWP) method was described in Appendix IV in detail.

It is understood that the in-situ infiltration test was not tested at the actual LID bottom but based on sieve size analysis and borehole soil samples, it is in the Engineer's opinion as a geotechnical engineer that the soils perform similarly in hydrological infiltration potential.

The ETC Pask Permeameter is a convenient and easy-to-use apparatus for ponding a constant head of water in a well, and simultaneously measuring the flow into the soil. The K_{fs} was calculated as:

K_{fs101} = 1.4E-6 m/sec= 1.4E-4 cm/sec
K_{fs102} = 2.5E-8 m/sec= 2.5E-6 cm/sec
K_{fs103} = 6.9E-7 m/sec= 6.9E-5 cm/sec
K_{fs104} = 1.4E-6 m/sec= 1.4E-4 cm/sec

Then using the temperature correction factor (for t=18-22$^{°c}$) from the manual:

K_{a101} = 8.4E-7 m/sec= 8.4E-5 cm/sec
K_{a102} = 1.7E-8 m/sec= 1.7E-6 cm/sec
K_{a103} = 4.6E-7 m/sec= 4.6E-5 cm/sec
K_{a104} = 8.4E-7 m/sec= 8.4E-5 cm/sec

Correlations between Perc Time (PT) and field-saturated hydraulic conductivity (K_{fs}) are often used in the development of on-site water recycling and treatment facilities that operate by infiltration into unsaturated soil. Based on OMMAH (1997) interpolation, the measured infiltration rate may be interpolated as:

PT_{101} = 13.6 min / cm (Infiltration Rate = 44.1 mm/hour)

PT_{102} = 38.7 min / cm (Infiltration Rate = 15.5 mm/hour)

PT_{103} = 16 min / cm (Infiltration Rate = 37.6 mm/hour)

PT_{104} = 13.6 min / cm (Infiltration Rate = 44.1 mm/hour)

The engineer's opinion is to trust the values obtained from the OMMAH (1997), with an averaged unfactored infiltration rate = 42 mm/hour for entire the site area with clayey sand material while an unfactored infiltration rate = 15.5 mm/hour for the eastern portion, west of the natural heritage area with sandy clay material.

For a conservative approach to infiltration speeds, the Wisconsin Department of Natural Resources (2004) method shall be used for the calculation of a factored design infiltration rate and the Engineer's opinion is that the factored engineering design infiltration rate is 6.2 – 16.8 mm/hour, with a safety factor of 2.5. See Appendix IV for more details, the calculations, and the graphs provided.

3. Pre-development site conditions

The site conditions prior to development can be broken down into several groups of information:

3.1. Topographic Elevation & Base Precipitation

- This site is located within the Hummocky Halton Till Plain physiographic region and Reesor Creek Subwatershed, it was a net recharge zone, with a shallow slope from northeast to southwest and southeast at a 2 - 4% gradient.

- The subject site municipally described as 123 Regional Highway 47 is partially within the TRCA Regulated Area of the Duffins Creek watershed. This site is also regulated with respect to the Duffins Creek Valley corridor which encroaches onto the site from the east.
- Site survey & topographic information in Appendix I, Grading & Servicing Plans in Appendix II
- Average annual precipitation reported 844mm by Clarifica (May 2002) based on four stations' climate data (1986-2000, Table 2, Page 34), however, the TRSPA Water balance Tool reported 868mm for this site, probably based on the nearest station located in the southwest of the site, Stouffville WPCP #6158084 (Appendix V). The annual rainfall and snowfall were also 702 and 142 mm, respectively. The first data reference was in "Duffins Creek Watershed, Hydrogeology and Assessment of Land Use Change on the Groundwater Flow System" used in this study.
- Based on the TRSPA Water Balance Tool, precipitation, evapotranspiration, runoff, and recharge are 868, 539, 194, and 344 mm/year for this site, respectively (Appendix V).
- The site is within the Duffins Creek Watershed, with Sandy Clay Hydrologic Soil Group B/D.
- The subject development area is located in a "Significant Groundwater Recharge Area" and within the WHPA Q1/Q2 area.
- In the northwestern corner of the Duffins Creek watershed is the Reesor Creek Subwatershed that discharges into the Duffins Creek west river system. Duffins Creek is in the eastern part of Toronto and Region Conservation's (TRCA) jurisdiction.
- Duffins Creek is one of the healthiest watersheds along the north shore of Lake Ontario, drains an area of 283 square kilometers, and is one of the most comprehensively studied watersheds in Canada. While a major part of the watershed is in the Regional Municipality of Durham, smaller portions fall within the Regional Municipality of York.

3.2. Vegetation & Evapotranspiration

- The site soil is mostly sandy clay, The Hydrologic Soil Group should be B/D.
- The site property is considered triangular in shape and is located on low-lying land south of Durham Regional Highway 47. The eastern portion of the subject property is situated near the valley land corridor of a tributary of Reesor Creek along with woodland and unevaluated wetland features. The site was used as farmland, with only three buildings in the north portion, with around 1% TIMP.
- The site has some scattered trees along all boundaries while there is a woodlot along the east property boundary.
- 20.8 ha / 86% of the site was cultivated land.
- Averaged site evapotranspiration was reported at 479 – 489 mm/year (Clarificia, data period: 1986-2000) and 539 mm/year (TRSPA, data period: 1983-2013) (Appendix V)

3.3.Precipitation Surplus (Recharge + Runoff)

- Net surplus (precipitation surplus) = 844 - 479 = 365 mm/year for cultivated & grass area
- Net surplus (precipitation surplus) = 844 - 489 = 355 mm/year for woodland area
- Recharge for pervious area based on MOEE Hydrogeological Tech Info, 1995, Table 2: Infiltration factors.
  - Topography = 0.2 (Rolling land) and 0.3 (Flat land)
  - Soil (Medium combinations of clay and loam) = 0.2
  - Cover = 0.1 (cultivated lands) and 0.2 (woodland)
  - MOE infiltration factor = 0.6 for both woodland and cultivated area
  - Recharge rate for cultivated and grass areas would be 0.3*365=109.5 mm/year
  - Recharge rate for woodland area would be 0.3*355=106.5 mm/year
- Storm runoff from the grass and cultivated area = 365 –109.5 = 255.5 mm/year
- Storm runoff from the woodland area = 355 –106.5 = 248.5 mm/year
- Total area-weighted average storm runoff = 151mm/year
- Total area-weighted average recharge = 216mm/year
- Total area-weighted average precipitation surplus (recharge + runoff) = 367mm/year.

3.4.Stormwater Run-off

- There are no city-maintained stormwater sewers, with stormwater generally collected by the north roadside ditch of Hwy 47 or flowing towards the southeast and southwest directions to the low-lying area into the neighbors, then directed into the existing creeks.
- The existing drainage conditions are based on the natural contours and land uses of the site. The subject site exhibits relatively gentle rolling topography. There is an existing highpoint in the northeast corner and western central portion of the site with approximately 82% of the site draining towards the eastern boundary and 18% of the site draining towards the southwest corner of the site.
- (towards an existing watercourse) in the pre-development condition.
- All minor and major storm site drainage is to be collected on-site. While there is no storm sewer system, all runoff is conveyed by a roadside ditch at the front of each lot. This facility then discharged to the SWM dry pond which is connected to a tributary of Reesor Creek and flows south to the Lake of Ontario.
- All stormwater in roadside ditches is generally infiltrated or moved downstream. The historical well records and eight new monitoring boreholes drilled by the Engineer in the entire site, confirm that the groundwater level in this property is low (Table 2 above), while there was shallow groundwater in BH # 106 during drilling in May, located in the middle of the site.
- Based on an in-situ infiltration test using ETC Pask Permeameter Apparatus, the average infiltration rate is 14.4 min/cm = 0.694 mm/min = 42mm/hour, except a small portion of the

eastern strip, in front of the woodland area with a lower infiltration rate = 38.7 min/cm = 0.258 mm/min = 15.5mm/hour.

- Native permeable infiltration rate should use a non-factored infiltration rate of 42 mm/hour because the predominant soil material of this site is composed of sandy clay (CL) to a depth of more than 3 meters and a factored engineering design infiltration rate of 16.8 mm/hour with a safety factor of 2.5 for pond and septic.
- Based on the Township of Uxbridge requirements, the Regional Storm is the Timmins Storm event, with data from Design Criteria Standard Drawings of Township of Uxbridge, with A, B, C values of 3-parameter Chicago distribution design storm as Intensity = a / $(t+b)^c$.
- See Table 4: Chicago Distribution Design Storm Parameters and Rainfall Amounts cited in the "Design Criteria Standard Drawings", Township of Uxbridge (Drawing No. US-600, March 1989) (Appendix VI).

Table 4 - Township of Uxbridge Chicago Distribution Storm Parameters and IDF values

Return Period	2 Year	5 Year	10 Year	25 Year	100 Year
A	645	904	1065	1234	1799
B	5	5	5	4	5
C	0.786	0.788	0.788	0.787	0.810

	Return Period (year)					
IDF Parameters	2	5	10	25	50	100
a	645	904	1065	1234	1540	1799
b	5	5	5	4	4.5	5
c	0.786	0.788	0.788	0.787	0.8	0.81
Duration						
5 min	105.57	147.29	173.52	218.94	254.30	278.63
10 min	76.76	107.01	126.06	154.64	181.31	200.63
15 min	61.23	85.30	100.49	121.60	143.05	158.93
30 min	39.44	54.88	64.66	76.92	90.63	101.00
1 hr	24.24	33.70	39.70	46.76	54.94	61.17
2 hr	14.50	20.13	23.71	27.78	32.46	36.02
4 hr	8.54	11.84	13.95	16.31	18.92	20.88
6 hr	6.25	8.65	10.19	11.90	13.75	15.12
12 hr	3.64	5.04	5.93	6.93	7.93	8.67
24 hr	2.12	2.93	3.45	4.02	4.57	4.96

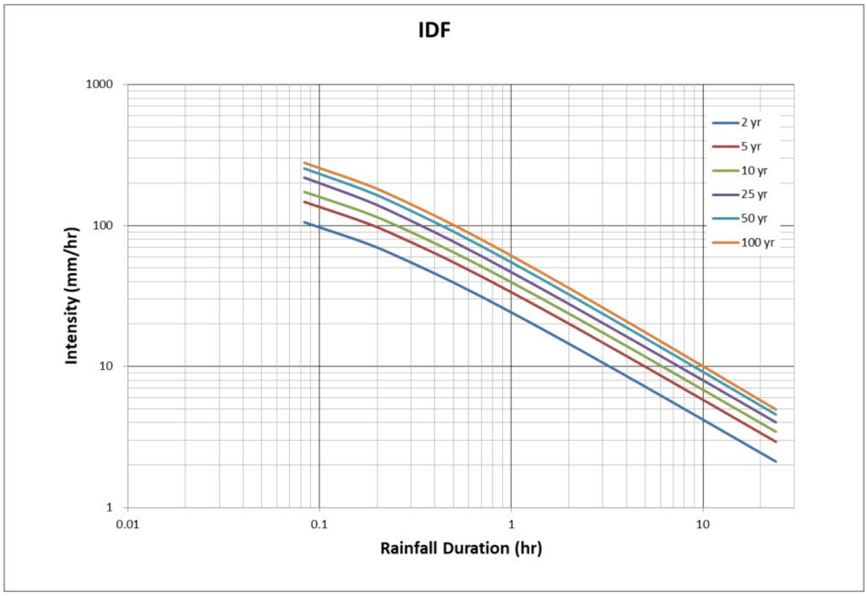

Figure 3- Intensity-Frequency-Duration (IDF) Curves calculated from Table 4 above

As discussed above, the site is in the TRCA's Duffin's Creek Watershed. As such, it must adhere to the quantity control release rates specified in the TRCA's SWM Criteria.

According to some Technical Guidelines for Stormwater Management calculations, two methods are generally used to derive synthetic design storms. One method develops the storm hyetograph from the IDF curve or using uniform rainfall methods, named the Chicago design storm (Keifer and Chu, 1957) or the modified Rational Method. The second method develops the synthetic design storm from an analysis of historic storm events and produces rainfall distribution instead of a certain amount for peak discharge. Examples of this type of historical analysis included the methods applying the U.S. Natural Resource Conservation Service formerly Soil Conservation Service (SCS) design storm, and the Canadian Atmospheric Environment Service (AES) design storm.

The modified rational method may be used for simple hydrology and for storage calculations. This method is based on a simple empirical formula used to determine flow that results from a rainfall of specific intensity applied to an area based on an average catchment land use condition.

- Pre-development 1 in 2 years, 1 in 5 years, 1 in 10 years, 1 in 25 years, 1 in 50 years, and the 1 in 100-year design storm events, peak flow conditions are calculated as follows:
- Peak flow rate Modified Rational Formula: Qp = (0.001/3600) * A * C * Ca * i
    - A = Total area = 24,1 ha (4.38 ha WEST catchment and 19.74 ha EAST catchment)
    - C = Runoff coefficient = 0.54 (WEST) and 0.51 (EAST), See Appendix X for details.
    - Ca = Antecedent Precipitation Factor = 1.0 for 2, 5 and 10 years, 1.10 for 25 years, 1.20 for 50 years, and 1.25 for 100 years.

- i = average rainfall intensity in mm/hour (4, 12 & 24 hours IDF for Uxbridge, Table 4 above)
- Detailed calculations are contained within the attached Excel Spreadsheet.

- Time of Concentration:
  - Bransby Williams Method if $C > 0.4$, $S_w = 3\%$, $L = 472$ m, $A = 4.37$ ha*, C = 0.54: ***Tc* = 18.6 min (WEST Catchment)**
  - Bransby Williams Method if $C > 0.4$, $S_w = 1\%$, $L = 740$ m, $A = 19.74$ ha*, C = 0.51: ***Tc* = 31.3 min (EAST Catchment)**

Table 5– Flow Rate Calculations using Modified Rational Method

(Pre-Development Scenario)

Parameter		Design Storm					
		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Intensity (mm/hr)		53.76	74.87	88.21	106.08	124.92	138.99
Total Runoff Qp (cms)	WEST Catchment	0.4	0.5	0.6	0.8	1.0	1.1
	EAST Catchment	1.50	2.09	2.47	3.26	4.19	4.86

4. Stormwater Management Plan

The SWM plan has been prepared in accordance with the MOE Stormwater Management Planning and Design Manual, and TRCA Stormwater Technical Guidelines as detailed in Section 11. The SWM plan is subject to review and approval by the Township, TRCA, and is presented in the following sections.

4.1.Design Criteria

The following design criteria are to be satisfied in the proposed SWM plan:

- The stormwater management plan must maintain existing stormwater runoff rates at the site outlet by restricting post-development peak flow rates to pre-development levels for the 1:2-year through 1:100-year design storms;
- The stormwater management plan must provide quantity control storage for storm events up to and including a 1:100-year design storm in addition to the 25mm storm runoff volume;
- Safe conveyance of the 2-year to 100-year peak flows through the site to the downstream drainage system must be provided for surface runoff generated within the development;
- Storage requirements for a dry pond (extended detention) for quality treatment following Table 3.2 in "Stormwater Management Planning and Design Manual" (MOECP, 2003); and

- Protect life and property from flooding and erosion.

4.2.Stormwater Management Strategy

The proposed stormwater management strategy comprises a "treatment train" approach utilizing a combination of lot level controls and Low Impact Development (LID) measures to minimize potential increases in the volume of runoff and provide, as far as practical, a natural hydrologic response. Measures are proposed to be undertaken at the source, conveyance, and end of pipe locations, and are as follows:

- recharge of rooftop stormwater by direction to grassed and naturalized areas to promote filtering and natural infiltration;
- by lot grading, as far as practical, the direction of structure envelope drainage, via sheet flow, towards grassed and naturalized areas versus the road right of way;
- as far as practical, application of grassed swales for road drainage versus a piped storm sewer system;
- use of an oil/grit separator for each outfall; and
- use of a dry pond to temporarily detain and slowly release stormwater to meet applicable stormwater management criteria.

The use of grassed swales versus a piped storm sewer system is proposed to encourage passive infiltration of stormwater, provide linear storage in the conveyance system to dampen hydrologic response, and provide pre-treatment of stormwater prior to discharge to the proposed pond.

4.3.Proposed SWM Plan

The Client has proposed to construct a 14-lot industrial subdivision and a new drive aisle. Since the runoff coefficients for post-dev of 0.78 (WEST) and 0.78 (EAST) are greater than the pre-dev runoff coefficients of 0.54 (WEST) and 0.51 (EAST), we need SWM control measures of BOTH peak flow rates as well as total volume discharged. A proposed Drainage Plan illustrating the proposed drainage conditions for the development is enclosed in Appendix IX.

Based on the high seasonal groundwater table observed during the snowmelt season, April to June, the Engineer proposes that rooftop downspouts are directed to the grassy lawn area surrounding the building OR to catchbasins on each lot and direct to the roadside ditch. On the other hand, the impervious pavements (parking lot, walkway, and driveway within each lot) be captured by asphalt directly and then directed to the roadside ditch, in front of each lot, and conveyed downstream into the proposed dry pond. It is recommended that separate Oil/Grit Separators (OGS) units be installed in each lot to treat the pollutant-generating areas, such as the roadways, driveways, parking spaces, etc.

A 180 mm diameter orifice pipe along with a quantity control weir (L=1.8m) is proposed to reduce the 2 through 100-year post-development peak flows to pre-development values. In case of blockage to the outlet structures, a 12 m wide overflow spillway (crest elevation = 330.70m) is proposed at the northeast embankment to safely convey the peak flow rate from a 100-year event, which is greater than the peak flow rate from the regional storm. The top of the berm of the pond is set at 331.20m, providing 0.50 m of freeboard above the 100-year storm elevation. Riprap will be placed at both the inlet and outlet locations to prevent erosion. The following Table 6 contains a summary of the outflow from the pond and the associated storage volume and water level above the orifice and weir controls. The pond will outlet northeast towards the existing creek located in the neighboring property.

The WEST catchment (Lot 1) in the southwest corner will discharge uncontrolled towards the west to be intercepted by a swale which discharges to the existing creek.

Below is a summary of the proposed site conditions:

- Total site surface area = 24.1 ha
- Total pervious surface area (landscape) = 4.9 ha (20%)
- Total impervious surface area (TIMP) = 19.2 ha (80%)
    - 77,862m^2 – new buildings
    - 98,027m^2 – new roadways and Parking Lot
    - 9973m^2 – new walkway
- The rooftop downspouts either discharge onto the landscaped (grass) area and then overflow onto the roadside ditch and direct to the pond through a culvert or connect to the catchbasins on each lot and direct to the roadside ditch.
- The parking lot and driveway runoffs are captured by on-site catchbasins located within the lots and discharged to the proposed roadside ditch through an OGS unit in each lot for pre-treatment purposes. Then it will be directed to the SWM dry pond through a pipe culvert, located in the easement of Lots 13 and 14.
- Post-development peak flow conditions are calculated as follows:
- Peak flow rate Modified Rational Formula: Qp = (0.001/3600) * A * C * Ca * i
    - A = Total area = 24.1 ha
    - A_{west} = West catchment area (uncontrolled) in m^2 = 4.37 ha
    - A_{east} = East catchment area (controlled) = 19.76 ha
    - C = runoff coefficients = 0.78 for both uncontrolled and controlled catchment areas. See Appendix X for more details.
    - Ca = Antecedent Precipitation Factor = 1.0 for 2, 5, and 10 years, 1.10 for 25 years, 1.20 for 50 years, and 1.25 for 100 years.
    - i = average rainfall intensity in mm/hour using the Township's Rational Method with A, B, and C values of the 3-parameters design storm.

- Time of Concentration:
    - Bransby Williams Method if $C > 0.4$, $S_w = 2\%$, $L = 345$ m, $A = 4.37$ ha, C = 0.78: ***Tc* = 14.8 min (WEST Catchment or Lot # 1)**
    - Bransby Williams Method if $C > 0.4$, $S_w = 1 - 2\%$, L = Variable, $A = 0.59 – 2.1$ ha, C = 0.84 – 0.93: ***Tc* < 10 min (EASTERN Lots # 2 - 14)** ⟹ **(Tc_{min} = 10 min)**

- Bransby Williams Method if $C > 0.4$, $S_w = 2\%$, $L = 399$ m, $A = 2.22$ ha, C = 0.67:
  ***Tc* = 18.3 min (Roadway Catchment)**

- Airport Method if $C < 0.4$, $S_w = 1.5\%$, $L = 468$ m, $A = 4.2$ ha, C = 0.23:
  ***Tc* = 47.5 min (Pond Catchment)**

- See Table 6: Post-development peak flows for the 1:2-year through 1:100-year design storms based on the Township's Rational Method along with appropriate pre-development peaks flow for each sub-catchment (lot). The Modified Rational Method calculations are included in Appendix XI for reference.

Table 6 – Proposed peak flows based on the Modified Rational Method

Design Storm	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Intensity for post-development (mm/hr) (*UNCONTROLLED*)	61.8	86.1	101.4	122.8	144.5	160.5
Post-Development Peak Flows (cms) (*UNCONTROLLED*)	0.6 (*0.4*)	0.8 (*0.5*)	1.0 (*0.6*)	1.3 (*0.8*)	1.6 (*1.0*)	1.9 (*1.1*)
Intensity for post-development (*CONTROLLED*) (mm/hr)	76.8	107.0	126.1	154.6	181.3	200.6
Post-Development Peak Flows (cms) (*CONTROLLED*)	3.3 (*1.50*)	4.6 (*2.09*)	5.4 (*2.47*)	7.3 (*3.26*)	9.3 (*4.19*)	10.7 (*4.86*)
Total Post-Development Peak Flows (cms) (Before Mitigation)	3.9 (*1.86*)	5.4 (*2.59*)	6.4 (*3.05*)	8.6 (*4.03*)	10.9 (*5.18*)	12.6 (*6.0*)
Allowable Post-Development Peak Flows (cms)	**1.27**	**1.77**	**2.09**	**2.75**	**3.54**	**4.10**

Note: (*0.4*) denotes pre-development peak flow.
* Allowable Peak Flow = Total Pre-dev. Peak flow – Uncontrolled Post-dev. Peak Flow

Table 7 – SWM Dry Pond Release Rates and Water Levels

Return Period (year)	2	5	10	25	50	100
Peak Flow (l/s)	70.0	209.0	339.0	664.2	1169.7	1582.0
Storage Volume (m^3)	4321.4	4743.4	5025.3	5611.4	6379.4	6950.0
Water Elevation (m)	329.73	329.83	329.90	330.04	330.21	330.32

The existing property is currently vacant (farmland) and is not serviced by any storm sewer or stormwater management facilities. Due to the high groundwater table in this site, the proposed stormwater facility consists of a dry pond and a multiple outlet structure (orifice + weir + emergency spillway) located northeast corner. All outlets will be discharged into a swale which will be established towards the existing creek on the adjacent property to the east and join the Reesor Creek.

See Appendix II & XII for detailed design information and SWM flowchart (Figure 4 below).

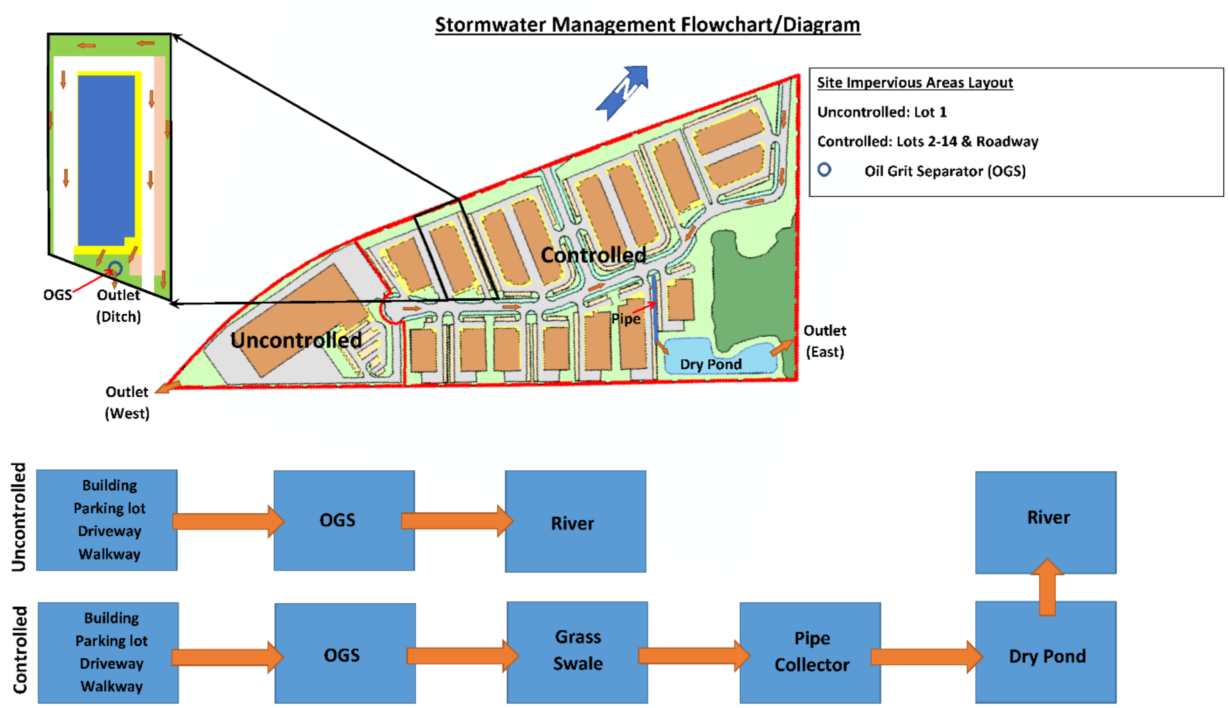

Figure 4- Stormwater Management Flowchart/Diagram

4.4. Dry Pond (LID)

An L-shaped dry pond will be constructed in the southeast corner of the site that intercepts runoff from impervious areas (LID). Dry detention ponds or "detention basins", are stormwater basins designed to capture, temporarily hold, and gradually release a volume of stormwater runoff to attenuate and delay stormwater runoff peaks. Dry detention basins are relatively easy to construct, require low maintenance, and may also provide for recreational activities during dry periods.

Runoff captured by rooftops discharges either onto the grassy lawn area or proposed catchbasins on each lot and then directs to the roadside ditch to convey to the SWM pond. The parking lot and driveway runoff are captured by catchbasins and discharged to the roadside ditch through an OGS unit and storm sewer system. The roadside ditches direct to the SWM pond through an underground STM pipe. Using this type of LID, both water quantity control and water quality control criteria are achieved. LID is designed to receive 1:5-year to 1:100-year storms using the Township of Uxbridge IDF curve values. See Appendices IX to XI for more details.

- Dimensions: 3.0 m depth, 43.4 – 51.2 m top width, 18.3 – 26.9 m bottom width, 161.2 m top length & 136.3 m bottom length.
- Pond bottom elevation (m) = 328.2
- Factored engineering infiltrate rate of 16.8 mm/hour (with FS=2.5)
- Detailed diagrams and design maps are shown in Appendices II & XII
- Based on a recent field visit by the Engineer and geotechnical investigation through Borehole # 107 at the pond location, it can be concluded that the bottom of the pond (El. = 328.2m) is located far enough from the maximum seasonal groundwater level (min 1.0 m).
- The total pond height is 250 cm plus a 50 cm freeboard from the crest.
- The post-development runoff is attenuated to the allowable release rate with a quality control orifice (Ø = 180mm) along with a quantity control weir (L=1.8m).
- Using the falling head orifice equation, the 25 mm storm volume control target above the orifice control plate (**V=2115m^3**) is released over a period of 24 hours, which satisfies the minimum drawdown time as per the MECP Guidelines. The remaining volume (**V=1830m^3**) between the orifice outlet and the pond bottom (328.2 – 329.0 m) will be infiltrated into the ground over a period of 48 hours, as per the factored engineering design infiltration rate of 16.8 mm/hour.
- Outflows from the dry pond would be conveyed through approximately 75 m of sheet flow prior to discharge towards the existing tributary.
- The pond facility will have an emergency spillway (L=12m) located above the high year water level to manage overflows in the event that all outlet structures are blocked. The spillway will be suitably protected and landscaped to prevent erosion and could be integrated into a restoration design. The emergency flow capacity is the greater of the Regional Storm or 100-year flow in the event of a blockage of the primary outlets (~9.4 cms).
- Riprap is to be placed at the bottom of the inlet slope for erosion and scour protection and surrounding the outlet structure to capture any remaining sediments that are not captured by the pond or swale (Appendix XI).

See Appendix XII for a detailed SWM flowchart, and Appendix XI for Stormwater Management Calculations and LID sizing design information.

4.5.Grass Swale for Conveyance (LID)

Swales are one of several LIDs for the treatment of stormwater runoff from project areas that are anticipated to produce pollutants of concern (e.g., roadways). Grass swales are vegetated, typically trapezoidal channels, which receive and convey stormwater flows while meeting water quality criteria and other flow criteria.

- Flatbed swales along both sides of new roadways are sized to convey minor and major flows (1:5 to 1:100 years) using Uxbridge's IDF curve values.
- Swales are designed at 0.7 m depth, 0.8 m bottom width at 3H:1V sloped sides, cross-sectional area of 2.03 m^2.
- Swales grade at roughly 0.5-1.2%, and it is recommended to plant grass and forb in the channel bed and banks to retain their long-term shape. See Appendix XI for swale design information.
- Swales collect stormwater from all impermeable municipal roadways as well as stormwater overflow from each lot in the Eastern Catchment.

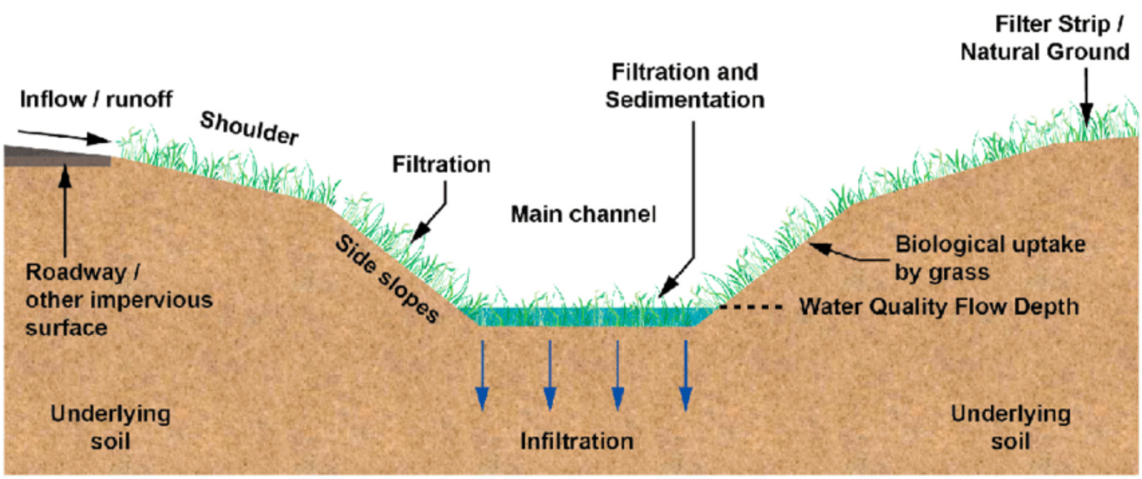

Figure 5- Sample Grass Swale Section

5. Water Quantity

5.1.Peak flow

Stormwater runoff peak flow discharges must be controlled to the pre-development levels for the 2-to-100-year design storms for the Subdivision Plan area in accordance with the TRCA's criteria for peak flow control and the guidelines of the Ministry of Environment Stormwater Management Planning and Design Manual, March 2003.

Prior to development, the property was considered farmland with three buildings in the north portion along with a small portion of natural heritage containing trees and grassy lawn along the east boundary (1.8ha), with a Total Impervious Surface Area of 1%. The property is grading 2 - 4% towards the southwest and southeast, with sandy clay-primary soil having medium infiltration rates.

Post-development has a TIMP = 80% and combined with the proposed construction of a dry pond LID, there does not expect to be any changes in peak runoff flow rates or total volumes. With the proposed pond for all rooftop downspouts, captured runoff from parking lots, sidewalks & driveway, total peak flow control is achieved through precipitation volume storage using LID (pond) storage.

Stormwater quantity control will be provided on-site via an SWM dry pond storage. The dry pond has been sized to ensure the volume generated by the 100-year storm event is captured and released at the 2-year pre-development flow rate or less. Calculations in Appendix XI demonstrate that 6950 m^3 is required to control the 100-year storm event to pre-development values while the proposed dry pond provides a total of 8906 m^3 quantity storage below the emergency spillway.

An engineered (orifice + Weir + spillway) outlet has been designed at the outlet of the storage system to control peak flows from the site to pre-development levels for the 1:2-year through 1:100-year design storms. The pond storage system with a footprint of approximately 5508 m^2 (6340 m^2 with FB) will provide 8906 m^3 of total volume capacity @ 2.5m depth, which is sufficient to provide quantity control for the 1:2-year through 1:100-year design storms.

The proposed primary outlet from the pond consists of a 300mm reverse slope pipe along with a 180 mm diameter orifice plate that outlets to an outflow control manhole (Ø = 2400mm). In the event of an obstruction to the primary outlet, an overflow weir (1.8m crest length) has been included in the outlet structure. The outflow manhole structure equipped with a 1500 mm diameter storm pipe @ 1% slope to discharge via a trapezoidal swale towards Reesor Creek. A 3.0 m wide access road will provide access to the inlet and outlet structures for maintenance purposes.

Post-development peak flows for each catchment are calculated above using the Modified Rational Method (Table 6). The calculations are included in Appendix XI. Detailed stage-storage-discharge calculations are along with the pond sizing calculations also included in Appendix XI for reference.

5.2. Volume control

In Table 8 the total runoff volume control target for post development scenario (25mm storm event) and volume capacity of the proposed LID are shown. As can be seen, the total volume of stormwater runoff produced due to a 25 mm rainfall event from the total impervious area of the study site is 4805 m^3, which is less than the storage capacity intended for storm runoff at the site 8906 m^3. The below table shows that runoff volume reduction is met, and the post-construction runoff volume shall be captured and retained on the site from a 25 mm rainfall event from the total impervious area. See Appendix II & XII for detailed design information.

Table 8 – Runoff volume control target (25 mm) and values provided by post-development design (m^3/s)

Parameter	Building	Parking lot	Walkway	Driveway	Pond	Total
TIMP Area (m^2)	77,862	16,935	9973	81,092	6338	192,200
25 mm runoff volume control (m^3)	1946.5	423.4	249.3	2027.3	158.5	4805

- **Active volume capacity through dry pond @ max. depth of 2.5 m ~ 8906m^3 versus a site-wide volume control target of 4805m^3.**

5.3.Major-minor system conveyance

This site is classified as a medium infiltration area due to the presence of sandy clay soil in most part of the developed area, 42mm/hr unfactored infiltration rate, except at the eastern portion, in front of the woodland area.

The proposed development shall control both minor (i.e., 76.7mm/hr precipitation in 2yr storm event) and major (i.e., 200.6mm/hr precipitation in 100yr storm event) flows to the downstream creeks. The proposed subdivision is considered to be a commercial/industrial development with a calculated percentage of impervious area of 80 % for the area draining to the pond. This impervious area includes all anticipated hardened surfaces, such as driveways, roads, walkways, and rooftops.

On-site catchbasin spacing is to provide sufficient inlet capacity to collect the entire minor flow within each lot, if required, into the underground pipe system which is also designed to collect and convey runoff from 5-year storm events. On the other hand, the proposed roadside swales along with the dry stormwater management pond located in the southeast corner will be sized for 100-year storms to collect both minor and major flows. The majority of the site (EAST Catchment = 82%) will be graded in order to drain to the southeast portion of the site, except the western corner (WEST Catchment or Lot 1 = 18%).

The major system conveyance is for flows between 5- and 100-year storm events and is the same for pre-development and post-development, generally flowing towards southeast for the controlled catchment (EAST) and southwest for the uncontrolled catchment (WEST). The major storm events from the development's contributing drainage area (EAST Catchment) will be conveyed along the roadways to the stormwater pond through the proposed conveyance swales. The maximum overland flow depth or static ponding for roads shall not exceed 9 cm above the roadsides and no ponding above the crown of the roads (See Appendix XI for more details).

When pond storage is completed, the overflow is discharged to the existing creek through a trapezoidal swale at the southeast, northeast of the pond.

Overland routes on the western and northern sections of the site which are undisturbed are expected to follow the pre-grading and flowing towards the existing ditch.

5.4.Regulatory storm conveyance

The site property is serviced by a roadside ditch plus two different creeks along the eastern and western property boundaries, and at the same time, the north portion of the property along Highway 47 is also locally elevated. There are no streams or regulatory storm conveyance on the site property, with neighbors to the south and east being lower than the proposed site plan.

Since the pond has an emergency wide spillway with a 12-meter bottom crest, there is no possibility of clogging like the orifice control structure. Furthermore, a riprap-lined spillway between the pipe collector inlet and pond berm will be provided to convey drainage where the capacity of the pipe is exceeded or the inlet structure becomes blocked.

In general, the northern roadside ditch between Highway 47 and the subject property is not disturbed, and stormwater from the subject property DOES NOT enter into this ditch, except a narrow strip of the northern property boundary, which has a natural slope towards the ditch.

There are no external drainage areas flowing through the site property.

6. Water Quality

6.1. Total Suspended solids

TRCA requires that the development area provide an Enhanced Level of Protection or a long-term average removal of 80% of TSS on an average annual basis. Water quality treatment methods must conform to provincial standards as defined by the MOE's Stormwater Management Planning and Design Manual (MOE, 2003).

Within this site, the proposed roof area is not prone to sediment generation and may be considered clean for the purposes of water quality control. However, stormwater runoff from the driveway and parking area will require water quality treatment to an 80% TSS removal standard, as per the TRCA criteria. This will be accomplished mainly through the installation of oil-grit separator (OGS) units at each discharge point for 14 proposed lots.

Post-development contaminates generated in an industrial estate land-use setting would be captured by an OGS unit at each discharge point for 13 lots (East Catchment) and then go to the grass swale to convey to the proposed dry pond. Each OGS will be sized based on its contributing catchment/lot area and the overall imperviousness of the lot. For the West Catchment (Lot 1), treatment will be done mainly through the installation of two separate oil-grit separators (OGS) units for the northern and southern half of the lot and then discharge into the existing creek.

Based on MOE 2003 SWM PDM Table 3.2, Basic 60% S.S. Removal by the dry pond (continuous flow) requires $200m^3$/Ha or $240m^3$/Ha for 70% or 85% levels of imperviousness, respectively. With TIMP equal to 80% for controlled catchment (EAST), required storage volumes may be obtained by <u>interpolating the values provided in Table 3.2, which is about $227m^3$/Ha</u>. Therefore, the minimum storage volume required is $4472m^3$ in this project, for a 19.7 ha development in the controlled catchment area (EAST) while the proposed site property has a total storage volume of more than 9000 m^3 with a proposed SWM dry pond.

In this project, the Stormceptor Model EFO6 to EFO12 will be sized for TSS removal using the Environment Technology Verification (ETV) Canada particle size distribution. Sizing information for the OGS unit for each lot is available in Appendix XIV. Quality control for the EAST Catchment Lots (2-14) is to be provided by a treatment train approach using the combined treatment from one proposed oil/grit separator (OGS) unit, the grass swale, and the dry pond facility. The proposed OGS is to provide 61.7% averaged TSS removal on eastern lots and the dry pond and grass swale are to provide 60% TSS removal, resulting in an overall treatment of more than 80% TSS removal for the Eastern SWM facility. The TSS removal efficiency for Western Lot 1 would be 57% based on the proposed OGS unit.

See the SWM & Servicing plan in Appendix II to find the marked locations of proposed OGSs.

Total developed area draining to dry pond for quality control = 13.33 ha (Lots # 2 – 14) + 2.22 ha (Roadway) while 19% of non-treated runoff volume captured by the WEST catchment (Lot 1 = 4.37 ha) would be discharged to the western creek/ditch through the OGS units. Thus, the average efficiency would be:

1# WEST Catchment: Lot # 1 (= 4.37 ha)

Initial TSS Load = 1.0
TSS Load Removed by OGS Unit (EFO12)= 1.0 X 57% Removal Rate = 0.57
Final TSS Load Downstream of OGS Unit which drained to downstream creek = 1.0 – 0.57= 0.43
TSS Removal Rate for 19% of Runoff Volume = 1.0 – 0.43 = 0.57 or 57%

2# EAST Catchment: Lots # 2 - 14 (= 13.33 ha)

Initial TSS Load = 1.0
TSS Load Removed by OGS (EFO6, EFO8, EFO10) = 1.0 X 61.7% Removal Rate = 0.617
Remaining TSS Load Downstream of OGS = 1.0 – 0.617 = 0.383
TSS Load Removed by Grass Swale = 0.383 X 60% Removal Rate = 0.23
Remaining TSS Load Downstream of Grass Swale = 0.383 – 0.23 = 0.153
TSS Load Removed by Dry Pond (LID) = 0.153 X 60% Removal Rate = 0.0918
Final TSS Load Downstream of Pond which drained to downstream creek = 0.153 – 0.0918= 0.0612
TSS Removal Rate for 71.3% of Runoff Volume = 1.0 – 0.0612 = 0.94 or 94%

3# EAST Catchment: Roadway (= 2.22 ha)

Initial TSS Load = 1.0
TSS Load Removed by Grass Swale = 1.0 X 60% Removal Rate = 0.60
Remaining TSS Load Downstream of Grass Swale = 1.0 – 0.60 = 0.40
TSS Load Removed by Dry Pond = 0.40 X 60% Removal Rate = 0.24
Final TSS Load Downstream of Dry Pond which drained to downstream creek = 0.40 – 0.24= 0.16
TSS Removal Rate for 7.2% of Runoff Volume = 1.0 – 0.16 = 0.84 or 84%

Finally,

$$\text{The averaged area TSS removal rate} = \frac{(4.37\,ha \times 57\%\text{ efficiency}) + (13.33\,ha \times 94\%\text{ efficiency}) + (2.22\,ha \times 84\%\text{ efficiency})}{(4.37 + 13.33 + 2.22)\,ha}$$

The averaged area TSS removal rate = 0.85 or 85%

The OGS units combined with the SWM dry pond and grass swale will treat the post-development flows to the required MOE quality standard, with a TSS removal rate of approximately 85%.

6.2. Winter salt

Post-development winter salt use is anticipated to be higher than pre-development. This is primarily a concern for the roadways. Design practices that help reduce winter salt use include:

- Minimal trees are considered for landscaping near driveways, to reduce winter shading,
- All driveways are graded up towards building entrances, preventing ice build-up at entrances,
- Recommend the client to use sand & gravel for traction instead of salt.

7. Water Balance

This site is in a TRCA Significant Groundwater Recharge Area with a score of 2 with no policies associated with this area. Further, the site is also located within the wellhead protection area Q1 and Q2* with a stress rating of moderate which means if additional water taking is required then recharge will be needed to offset any recharge loss.

*Note: WHPA Q1- Refers to the area where activities that take water without returning it to the same source may be a threat, while WHPA Q2- refers to the area where activities that reduce recharge may be a threat.

Based on Duffin Creek Watershed Climate Data, precipitation is 844mm/year, and the averaged evapotranspiration rate is 484mm/year which is mostly intensive agriculture, and TRCA natural heritage in hydrologic soil group B/D, 479 and 489mm/year, respectively (Appendix V).

Pre-development site conditions have low groundwater infiltration/recharge, as the site is predominantly sandy clay soil with slopes <2 - 4% grade and therefore a small portion of the runoff flows into the downstream creek through the sheet flow. On a 24.1Ha with 1% TIMP, there is an estimated 52,059 m^3 of groundwater recharge per year. Runoff is 151mm/year = 36,464 m^3/yr.

As seen in Table 9 below, pre-development conditions are discussed in detail in Section 3. The site is within the Reesor Creek Subwatershed, part of Duffin Creek Watershed, with Sandy Clay Hydrologic Soil Group B/D, with 1% TIMP.

The proposed post-development TIMP = 18.6Ha / 80%, and without any LID treatments, the site recharge is estimated at an equivalent of 53mm/year for the site, or 12,671m^3 (76% decrease as compared to pre-development).

Table 9 –Water Balance Summary

Characterstic	Site				
	Pre-Development	Post-Development	Change (Pre- to Post-)	Post-Development with Mitigation	Change (Pre- to Post- with Mitigation)
Inputs (Volumes)					
Precipitaiton (m^3/yr)	203,606	203,606	0.0%	203,606	0.0%
Run-On (m^3/yr)	0	0	0.0%	0	0.0%
Other Inputs (m^3/yr)	0	0	0.0%	0	0.0%
Total Inputs (m^3/yr)	203,606	203,606	0.0%	203,606	0.0%
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	88,523	169,052	91.0%	169,052	91.0%
Net Surplus (m^3/yr)	88,523	169,052	91.0%	169,052	91.0%
Evapotranspiratin (m^3/yr)	115,083	34,554	-70.0%	34,554	-70.0%
Infiltration (m^3/yr)	52,059	12,671	-75.7%	55,314	6.3%
Rooftop Infiltration (m^3/yr)	0	0	0.0%	31,215	0.0%
Total Infiltration (m^3/yr)	52,059	12,671	-75.7%	86,529	66.2%
Runoff Pervious Area (m^3/yr)	34,706	7,358	-78.8%	8,012	-76.9%
Runoff Impervious Area (m^3/yr)	1,758	149,023	8379.1%	74,512	4139.5%
Total Runoff (m^3/yr)	36,464	156,381	328.9%	82,523	126.3%
Total Outputs (m^3/yr)	203,606	172,415	-15.3%	203,606	0.0%

Post-development, TIMP = 18.6Ha / 80%, with all the impermeable surfaces from a reduction of agriculture or grass fields. This causes a reduction of evapotranspiration (-70%), while all the precipitation within the TIMP area is managed for 50% recharge and infiltration (+66.2%). The results show that the amount of external outflow has increased compared to the pre-development state (151mm to 342mm or ΔV= +46,059m^3).

Post-development with mitigation, the total rate of infiltration has increased from 216 to 359mm/year or 52,059m^3 to 86,529m^3 (+66.2%). Detailed calculations of water balance for each scenario are presented in Appendix XIII.

8. Erosion and Sediment Control

In general, the guiding principles of the ESC Plan are according to the TRCA:

1. Minimizing soil erosion at the source;
2. Containing sediment on site;
3. Treat sediment-laden water in a location away from the work area.
4. Being proactive, not reactive.

During construction, much of the topsoil of the subject site will be stripped and there is potential for short-term sediment wash-off from the site. Exposed soil is susceptible to erosion. To protect the downstream receiving watercourse, on-site erosion and sediment control (ESC) measures are necessary during construction and it will be submitted after plan approval. The ESC measures focus on minimizing adverse environmental impacts by restricting the mobilization and transport of sediment, the following general practices are recommended:

1.1. Minimizing soil erosion at the source:
Based on the proposed developments and the shallow seasonal groundwater in the northwest portion, the site needs to cut the materials to construct SWM facilities (pond and ditch) and septic beds in each lot, and thus earthworks generally cause significant erosion. The main area of concern for ESC is the construction of the new proposed SWM dry pond, and septic beds, cutting the berm to install a new gabion retaining wall at the southwest corner, and cutting of the northeastern strip to construct a new road and ditch. However, the pond area will be used as a catchment infiltration basin due to its large footprint area and medium permeability materials replaced. All temporary grading will have slopes directed into the excavated area.

1.2. Containing sediment on site:
Where sediments are not directed into the excavation building area, it is a requirement to install Silt Fences as per TRCA design charts at the site boundaries.

1.3. Treat sediment-laden water in a location away from the work area:
The proposed significant cut & fill plan requires careful management to prevent sediment-laden storm runoff from being conveyed off-site and into downstream rivers or external waterbodies. Based on the medium-infiltration rate of the site property (sandy clay soil & infiltration rate = 14min/cm), it is estimated that part of the runoff will leave the site, however, the proposed pond LID has enough space for retaining 5mm runoff for all surfaces, which is contributed about 50% of the total average annual rainfall volumes based on TRCA investigation for rainfall data from 16 rain gauge stations in Toronto. Assuming that Silt Fences are adequately installed and maintained, any temporary ponding of sediment-laden runoff will be quickly infiltrated into the natural soils.

1.4. Being proactive, not reactive:
It is acknowledged that the project proposes cut & fill operations. Topsoil stripping of the fill location must be prepared prior to the actual cut operations. This would allow the fill portion to occur as soon as feasible, with minimal stockpiling. It is also a requirement to seed the backfilled area as soon as possible.

This project can be separated into four (4) separate phases as follows:

Phase 1 – Site Preparations: Driveway construction and the preparation for future cut & fill operations require topsoil stripping. Actual silt fences are also installed in this phase. All topsoil shall be stockpiled at the southwest corner of the property, behind the silt fences, to act as a loose permeable filtration mound.

Phase 2 – Cut & Fill Operations: Once site preparation is completed, the actual cut & fill operation for the SWM pond, ditches, buildings, and septic beds can begin. It is a requirement that all excavated materials (sandy clay soils) be used for local backfill & grading. At the edges of the excavation void/cut area, all surface grading must slope into the excavation void, such that all stormwater and drainage are captured by the excavation itself. Stripped topsoil needs to be transported and stockpiled at the southwest corner, while excess soils can be locally used as backfill or as the base layer for driveway construction. Emergency spill kits are required to be available at the site at all times.

Phase 3 –Main construction: The proposed buildings will be constructed in this phase. When initial excavation is completed, concrete foundation and walls will be formed and poured. Septic holding tanks are also installed and buried in this phase, along with other site services, such as propane tanks and buried electrical cables. All excavated soils must be fully backfilled, graded, topsoil-covered, and reseeded as soon as possible.

Phase 4 – Final Grading & Auxiliary Structures: After the overall backfill is completed, the physical construction may be completed, as well as keeping a very small amount of soil for final grading. Auxiliary structures will be constructed at this time, like paving parking lots, driveways, and sidewalks, planting, and landscaping. Previously stockpiled topsoil would be mechanically processed and then covered on all exposed soils.

Routine inspection and maintenance of the ESC measures is required to ensure these measures function properly and effectively. Details of Erosion and Sediment Control Measures and Cut & Fill Details provided in a separate ESC plan report in the near future.

9. Reliance & Signature

This report is the intellectual property of King EPCM and has been prepared for the sole use of 123 Highway 47 Inc. (the Client). King EPCM accepts no liability for claims arising from the use of this report, or from actions taken or decisions made as a result of this report, by parties other than the Client. The Client may submit this report to the Township of Uxbridge, Toronto and Region Conservation Authority (TRCA), and Regional Municipality of Durham (Durham Region) in regards to the Client's industrial development project at 123 Regional Highway 47, Uxbridge, ON.

Respectfully,

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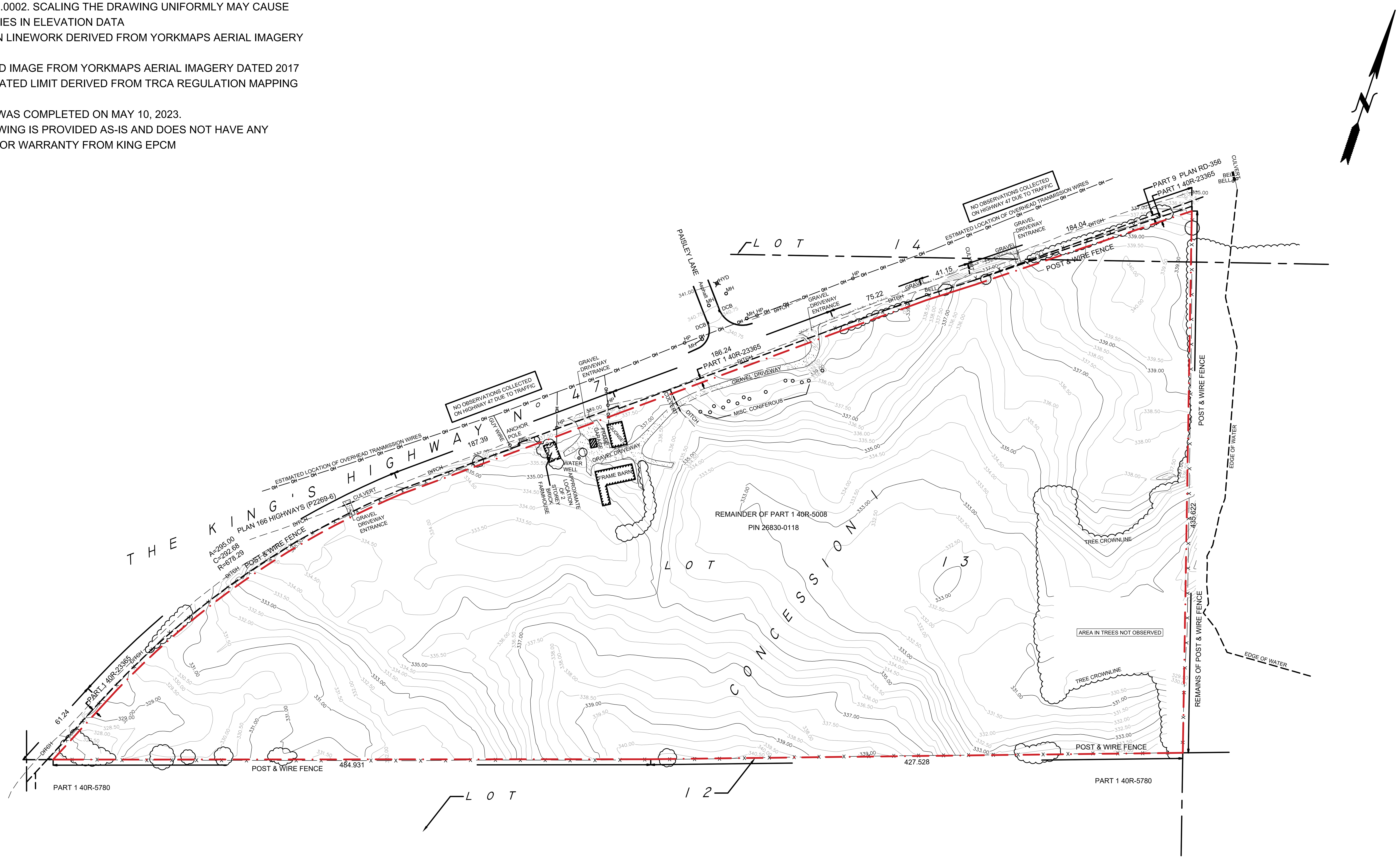
APPENDIX I – SITE SURVEY PLAN

GENERAL NOTES:

- THIS IS NOT A PLAN OF SURVEY. BOUNDARY, PLANS, AND DISTANCES SHOWN HEREON ARE COMPILED FROM REGISTRY OFFICE RECORDS AND BEST FIT TO FIELDWORK
- ELEVATION AND DISTANCES ARE IN METERS UNLESS OTHERWISE NOTED
- ELEVATIONS ARE GEODETIC HT_2(2010) AND ARE DERIVED FROM CAN-NET VRS NETWORK
- THIS DRAWING IS PREPARED IN UTM NAD 83 ZONE 17 (CSRS 2010). BOUNDARY IS APPROXIMATE AND HAS NOT BEEN CONFIRMED IN THE FIELD
- HORIZONTAL COORDINATES IN THIS DRAWING ARE IN GRID COORDINATES AND CAN BE SCALED UP TO GROUND USING A SCALE FACTOR OF 1.0002. SCALING THE DRAWING UNIFORMLY MAY CAUSE DISCREPANCIES IN ELEVATION DATA
- TREE CROWN LINEWORK DERIVED FROM YORKMAPS AERIAL IMAGERY DATED 2017
- BACKGROUND IMAGE FROM YORKMAPS AERIAL IMAGERY DATED 2017
- TRCA REGULATED LIMIT DERIVED FROM TRCA REGULATION MAPPING IMAGERY
- FIELDWORK WAS COMPLETED ON MAY 10, 2023.
- DIGITAL DRAWING IS PROVIDED AS-IS AND DOES NOT HAVE ANY GUARANTEE OR WARRANTY FROM KING EPCM

LEGEND:

DCB	DOUBLE CATCHBASIN
HP	HYDRO POLE
HYD	HYDRANT
MH	MANHOLE
HO	OVERHEAD UTILITY WIRE
	GUY ANCHOR
	LEGAL PROPERTY BOUNDARY
	TREE CROWNLINE



SCALE 1:2000
1cm = 20m

0m 100m 200m

Municipality Notes

DRAWN: DH

DATE: MAY 17, 2023

STAMP: LICENSED PROFESSIONAL ENGINEER Y. T. WANG May 18, 2023 PROVINCE OF ONTARIO

KEY MAP

N.T.S.

KING EPCM
570 Hood Rd, Unit 26
Markham, ON, L3R 4G7
www.KingEPCM.com
647-459-5647

CLIENT: 123 HWY 47 INC.

PROJECT NAME: **123 HIGHWAY 47**

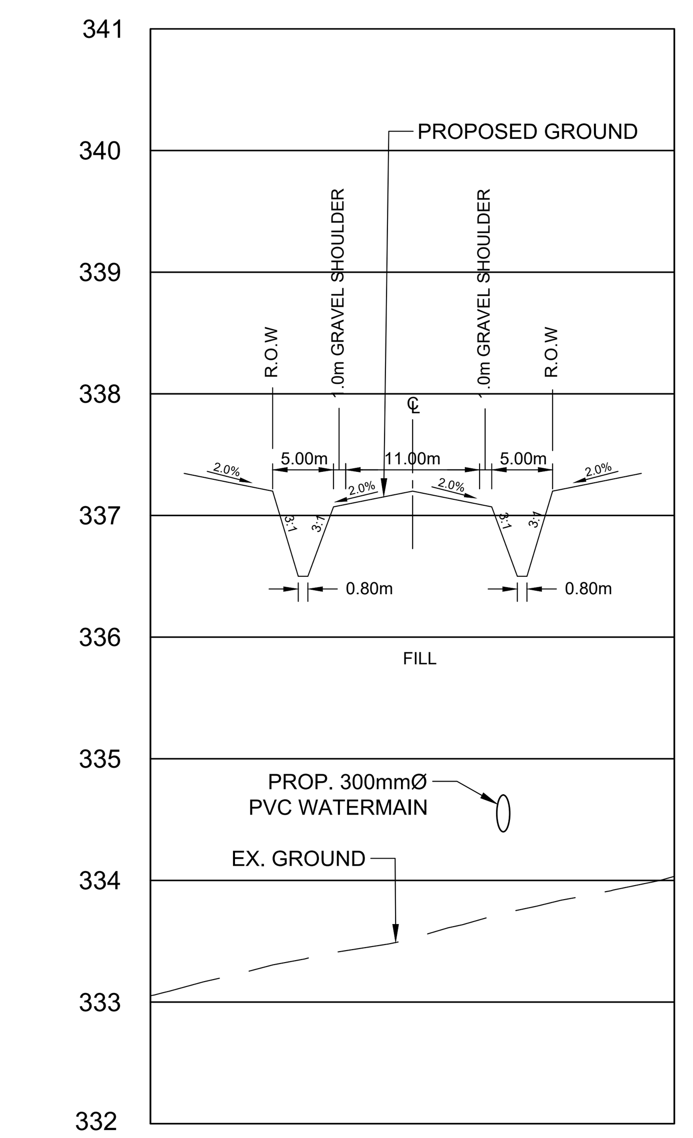
PROJECT LOCATION: 123 HIGHWAY 47
LEGAL DESCRIPTION: PT LTS 13 & 14 CON 1 UXBRIDGE PT 1 PL 40R5008 EXCEPT PT 1 PL 40R23365; UXBRIDGE, PIN 26830-0118

PRINT TITLE: **TOPOGRAPHIC PLAN**

FILE No.: SVY 1.1

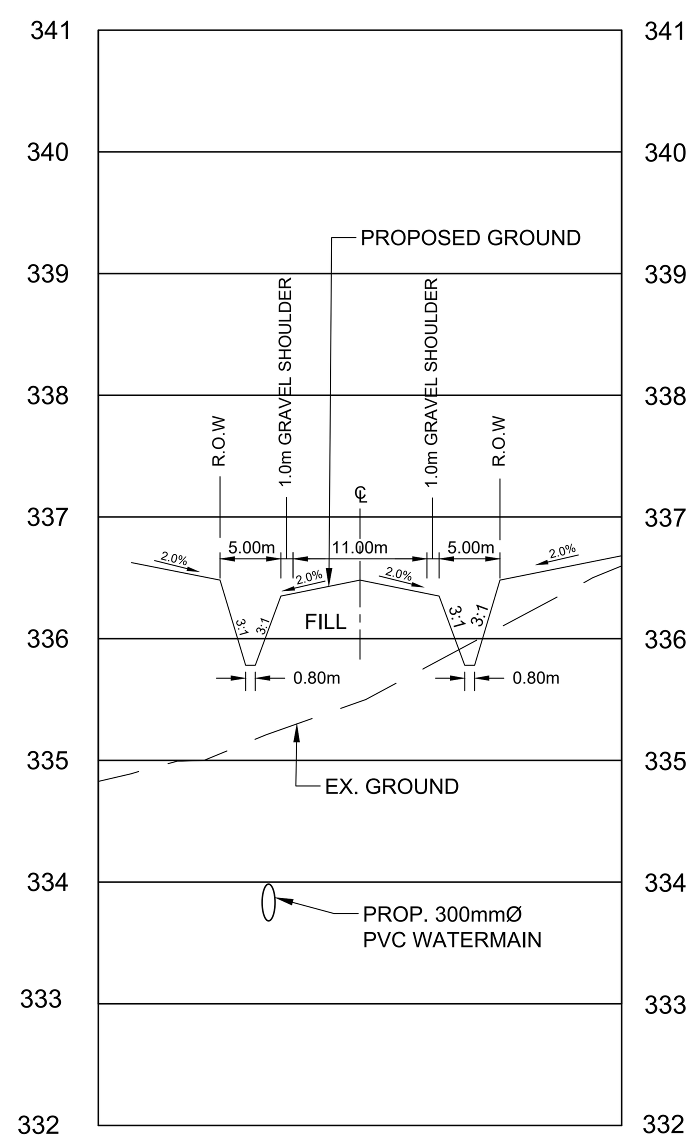
No.	ISSUED FOR:	DATE	DRAW BY	CHECK
V1	INTERNAL REVIEW	MAY 17, 2023	DH	TW

APPENDIX II – SITE GRADING PLAN & SITE SERVICING PLAN



CROSS SECTION A - A (TYP.)

SCALE H 1: 500 V 1: 50



CROSS SECTION B - B (TYP.)

SCALE H 1: 500 V 1: 50

GENERAL NOTES:

- THIS IS NOT A PLAN OF SURVEY. BOUNDARY, PLANS, AND DISTANCES SHOWN HEREON ARE COMPILED FROM REGISTRY OFFICE RECORDS AND BEST FIT TO FIELDWORK USING PREVIOUS TOPOGRAPHIC DETAIL FROM KING EPCM
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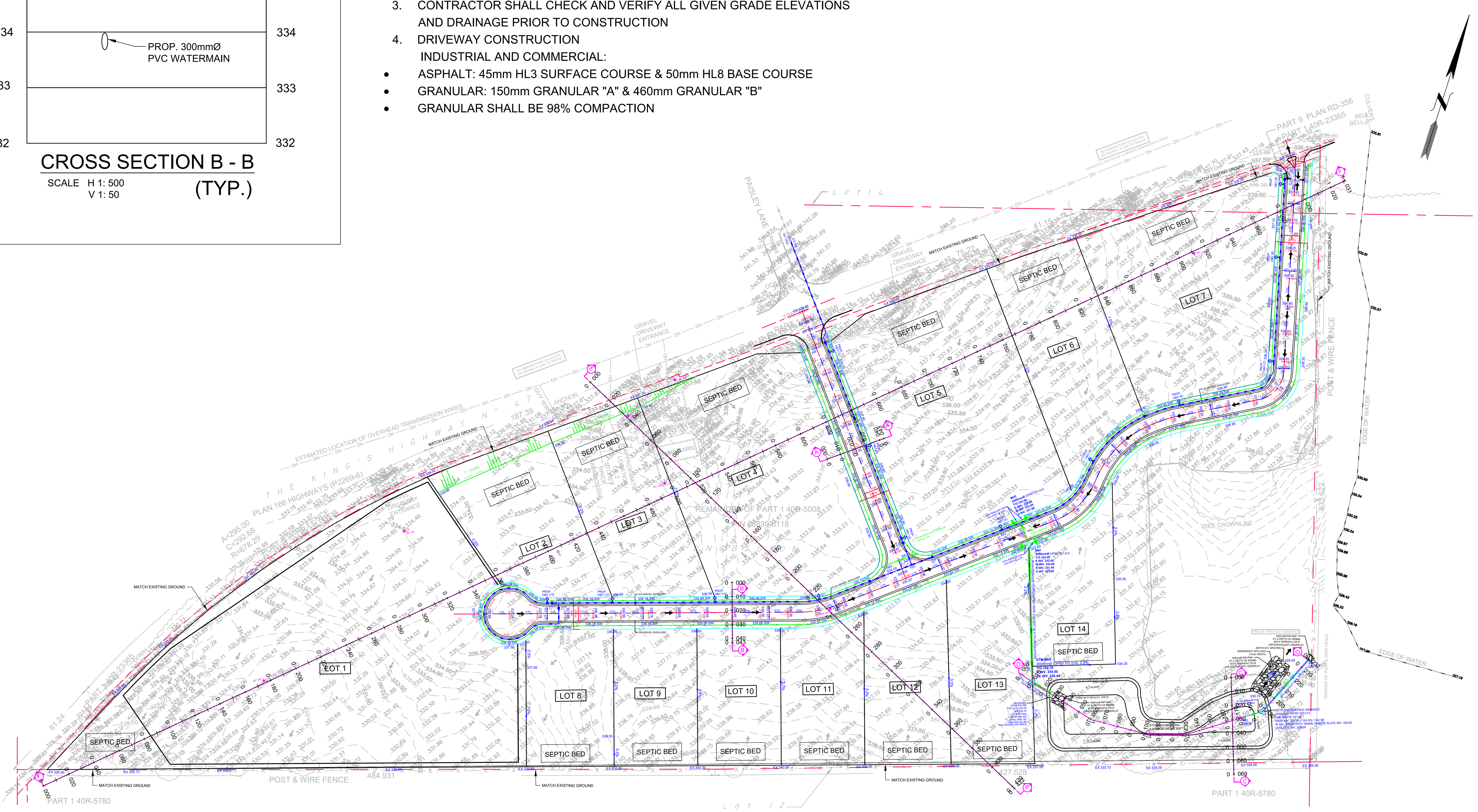
- BACKGROUND IMAGE FROM YORKMAPS AERIAL IMAGERY DATED 2017
- TRCA REGULATED LIMIT DERIVED FROM TRCA REGULATION MAPPING IMAGERY
- DIGITAL DRAWING IS PROVIDED AS-IS AND DOES NOT HAVE ANY GUARANTEE OR WARRANTY FROM KING EPCM
- ORIGINAL TREE CROWNLINE OBSERVED MAY 9, 2023; TRCA STAKING OBSERVED JULY 13, 2023 BY KING EPCM.

1. CONTRACTOR TO BE RESPONSIBLE TO ENSURE THAT THIS LOT AND ADJOINING AREAS OF SITE ARE KEPT CLEAN AND FREE OF CONSTRUCTION DEBRIS, AND THAT ROADWAYS ARE KEPT CLEAN OF MUD AND DEBRIS
2. ALL MEASUREMENTS STATED IN METERS, PIPE SIZES IN MILLIMETERS, UNLESS OTHERWISE SPECIFIED EQUIVALENTS
3. CONTRACTOR SHALL CHECK AND VERIFY ALL GIVEN GRADE ELEVATIONS AND DRAINAGE PRIOR TO CONSTRUCTION
4. DRIVEWAY CONSTRUCTION
   INDUSTRIAL AND COMMERCIAL:

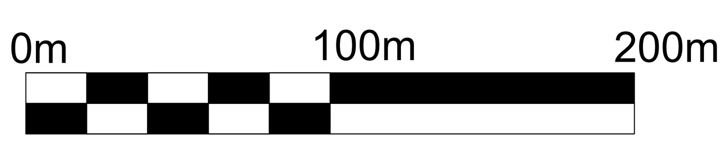
- ASPHALT: 45mm HL3 SURFACE COURSE & 50mm HL8 BASE COURSE
- GRANULAR: 150mm GRANULAR "A" & 460mm GRANULAR "B"
- GRANULAR SHALL BE 98% COMPACTION

LEGEND:

Symbol	Description
EX. 339.20	EXISTING ELEVATION
339.20	PROPOSED ELEVATION
339.20 SW	PROPOSED CL SWALE ELEVATION
INV. 339.20	PROPOSED SWALE INVERT ELEVATION
	EXISTING SURFACE FLOW ROUTE
	PROPOSED SURFACE FLOW ROUTE
339	EXISTING ELEVATION CONTOUR LINES
	R.O.W.
	PROPOSED CENTERLINE SWALE
WATER	PROPOSED WATERMAIN
	PROPOSED HYDRANT
	PROPOSED GATE VALVE
BH 106	BOREHOLE
DICB	DITCH INLET CATCHBASIN
DCB	DOUBLE CATCHBASIN
HP	HYDRO POLE
MH	MANHOLE
HO	OVERHEAD UTILITY WIRE
	GUY ANCHOR
	LEGAL PROPERTY BOUNDARY
	TREE CROWNLINE



SCALE 1:2000
1cm = 20m



Municipality Notes

DRAWN: K.L.

DATE: DEC. 15, 2023

STAMP: LICENSED PROFESSIONAL ENGINEER Y. T. WANG 100228476 DEC 17, 2023 PROVINCE OF ONTARIO

KEY MAP

N.T.S.

KING EPCM

3780 14th Ave., Unit 211
Markham, ON, L3R 9Y5
www.KingEPCM.com
647-459-5647

CLIENT: 123 HWY 47 INC.

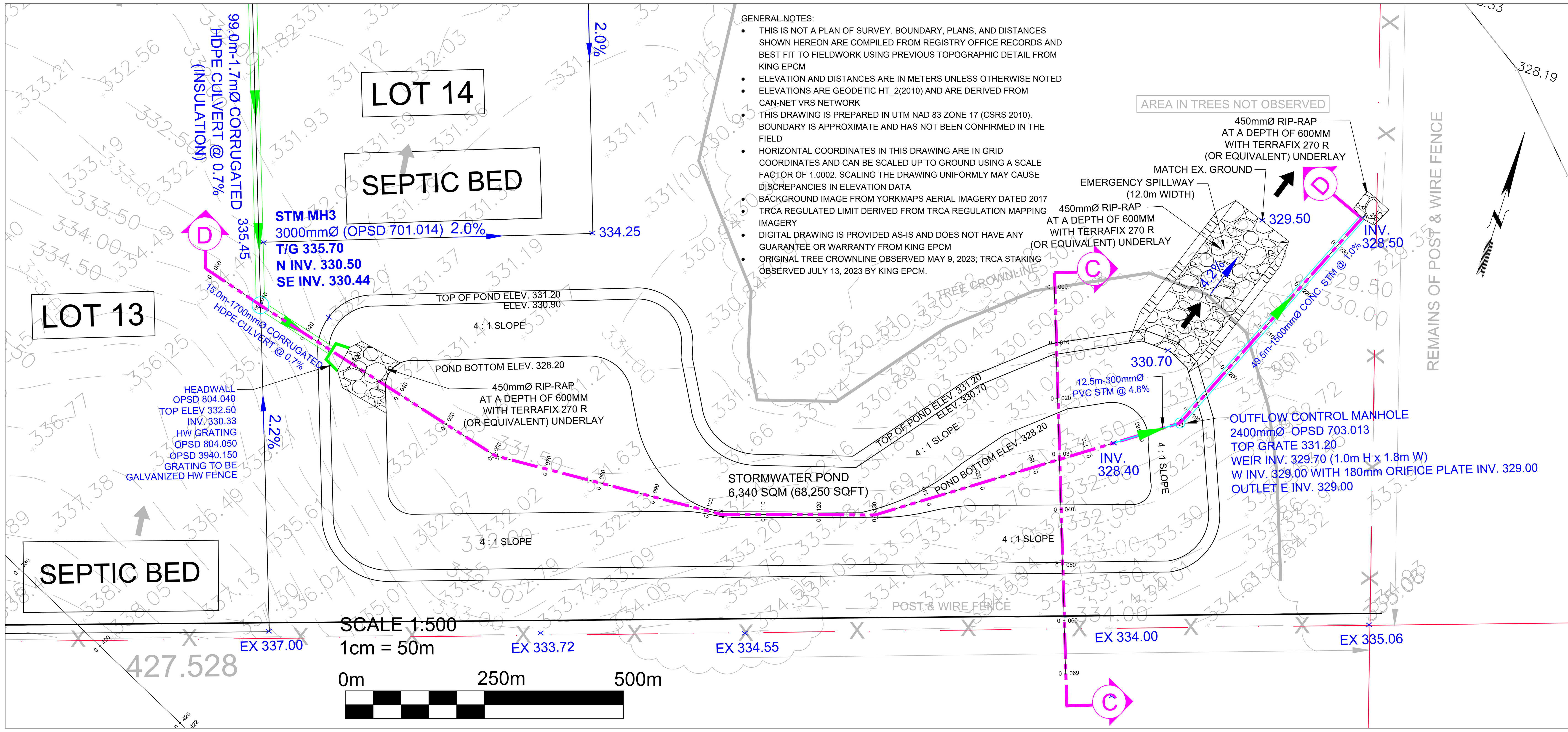
PROJECT NAME: 123 HIGHWAY 47

PROJECT LOCATION: 123 HIGHWAY 47
LEGAL DESCRIPTION: PT LTS 13 & 14 CON 1 UXBRIDGE PT 1 PL 40R5008 EXCEPT PT 1 PL 40R23365; UXBRIDGE, PIN 26830-0118

PRINT TITLE: SITE GRADING AND SITE SERVICING PLAN

FILE No.: EGR 1.1

No.	ISSUED FOR:	DATE	DRAW BY	CHECK
V16	ISSUED TO CLIENT	DEC 15, 2023	KL	TW



GENERAL NOTES:

- THIS IS NOT A PLAN OF SURVEY. BOUNDARY, PLANS, AND DISTANCES SHOWN HEREON ARE COMPILED FROM REGISTRY OFFICE RECORDS AND BEST FIT TO FIELDWORK USING PREVIOUS TOPOGRAPHIC DETAIL FROM KING EPCM
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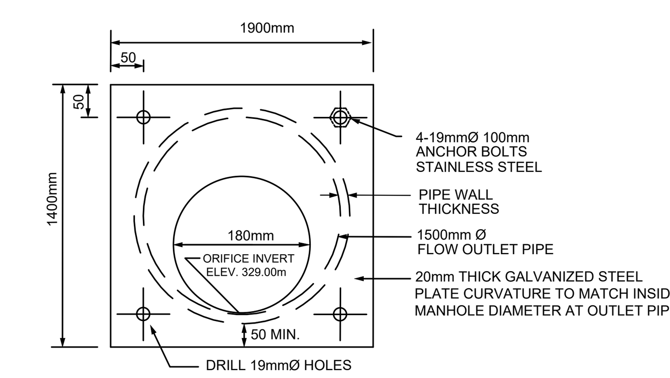
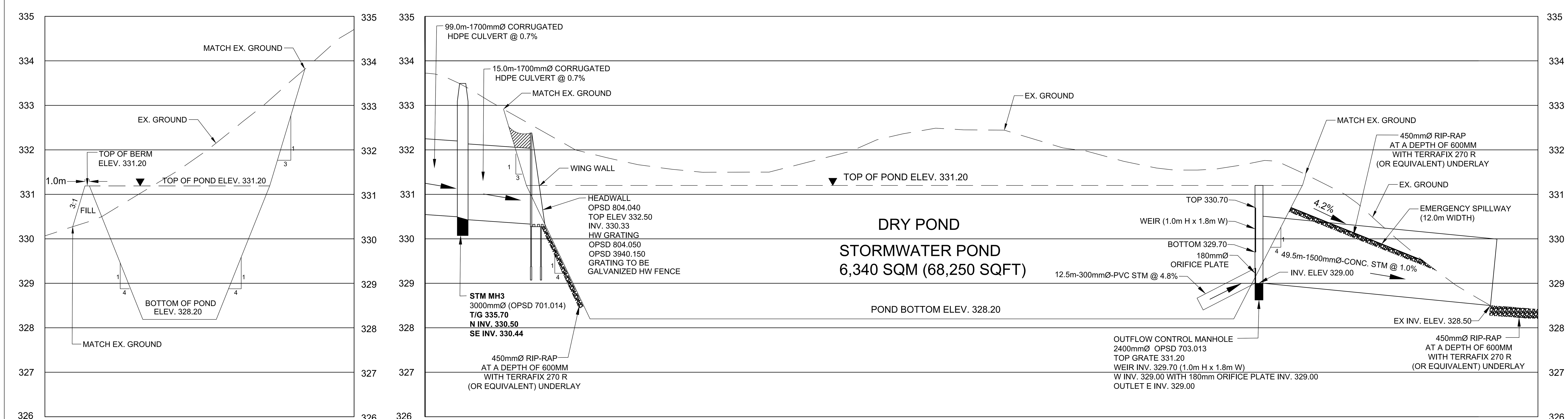
- BACKGROUND IMAGE FROM YORKMAPS AERIAL IMAGERY DATED 2017
- TRCA REGULATED LIMIT DERIVED FROM TRCA REGULATION MAPPING IMAGERY
- DIGITAL DRAWING IS PROVIDED AS-IS AND DOES NOT HAVE ANY GUARANTEE OR WARRANTY FROM KING EPCM
- ORIGINAL TREE CROWNLINE OBSERVED MAY 9, 2023; TRCA STAKING OBSERVED JULY 13, 2023 BY KING EPCM.



ORIFICE PLATE DETAIL - OUTFLOW MH

N.T.S.



CROSS SECTION C - C

SCALE H 1: 500
V 1: 50

CROSS SECTION D - D

SCALE H 1: 500
V 1: 50

Municipality Notes

DRAWN: K.L.

DATE: DEC 14, 2023

STAMP: LICENSED PROFESSIONAL ENGINEER Y. T. WANG 100228476 DEC 17, 2023 PROVINCE OF ONTARIO

KEY MAP

N.T.S.

KING EPCM

3780 14th Ave., Unit 211
Markham, ON, L3R 9Y5
www.KingEPCM.com
647-459-5647

CLIENT: 123 HWY 47 INC.

PROJECT NAME: 123 HIGHWAY 47

PROJECT LOCATION: 123 HIGHWAY 47
LEGAL DESCRIPTION: PT LTS 13 & 14 CON 1 UXBRIDGE PT 1 PL 40R5008 EXCEPT PT 1 PL 40R23365; UXBRIDGE, PIN 26830-0118

PRINT TITLE: STORMWATER MANAGEMENT FACILITY POND

FILE No.: EGR 1.2

No.	ISSUED FOR:	DATE	DRAW BY	CHECK
V1	ISSUED TO CLIENT	DEC 14, 2023	KL	TW

GENERAL NOTES:

- THIS IS NOT A PLAN OF SURVEY. BOUNDARY, PLANS, AND DISTANCES SHOWN HEREON ARE COMPILED FROM REGISTRY OFFICE RECORDS AND BEST FIT TO FIELDWORK USING PREVIOUS TOPOGRAPHIC DETAIL FROM KING EPCM
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- BACKGROUND IMAGE FROM YORKMAPS AERIAL IMAGERY DATED 2017
- TRCA REGULATED LIMIT DERIVED FROM TRCA REGULATION MAPPING IMAGERY
- DIGITAL DRAWING IS PROVIDED AS-IS AND DOES NOT HAVE ANY GUARANTEE OR WARRANTY FROM KING EPCM
- ORIGINAL TREE CROWNLINE OBSERVED MAY 9, 2023; TRCA STAKING OBSERVED JULY 13, 2023 BY KING EPCM.

1. CONTRACTOR TO BE RESPONSIBLE TO ENSURE THAT THIS LOT AND ADJOINING AREAS OF SITE ARE KEPT CLEAN AND FREE OF CONSTRUCTION DEBRIS, AND THAT ROADWAYS ARE KEPT CLEAN OF MUD AND DEBRIS
2. ALL MEASUREMENTS STATED IN METERS, PIPE SIZES IN MILLIMETERS, UNLESS OTHERWISE SPECIFIED EQUIVALENTS
3. CONTRACTOR SHALL CHECK AND VERIFY ALL GIVEN GRADE ELEVATIONS AND DRAINAGE PRIOR TO CONSTRUCTION

LEGEND:

Symbol	Description
EX 339.20	EXISTING ELEVATION
339.20 SW	PROPOSED CL SWALE ELEVATION
INV. 339.20	PROPOSED SWALE INVERT ELEVATION
	EXISTING SURFACE FLOW ROUTE
	PROPOSED SURFACE FLOW ROUTE
339	EXISTING ELEVATION CONTOUR LINES
	R.O.W.
	PROPOSED CENTERLINE SWALE
	DRAINAGE AREAS
	DRAINAGE AREAS / RUNOFF COEFFICIENT
BH 106	BOREHOLE
DICB	DITCH INLET CATCHBASIN
DCB	DOUBLE CATCHBASIN
HP	HYDRO POLE
MH	MANHOLE
HO	OVERHEAD UTILITY WIRE
	GUY ANCHOR
	LEGAL PROPERTY BOUNDARY
	TREE CROWNLINE

SCALE 1:2000

1cm = 20m

0m 100m 200m

Municipality Notes

DRAWN	STAMP
K.L.	
DATE	
DEC. 18, 2023	DEC 18, 2023

KEY MAP

N.T.S.

KING EPCM

3780 14th Ave., Unit 211
Markham, ON, L3R 9Y5
www.KingEPCM.com
647-459-5647

CLIENT

123 HWY 47 INC.

PROJECT NAME

123 HIGHWAY 47

PROJECT LOCATION

123 HIGHWAY 47

LEGAL DESCRIPTION: PT LTS 13 & 14 CON 1 UXBRIDGE PT 1 PL 40R5008 EXCEPT PT 1 PL 40R23365; UXBRIDGE, PIN 26830-0118

PRINT TITLE

DRAINAGE PLAN

FILE No.

EGR 1.3

No.	ISSUED FOR:	DATE	DRAW BY	CHECK
V16	ISSUED TO CLIENT	DEC 18, 2023	KL	TW

APPENDIX III – BOREHOLE DRILL LOG

KING EPCM
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GROUNDWATER MONITORING Well BH101

PROJECT NUMBER	**DRILLING COMPANY** King EPCM	**COORDINATES** 641617.133 m E, 4875221.249 m N
PROJECT NAME 123 Durham Regional Hwy 47	**DRILLER** Chris, Leng	**COORD SYS** UTM-17
CLIENT	**DRILL RIG** Little Beaver	**SURFACE ELEVATION** 336.888 m
ADDRESS 123 Hwy 47, Stouffville	**DRILLING METHOD** Solid Auger	**WELL TOC** None
DRILLING DATE 07/10/2023	**TOTAL DEPTH** 6.1 m	**LOGGED BY** Chris Chen
LICENCE NO. C-7691	**DIAMETER** 2.5 in	**CHECKED BY** Tony Wang, P Eng, Principal Engineer
COMPLETION	**CASING** 2 inch	**SCREEN** 2 inch

COMMENTS

Depth (m)	Graphic Log	USCS SAMPLES	Material Description	Additional Observations	Well Installation	Elevation (m)
		PEAT	Top soil, black, moist			
0.5		USCS: CL	Brown sandy clay, dry	Bearing capacity tested at 1.5m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 1.5m deep		336.5
1						336
1.5		USCS:CL	Brown sandy clay, moist			335.5
2		USCS:ML	Brown silt			335
2.5				Bearing capacity tested at 3.0m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 3.0m deep		334.5
3						334
3.5						333.5
4						333
4.5						332.5
5						332
5.5						331.5
6						331
			Termination Depth at: 6.1 m			330.5

Disclaimer

GROUNDWATER MONITORING Well BH102

Flexible. Dependable. On-site Engineering.

PROJECT NUMBER	**DRILLING COMPANY** King EPCM	**COORDINATES** 641640.572 m E, 4875247.159 m N
PROJECT NAME 123 Durham Regional Hwy 47	**DRILLER** Chris, Leng	**COORD SYS** UTM-17
CLIENT	**DRILL RIG** Little Beaver	**SURFACE ELEVATION** 337.559 m
ADDRESS 123 Hwy 47, Stouffville	**DRILLING METHOD** Solid Auger	**WELL TOC** None
DRILLING DATE 06/06/2023	**TOTAL DEPTH** 4.6 m	**LOGGED BY** Chris Chen
LICENCE NO. C-7691	**DIAMETER** 2.5 in	**CHECKED BY** Tony Wang, P Eng, Principal Engineer
COMPLETION	**CASING** 2 inch	**SCREEN** 2 inch

COMMENTS

Depth (m)	USCS SAMPLES	Material Description	Additional Observations
0.0 – 0.3	PEAT	Top soil, black, moist	
0.3 – 1.8	USCS: CL	Brown sandy clay, dry	Bearing capacity tested at 1.5m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 1.5m deep
1.8 – 2.4	USCS:GC	Till, moist	
2.4 – 4.0	USCS:CL	Sandy clay, wet	Bearing capacity tested at 3.0m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 3.0m deep
4.0 – 4.6	USCS:ML	Brown silt	
4.6		Termination Depth at: 4.6 m	

Depth (m)	Elevation (m)
0.2	337.4
0.4	337.2
0.6	337
0.8	336.8
1	336.6
1.2	336.4
1.4	336.2
1.6	336
1.8	335.8
2	335.6
2.2	335.4
2.4	335.2
2.6	335
2.8	334.8
3	334.6
3.2	334.4
3.4	334.2
3.6	334
3.8	333.8
4	333.6
4.2	333.4
4.4	333.2
4.6	333
4.8	332.8

Disclaimer

GROUNDWATER MONITORING Well BH103

KING EPCM — Flexible. Dependable. On-site Engineering.

PROJECT NUMBER	**DRILLING COMPANY** King EPCM	**COORDINATES** 641652.062 m E, 4875173.245 m N
PROJECT NAME 123 Durham Regional Hwy 47	**DRILLER** Chris, Leng	**COORD SYS** UTM-17
CLIENT	**DRILL RIG** Little Beaver	**SURFACE ELEVATION** 334.476 m
ADDRESS 123 Hwy 47, Stouffville	**DRILLING METHOD** Solid Auger	**WELL TOC** None
DRILLING DATE 07/07/2023	**TOTAL DEPTH** 4.6 m	**LOGGED BY** Chris Chen
LICENCE NO. C-7691	**DIAMETER** 2.5 in	**CHECKED BY** Tony Wang, P Eng, Principal Engineer
COMPLETION	**CASING** 2 inch	**SCREEN** 2 inch

COMMENTS

Depth (m)	Graphic Log	USCS SAMPLES	Material Description	Additional Observations	Well Installation	Elevation (m)
0–0.3		PEAT	Top soil, black, moist			334
0.3–1.5		USCS: CL	Brown sandy clay, dry	Bearing capacity tested at 1.5m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 1.5m deep		333.8 – 332.8
1.5–1.8		USCS:CL	Till, moist			332.6 – 332.4
1.8–4.6		USCS:ML	Brown silt	Bearing capacity tested at 3.0m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 3.0m deep		332.2 – 329.6
4.6			Termination Depth at: 4.6 m			329.4

Depth scale (m): 0.2, 0.4, 0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2, 2.2, 2.4, 2.6, 2.8, 3, 3.2, 3.4, 3.6, 3.8, 4, 4.2, 4.4, 4.6, 4.8

Elevation scale (m): 334, 333.8, 333.6, 333.4, 333.2, 333, 332.8, 332.6, 332.4, 332.2, 332, 331.8, 331.6, 331.4, 331.2, 331, 330.8, 330.6, 330.4, 330.2, 330, 329.8, 329.6, 329.4

Disclaimer

KING EPCM

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GROUNDWATER MONITORING Well BH104

PROJECT NUMBER	**DRILLING COMPANY** King EPCM	**COORDINATES** 641513.50m E, 4875068.359m N
PROJECT NAME 123 Durham Regional Hwy 47	**DRILLER** Chris, Leng	**COORD SYS** UTM-17
CLIENT	**DRILL RIG** Little Beaver	**SURFACE ELEVATION** 334.670 m
ADDRESS 123 Hwy 47, Stouffville	**DRILLING METHOD** Solid Auger	**WELL TOC** None
DRILLING DATE 05/18/2023	**TOTAL DEPTH** 4.5 m	**LOGGED BY** Chris Chen
LICENCE NO. C-7691	**DIAMETER** 2.5 in	**CHECKED BY** Tony Wang, P Eng, Principal Engineer
COMPLETION	**CASING** 2 inch	**SCREEN** 2 inch

COMMENTS

USCS SAMPLES	Material Description	Additional Observations
PEAT	Top soil, black, moist	
USCS: CL	Brown sandy clay, dry	DCP test performed at 1.5m; DCP test performed at 3.0m
USCS:CL	Brown sandy clay, moist	
USCS:ML	Brown silt	
	Termination Depth at: 4.5 m	

Depth (m): 0.2, 0.4, 0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2, 2.2, 2.4, 2.6, 2.8, 3, 3.2, 3.4, 3.6, 3.8, 4, 4.2, 4.4, 4.6

Elevation (m): 334.6, 334.4, 334.2, 334, 333.8, 333.6, 333.4, 333.2, 333, 332.8, 332.6, 332.4, 332.2, 332, 331.8, 331.6, 331.4, 331.2, 331, 330.8, 330.6, 330.4, 330.2, 330

Disclaimer

produced by ESlog.ESdat.net on 13 Nov 2023

GROUNDWATER MONITORING Well BH105

Flexible. Dependable. On-site Engineering.

PROJECT NUMBER	**DRILLING COMPANY** King EPCM	**COORDINATES** 641435.399m E, 4874952.450 m N
PROJECT NAME 123 Durham Regional Hwy 47	**DRILLER** Chris, Leng	**COORD SYS** UTM-17
CLIENT	**DRILL RIG** Little Beaver	**SURFACE ELEVATION** 329.933m
ADDRESS 123 Hwy 47, Stouffville	**DRILLING METHOD** Solid Auger	**WELL TOC** None
DRILLING DATE 05/25/2023	**TOTAL DEPTH** 4.5 m	**LOGGED BY** Chris Chen
LICENCE NO. C-7691	**DIAMETER** 2.5 in	**CHECKED BY** Tony Wang, P Eng, Principal Engineer
COMPLETION	**CASING** 2 inch	**SCREEN** 2 inch

COMMENTS

Depth (m)	Graphic Log	USCS SAMPLES	Material Description	Additional Observations	Well Installation	Elevation (m)
0.0–0.4		PEAT	Top soil, black, moist			
0.4–3.7		USCS: CL	Brown sandy clay, dry	DCP test performed at 1.5m Bearing capacity tested at3.0m deep showing 700kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 3.0m deep		
3.7–4.5		USCS:CL	Brown sandy clay, moist, medium plastic			
4.5			Termination Depth at: 4.5 m			

Depth scale (m): 0.2, 0.4, 0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2, 2.2, 2.4, 2.6, 2.8, 3, 3.2, 3.4, 3.6, 3.8, 4, 4.2, 4.4, 4.6

Elevation scale (m): 329.8, 329.6, 329.4, 329.2, 329, 328.8, 328.6, 328.4, 328.2, 328, 327.8, 327.6, 327.4, 327.2, 327, 326.8, 326.6, 326.4, 326.2, 326, 325.8, 325.6, 325.4

Disclaimer

GROUNDWATER MONITORING Well BH106

Flexible. Dependable. On-site Engineering.

PROJECT NUMBER	**DRILLING COMPANY** King EPCM	**COORDINATES** 641754.682m E, 641754.682m N
PROJECT NAME 123 Durham Regional Hwy 47	**DRILLER** Chris, Leng	**COORD SYS** UTM-17
CLIENT	**DRILL RIG** Little Beaver	**SURFACE ELEVATION** 336.035m
ADDRESS 123 Hwy 47, Stouffville	**DRILLING METHOD** Solid Auger	**WELL TOC** None
DRILLING DATE 05/24/2023	**TOTAL DEPTH** 4.5 m	**LOGGED BY** Chris Chen
LICENCE NO. C-7691	**DIAMETER** 2.5 in	**CHECKED BY** Tony Wang, P Eng, Principal Engineer
COMPLETION	**CASING** 2 inch	**SCREEN** 2 inch

COMMENTS

Depth (m)	Graphic Log	USCS SAMPLES	Material Description	Additional Observations	Well Installation	Elevation (m)
0.0–0.4 (0.2)		PEAT	Top soil, black, moist			336, 335.8
0.4–0.8 (0.6)		USCS: CL	Brown sandy clay, moist, medium plastic			335.6, 335.4
0.8–1.5 (1, 1.2, 1.4)		USCS:CL	Brown sandy clay, wet, medium plastic	Bearing capacity tested at 1.5m deep showing 700kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 1.5m deep		335.2, 335, 334.8, 334.6
1.5–4.5 (1.6 … 4.4)		USCS:ML	Brown silt	Bearing capacity tested at 3.0m deep showing 700kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 130kPa resistance at 3.0m deep Note: Started drilling at site in the afternoon due to morning 5mm rain. Soil surface was very moist due to the rain.		334.4 … 331.6
4.6			Termination Depth at: 4.5 m			331.4

Disclaimer

KING EPCM
Flexible. Dependable. On-site Engineering.

GROUNDWATER MONITORING Well BH107

PROJECT NUMBER
PROJECT NAME 123 Durham Regional Hwy 47
CLIENT
ADDRESS 123 Hwy 47, Stouffville
DRILLING DATE 05/30/2023
LICENCE NO. C-7691

DRILLING COMPANY King EPCM
DRILLER Chris, Leng
DRILL RIG Little Beaver
DRILLING METHOD Solid Auger
TOTAL DEPTH 7.6 m
DIAMETER 2.5 in

COORDINATES 641944.829m E, 4875218.014m N
COORD SYS UTM-17
SURFACE ELEVATION 332.946m
WELL TOC None
LOGGED BY Chris Chen
CHECKED BY Tony Wang, P Eng, Principal Engineer

COMPLETION
CASING 2 inch
SCREEN 2 inch

COMMENTS

Depth (m)	Graphic Log	USCS SAMPLES	Material Description	Additional Observations	Well Installation	Elevation (m)
0 – 0.4		PEAT	Top soil, brown, moist			
0.4 – 5.8		USCS: CL	Brown sandy clay, moist, low plastic	Bearing capacity tested at 1.5m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 240kPa resistance at 1.5m deep Bearing capacity tested at 3.0m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 240kPa resistance at 3.0m deep		
5.8 – 7.6		USCS:ML	Brown silt			
			Termination Depth at: 7.6 m			

Depth scale (m): 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5

Elevation scale (m): 332.5, 332, 331.5, 331, 330.5, 330, 329.5, 329, 328.5, 328, 327.5, 327, 326.5, 326, 325.5, 325

Disclaimer

KING EPCM

Flexible. Dependable. On-site Engineering.

GROUNDWATER MONITORING Well BH108

PROJECT NUMBER	**DRILLING COMPANY** King EPCM	**COORDINATES** 641986.471m E, 4875430.069m N
PROJECT NAME 123 Durham Regional Hwy 47	**DRILLER** Chris, Leng	**COORD SYS** UTM-17
CLIENT	**DRILL RIG** Little Beaver	**SURFACE ELEVATION** 339.342m
ADDRESS 123 Hwy 47, Stouffville	**DRILLING METHOD** Solid Auger	**WELL TOC** None
DRILLING DATE 06/05/2023	**TOTAL DEPTH** 4.5 m	**LOGGED BY** Chris Chen
LICENCE NO. C-7691	**DIAMETER** 2.5 in	**CHECKED BY** Tony Wang, P Eng, Principal Engineer
COMPLETION	**CASING** 2 inch	**SCREEN** 2 inch

COMMENTS

Depth (m)	Graphic Log	USCS SAMPLES	Material Description	Additional Observations	Well Installation	Elevation (m)
0.2		PEAT	Top soil, dry			339.2
0.4, 0.6, 0.8, 1, 1.2, 1.4, 1.6		USCS: CL	Brown clayey sand, dry	Bearing capacity tested at 1.5m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 240kPa resistance at 1.5m deep		339, 338.8, 338.6, 338.4, 338.2, 338, 337.8, 337.6
1.8, 2, 2.2, 2.4, 2.6, 2.8, 3, 3.2, 3.4		USCS:ML	Brown sand, moist	Bearing capacity tested at 3.0m deep showing 1400kPa resistance with less than 0.5cm displacement Shear vane tested at minimum 240kPa resistance at 3.0m deep		337.4, 337.2, 337, 336.8, 336.6, 336.4, 336.2, 336
3.6, 3.8, 4, 4.2, 4.4		USCS:GC	Brown clayey sand mixed with gravel, moist			335.8, 335.6, 335.4, 335.2, 335
4.6			Termination Depth at: 4.5m Auger refusal			334.8

Disclaimer

APPENDIX IV – FIELD PERMEABILITY TEST

In-situ Measurement of Field Saturated Hydraulic Conductivity

1. Field Permeability Test

The "Constant Head Well Permeameter" (CHWP) method (Reynolds, 1993; Elrick and Reynolds, 1986) is based on the observation that when a constant height or "head" of water is ponded in a borehole or "well" augured into unsaturated soil, a "bulb" of field-saturated soil is gradually established around the base of the well. The K_{fs} value achieved through this method can be less than or equal to half of K_s (Saturated hydraulic conductivity) due to the partial blocking of soil pores by air bubbles and it is preferred over Ks in the design of on-site stormwater LID infiltration design because drainage through the soil should be designed to occur at less than complete soil saturation.

The in-situ measurements were done by the both ETC standard and Slow Soils Pask Permeameters, which is an extended single-head analysis method and calculations procedure used here are based on the work of W.D. Reynolds and D.E. Elrick formerly of the University of Guelph, Ontario, Canada.

The ETC Pask Permeameter is a convenient and easy-to-use apparatus for ponding a constant head of water in a well, and simultaneously measuring the flow into the soil. The rate of fall (R) of the water level in the permeameter reservoir and reservoir cross-sectional area (X) allows the determination of quasi-steady water flow Irate (Q) into the soil (i.e. Q = XR). K_{fs} is then calculated using Equation 1 (Reynolds, 1993):

$$K_{fs} = CQ / [2\pi H^2 + C\pi a^2 + (2\pi H/\alpha^*)] \qquad \text{(Eq. 1)}$$

In which:
K_{fs} = the calculated permeability from the field test

Table 1. Parameters used

Parameter	Description	BH			
		BH101	BH102	BH103	BH104
Soil Texture Factor (**α***) in cm^{-1}	Most structured and medium textured materials; including structured clayey and loamy soils, as well as unstructured medium single-grain sands. This category is generally the first choice for most soils.	0.12	0.12	0.12	0.12
R in cm/min	Quasi-steady state (constant) rate of fall of water in permeameter reservoir (Measured in the site)	0.2	0.02	0.1	0.2
T in $^{\circ}C$	Soil Temperature	22	18	18	22
μ_k/μ_a	Temperature Correction Factor (t= 1 $^{\circ}c$)	0.606	0.667	0.667	0.606
Method		Standard	Slow	Standard	Standard
C	Shape factor	1.36			
X in cm^2	Cross-sectional area of permeameter reservoir	12.8	53.46	12.8	12.8

H in cm	Height of air inlet hole from the bottom of the test hole	15
a in cm	Well hole radius	4.15

Based on data described in the above table and using Pask Permeameter ETC Quick Field Reference Tables for Slow Soils, the K_{fs} was calculated as:

K_{fs101} = 1.4E-6 m/sec= 1.4E-4 cm/sec
K_{fs102} = 2.5E-8 m/sec= 2.5E-6 cm/sec
K_{fs103} = 6.9E-7 m/sec= 6.9E-5 cm/sec
K_{fs104} = 1.4E-6 m/sec= 1.4E-4 cm/sec

And then the temperature-corrected permeability would be calculated using equation 2 for the rest of the site, as follows:

$K_a = K_{fs} \times \mu_k/\mu_a$ (Eq. 2)

In which:
K_a = corrected permeability adjusted for design temperature conditions

Then using the temperature correction factor (for t=18 and 22$^{°c}$) from the manual:

K_{a101} = 8.4E-7 m/sec= 8.4E-5 cm/sec
K_{a102} = 1.7E-8 m/sec= 1.7E-6 cm/sec
K_{a103} = 4.6E-7 m/sec= 4.6E-5 cm/sec
K_{a104} = 8.4E-7 m/sec= 8.4E-5 cm/sec

The field permeability data sheet is in the following.

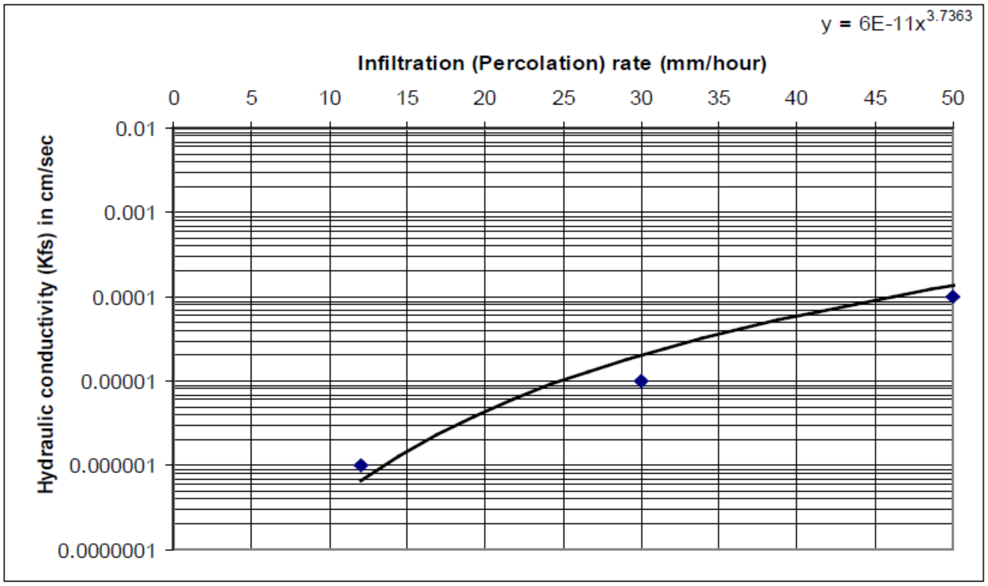
2. Percolation time/infiltration rate for design (OMMAH, 1997)

Despite the newer academic papers published by Reynolds et al. (2015), TRCA and other Conservation Authorities often still review the design of infiltration basins based on historic trends. Below are two TRCA (2012) design criteria that describe the relationship between K_{fs}, PT, and infiltration rates, based on the 1997 (OMMAH) supplementary guidelines to OBC (1997).

Table 2. Approximate relationships between hydraulic conductivity, percolation time and infiltration rate

Hydraulic Conductivity, K_{fs} (centimetres/second)	Percolation Time, T (minutes/centimetre)	Infiltration Rate, 1/T (millimetres/hour)
0.1	2	300
0.01	4	150
0.001	8	75
0.0001	12	50
0.00001	20	30
0.000001	50	12

***Source**: Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to the Ontario Building Code 1997. SG-6 Percolation Time and Soil Descriptions. Toronto, Ontario.*



***Source**: Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to the Ontario Building Code 1997. SG-6 Percolation Time and Soil Descriptions. Toronto, Ontario.*

Figure 1. Approximate relationship between infiltration rate and hydraulic conductivity

Based on OMMAH interpolation from Table 2 and Figure 1 above, the measured K_{fs} may be interpolated as:

PT_{101} = 13.6 min / cm (Infiltration Rate = 44.1 mm/hour)

PT_{102} = 38.7 min / cm (Infiltration Rate = 15.5 mm/hour)

PT_{103} = 16 min / cm (Infiltration Rate = 37.6 mm/hour)

PT_{104} = 13.6 min / cm (Infiltration Rate = 44.1 mm/hour)

As per the TRCA Stormwater Management Criteria guideline, the engineer's opinion is to trust the values obtained from this method (OMMAH, 1997), with an averaged unfactored infiltration rate = 42 mm/hour for entire the site area with clayey sand material while an unfactored infiltration rate = 15.5 mm/hour for the eastern portion, west of the natural heritage area with sandy clay material.

3. Factored Engineering Design Infiltration Rate (Wisconsin Department of Natural Resources, 2004)

For a conservative approach to infiltration speeds, the Wisconsin Department of Natural Resources (2004) method shall be used for the calculation of a factored design infiltration rate. The overall massive soil formation is clayey sand or sandy clay below a thin topsoil layer (40cm) followed by sandy clay or silt material to depth, with an unfactored infiltration rate = 15.5 - 42 mm/hour at the top layer. However, the infiltration rate used to design an infiltration BMP must incorporate a safety correction factor that compensates for potential reductions in soil permeability due to compaction or smearing during construction, gradual accumulation of fine sediments over the lifespan of the BMP, and uncertainty in measured values when less permeable soil horizons exist within 1.5 meters below the proposed bottom elevation of the BMP. As discussed in the Geotechnical Report, the predominant soil material is composed of sandy clay or clayey sand with different moisture content to a depth of more than 3 meters and then gradually transfers to sandy clay and/or silt soil, which has a medium to low permeability.

Based on Borehole datasets, the soil layer remains consistent with sandy clay or clayey sand material, including the soil layers 1.5 meters below the proposed bottom of the probable BMP. This means that based on below Table 3, the measured infiltration rate should be divided by a safety correction factor to calculate the design infiltration rate. Thus the mean infiltration rate measured at the proposed bottom elevation of the BMP is 15.5 – 42 mm/hour, and the mean infiltration rate measured in the slowest underlying soil horizon is 6.2 – 16.8 mm/hour, and the ratio of infiltration rates is 2.5.

Table 3. Safety correction factors for calculating design infiltration rates

Ratio of Mean Measured Infiltration Rates[1]	Safety Correction Factor[2]
≤ 1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

Source: *Wisconsin Department of Natural Resources. 2004. Conservation Practice Standards. Site Evaluation for Stormwater Infiltration (1002). Madison, WI.*

Notes:

1. *Ratio is determined by dividing the geometric mean measured infiltration rate at the proposed bottom elevation of the BMP by the geometric mean measured infiltration rate of the least permeable soil horizon within 1.5 metres below the proposed bottom elevation of the BMP.*
2. *The design infiltration rate is calculated by dividing the geometric mean measured infiltration rate at the proposed bottom elevation of the BMP by the safety correction factor.*

Field Permeability Test Sheet

Engineering Technologies Canada Ltd.

OWNER'S NAME:

SITE LOCATION: 123 Durham Regional Hwy 47

PID #:

TEST PIT#: BH101

TECHNICIAN: Leng

DATE: June 16 2023

WEATHER/TEMPERATURE: Cloudy, 22C

FIELD PERMEABILITY TEST #:

D - reservoir diameter (cm)	Standard	Soil Texture	Clayey sand
d - well hole diameter (cm)		Soil Structure	
H - height of water in well (cm)		α*(cm-1)	
Depth below ground surface(cm)		C - Factor	

TIME (min)	(1) CHANGE IN TIME (min)	RESERVOIR WATER LEVEL (WL) (cm)	(2) CHANGE IN WL (cm)	(2) / (1) RATE OF FALL (R) (cm/min)
0		39.9		
1	1	39.7	0.2	0.2
2	1	39.5	0.2	0.2
3	1	39.3	0.2	0.2
4	1	39	0.3	0.3
5	1	38.8	0.2	0.2
6	1	38.6	0.2	0.2
7	1	38.3	0.3	0.3
8	1	38.1	0.2	0.2
9	1	37.9	0.2	0.2
10	1	37.7	0.2	0.2

uasi Steady-State Rate of Fall(R) = 0.2 cm/min

Engineering Technologies Canada Ltd.

OWNER'S NAME:

SITE LOCATION: 123 Durham Regional Hwy 47

PID #:

TEST PIT#: BH102

TECHNICIAN: Leng

DATE: June 16 2023

WEATHER/TEMPERATURE: Cloudy, 18C

FIELD PERMEABILITY TEST #:

D - reservoir diameter (cm)	Slow tube	Soil Texture	Sandy clay
d - well hole diameter (cm)		Soil Structure	
H - height of water in well (cm)		α*(cm-1)	
Depth below ground surface(cm)		C - Factor	

TIME (min)	(1) CHANGE IN TIME (min)	RESERVOIR WATER LEVEL (WL) (cm)	(2) CHANGE IN WL (cm)	(2) / (1) RATE OF FALL (R) (cm/min)
0		24.7		
5	5	24.9	-0.2	0.0
10	5	24.5	0.4	0.08
15	5	24.2	0.3	0.06
20	5	24.1	0.1	0.02
25	5	24	0.1	0.02
30	5	23.9	0.1	0.02
35	5	23.8	0.1	0.02
40	5	23.7	0.1	0.02
45	5	23.6	0.1	0.02
50	5	23.5	0.1	0.02
55	5	23.4	0.1	0.02
60	5	23.3	0.1	0.02

uasi Steady-State Rate of Fall(R) = 0.02 cm/min

Engineering Technologies Canada Ltd.

OWNER'S NAME:

SITE LOCATION: 123 Durham Regional Hwy 47

PID #:

TEST PIT#: BH103

TECHNICIAN: Leng

DATE: June 16 2023

WEATHER/TEMPERATURE: Cloudy, 18C

FIELD PERMEABILITY TEST #:

D - reservoir diameter (cm)	Standard	Soil Texture	Clayey sand
d - well hole diameter (cm)		Soil Structure	
H - height of water in well (cm)		α*(cm-1)	
Depth below ground surface(cm)		C - Factor	

TIME (min)	(1)CHANGE IN TIME (min)	RESERVOIR WATER LEVEL (WL) (cm)	(2)CHANGE IN WL (cm)	(2) / (1) RATE OF FALL (R) (cm/min)
0		42.9		
1	1	42.8	0.1	0.1
2	1	42.7	0.1	0.1
3	1	42.6	0.1	0.1
4	1	42.5	0.1	0.1
5	1	42.4	0.1	0.1
6	1	42.3	0.1	0.1
7	1	42.2	0.1	0.1
8	1	42.1	0.1	0.1
9	1	42	0.1	0.1
10	1	41.9	0.1	0.2
11	1	41.9	0.0	0.0
12	1	41.8	0.1	0.1
13	1	41.7	0.1	0.1
14	1	41.6	0.1	0.1
15	1	41.5	0.1	0.1

uasi Steady-State Rate of Fall(R) = 0.1 cm/min

Engineering Technologies Canada Ltd.

OWNER'S NAME:

SITE LOCATION: 123 Durham Regional Hwy 47

PID #:

TEST PIT#: BH104

TECHNICIAN: Leng

DATE: June 16 2023

WEATHER/TEMPERATURE: Cloudy, 22C

FIELD PERMEABILITY TEST #:

D - reservoir diameter (cm)	Standard	Soil Texture	Clayey sand
d - well hole diameter (cm)		Soil Structure	
H - height of water in well (cm)		α*(cm-1)	
Depth below ground surface(cm)		C - Factor	

TIME (min)	(1)CHANGE IN TIME (min)	RESERVOIR WATER LEVEL (WL) (cm)	(2)CHANGE IN WL (cm)	(2) / (1) RATE OF FALL (R) (cm/min)
0		32		
1	1	31.9	0.1	0.1
2	1	31.7	0.2	0.2
3	1	31.5	0.2	0.2
4	1	31.3	0.2	0.2
5	1	31.1	0.2	0.2
6	1	30.9	0.2	0.2

uasi Steady-State Rate of Fall(R) = 0.2 cm/min

APPENDIX V –CLIMATE DATA TABLE

Table 5 Summary of Clarifica (May, 2002) annual average water balance estimates for the Duffins Creek watershed (1986-2000).

Basin	Area [ha]	PRECIP	RAIN	SNOW	Impervious (fraction) #1	#2	#3	#4	RO #1	#2	#3	#4	GWI #1	#2	#3	#4	ET #1	#2	#3	#4
1	282	844	702	142	0.022	0.022	0.022	0.022	156	156	141	156	200	200	201	200	483	483	498	483
2	1085	844	702	142	0.091	0.182	0.182	0.219	219	290	277	312	177	**151**	157	144	443	398	406	384
3	1898	844	702	142	0.023	0.034	0.034	0.042	145	155	145	161	208	205	204	203	485	479	489	475
4	682	844	702	142	0.000	0.000	0.000	0.360	150	150	149	420	197	197	197	103	492	492	493	319
5	921	844	702	142	0.000	0.000	0.000	0.000	60	60	51	60	231	231	218	231	549	549	571	549
6	644	844	702	142	0.000	0.000	0.000	0.028	139	139	125	159	185	185	181	179	515	515	533	502
7	1082	844	702	142	0.000	0.000	0.000	0.007	95	95	84	100	215	215	210	213	530	530	545	526
8	517	844	702	142	0.000	0.000	0.000	0.390	108	108	107	384	210	210	209	123	521	521	522	335
9	1073	844	702	142	0.000	0.000	0.000	0.343	140	140	137	388	184	184	183	107	514	514	518	348
10	263	844	702	142	0.000	0.000	0.000	0.398	109	109	109	377	208	208	208	126	522	522	522	339
11	2069	844	702	142	0.004	0.025	0.025	0.372	149	163	160	414	200	198	197	109	489	479	482	319
11.1	425	844	702	142	0.000	0.000	0.000	0.433	177	177	172	543	180	180	181	48	482	482	487	255
12	895	844	702	142	0.053	0.192	0.192	0.217	145	250	250	268	214	**180**	180	174	480	410	409	398
13	1737	844	702	142	0.016	0.016	0.016	0.074	142	142	119	183	210	210	212	196	488	488	508	461
14	623	844	702	142	0.023	0.023	0.023	0.242	143	143	133	298	209	209	209	156	487	487	497	386
15	1703	844	702	142	0.000	0.000	0.000	0.000	62	62	46	62	237	237	222	237	540	540	572	540
16	2625	844	702	142	0.000	0.000	0.000	0.070	94	94	83	144	232	232	228	217	513	513	528	478
17	708	844	702	142	0.002	0.002	0.002	0.055	102	102	87	141	228	228	225	217	509	509	528	482
18	507	844	702	142	0.000	0.000	0.000	0.217	120	120	95	268	217	217	215	170	502	502	529	402
19	619	844	702	142	0.021	0.021	0.021	0.311	125	125	118	332	217	217	216	150	497	497	505	359
20	1547	844	702	142	0.007	0.007	0.007	0.401	132	132	129	417	217	217	215	115	490	490	495	310
21	509	844	702	142	0.134	0.231	0.231	0.269	247	316	316	348	175	**151**	151	140	418	373	373	354
21.1	327	844	702	142	0.000	0.007	0.007	0.201	90	95	95	237	236	235	229	190	513	509	514	413
22	633	844	702	142	0.000	0.028	0.028	0.386	175	196	193	508	185	179	179	63	478	465	466	274
23	804	844	702	142	0.008	0.222	0.222	0.262	135	320	320	355	216	**150**	150	137	488	371	370	350
24	714	844	702	142	0.000	0.119	0.119	0.356	140	225	224	396	206	**179**	180	119	494	435	436	328
25	591	844	702	142	0.022	0.255	0.255	0.255	119	300	300	300	226	**165**	166	165	494	375	375	375
26	523	844	702	142	0.337	0.337	0.337	0.337	392	388	388	388	120	124	124	124	328	329	329	329
27	1698	844	702	142	0.230	0.271	0.271	0.399	257	287	287	379	171	163	163	133	412	390	390	330
28	601	844	702	142	0.230	0.416	0.416	0.416	258	393	393	393	161	**115**	114	115	420	331	332	331
	####																			

Subcatchment under study

Scenarios

#1 Existing

#2 Future Official Plan

#3 Future OP + TRCA Natural Heritage

#4 Future OP + 50% impervious for lands south of Oak Ridges Moraine.

Subcatchment or basin with future landuse scenario (#2) GWI estimate different from existing landuse (Scenario #1).

All values in mm/year unless noted otherwise.

See Figure 25 for subcatchment locations.

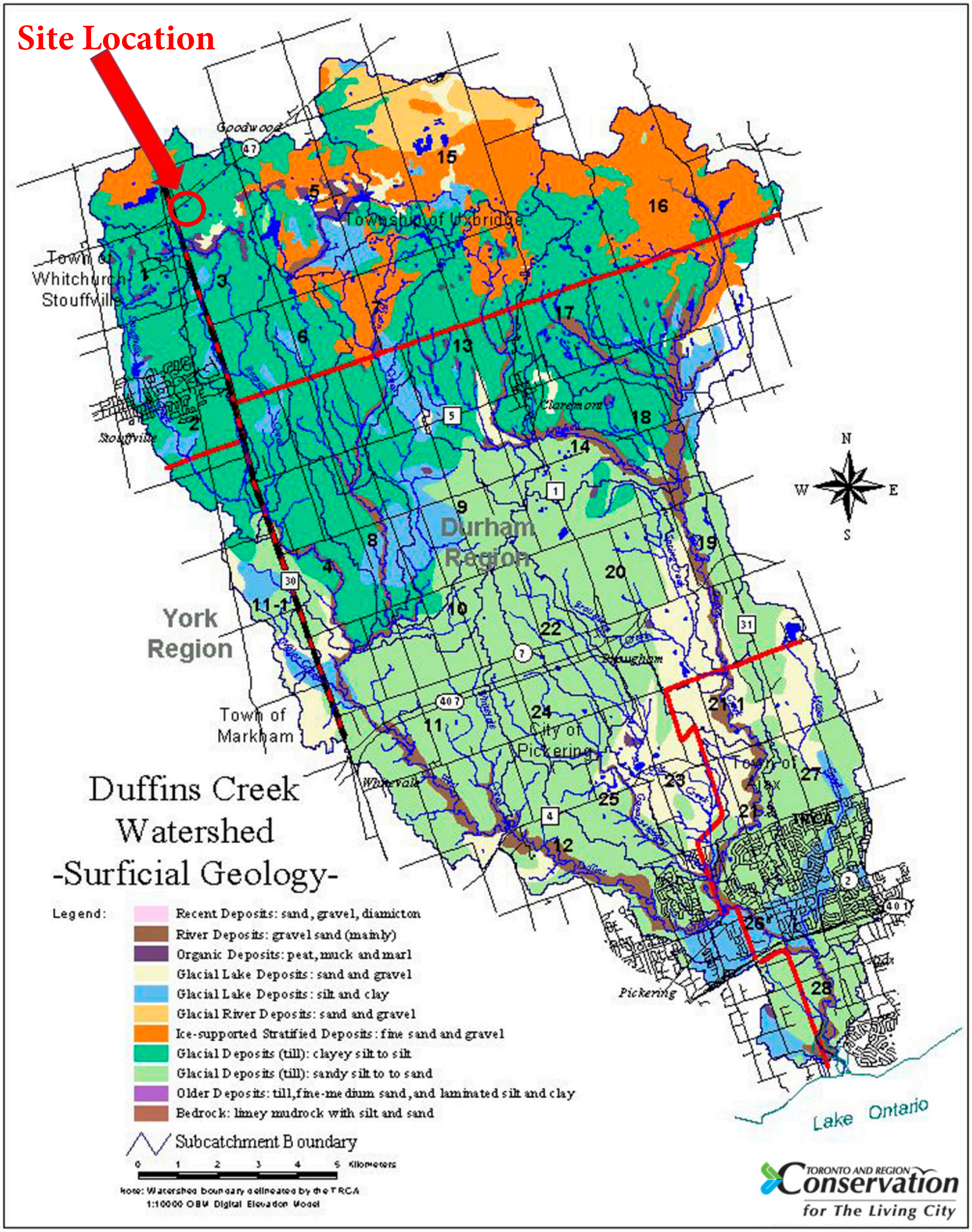
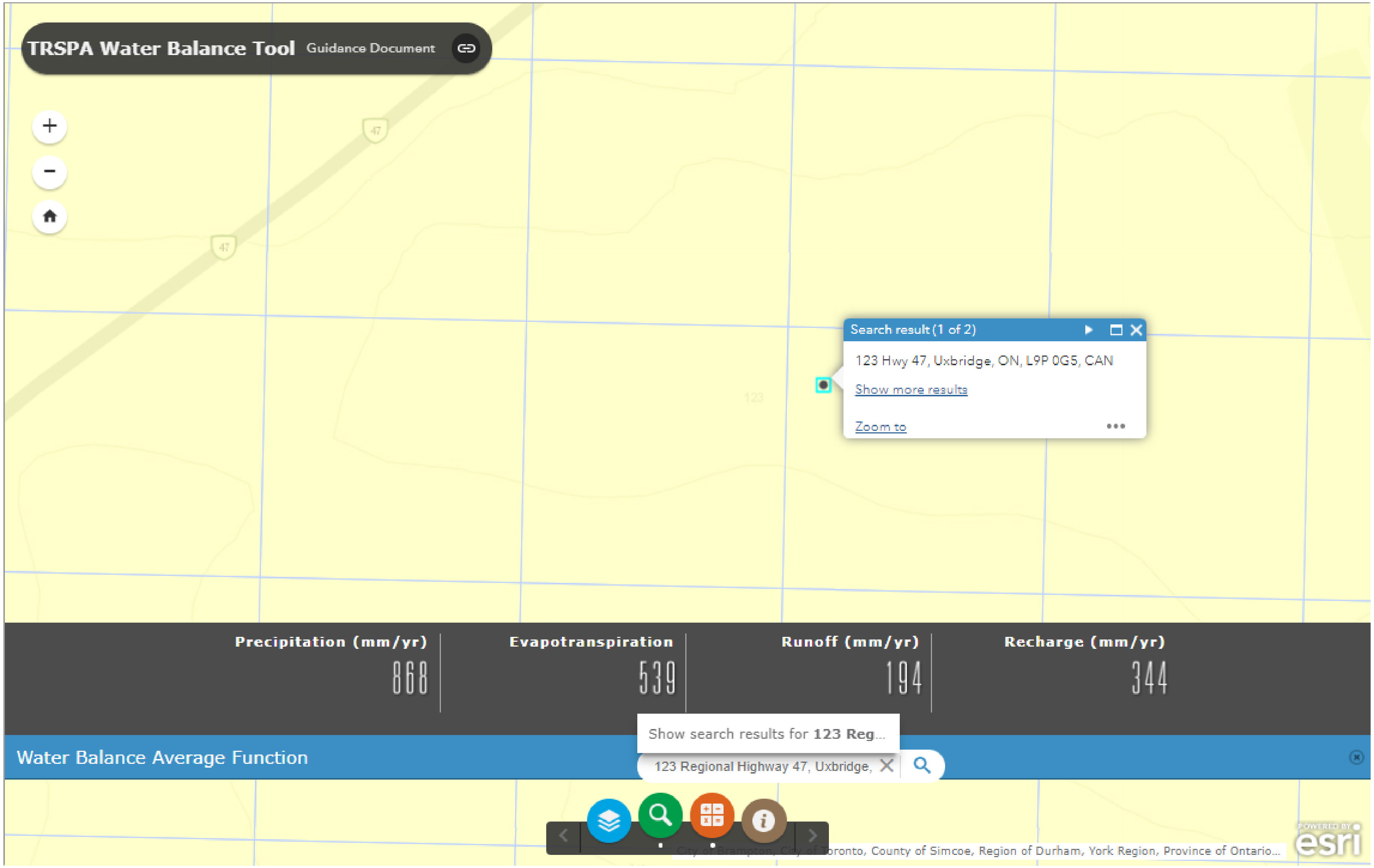
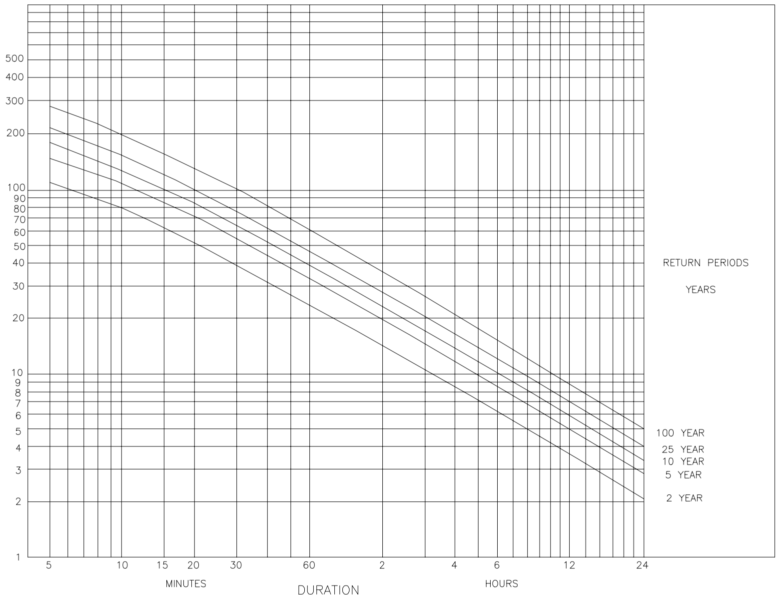


Figure 25: 30 sub-catchments and GSC surficial geology. Figure provided by TRCA.

TRSPA WATER BALANCE TOOL



APPENDIX VI –IDF DATA



1. EQUATION FOR TYPICAL INTENSITY–DURATION–FREQUENCY CURVES: T–TIME(MINUTES)
I – INTENSITY (mm/hr)

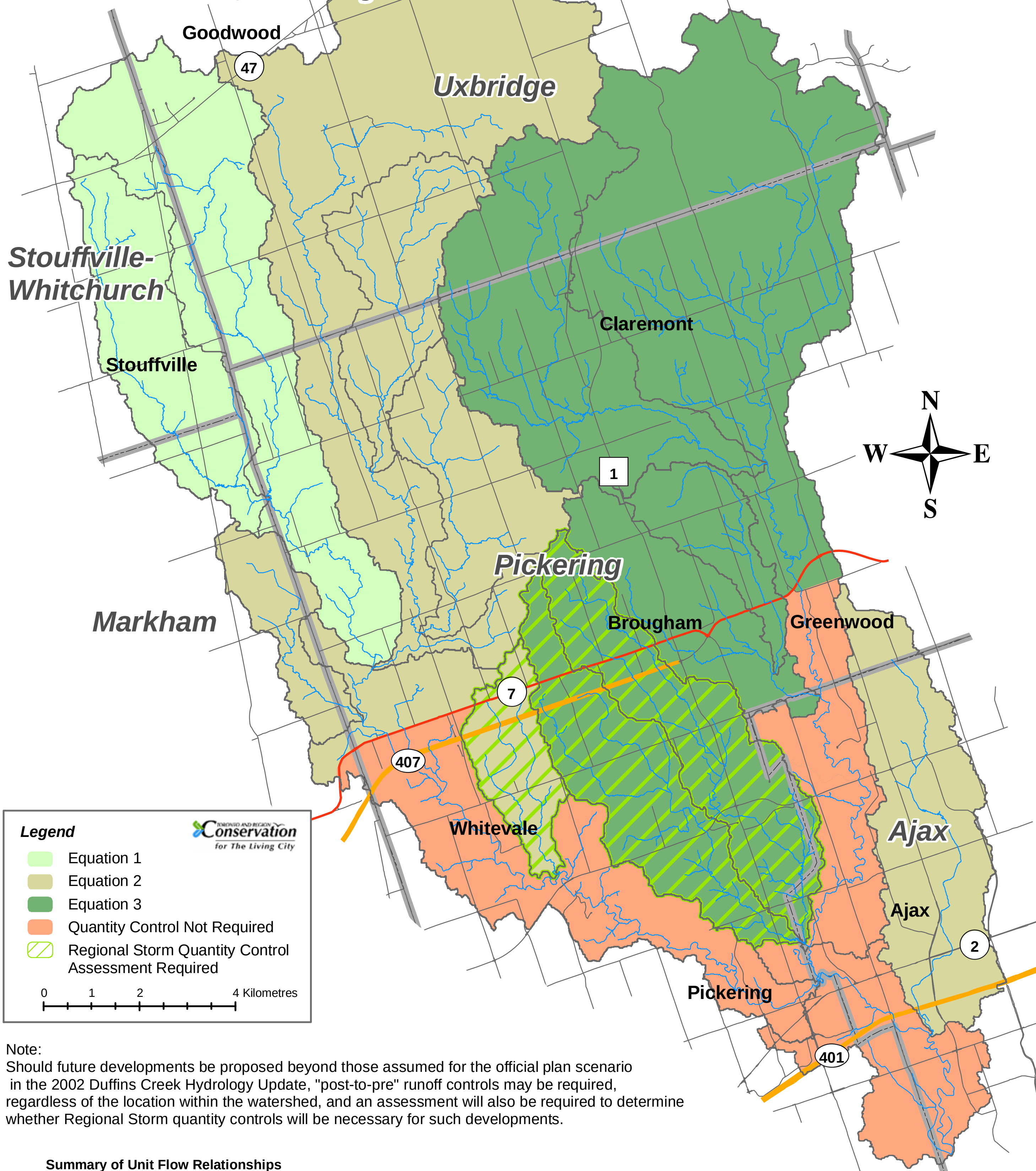
$I_2 = \frac{645}{(T+5)^{0.786}}$ $I_5 = \frac{904}{(T+5)^{0.788}}$ $I_{10} = \frac{1065}{(T+5)^{0.788}}$ $I_{25} = \frac{1234}{(T+4)^{0.787}}$ $I_{100} = \frac{1799}{(T+5)^{0.810}}$

2. THE ABOVE EQUATION ARE ONLY VALID FOR T=10 MINUTES TO 1440 MINUTES

APPROVED	TOWNSHIP OF UXBRIDGE	DATE OF ISSUE MARCH 1989
REVISION DATE OF REVISION	RAINFALL INTENSITY DURATION CURVES	DRAWING No. US–600

APPENDIX VII –Duffin Creek Unit Flow Relationships

Duffins Creek Stormwater Management Quantity Control Release Rates



Note:
Should future developments be proposed beyond those assumed for the official plan scenario in the 2002 Duffins Creek Hydrology Update, "post-to-pre" runoff controls may be required, regardless of the location within the watershed, and an assessment will also be required to determine whether Regional Storm quantity controls will be necessary for such developments.

Summary of Unit Flow Relationships

Return Period	Equation 1	Equation 2	Equation 3
2-Year	Q_2 = 5.364 - 0.520 * LN(Drainage Area)	Q_2 = 6.125 - 0.675 * LN(Drainage Area)	Q_2 = 9.933 - 1.149 * LN(Drainage Area)
5-Year	Q_5 = 8.535 - 0.826 * LN(Drainage Area)	Q_5 = 8.601 - 0.890 * LN(Drainage Area)	Q_5 = 16.081 - 1.873 * LN(Drainage Area)
10-Year	Q_{10} = 10.729 - 1.036 * LN(Drainage Area)	Q_{10} = 11.032 - 1.168 * LN(Drainage Area)	Q_{10} = 20.440 - 2.397 * LN(Drainage Area)
25-Year	Q_{25} = 13.832 - 1.334 * LN(Drainage Area)	Q_{25} = 14.199 - 1.530 * LN(Drainage Area)	Q_{25} = 26.633 - 3.139 * LN(Drainage Area)
50-Year	Q_{50} = 16.132 - 1.549 * LN(Drainage Area)	Q_{50} = 15.580 - 1.612 * LN(Drainage Area)	Q_{50} = 32.296 - 3.867 * LN(Drainage Area)
100-Year	Q_{100} = 18.629 - 1.787 * LN(Drainage Area)	Q_{100} = 17.972 - 1.870 * LN(Drainage Area)	Q_{100} = 37.346 - 4.471 * LN(Drainage Area)

Table 5.1

Summary of Unit Flow Relationships

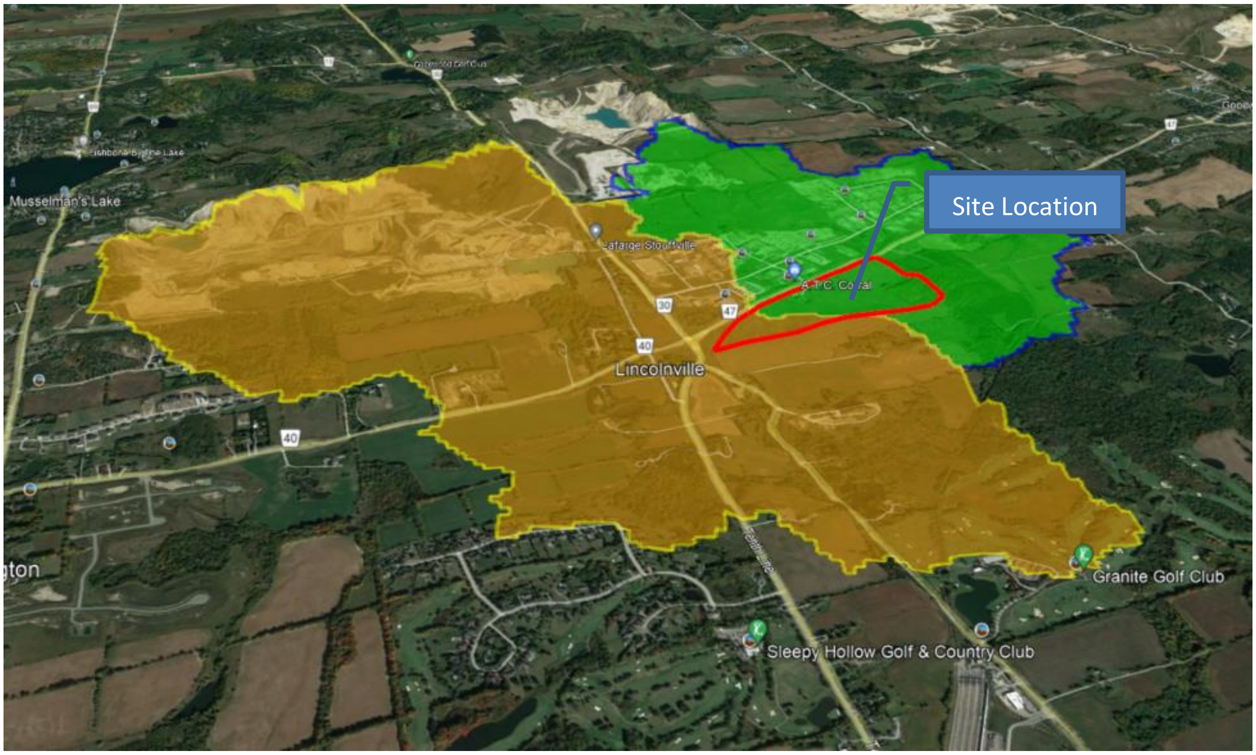
Return Period	Catchment 3 (Reesor Creek)	Catchment 9 (W.Duffins Creek Trib)	Catchment 23 (Urfe Creek)
2-year	Q_2= 5.364-0.520 ln(A)	Q_2= 6.125-0.675 ln(A)	Q_2= 9.933-1.149 ln(A)
5-year	Q_5= 8.535-0.826 ln(A)	Q_5= 8.601-0.890 ln(A)	Q_5= 16.081-1.873 ln(A)
10-year	Q_{10}= 10.729-1.036 ln(A)	Q_{10}= 11.032-1.168 ln(A)	Q_{10}= 20.440-2.397 ln(A)
25-year	Q_{25}= 13.832-1.334 ln(A)	Q_{25}= 14.199-1.530 ln(A)	Q_{25}= 26.633-3.139 ln(A)
50-year	Q_{50}= 16.132-1.549 ln(A)	Q_{50}= 15.580-1.612 ln(A)	Q_{50}= 32.296-3.867 ln(A)
100-year	Q_{100}= 18.629-1.787 ln(A)	Q_{100}= 17.972-1.870 ln(A)	Q_{100}= 37.346-4.471 ln(A)

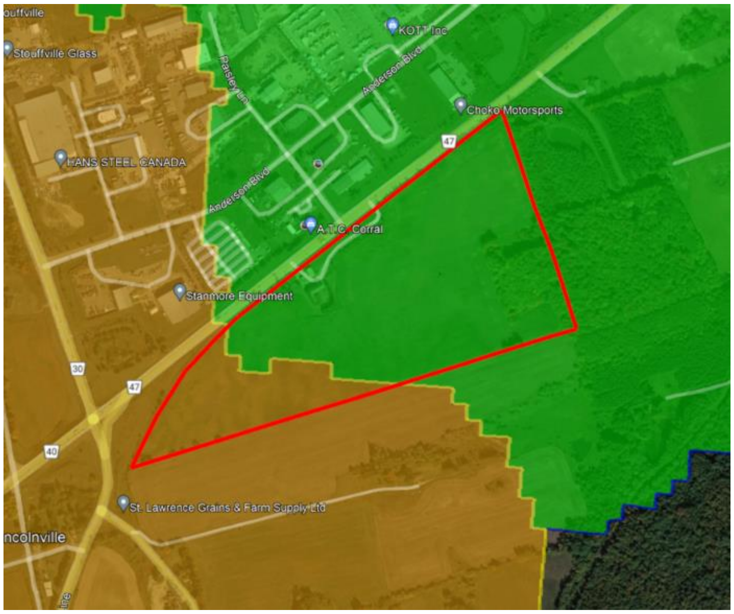
Note: - Area (A) in hectares

- Unit Flow (Q_n) in Litres/s/ha

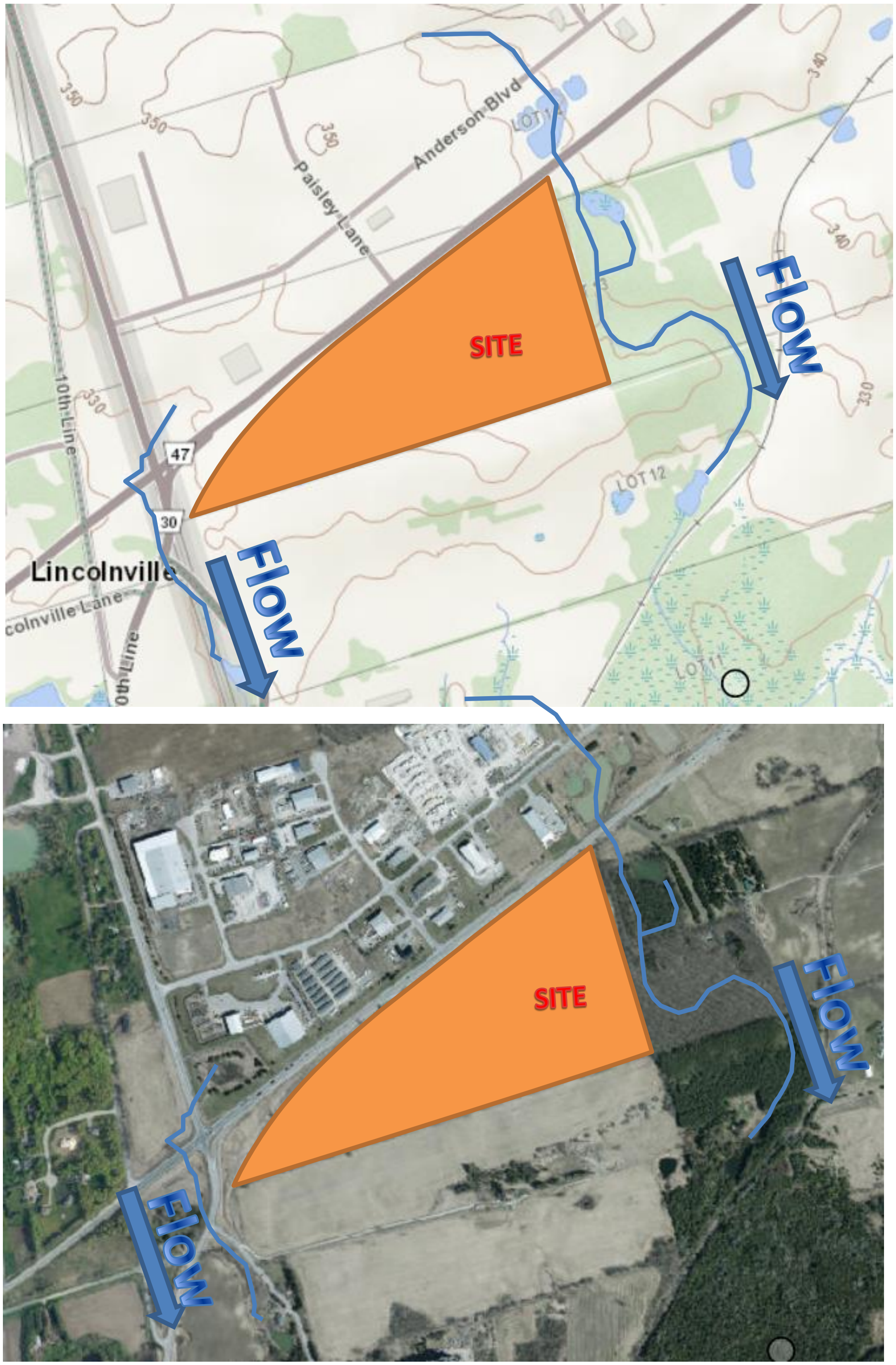
APPENDIX VIII –SUBWATERSHEDS WHITHIN THE SITE

Watershed Calculations





Overview of Subwatershed and Property Boundary



Identified ponds and watercourses near the site

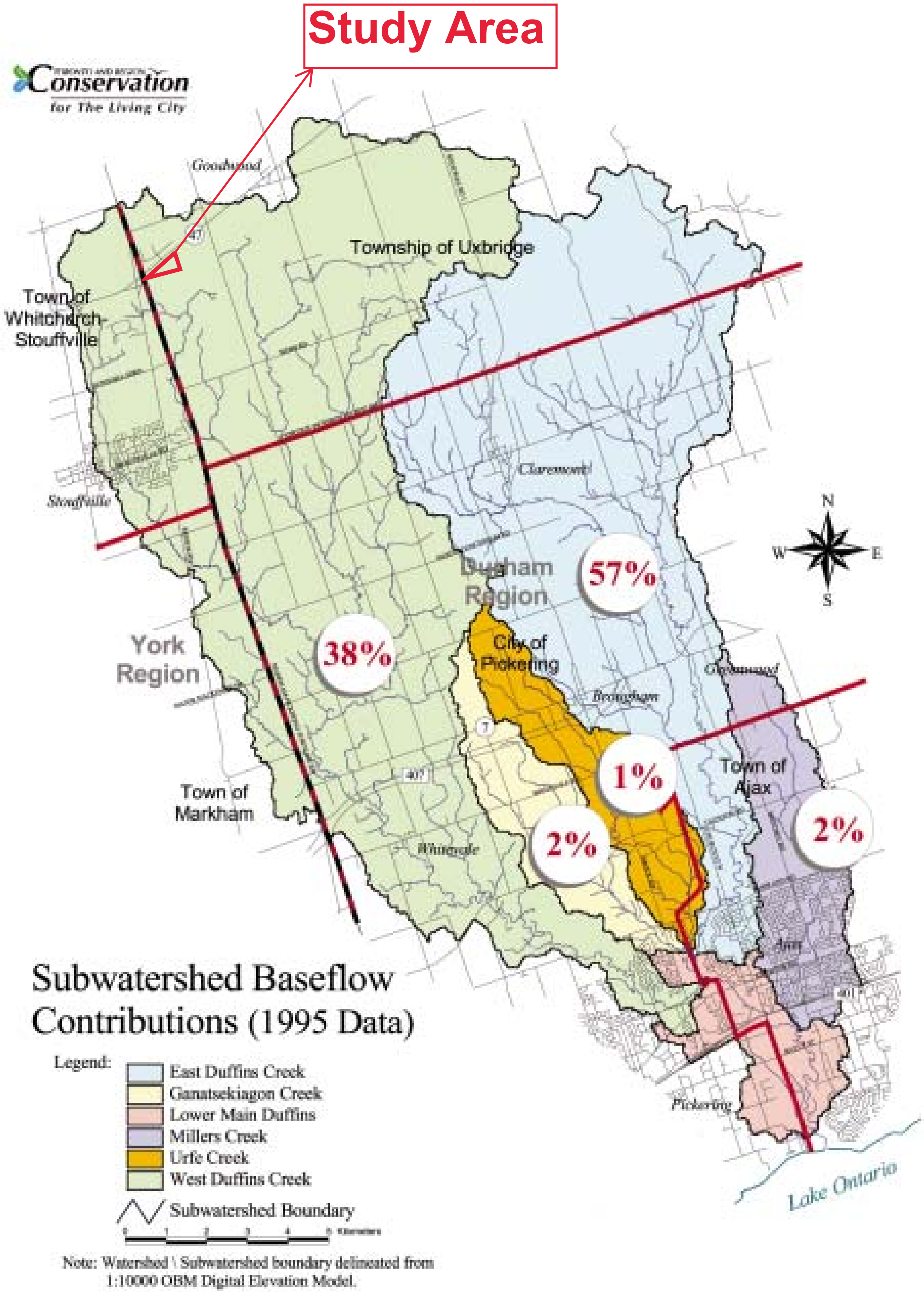
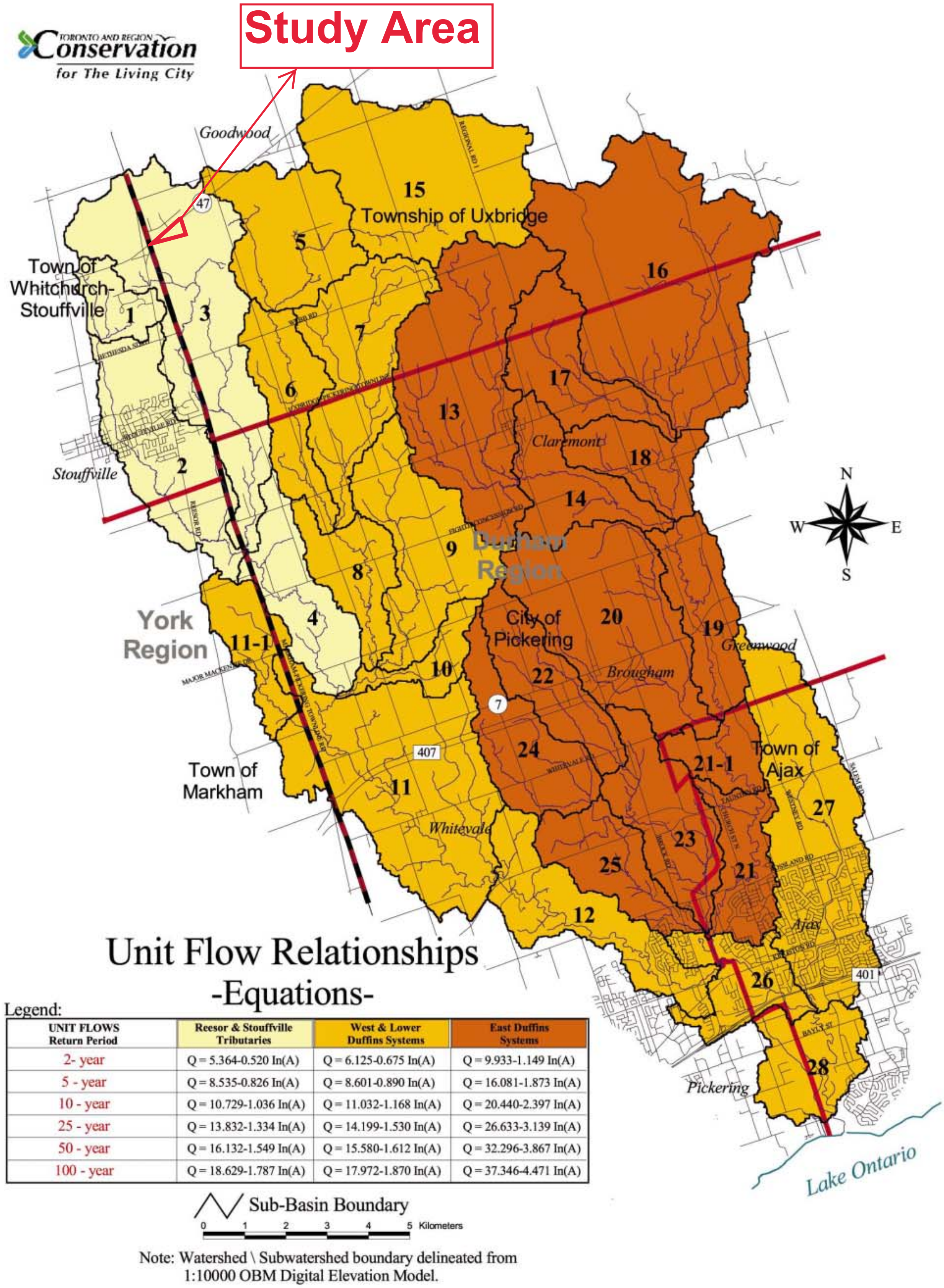

Study Area
Conservation for The Living City
Township of Uxbridge
Town of Whitchurch-Stouffville
Stouffville
Claremont
Durham Region
57%
York Region
38%
City of Pickering
Brougham
Town of Ajax
1%
2%
2%
Town of Markham
Whitevale
Ajax
Pickering
Lake Ontario
N
W
E
S
Subwatershed Baseflow Contributions (1995 Data)
Legend:
East Duffins Creek
Ganatsekiagon Creek
Lower Main Duffins
Millers Creek
Urfe Creek
West Duffins Creek
Subwatershed Boundary
Note: Watershed \ Subwatershed boundary delineated from 1:10000 OBM Digital Elevation Model.

FIGURE 6.12



UNIT FLOWS Return Period	Reesor & Stouffville Tributaries	West & Lower Duffins Systems	East Duffins Systems
2- year	Q = 5.364-0.520 In(A)	Q = 6.125-0.675 In(A)	Q = 9.933-1.149 In(A)
5 - year	Q = 8.535-0.826 In(A)	Q = 8.601-0.890 In(A)	Q = 16.081-1.873 In(A)
10 - year	Q = 10.729-1.036 In(A)	Q = 11.032-1.168 In(A)	Q = 20.440-2.397 In(A)
25 - year	Q = 13.832-1.334 In(A)	Q = 14.199-1.530 In(A)	Q = 26.633-3.139 In(A)
50 - year	Q = 16.132-1.549 In(A)	Q = 15.580-1.612 In(A)	Q = 32.296-3.867 In(A)
100 - year	Q = 18.629-1.787 In(A)	Q = 17.972-1.870 In(A)	Q = 37.346-4.471 In(A)

FIGURE 5.5

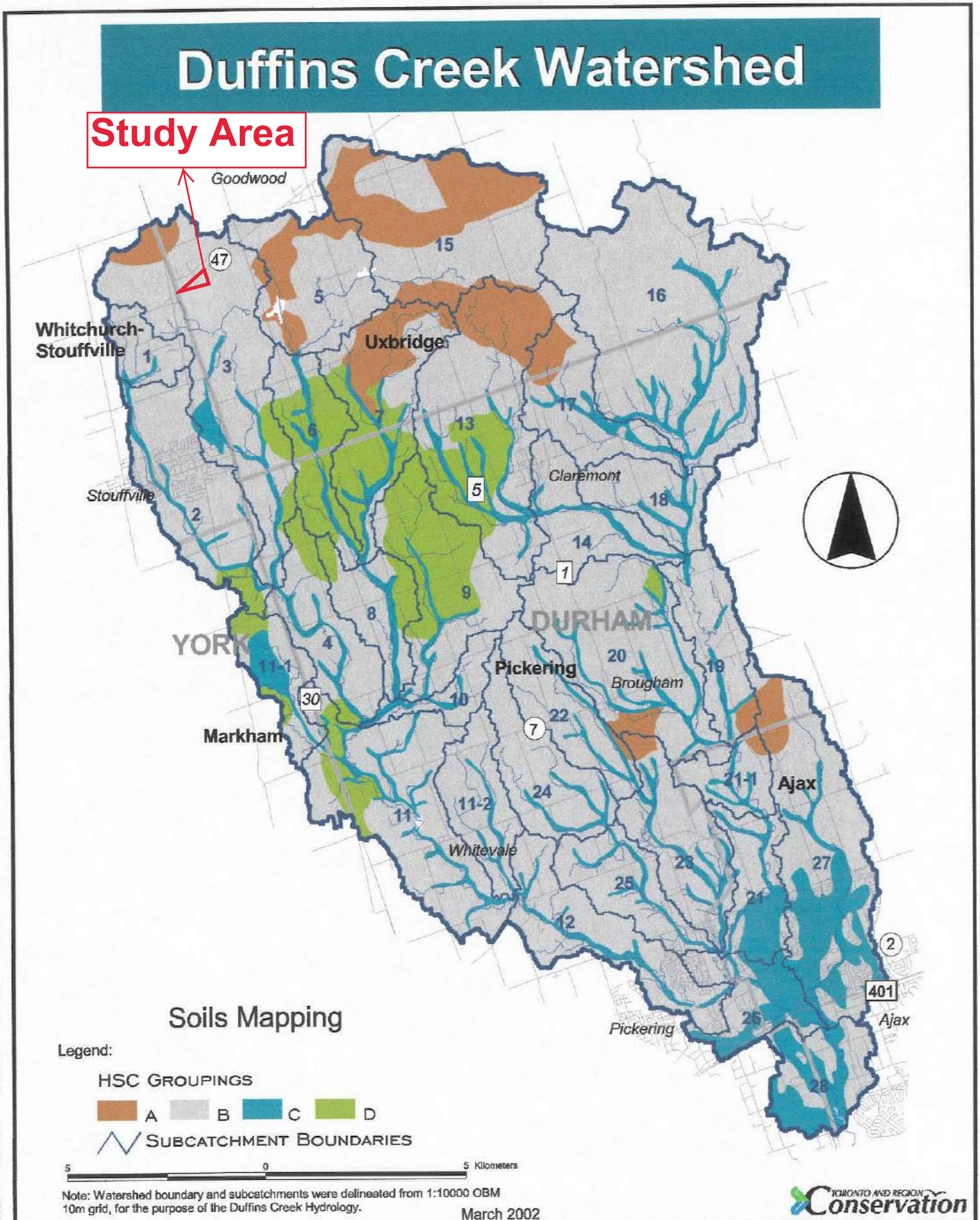
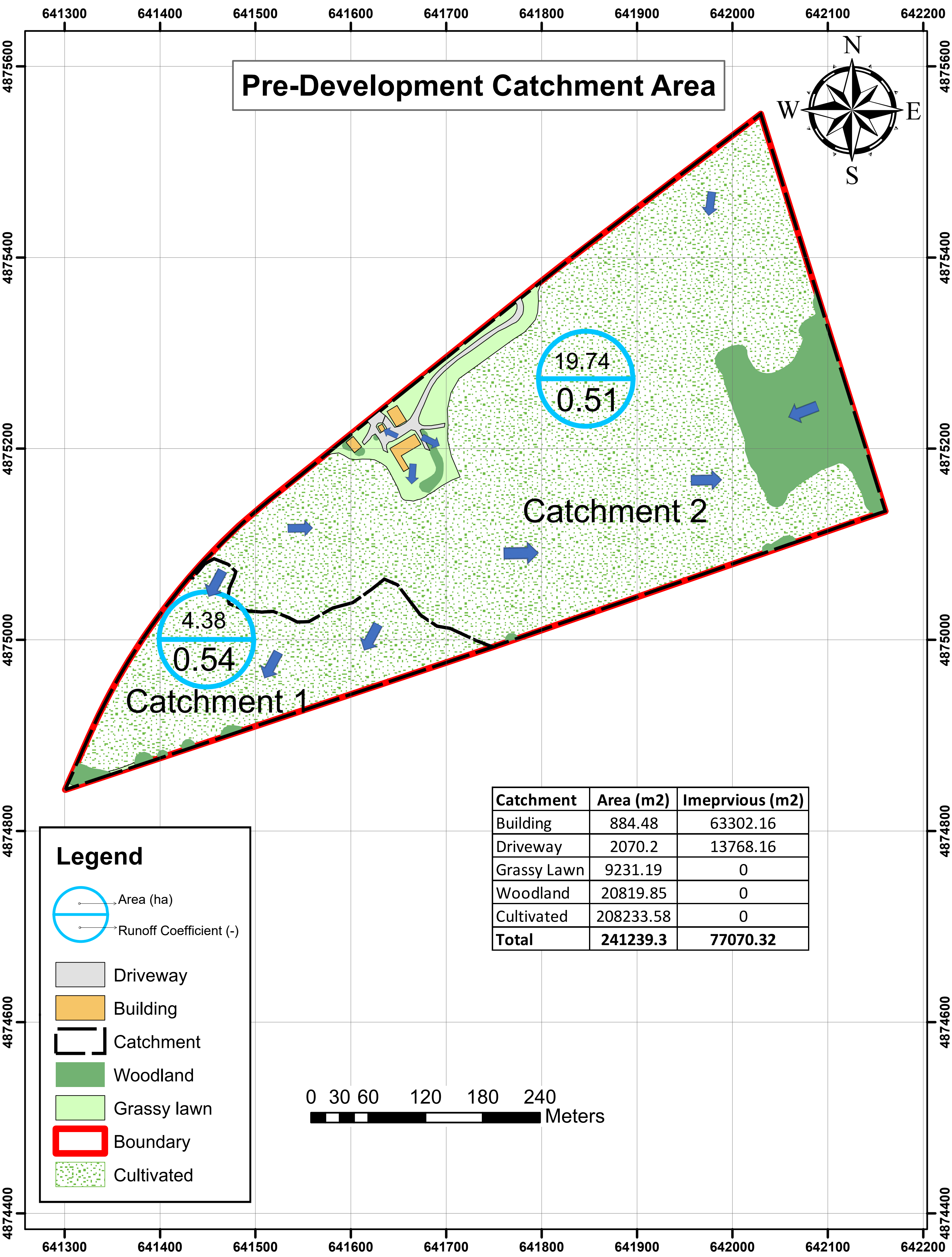
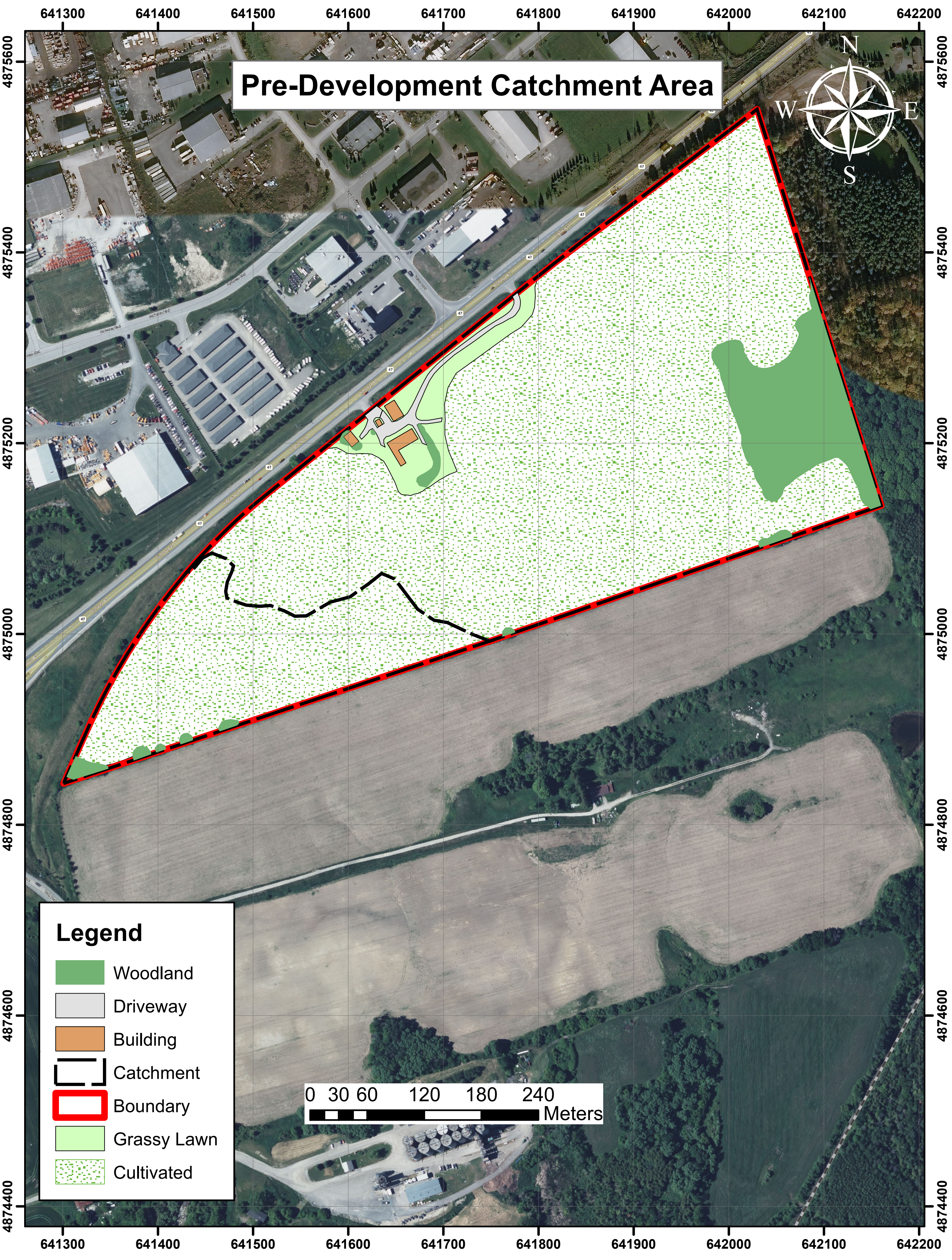


Figure A.1 *Soils Mapping*

APPENDIX IX –PRE- AND POST-DEVELOPMENT CATCHEMENT AREA

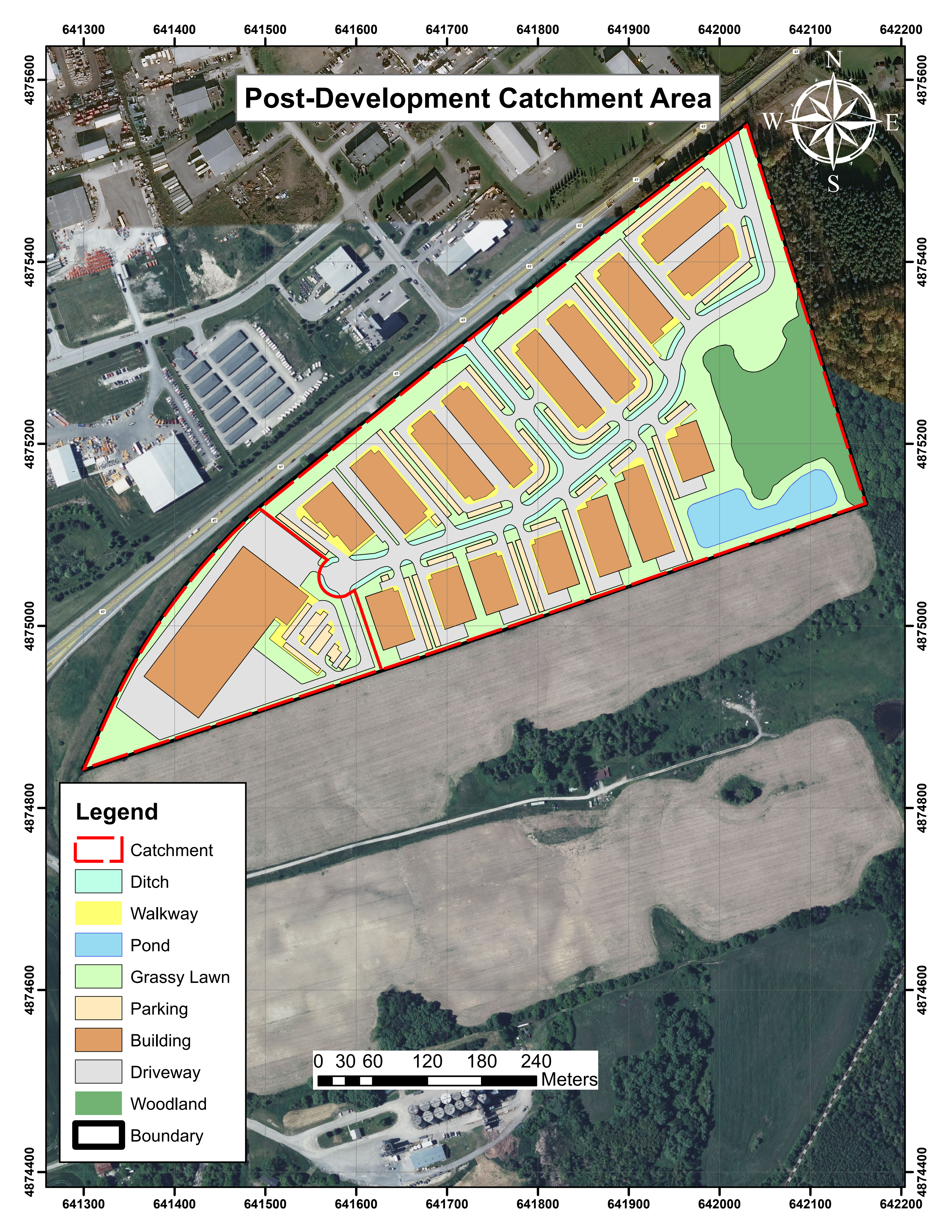


Catchment	Area (m2)	Imeprvious (m2)
Building	884.48	63302.16
Driveway	2070.2	13768.16
Grassy Lawn	9231.19	0
Woodland	20819.85	0
Cultivated	208233.58	0
Total	**241239.3**	**77070.32**



Pre-Development Catchment Area
N
S
W
E
641300
641400
641500
641600
641700
641800
641900
642000
642100
642200
4874400
4874600
4874800
4875000
4875200
4875400
4875600
Legend
Woodland
Driveway
Building
Catchment
Boundary
Grassy Lawn
Cultivated
0 30 60 120 180 240
Meters

Catchment	Area (m2)	Imeprvious (m2)
Building	77861.66	77861.66
Driveway	81091.9	81091.9
Parking Lot	16934.8	16934.8
Walkway	9972.6	9972.6
Ditch	7951.98	0
Grassy Lawn	22666.1	0
Dry Pond	6338.31	0
Woodland	18422	0
Total	**241239.3**	**185860.9**



Post-Development Catchment Area
N
S
E
W
641300
641400
641500
641600
641700
641800
641900
642000
642100
642200
4875600
4875400
4875200
4875000
4874800
4874600
4874400
Legend
Catchment
Ditch
Walkway
Pond
Grassy Lawn
Parking
Building
Driveway
Woodland
Boundary
0 30 60 120 180 240
Meters

APPENDIX X – RUNOFF COEFFICIENT CALCULATIONS

PRE-DEVELOPMENT (Runoff coefficient)

Ref.: Runoff Coefficients, Section 22, Appendix C, MTO Drainage Management Manual 1997 design chart 1.07 for rural & urban

Both Catchments # 1, 2

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m^2)	A × C	A × % Imp.
Building	0.95	100	884.5	840.3	884.5
Driveway (Gravel)	0.6	100	2070.2	1242.1	2070.2
Woodland, 0-5% slopes, Clay	0.35	0.0	20820	7287	0.0
Cultivated, 0-5% slopes, Clay	0.55	0.0	208233.6	114528.5	0.0
Grassy Lawn, <2% grade, Clayey soil	0.17	0.0	9231.2	1569.3	0.0
Weighted Average			**241239.3**	**0.52**	**1.2%**

Catchment # 1

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m^2)	A × C	A × % Imp.
Woodland, 0-5% slopes, Clay	0.35	0.0	1139	398.7	0.0
Cultivated, 0-5% slopes, Clay	0.55	0.0	42577	23417.1	0.0
Grassy Lawn, <2% grade, Clayey soil	0.17	0.0	126.3	21.5	0.0
Weighted Average			**43841.9**	**0.54**	**0.0%**

Catchment # 2

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m^2)	A × C	A × % Imp.
Building	0.95	100	884.5	840.3	884.5
Driveway (Gravel)	0.6	100	2070.2	1242.1	2070.2
Woodland, 0-5% slopes, Clay	0.35	0.0	19681	6888.3	0.0
Cultivated, 0-5% slopes, Clay	0.55	0.0	165657	91111.4	0.0
Grassy Lawn, <2% grade, Clayey soil	0.17	0.0	9104.9	1547.8	0.0
Weighted Average			**197397.4**	**0.51**	**1.5%**

POST-DEVELOPMENT (Runoff coefficient)

Ref.: Runoff Coefficients, Section 22, Appendix C, MTO Drainage Management Manual 1997 design chart 1.07 for rural & urban

Both Catchments # 1, 2

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m^2)	A × C	A × % Imp.
Building	0.95	100	77,861.7	73,968.6	77,861.7
Driveway/Parking (Asphalt)	0.95	100	98,026.7	93,125.4	98,026.7
Walkway (Concrete)	0.95	100	9972.6	9473.9	9972.6
Woodland, 0-5% slopes, Clay	0.35	0.0	18,422	6447.7	0.0
Grassy Lawn, <2% grade, Clayey soil	0.17	0.0	22,666.1	3853.2	0.0
Ditch/Swale	0.17	0.0	7952	1351.8	0.0
Dry Pond	0.05	0.0	6338.3	316.9	0.0
Weighted Average			**241239.3**	**0.78**	**80%**

Catchment # 1

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m^2)	A × C	A × % Imp.
Building	0.95	100	14245	13,532.8	14245
Driveway/Parking (Asphalt)	0.95	100	19304	18,338.8	19304
Walkway (Concrete)	0.95	100	865.8	822.5	865.8
Grassy Lawn, <2% grade, Clayey soil	0.17	0.0	9257.6	1573.8	0.0
Weighted Average			**43672.4**	**0.78**	**79%**

Catchment # 2

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m^2)	A × C	A × % Imp.
Building	0.95	100	63,616.7	60,435.8	63,616.7
Driveway/Parking (Asphalt)	0.95	100	78,722.7	74,786.6	78,722.7
Walkway (Concrete)	0.95	100	9106.8	8651.4	9106.8
Woodland, 0-5% slopes, Clay	0.35	0.0	18,422	6447.7	0.0
Grassy Lawn, <2% grade, Clayey soil	0.17	0.0	13,408.4	2279.4	0.0
Ditch/Swale	0.17	0.0	7952	1351.8	0.0
Dry Pond	0.05	0.0	6338.3	316.9	0.0
Weighted Average			**197566.9**	**0.78**	**80%**

Lots

Lot Number	Total Area (m^2)	% Imperviousness	Weighted Runoff Coefficient "C"
1	43672.4	79	0.78
2	8884.61	91	0.88
3	9647.02	97	0.93
4	20532.13	98	0.93
5	21336.4	97	0.93
6	9952.3	95	0.91
7	16930.61	95	0.91
8	6068.3	87	0.84
9	5910.63	96	0.92
10	5911.3	96	0.92
11	6095.4	93	0.89
12	7378.4	94	0.91
13	8632.9	98	0.93
14	6040.1	89	0.86
15 (Roadway)	22225.4	64	0.67
16 (Pond)	42021.4s	0.0	0.23

APPENDIX XI – STORMWATER MANAGEMENT CALCULATIONS

STORMWATER MANAGEMENT CALCULATIONS

Pre-Development Peak Flows

Storm (yrs)	Town of Uxbridge Coeff A	Coeff B	Coeff C
2	645	5	0.786
5	904	5	0.788
10	1065	5	0.788
25	1234	4	0.787
50	1540	4.5	0.8
100	1799	5	0.81

Modified Rational Method
Q= CaCIA/360

Where:
Q- Flow Rate (m3/s)
Ca- Peaking Coefficient
C- Rational Method Runoff Coefficient
I- Storm Intensity (mm/hr)
A- Area (ha)

Area #	1		2	
Area	4.38	ha	19.74	ha
Runoff Coefficient	0.54		0.51	
Time of Concentration	18.6	min	31.3	min
Return Rate	2	year	2	year
Peaking Coefficient	1.0		1.0	
Rainfall Intensity	53.76	mm/hr	53.76	mm/hr
Pre-Development Peak Flow	0.4	cms	1.50	cms
Return Rate	5	year	5	year
Peaking Coefficient	1.0		1.0	
Rainfall Intensity	74.87	mm/hr	74.87	mm/hr
Pre-Development Peak Flow	0.5	cms	2.09	cms
Return Rate	10	year	10	year
Peaking Coefficient	1.0		1.0	
Rainfall Intensity	88.21	mm/hr	88.21	mm/hr
Pre-Development Peak Flow	0.6	cms	2.47	cms
Return Rate	25	year	25	year
Peaking Coefficient	1.1		1.1	
Rainfall Intensity	106.08	mm/hr	106.08	mm/hr
Pre-Development Peak Flow	0.8	cms	3.26	cms
Return Rate	50	year	50	year
Peaking Coefficient	1.2		1.2	
Rainfall Intensity	124.92	mm/hr	124.92	mm/hr
Pre-Development Peak Flow	1.0	cms	4.19	cms
Return Rate	100	year	100	year
Peaking Coefficient	1.25		1.25	
Rainfall Intensity	138.99	mm/hr	138.99	mm/hr
Pre-Development Peak Flow	1.1	cms	4.86	cms

Post-Development Peak Flows

Storm (yrs)	Town of Uxbridge Coeff A	Coeff B	Coeff C	Modified Rational Method Q= CaCIA/360	
2	645	5	0.786	Where:	
5	904	5	0.788	Q-	Flow Rate (m3/s)
10	1065	5	0.788	Ca-	Peaking Coefficient
25	1234	4	0.787	C-	Rational Method Runoff Coefficient
50	1540	4.5	0.8	I-	Storm Intensity (mm/hr)
100	1799	5	0.81	A-	Area (ha)

Area #	1		2	
Area	4.37	ha	19.76	ha
Runoff Coefficient	0.78		0.78	
Time of Concentration	14.8	min	10	min
Return Rate	2	year	2	year
Peaking Coefficient	1.0		1.0	
Rainfall Intensity	61.81	mm/hr	76.76	mm/hr
Post-Development Peak Flow	0.6	cms	3.29	cms
Return Rate	5	year	5	year
Peaking Coefficient	1.0		1.0	
Rainfall Intensity	86.11	mm/hr	107.01	mm/hr
Post-Development Peak Flow	0.8	cms	4.58	cms
Return Rate	10	year	10	year
Peaking Coefficient	1.0		1.0	
Rainfall Intensity	101.44	mm/hr	126.06	mm/hr
Post-Development Peak Flow	1.0	cms	5.40	cms
Return Rate	25	year	25	year
Peaking Coefficient	1.1		1.1	
Rainfall Intensity	122.81	mm/hr	154.64	mm/hr
Post-Development Peak Flow	1.3	cms	7.28	cms
Return Rate	50	year	50	year
Peaking Coefficient	1.2		1.2	
Rainfall Intensity	144.46	mm/hr	181.31	mm/hr
Post-Development Peak Flow	1.6	cms	9.31	cms
Return Rate	100	year	100	year
Peaking Coefficient	1.25		1.25	
Rainfall Intensity	160.47	mm/hr	200.63	mm/hr
Post-Development Peak Flow	1.9	cms	10.74	cms

Pre-Development Peak Flows – Lots

LOT #	1	2	3	4	5	6	7	8
Area	4.37 ha	0.89 ha	0.96 ha	2.05 ha	2.13 ha	1.00 ha	1.69 ha	0.61 ha
Runoff Coefficient	0.54	0.51	0.51	0.51	0.51	0.51	0.51	0.54
Time of Concentration	18.6 min	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min
Return Rate	2 year	2 year	2 year	2 year	2 year	2 year	2 year	2 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	53.69 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr
Pre-Development Peak Flow	351.7 l/s	96.6 l/s	104.9 l/s	223.3 l/s	232.0 l/s	108.2 l/s	184.1 l/s	69.9 l/s
Return Rate	5 year	5 year	5 year	5 year	5 year	5 year	5 year	5 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	74.78 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr
Pre-Development Peak Flow	489.9 l/s	134.7 l/s	146.2 l/s	311.3 l/s	323.4 l/s	150.9 l/s	256.7 l/s	97.4 l/s
Return Rate	10 year	10 year	10 year	10 year	10 year	10 year	10 year	10 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	88.10 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr
Pre-Development Peak Flow	577.1 l/s	158.7 l/s	172.3 l/s	366.7 l/s	381.1 l/s	177.7 l/s	302.4 l/s	114.7 l/s
Return Rate	25 year	25 year	25 year	25 year	25 year	25 year	25 year	25 year
Peaking Coefficient	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Rainfall Intensity	105.94 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr
Pre-Development Peak Flow	763.4 l/s	214.1 l/s	232.5 l/s	494.8 l/s	514.2 l/s	239.8 l/s	408.0 l/s	154.8 l/s
Return Rate	50 year	50 year	50 year	50 year	50 year	50 year	50 year	50 year
Peaking Coefficient	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Rainfall Intensity	124.76 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr
Pre-Development Peak Flow	980.7 l/s	273.8 l/s	297.3 l/s	632.9 l/s	657.7 l/s	306.7 l/s	521.9 l/s	198.0 l/s
Return Rate	100 year	100 year	100 year	100 year	100 year	100 year	100 year	100 year
Peaking Coefficient	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Rainfall Intensity	138.81 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr
Pre-Development Peak Flow	1136.7 l/s	315.6 l/s	342.7 l/s	729.5 l/s	758.1 l/s	353.6 l/s	601.5 l/s	228.3 l/s

LOT #	9	10	11	12	13	14	15 (Road)	16 (Pond)
Area	0.59 ha	0.59 ha	0.61 ha	0.74 ha	0.86 ha	0.60 ha	2.22 ha	4.20 ha
Runoff Coefficient	0.53	0.51	0.51	0.51	0.51	0.51	0.51	0.46
Time of Concentration	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min	19.9 min	21.3 min
Return Rate	2 year	2 year	2 year	2 year	2 year	2 year	2 year	2 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	51.53 mm/hr	49.36 mm/hr
Pre-Development Peak Flow	66.8 l/s	64.3 l/s	66.3 l/s	80.2 l/s	93.9 l/s	65.7 l/s	162.2 l/s	265.0 l/s
Return Rate	5 year	5 year	5 year	5 year	5 year	5 year	5 year	5 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	71.75 mm/hr	68.73 mm/hr
Pre-Development Peak Flow	93.1 l/s	89.6 l/s	92.4 l/s	111.8 l/s	130.9 l/s	91.6 l/s	225.9 l/s	369.0 l/s
Return Rate	10 year	10 year	10 year	10 year	10 year	10 year	10 year	10 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	84.53 mm/hr	80.97 mm/hr
Pre-Development Peak Flow	109.7 l/s	105.6 l/s	108.9 cms	131.8 l/s	154.2 l/s	107.9 l/s	266.2 l/s	434.7 l/s
Return Rate	25 year	25 year	25 year	25 year	25 year	25 year	25 year	25 year
Peaking Coefficient	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Rainfall Intensity	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	101.48 mm/hr	97.04 mm/hr
Pre-Development Peak Flow	148.0 l/s	142.4 l/s	146.9 l/s	177.8 l/s	208.0 l/s	145.6 l/s	351.5 l/s	573.1 l/s
Return Rate	50 year	50 year	50 year	50 year	50 year	50 year	50 year	50 year
Peaking Coefficient	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Rainfall Intensity	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	119.53 mm/hr	114.32 mm/hr
Pre-Development Peak Flow	189.3 l/s	182.2 l/s	187.9 l/s	227.4 l/s	266.1 l/s	186.2 l/s	451.6 l/s	736.6 l/s
Return Rate	100 year	100 year	100 year	100 year	100 year	100 year	100 year	100 year
Peaking Coefficient	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Rainfall Intensity	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	133.04 mm/hr	127.28 mm/hr
Pre-Development Peak Flow	218.2 l/s	210.0 l/s	216.5 l/s	262.1 l/s	306.7 l/s	214.6 l/s	523.6 l/s	854.3 l/s

Post-Development Peak Flows – Lots

LOT #	1	2	3	4	5	6	7	8
Area	4.37 ha	0.89 ha	0.96 ha	2.05 ha	2.13 ha	1.00 ha	1.69 ha	0.61 ha
Runoff Coefficient	0.78	0.88	0.93	0.93	0.93	0.91	0.91	0.84
Time of Concentration	14.8 min	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min
Return Rate	2 year	2 year	2 year	2 year	2 year	2 year	2 year	2 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	61.81 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr
Post-Development Peak Flow	588.3 l/s	166.3 l/s	191.3 l/s	409.0 l/s	421.6 l/s	192.8 l/s	327.9 l/s	109.3 l/s
Return Rate	5 year	5 year	5 year	5 year	5 year	5 year	5 year	5 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	86.11 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr
Post-Development Peak Flow	819.7 l/s	231.8 l/s	266.7 l/s	570.1 l/s	587.7 l/s	268.8 l/s	457.0 l/s	152.4 l/s
Return Rate	10 year	10 year	10 year	10 year	10 year	10 year	10 year	10 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	101.44 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr
Post-Development Peak Flow	965.6 l/s	273.1 l/s	314.2 l/s	671.7 l/s	692.4 l/s	316.7 l/s	538.4 l/s	179.6 l/s
Return Rate	25 year	25 year	25 year	25 year	25 year	25 year	25 year	25 year
Peaking Coefficient	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Rainfall Intensity	122.81 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr
Post-Development Peak Flow	1285.9 l/s	368.5 l/s	424.0 l/s	906.3 l/s	934.2 l/s	427.3 l/s	726.5 l/s	242.3 l/s
Return Rate	50 year	50 year	50 year	50 year	50 year	50 year	50 year	50 year
Peaking Coefficient	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Rainfall Intensity	144.46 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr
Post-Development Peak Flow	1650.1 l/s	471.4 l/s	542.3 l/s	1159.2 l/s	1194.9 l/s	546.6 l/s	929.3 l/s	309.9 l/s
Return Rate	100 year	100 year	100 year	100 year	100 year	100 year	100 year	100 year
Peaking Coefficient	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Rainfall Intensity	160.47 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr
Post-Development Peak Flow	1909.4 l/s	543.4 l/s	625.1 l/s	1336.2 l/s	1377.3 l/s	630.0 l/s	1071.1 l/s	357.2 l/s

LOT #	9	10	11	12	13	14	15 (Road)	16 (Pond)
Area	0.59 ha	0.59 ha	0.61 ha	0.74 ha	0.86 ha	0.60 ha	2.22 ha	4.20 ha
Runoff Coefficient	0.92	0.92	0.89	0.91	0.93	0.86	0.67	0.23
Time of Concentration	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min	10.0 min	18.3 min	47.5 min
Return Rate	2 year	2 year	2 year	2 year	2 year	2 year	2 year	2 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	76.76 mm/hr	54.36 mm/hr	28.70 mm/hr
Post-Development Peak Flow	115.3 l/s	115.3 l/s	116.0 l/s	142.4 l/s	171.4 l/s	111.3 l/s	225.2 l/s	77.3 l/s
Return Rate	5 year	5 year	5 year	5 year	5 year	5 year	5 year	5 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	107.01 mm/hr	75.72 mm/hr	39.90 mm/hr
Post-Development Peak Flow	160.7 l/s	160.8 l/s	161.7 l/s	198.5 l/s	238.9 l/s	155.1 l/s	313.6 l/s	107.5 l/s
Return Rate	10 year	10 year	10 year	10 year	10 year	10 year	10 year	10 year
Peaking Coefficient	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rainfall Intensity	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	126.06 mm/hr	89.20 mm/hr	47.01 mm/hr
Post-Development Peak Flow	189.4 l/s	189.4 l/s	190.5 l/s	233.9 l/s	281.5 l/s	182.8 l/s	369.5 l/s	126.6 l/s
Return Rate	25 year	25 year	25 year	25 year	25 year	25 year	25 year	25 year
Peaking Coefficient	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Rainfall Intensity	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	154.64 mm/hr	107.33 mm/hr	55.52 mm/hr
Post-Development Peak Flow	255.5 l/s	255.6 l/s	257.0 l/s	315.6 l/s	379.8 l/s	246.6 l/s	489.0 l/s	164.5 l/s
Return Rate	50 year	50 year	50 year	50 year	50 year	50 year	50 year	50 year
Peaking Coefficient	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Rainfall Intensity	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	181.31 mm/hr	126.38 mm/hr	65.32 mm/hr
Post-Development Peak Flow	326.8 l/s	326.9 l/s	328.7 l/s	403.7 l/s	485.8 l/s	315.5 l/s	628.2 l/s	211.2 l/s
Return Rate	100 year	100 year	100 year	100 year	100 year	100 year	100 year	100 year
Peaking Coefficient	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Rainfall Intensity	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	200.63 mm/hr	140.60 mm/hr	72.78 mm/hr
Post-Development Peak Flow	376.7 l/s	376.8 l/s	378.9 l/s	465.3 l/s	560.0 l/s	363.6 l/s	728.0 l/s	245.1 l/s

Allowable Release Rate

$$Q = P_{pre} - Q_U$$

Where:

Q = Allowable Post-Development Release Rate
Q_{PRE} = Pre-Development Flow
Q_U = Post-Development Uncontrolled Flow

Storm	Pre-Development Flow	Post- Development Uncontrolled Flow	Allowable Outflow	Pond Release
(yrs)	Qpre (cms)	Q_U (cms)	Q (cms)	Q (cms)
2	1.9	0.6	1.27	0.11
5	2.6	0.8	1.77	0.24
10	3.0	1.0	2.09	0.37
25	4.0	1.3	2.75	0.69
50	5.2	1.6	3.54	1.16
100	6.0	1.9	4.10	1.55

Quantity Control Volume Calculations

Drainage Area (ha)	**19.74**
Runoff Coeff. (C)	**0.78**
Time of Concentration	10 min
Time Step	5 min
Controlled Release Rate (Q_C) (cms)	0.11 - 1.55
Max. Storage Required (m3)	**7010.4**

Results

Storm Event (yr)	Storage (m3)	Time (min)
2	3756.5	175
5	4540.8	105
10	4877.5	75
25	5544.1	50
50	6390.8	35
100	7010.4	30

Required Storage Volumes (2yr)

T	$I = A/(t+B)^C$	$Q_R = 0.0028(C.Ca.I.A)$	$V_R = Q_R.T.60$	$V_C = Q_C.T.60$	$V = V_R - V_C$
Time	Rainfall Intensity	Runoff	Runoff Vol.	Controlled Release Vol.	Storage Vol.
(min)	(mm/hr)	(cms)	(m3)	(m3)	(m3)
5	105.57	4.552	1365.5	33.5	1332.0
10	76.76	3.309	1985.7	67.0	1918.7
15	61.23	2.640	2375.7	100.4	2275.3
20	51.38	2.215	2658.0	133.9	2524.1
25	44.52	1.919	2878.9	167.4	2711.5
30	39.44	1.700	3060.5	200.9	2859.6
35	35.51	1.531	3214.8	234.4	2980.5
40	32.37	1.396	3349.2	267.9	3081.4
45	29.80	1.285	3468.4	301.3	3167.1
50	27.65	1.192	3575.7	334.8	3240.8
55	25.82	1.113	3673.2	368.3	3304.9
60	24.24	1.045	3762.8	401.8	3361.0
65	22.87	0.986	3845.7	435.3	3410.5
70	21.67	0.934	3922.9	468.7	3454.2
75	20.59	0.888	3995.2	502.2	3493.0
80	19.64	0.847	4063.3	535.7	3527.6
85	18.77	0.809	4127.6	569.2	3558.4
90	17.99	0.776	4188.5	602.7	3585.9
95	17.28	0.745	4246.5	636.1	3610.4
100	16.63	0.717	4301.9	669.6	3632.2
105	16.03	0.691	4354.8	703.1	3651.7
110	15.48	0.667	4405.5	736.6	3668.9
115	14.97	0.646	4454.2	770.1	3684.2
120	14.50	0.625	4501.1	803.6	3697.6
125	14.06	0.606	4546.3	837.0	3709.3
130	13.65	0.588	4590.0	870.5	3719.5
135	13.26	0.572	4632.2	904.0	3728.2
140	12.90	0.556	4673.1	937.5	3735.6
145	12.56	0.542	4712.7	971.0	3741.8
150	12.25	0.528	4751.2	1004.4	3746.7
155	11.94	0.515	4788.6	1037.9	3750.6
160	11.66	0.503	4824.9	1071.4	3753.5
165	11.39	0.491	4860.3	1104.9	3755.4
170	11.13	0.480	4894.8	1138.4	3756.4
175	10.89	0.469	4928.4	1171.9	3756.5
180	10.66	0.459	4961.2	1205.3	3755.9
185	10.43	0.450	4993.2	1238.8	3754.4
190	10.22	0.441	5024.5	1272.3	3752.3
195	10.02	0.432	5055.2	1305.8	3749.4
200	9.83	0.424	5085.1	1339.3	3745.9
205	9.64	0.416	5114.5	1372.7	3741.7
210	9.47	0.408	5143.2	1406.2	3737.0
215	9.30	0.401	5171.4	1439.7	3731.7

:Maximum Storage Volume

Required Storage Volumes (5yr)

T	$I = A/(t+B)^C$	$Q_R = 0.0028(C.Ca.I.A)$	$V_R = Q_R.T.60$	$V_C = Q_C.T.60$	$V = V_R - V_C$
Time	Rainfall Intensity	Runoff	Runoff Vol.	Controlled Release Vol.	Storage Vol.
(min)	(mm/hr)	(cms)	(m3)	(m3)	(m3)
5	147.29	6.350	1905.0	71.7	1833.3
10	107.01	4.613	2768.0	143.4	2624.6
15	85.30	3.678	3309.8	215.1	3094.7
20	71.55	3.085	3701.5	286.8	3414.7
25	61.97	2.672	4007.6	358.5	3649.2
30	54.88	2.366	4259.1	430.2	3828.9
35	49.40	2.130	4472.6	501.9	3970.8
40	45.02	1.941	4658.5	573.5	4085.0
45	41.44	1.786	4823.3	645.2	4178.1
50	38.44	1.657	4971.5	716.9	4254.5
55	35.89	1.547	5106.2	788.6	4317.6
60	33.70	1.453	5229.9	860.3	4369.6
65	31.79	1.370	5344.4	932.0	4412.3
70	30.10	1.298	5450.9	1003.7	4447.2
75	28.61	1.233	5550.7	1075.4	4475.3
80	27.28	1.176	5644.5	1147.1	4497.4
85	26.08	1.124	5733.2	1218.8	4514.4
90	24.99	1.077	5817.2	1290.5	4526.7
95	24.00	1.035	5897.2	1362.2	4535.0
100	23.09	0.996	5973.4	1433.9	4539.5
105	22.26	0.960	6046.3	1505.6	4540.8
110	21.50	0.927	6116.2	1577.3	4538.9
115	20.79	0.896	6183.3	1649.0	4534.4
120	20.13	0.868	6247.9	1720.6	4527.3
125	19.52	0.841	6310.2	1792.3	4517.8
130	18.94	0.817	6370.3	1864.0	4506.3
135	18.41	0.794	6428.4	1935.7	4492.7
140	17.91	0.772	6484.7	2007.4	4477.3
145	17.43	0.752	6539.2	2079.1	4460.1
150	16.99	0.732	6592.2	2150.8	4441.4
155	16.57	0.714	6643.6	2222.5	4421.1
160	16.17	0.697	6693.6	2294.2	4399.4
165	15.80	0.681	6742.3	2365.9	4376.4
170	15.44	0.666	6789.8	2437.6	4352.2
175	15.10	0.651	6836.0	2509.3	4326.7
180	14.78	0.637	6881.1	2581.0	4300.2
185	14.47	0.624	6925.2	2652.7	4272.6
190	14.18	0.611	6968.3	2724.4	4243.9
195	13.90	0.599	7010.4	2796.0	4214.3
200	13.63	0.588	7051.6	2867.7	4183.9
205	13.37	0.577	7091.9	2939.4	4152.5
210	13.13	0.566	7131.4	3011.1	4120.3
215	12.89	0.556	7170.2	3082.8	4087.3

:Maximum Storage Volume

Required Storage Volumes (10yr)

T	$I = A/(t+B)^C$	$Q_R = 0.0028(C.Ca.I.A)$	$V_R = Q_R.T.60$	$V_C = Q_C.T.60$	$V = V_R - V_C$
Time	Rainfall Intensity	Runoff	Runoff Vol.	Controlled Release Vol.	Storage Vol.
(min)	(mm/hr)	(cms)	(m3)	(m3)	(m3)
5	173.52	7.481	2244.2	110.8	2133.5
10	126.06	5.435	3260.9	221.6	3039.4
15	100.49	4.332	3899.2	332.3	3566.9
20	84.29	3.634	4360.7	443.1	3917.6
25	73.01	3.148	4721.4	553.9	4167.5
30	64.66	2.788	5017.6	664.7	4352.9
35	58.20	2.509	5269.2	775.5	4493.8
40	53.04	2.287	5488.2	886.2	4602.0
45	48.82	2.105	5682.3	997.0	4685.3
50	45.28	1.952	5856.9	1107.8	4749.1
55	42.28	1.823	6015.6	1218.6	4797.0
60	39.70	1.711	6161.4	1329.4	4832.0
65	37.45	1.614	6296.2	1440.1	4856.0
70	35.47	1.529	6421.7	1550.9	4870.8
75	33.71	1.453	6539.2	1661.7	4877.5
80	32.13	1.385	6649.8	1772.5	4877.3
85	30.72	1.324	6754.2	1883.3	4871.0
90	29.44	1.269	6853.3	1994.0	4859.2
95	28.27	1.219	6947.4	2104.8	4842.6
100	27.21	1.173	7037.3	2215.6	4821.7
105	26.23	1.131	7123.2	2326.4	4796.8
110	25.32	1.092	7205.5	2437.1	4768.3
115	24.49	1.056	7284.6	2547.9	4736.6
120	23.71	1.022	7360.7	2658.7	4702.0
125	22.99	0.991	7434.0	2769.5	4664.5
130	22.32	0.962	7504.8	2880.3	4624.6
135	21.69	0.935	7573.3	2991.0	4582.3

:Maximum Storage Volume

Required Storage Volumes (25yr)

T	$I = A/(t+B)^C$	$Q_R = 0.0028(C.Ca.I.A)$	$V_R = Q_R.T.60$	$V_C = Q_C.T.60$	$V = V_R - V_C$
Time	Rainfall Intensity	Runoff	Runoff Vol.	Controlled Release Vol.	Storage Vol.
(min)	(mm/hr)	(cms)	(m3)	(m3)	(m3)
5	218.94	10.383	3114.9	206.0	2908.9
10	154.64	7.333	4400.0	412.0	3988.1
15	121.60	5.767	5190.0	617.9	4572.1
20	101.18	4.798	5757.9	823.9	4934.0
25	87.18	4.134	6201.4	1029.9	5171.5
30	76.92	3.648	6566.1	1235.9	5330.2
35	69.05	3.274	6876.4	1441.9	5434.5
40	62.79	2.978	7147.0	1647.9	5499.1
45	57.69	2.736	7387.3	1853.8	5533.5
50	53.45	2.535	7603.9	2059.8	5544.1
55	49.85	2.364	7801.2	2265.8	5535.4
60	46.76	2.217	7982.6	2471.8	5510.8
65	44.07	2.090	8150.8	2677.8	5473.0
70	41.71	1.978	8307.5	2883.8	5423.8
75	39.62	1.879	8454.5	3089.7	5364.8
80	37.75	1.790	8592.9	3295.7	5297.2
85	36.07	1.711	8723.8	3501.7	5222.1
90	34.55	1.639	8848.1	3707.7	5140.4
95	33.17	1.573	8966.4	3913.7	5052.7
100	31.91	1.513	9079.3	4119.7	4959.7
105	30.75	1.458	9187.4	4325.6	4861.8
110	29.68	1.408	9291.1	4531.6	4759.5
115	28.70	1.361	9390.8	4737.6	4653.2
120	27.78	1.318	9486.7	4943.6	4543.2

:Maximum Storage Volume

Required Storage Volumes (50yr)

T	$I = A/(t+B)^C$	$Q_R = 0.0028(C.Ca.I.A)$	$V_R = Q_R.T.60$	$V_C = Q_C.T.60$	$V = V_R - V_C$
Time	Rainfall Intensity	Runoff	Runoff Vol.	Controlled Release Vol.	Storage Vol.
(min)	(mm/hr)	(cms)	(m3)	(m3)	(m3)
5	254.30	13.156	3946.8	349.3	3597.5
10	181.31	9.380	5628.1	698.6	4929.5
15	143.05	7.401	6660.6	1047.8	5612.8
20	119.18	6.166	7398.6	1397.1	6001.5
25	102.72	5.314	7971.4	1746.4	6225.0
30	90.63	4.689	8439.5	2095.7	6343.9
35	81.33	4.207	8835.7	2444.9	6390.8
40	73.93	3.825	9179.6	2794.2	6385.4
45	67.89	3.513	9483.8	3143.5	6340.3
50	62.86	3.252	9756.8	3492.8	6264.0
55	58.60	3.032	10004.7	3842.1	6162.6
60	54.94	2.842	10231.9	4191.3	6040.6
65	51.75	2.677	10441.9	4540.6	5901.3
70	48.95	2.533	10637.2	4889.9	5747.3
75	46.48	2.404	10819.8	5239.2	5580.7
80	44.26	2.290	10991.5	5588.4	5403.1
85	42.27	2.187	11153.6	5937.7	5215.8
90	40.47	2.094	11307.1	6287.0	5020.1
95	38.84	2.009	11453.0	6636.3	4816.7
100	37.34	1.932	11592.0	6985.6	4606.5
105	35.97	1.861	11725.0	7334.8	4390.1
110	34.71	1.796	11852.3	7684.1	4168.2
115	33.54	1.735	11974.5	8033.4	3941.1
120	32.46	1.679	12092.0	8382.7	3709.4

:Maximum Storage Volume

Required Storage Volumes (100yr)

T	$I = A/(t+B)^C$	$Q_R = 0.0028(C.Ca.I.A)$	$V_R = Q_R.T.60$	$V_C = Q_C.T.60$	$V = V_R - V_C$
Time	Rainfall Intensity	Runoff	Runoff Vol.	Controlled Release Vol.	Storage Vol.
(min)	(mm/hr)	(cms)	(m3)	(m3)	(m3)
5	278.63	15.016	4504.7	464.5	4040.1
10	200.63	10.812	6487.2	929.1	5558.2
15	158.93	8.565	7708.1	1393.6	6314.5
20	132.65	7.148	8578.1	1858.1	6720.0
25	114.44	6.167	9250.5	2322.6	6927.8
30	101.00	5.443	9797.6	2787.2	7010.4
35	90.65	4.885	10258.7	3251.7	7007.0
40	82.40	4.441	10657.4	3716.2	6941.1
45	75.66	4.077	11008.8	4180.8	6828.0
50	70.04	3.774	11323.2	4645.3	6677.9
55	65.27	3.518	11607.9	5109.8	6498.1
60	61.17	3.297	11868.2	5574.3	6293.8
65	57.61	3.105	12108.1	6038.9	6069.2
70	54.48	2.936	12330.8	6503.4	5827.4
75	51.70	2.786	12538.6	6967.9	5570.7
80	49.23	2.653	12733.6	7432.5	5301.2
85	47.00	2.533	12917.4	7897.0	5020.4
90	44.99	2.424	13091.2	8361.5	4729.7
95	43.16	2.326	13256.1	8826.0	4430.1
100	41.48	2.236	13413.1	9290.6	4122.5
105	39.95	2.153	13562.9	9755.1	3807.8
110	38.54	2.077	13706.3	10219.6	3486.7
115	37.23	2.006	13843.7	10684.2	3159.6
120	36.02	1.941	13975.8	11148.7	2827.1

:Maximum Storage Volume

Stage-Storage-Discharge Table

Water level	Orifice Discharge	Weir Discharge	Spillway Overflow Discharge	Total Discharge	Volume Pond	
(m)	(l/s)	(l/s)	(l/s)	(l/s)	(m3)	
328.2	0.0	0.0	0.0	0.0	0.00	Pond Bottom = 328.2m
328.3	0.0	0.0	0.0	0.0	182.13	Orifice = 328.3m
328.4	0.0	0.0	0.0	0.0	375.30	
328.5	30.3	0.0	0.0	30.3	579.96	
328.6	44.0	0.0	0.0	44.0	799.56	
328.7	54.4	0.0	0.0	54.4	1035.39	
328.8	63.1	0.0	0.0	63.1	1285.59	
328.9	70.7	0.0	0.0	70.7	1550.29	
329.0	77.6	0.0	0.0	77.6	1829.56	
329.1	83.9	0.0	0.0	83.9	2123.52	
329.2	89.7	0.0	0.0	89.7	2432.27	
329.3	95.3	0.0	0.0	95.3	2755.91	
329.4	100.5	0.0	0.0	100.5	3094.54	
329.5	105.4	0.0	0.0	105.4	3448.26	
329.6	110.2	0.0	0.0	110.2	3817.17	
329.7	114.7	0.00	0.0	114.7	4201.36	Weir = 329.7m
329.8	119.0	80.64	0.0	199.7	4600.95	
329.9	123.3	228.08	0.0	351.3	5016.03	
330.0	127.3	419.01	0.0	546.3	5446.71	
330.1	131.3	645.10	0.0	776.4	5893.08	
330.2	135.1	901.56	0.0	1036.7	6355.24	
330.3	138.8	1185.13	0.0	1324.0	6833.30	
330.4	142.4	1493.44	0.0	1635.9	7327.35	
330.5	146.0	1824.63	0.0	1970.6	7837.50	
330.6	149.4	2177.23	0.0	2326.7	8363.84	
330.7	152.8	2550.00	0.0	2702.8	8906.49	
330.8	156.1	2941.91	0.00	3098.0	9465.53	Spillway = 330.8 m
330.9	159.3	3352.06	708.20	4219.6	10041.07	
331.0	162.5	3779.68	2041.13	5983.3	10633.22	
331.1	165.6	4224.08	3819.66	8209.4	11242.06	
331.2	168.7	4684.65	5988.33	10841.6	11867.70	Pond Top= 331.2 m

Orifice		
Orifice Diameter (mm)		220
High Water Elev. (m)		331.2
Orifice Invert Elev.(m)		328.3
Orifice Center Elev. (m)		328.41
Head (m)		2.790
C		0.6
Orifice Area (m2)		0.0380
Flow Rate (cms)	Required	2.1
	Provided	0.2

weir		
Weir Length (m)		1.5
Weir Invert Elev. (m)		329.7

Major Storm Control Spillway	
Spillway Length (m)	12.0
Spillway Invert Elev. (m)	330.8

Drawdown Time

(Using the falling head orifice equation for total drawdown above the sill of orifice)

$$t = \frac{2A_p}{CA_o(2g)^{0.5}}\,(h_1^{0.5} - h_2^{0.5})$$

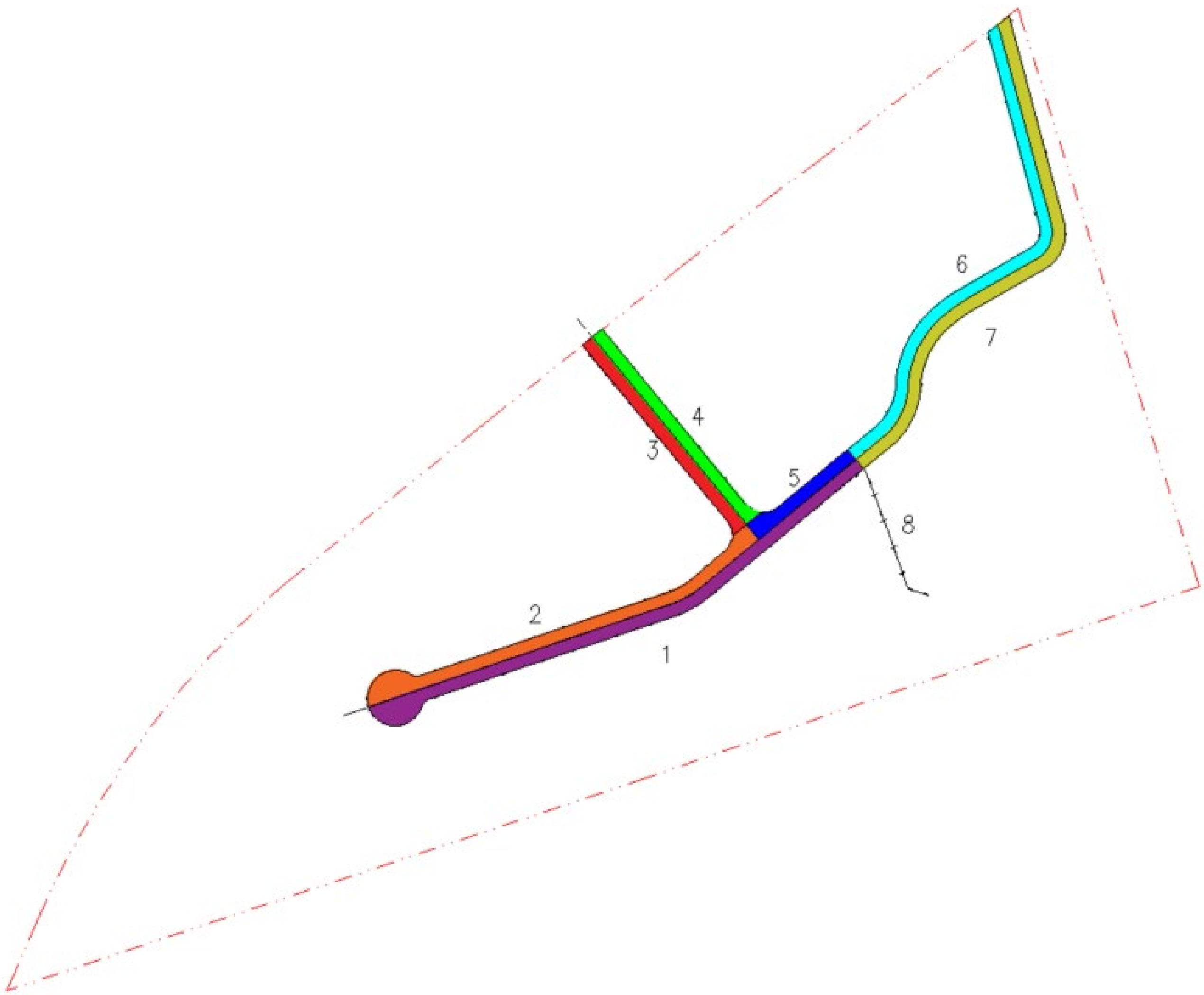
Where:

t = drawdown time in second		
A_p = average surface area of the pond for quality control volume (m^2)	3735	
C = discharge coefficient (orifice)	0.6	
A_o = cross-sectional area of orifice (m^2)	0.0380	
g = gravitational acceleration constant (9.81 m/s^2)		
h_1 = starting water elevation above the orifice (V= 3920m^3) (m)	329.68	1.38 m
h_2 = ending water elevation above the orifice (m)	328.3	0 m

t = 86918.20 seconds

t ~ 24.1 hours

Swale Size Calculation



S = 2.4% (Ditch # 5)

Manning Formula Uniform Trapezoidal Channel Flow at Given Slope and Depth

123 Hwy 47

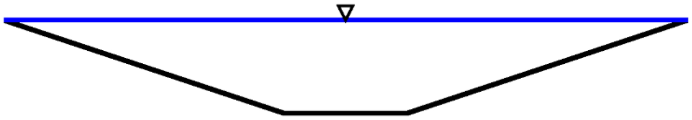
Swale Design

Inputs

Bottom width, b	0.8	m
Side slope 1 (horiz./vert.)	3	
Side slope 2 (horiz./vert.)	3	
Manning roughness, n ? Strickler B/B (See notes)	0.03	
Channel slope, S	0.024	rise/run
Flow depth, y	0.6	m
Bend Angle ? (for riprap sizing)	0	
Rock specific gravity (2.65)	2.65	
Design rock size, D50 Isbash Maynord Searcy * 1.25 (See notes)	0.3159	m

Results

Flow area, a	1.5600	m^2
Wetted perimeter, P_w	4.5947	m
Hydraulic radius, R_h	0.3395	m
Velocity, v	2.5132	m/s
Flow, Q	3.9206	m^3/s
Velocity head, h_v	0.3221	m
Top width, T	4.4000	m
Froude number, F	1.35	
Average shear stress (tractive force), tau	79.9038	N/m^2
n for design rock size per Strickler	0.0379	
n for design rock size per Blodgett	0.0917	
n for design rock size per Bathurst	0.0514	
Blodgett vs. Bathurst	Bathurst	
Required bottom angular rock size, D50 (Isbash & MC) ?	0.2398	m
Required side slope 1 angular rock size, D50 (Isbash & MC) ?	0.2527	m
Required side slope 2 angular rock size, D50 (Isbash & MC) ?	0.2527	m
Required angular rock size, D50 (Maynord, Ruff, and Abt 1989)	0.3112	m
Required angular rock size, D50 (Searcy 1967)	0.1390	m



S = 0.8% (Ditch # 1)

Manning Formula Uniform Trapezoidal Channel Flow at Given Slope and Depth

123 Hwy 47

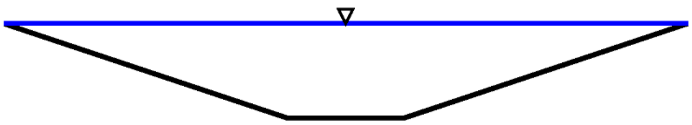
Swale Design

Inputs

Bottom width, b	0.8	m
Side slope 1 (horiz./vert.)	3	
Side slope 2 (horiz./vert.)	3	
Manning roughness, n ? ○Strickler ○B/B (See notes)	0.03	
Channel slope, S	0.008	rise/run
Flow depth, y	0.65	m
Bend Angle ? (for riprap sizing)	0	
Rock specific gravity (2.65)	2.65	
Design rock size, D50 ◉Isbash ○Maynord ○Searcy * 1.25 (See notes)	0.1155	m

Results

Flow area, a	1.7875	m^2
Wetted perimeter, P_w	4.9110	m
Hydraulic radius, R_h	0.3640	m
Velocity, v	1.5199	m/s
Flow, Q	2.7168	m^3/s
Velocity head, h_v	0.1178	m
Top width, T	4.7000	m
Froude number, F	0.79	
Average shear stress (tractive force), tau	28.5536	N/m^2
n for design rock size per Strickler	0.0326	
n for design rock size per Blodgett	0.0526	
n for design rock size per Bathurst	0.0359	
Blodgett vs. Bathurst	Blodgett	
Required bottom angular rock size, D50 (Isbash & MC) ?	0.0877	m
Required side slope 1 angular rock size, D50 (Isbash & MC) ?	0.0924	m
Required side slope 2 angular rock size, D50 (Isbash & MC) ?	0.0924	m
Required angular rock size, D50 (Maynord, Ruff, and Abt 1989)	0.0868	m
Required angular rock size, D50 (Searcy 1967)	0.0508	m



S = 0.7% (Ditch # 6)

Manning Formula Uniform Trapezoidal Channel Flow at Given Slope and Depth

123 Hwy 47

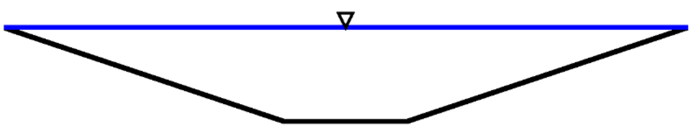
Swale Design

Inputs

Bottom width, b	0.8	m
Side slope 1 (horiz./vert.)	3	
Side slope 2 (horiz./vert.)	3	
Manning roughness, n ? ○Strickler ○B/B (See notes)	0.03	
Channel slope, S	0.007	rise/run
Flow depth, y	0.6	m
Bend Angle ? (for riprap sizing)	0	
Rock specific gravity (2.65)	2.65	
Design rock size, D50 ◉Isbash ○Maynord ○Searcy * 1.25 (See notes)	0.0921	m

Results

Flow area, a	1.5600	m^2
Wetted perimeter, P_w	4.5947	m
Hydraulic radius, R_h	0.3395	m
Velocity, v	1.3573	m/s
Flow, Q	2.1174	m^3/s
Velocity head, h_v	0.0939	m
Top width, T	4.4000	m
Froude number, F	0.73	
Average shear stress (tractive force), tau	23.3053	N/m^2
n for design rock size per Strickler	0.0315	
n for design rock size per Blodgett	0.0490	
n for design rock size per Bathurst	0.0332	
Blodgett vs. Bathurst	Blodgett	
Required bottom angular rock size, D50 (Isbash & MC) ?	0.0699	m
Required side slope 1 angular rock size, D50 (Isbash & MC) ?	0.0737	m
Required side slope 2 angular rock size, D50 (Isbash & MC) ?	0.0737	m
Required angular rock size, D50 (Maynord, Ruff, and Abt 1989)	0.0667	m
Required angular rock size, D50 (Searcy 1967)	0.0405	m



S = 0.65% (Ditch # 2)

Manning Formula Uniform Trapezoidal Channel Flow at Given Slope and Depth

123 Hwy 47

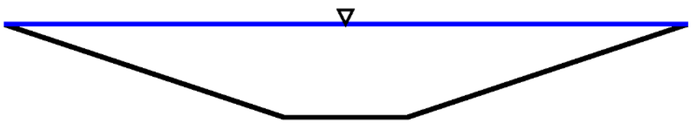
Swale Design

Inputs

Input	Value	Unit
Bottom width, b	0.8	m
Side slope 1 (horiz./vert.)	3	
Side slope 2 (horiz./vert.)	3	
Manning roughness, n ? ○Strickler ○B/B (See notes)	0.03	
Channel slope, S	0.0065	rise/run
Flow depth, y	0.6	m
Bend Angle ? (for riprap sizing)	0	
Rock specific gravity (2.65)	2.65	
Design rock size, D50 ◉Isbash ○Maynord ○Searcy * 1.25 (See notes)	0.0856	m

Results

Result	Value	Unit
Flow area, a	1.5600	m^2
Wetted perimeter, P_w	4.5947	m
Hydraulic radius, R_h	0.3395	m
Velocity, v	1.3079	m/s
Flow, Q	2.0403	m^3/s
Velocity head, h_v	0.0872	m
Top width, T	4.4000	m
Froude number, F	0.70	
Average shear stress (tractive force), tau	21.6406	N/m^2
n for design rock size per Strickler	0.0301	
n for design rock size per Blodgett	0.0442	
n for design rock size per Bathurst	0.0286	
Blodgett vs. Bathurst	Blodgett	
Required bottom angular rock size, D50 (Isbash & MC) ?	0.0649	m
Required side slope 1 angular rock size, D50 (Isbash & MC) ?	0.0684	m
Required side slope 2 angular rock size, D50 (Isbash & MC) ?	0.0684	m
Required angular rock size, D50 (Maynord, Ruff, and Abt 1989)	0.0608	m
Required angular rock size, D50 (Searcy 1967)	0.0376	m



S = 0.5% (Ditch # 3, 4, 7)

Manning Formula Uniform Trapezoidal Channel Flow at Given Slope and Depth

123 Hwy 47

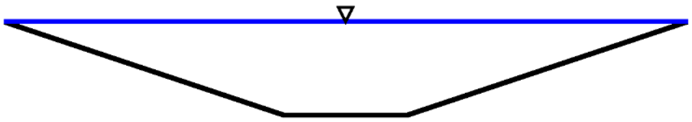
Swale Design

Inputs

Bottom width, b	0.8	m
Side slope 1 (horiz./vert.)	3	
Side slope 2 (horiz./vert.)	3	
Manning roughness, n ? ○Strickler ○B/B (See notes)	0.03	
Channel slope, S	0.005	rise/run
Flow depth, y	0.6	m
Bend Angle ? (for riprap sizing)	0	
Rock specific gravity (2.65)	2.65	
Design rock size, D50 ⦿Isbash ○Maynord ○Searcy * 1.25 (See notes)	0.0658	m

Results

Flow area, a	1.5600	m^2
Wetted perimeter, P_w	4.5947	m
Hydraulic radius, R_h	0.3395	m
Velocity, v	1.1471	m/s
Flow, Q	1.7895	m^3/s
Velocity head, h_v	0.0671	m
Top width, T	4.4000	m
Froude number, F	0.62	
Average shear stress (tractive force), tau	16.6466	N/m^2
n for design rock size per Strickler	0.0301	
n for design rock size per Blodgett	0.0442	
n for design rock size per Bathurst	0.0288	
Blodgett vs. Bathurst	Blodgett	
Required bottom angular rock size, D50 (Isbash & MC) ?	0.0500	m
Required side slope 1 angular rock size, D50 (Isbash & MC) ?	0.0527	m
Required side slope 2 angular rock size, D50 (Isbash & MC) ?	0.0527	m
Required angular rock size, D50 (Maynord, Ruff, and Abt 1989)	0.0438	m
Required angular rock size, D50 (Searcy 1967)	0.0289	m



Pipe Size Calculation (Collector)

Manning Formula Uniform Pipe Flow at Given Slope and Depth

123 Hwy 47

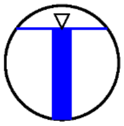
Pipe Culvert (1500mm)

Inputs

Pipe diameter, d_0	1500	mm
Manning roughness, n	0.011	
Pressure slope (possibly ? equal to pipe slope), S_0	1.4	% rise/run
Relative flow depth, y/d_0	0.8	fraction

Results

Flow depth, y	1.2000	m
Flow area, a	1.5155	m^2
Pipe area, a0	1.7671	m^2
Relative area, a/a0	0.8576	fraction
Wetted perimeter, P_w	3.3214	m
Hydraulic radius, R_h	0.4563	m
Top width, T	1.2000	m
Velocity, v	6.3753	m/s
Velocity head, h_v	2.0724	m H2O
Froude number, F	1.81	
Average shear stress (tractive force), tau	62.6413	N/m^2
Flow, Q (See notes)	9.6620	m^3/s
Full flow, Q0	9.8847	m^3/s
Ratio to full flow, Q/Q0	0.9775	fraction



Notes:

This is the flow and depth inside an *infinitely long* pipe.

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Rip Rap (Stone) Size Calculation

Manning Formula Uniform Trapezoidal Channel Flow at Given Slope and Depth

123 Hwy 47

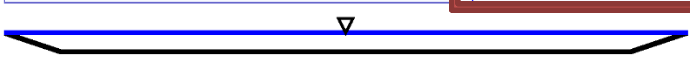
Riprap Design (Pond)

Inputs

Bottom width, b	12	m
Side slope 1 (horiz./vert.)	3	
Side slope 2 (horiz./vert.)	3	
Manning roughness, n ? ○Strickler ○B/B (See notes)	0.035	
Channel slope, S	0.02	rise/run
Flow depth, y	0.4	m
Bend Angle ? (for riprap sizing)	0	
Rock specific gravity (2.65)	2.65	
Design rock size, D50 ⦿Isbash ○Maynord ○Searcy * 1.25 (See notes)	0.2118	m

Results

Flow area, a	5.2800	m^2
Wetted perimeter, P_w	14.5298	m
Hydraulic radius, R_h	0.3634	m
Velocity, v	2.0576	m/s
Flow, Q	10.8642	m^3/s
Velocity head, h_v	0.2159	m
Top width, T	14.4000	m
Froude number, F	1.09	
Average shear stress (tractive force), tau	71.2682	N/m^2
n for design rock size per Strickler	0.0366	
n for design rock size per Blodgett	0.0772	
n for design rock size per Bathurst	0.0589	
Blodgett vs. Bathurst	Blodgett	
Required bottom angular rock size, D50 (Isbash & MC) ?	0.1607	m
Required side slope 1 angular rock size, D50 (Isbash & MC) ?	0.1694	m
Required side slope 2 angular rock size, D50 (Isbash & MC) ?	0.1694	m
Required angular rock size, D50 (Maynord, Ruff, and Abt 1989)	0.2089	m
Required angular rock size, D50 (Searcy 1967)	0.0931	m



Isbash Equation:

$$D_{50} = \frac{V^2}{2.g.C^2.(S-1)} = 0.18 \text{ m}$$

Where:

V = Water velocity approaching riprap = 2.06 m/s
C = Isbash constant: (0.86 for high turbulence and 1.2 for low turbulence)
S = Rock specific gravity = 2.65
g = Gravity = 9.81 m/s^2

USBR Method:

$D_{50} = 0.0122.(V_a)^{2.06}$ = 0.62 ft = 0.19 m

Where: V_a = Average channel velocity = 6.75 ft/s

USGS Method:

$D_{50} = 0.01.(V_a)^{2.44}$ = 1.05 ft = 0.32 m

Where: V_a = Average channel velocity = 6.75 ft/s

ASCE Method:

$$W = \frac{0.000041.SG.V^6}{(SG-1)^3.\cos(\theta)^3} = 3.5 \text{ lb}$$

$$D_{50} = \left(\frac{6.W}{\pi.\gamma_s}\right)^{\frac{1}{3}} = 0.32 \text{ ft} = 0.1 \text{ m}$$

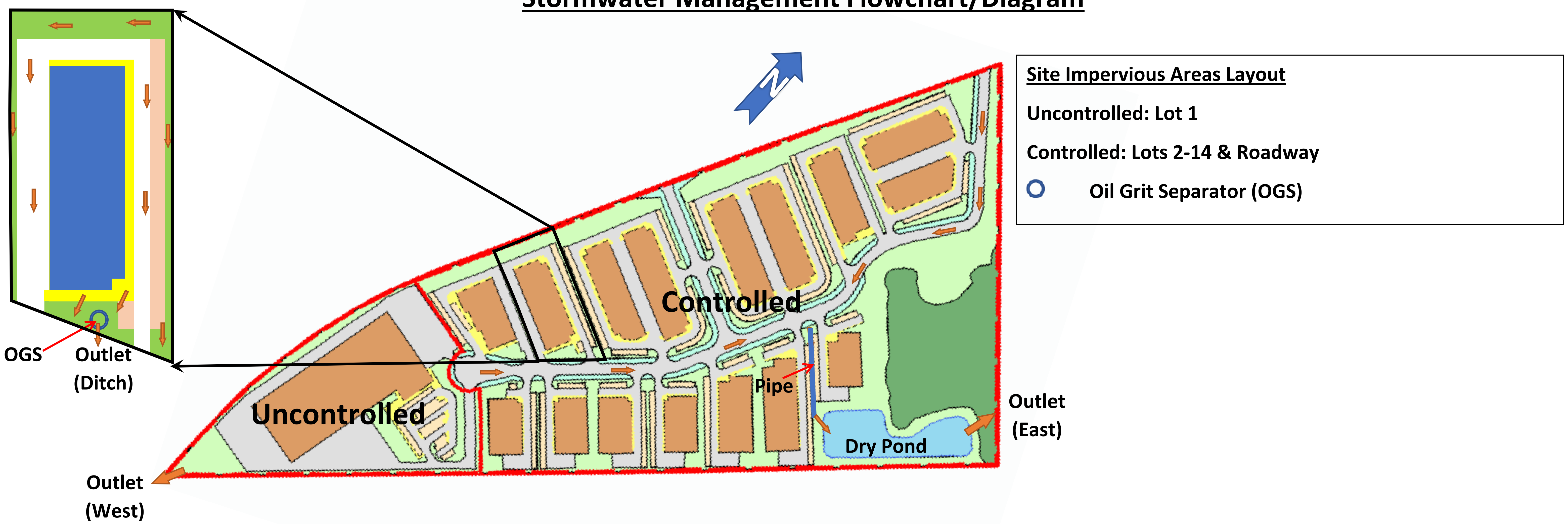
Where:

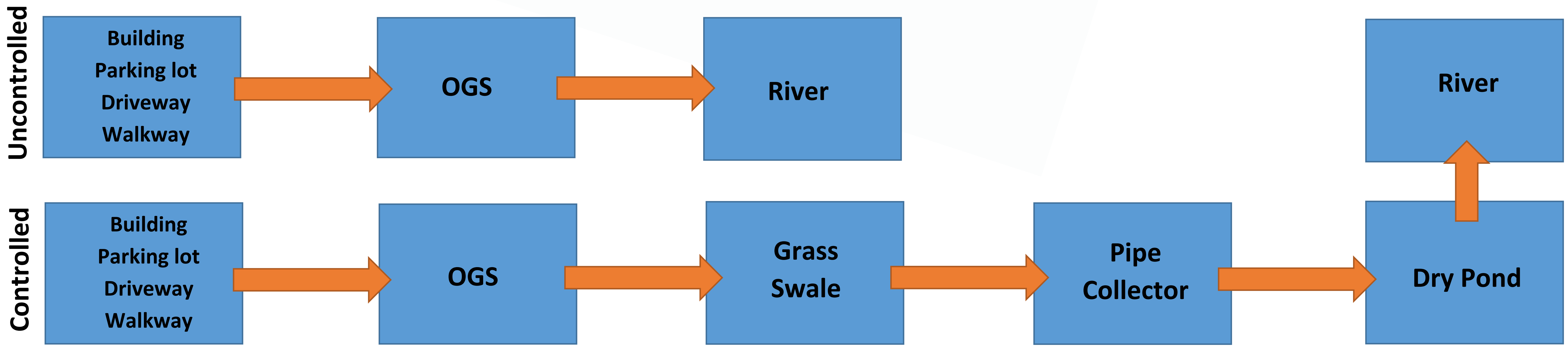
V = Local depth-averaged velocity = 6.75 cfs
γ_s = Unit weight of stone = 200 lb/ft^3
SG = Specific gravity of stone = 2.65
W = Weight of stone (lb)
θ = Bank angle (deg.) = 30 deg.

Based on the above methods, D50 = 300 mm was proposed for the gabion stone in the spillways.

APPENDIX XII –SWM FLOWCHART

Stormwater Management Flowchart/Diagram





APPENDIX XIII– WATER BALANCE CALCULATIONS

WATER BUDGET- PRE-DEVELOPMENT

WATER BALANCE/WATER BUDGET ASSESSMENT

Catchment Designation	Site					
	Building	Driveway	Grassy Lawn	Woodland	Cultivated	Total
Area (m^2)	885	2,070	9,231	20,820	208234	241,239
Pervious Area (m^2)	0	0	9,231	20,820	208,234	238,285
Impervious Area (m^2)	885	2070	0	0	0	2,955
Infiltration Factors						
Topography Infiltration Factor	0	0	0.3	0.2	0.3	
Soil Infiltratin Factor	0	0	0.2	0.2	0.2	
Land Cover Infiltration Factor	0	0	0.1	0.2	0.1	
MOE Infiltration Factor	0	0	0.6	0.6	0.6	
Actual Infiltratin Factor	0	0	0.6	0.6	0.6	
Run-Off Coefficient	1	1	0.4	0.4	0.4	
Runoff From Impervious Surfaces *	0.95	0.6	0	0	0	
Inputs (per unit area)						
Precipitation (mm/yr)	844	844	844	844	844	844
Run-On (mm/yr)	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0
Total Inputs (mm/yr)	**844**	**844**	**844**	**844**	**844**	**844**
Outputs (per unit area)						
Precipitation Surplus (mm/yr)	801.8	506.4	365	355	365	367
Net Surplus (mm/yr)	801.8	506.4	365	355	365	367
Evapotranspiratin (mm/yr)	42.2	337.6	479	489	479	477
Infiltration (mm/yr)	0	0	219	213	219	216
Rooftop Infiltration (mm/yr)	0	0	0	0	0	0
Total Infiltration (mm/yr)	0	0	219	213	219	216
Runoff Pervious Area	0	0	146	142	146	146
Runoff Impervious Area	801.8	506.4	0	0	0	240
Total Runoff (mm/yr)	801.8	506.4	146	142	146	151
Total Outputs (mm/yr)	844	844	844	844	844	844
Difference (Inputs-Outputs)	0	0	0	0	0	0
Inputs (Volumes)						
Precipitaiton (m^3/yr)	747	1,747	7,791	17,572	175,749	203,606
Run-On (m^3/yr)	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0
Total Inputs (m^3/yr)	747	1,747	7,791	17,572	175,749	203,606
Outputs (Volumes)						
Precipitation Surplus (m^3/yr)	709	1,048	3,369	7,391	76,005	88,523
Net Surplus (m^3/yr)	709	1,048	3,369	7,391	76,005	88,523
Evapotranspiratin (m^3/yr)	37	699	4,422	10,181	99,744	115,083
Infiltration (m^3/yr)	0	0	2,022	4,435	45,603	52,059
Rooftop Infiltration (m^3/yr)	0	0	0	0	0	0
Total Infiltration (m^3/yr)	0	0	2,022	4,435	45,603	52,059
Runoff Pervious Area (m^3/yr)	0	0	1,348	2,956	30,402	34,706
Runoff Impervious Area (m^3/yr)	709	1,048	0	0	0	1,758
Total Runoff (m^3/yr)	709	1,048	1,348	2,956	30,402	36,464
Total Outputs (m^3/yr)	747	1,747	7,791	17,572	175,749	203,606
Difference (Inputs-Outputs)	0	0	0	0	0	0

* Based on the Design Chart 1.07 (MTO, 1997), the runoff coefficients for roofs and gravel roads land uses are 0.7 - 0.95 and 0.4 - 0.6, respectively. We used the maximum amount, as the grades of the open gravel area is generally around 2%.

WATER BUDGET- POST-DEVELOPMENT

WATER BALANCE/WATER BUDGET ASSESSMENT

Catchment Designation	**Site**					
	Buildings	**Driveway/Parking/Walkway**	**Grassy Lawn**	**Woodland**	**Dry Pond**	**Total**
Area (m^2)	77,862	107,999	30,618	18,422	6,338	241,239
Pervious Area (m^2)	0	0	30,618	18,422	6,338	55,378
Impervious Area (m^2)	77,862	107,999	0	0	0	185,861
Infiltration Factors						
Topography Infiltration Factor	0	0	0.3	0.3	0.3	
Soil Infiltratin Factor	0	0	0.2	0.2	0.2	
Land Cover Infiltration Factor	0	0	0.1	0.2	0.1	
MOE Infiltration Factor	0	0	0.6	0.7	0.6	
Actual Infiltratin Factor	0	0	0.6	0.7	0.6	
Run-Off Coefficient	1	1	0.4	0.3	0.4	
Runoff From Impervious Surfaces *	0.95	0.95	0	0	0	
Inputs (per unit area)						
Precipitation (mm/yr)	844	844	844	844	844	844
Run-On (mm/yr)	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0
Total Inputs (mm/yr)	**844**	**844**	**844**	**844**	**844**	**844**
Outputs (per unit area)						
Precipitation Surplus (mm/yr)	801.8	801.8	365	355	365	701
Net Surplus (mm/yr)	801.8	801.8	365	355	365	701
Evapotranspiratin (mm/yr)	42.2	42.2	479	489	479	143
Infiltration (mm/yr)	0	0	219	248.5	219	53
Rooftop Infiltration (mm/yr)	0	0	0	0	0	0
Total Infiltration (mm/yr)	0	0	219	248.5	219	53
Runoff Pervious Area	0	0	146	106.5	146	133
Runoff Impervious Area	801.8	801.8	0	0	0	802
Total Runoff (mm/yr)	801.8	801.8	146	106.5	146	648
Total Outputs (mm/yr)	844	844	844	844	844	844
Difference (Inputs-Outputs)	0	0	0	0	0	0
Inputs (Volumes)						
Precipitaiton (m^3/yr)	65,715	91,151	25,842	15,548	5,350	203,606
Run-On (m^3/yr)	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0
Total Inputs (m^3/yr)	65,715	91,151	25,842	15,548	5,350	203,606
Outputs (Volumes)						
Precipitation Surplus (m^3/yr)	62,429	86,594	11,176	6,540	2,313	169,052
Net Surplus (m^3/yr)	62,429	86,594	11,176	6,540	2,313	169,052
Evapotranspiratin (m^3/yr)	3,286	4,558	14,666	9,008	3,036	34,554
Infiltration (m^3/yr)	0	0	6,705	4,578	1,388	12,671
Rooftop Infiltration (m^3/yr)	0	0	0	0	0	0
Total Infiltration (m^3/yr)	0	0	6,705	4,578	1,388	12,671
Runoff Pervious Area (m^3/yr)	0	0	4,470	1,962	925	7,358
Runoff Impervious Area (m^3/yr)	62,429	86,594	0	0	0	149,023
Total Runoff (m^3/yr)	62,429	86,594	4,470	1,962	925	156,381
Total Outputs (m^3/yr)	65,715	91,151	25,842	15,548	5,350	172,415
Difference (Inputs-Outputs)	0	0	0	0	0	31,191

* Based on the Design Chart 1.07 (MTO, 1997), the runoff coefficients for rooftop and pavement are 0.7 - 0.95 and 0.8 - 0.95, respectively. We used the maximum ratio of 95% for both Asphalt Pavement and Rooftops.

WATER BUDGET- POST-DEVELOPMENT WITH MITIGATION

WATER BALANCE/WATER BUDGET ASSESSMENT

Catchment Designation	Site					
	Buildings	Driveway/Parking/Walkway	Grassy Lawn	Woodland	Dry Pond	Total
Area (m^2)	77,862	107,999	30,618	18,422	6,338	241,239
Pervious Area (m^2)	0	0	30,618	18,422	6,338	55,378
Impervious Area (m^2)	77,862	107,999	0	0	0	185,861
Infiltration Factors						
Topography Infiltration Factor	0	0	0.3	0.2	0.3	
Soil Infiltratin Factor	0	0	0.2	0.2	0.2	
Land Cover Infiltration Factor	0	0	0.1	0.2	0.1	
MOE Infiltration Factor	0	0	0.6	0.6	0.6	
Actual Infiltratin Factor	0	0	0.6	0.6	0.6	
Run-Off Coefficient	1	1	0.4	0.4	0.4	
Runoff From Impervious Surfaces *	0.95	0.95	0	0	0	
Inputs (per unit area)						
Precipitation (mm/yr)	844	844	844	844	844	844
Run-On (mm/yr)	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0
Total Inputs (mm/yr)	**844**	**844**	**844**	**844**	**844**	**844**
Outputs (per unit area)						
Precipitation Surplus (mm/yr)	801.8	801.8	365	355	365	701
Net Surplus (mm/yr)	801.8	801.8	365	355	365	701
Evapotranspiratin (mm/yr)	42.2	42.2	479	489	479	143
Infiltration (mm/yr)	0	400.9	219	213	219	229
Rooftop Infiltration (mm/yr)	400.9	0	0	0	0	129
Total Infiltration (mm/yr)	400.9	400.9	219	213	219	359
Runoff Pervious Area	0	0	146	142	146	145
Runoff Impervious Area	400.9	400.9	0	0	0	401
Total Runoff (mm/yr)	400.9	400.9	146	142	146	342
Total Outputs (mm/yr)	844	844	844	844	844	844
Difference (Inputs-Outputs)	0	0	0	0	0	0
Inputs (Volumes)						
Precipitaiton (m^3/yr)	65,715	91,151	25,842	15,548	5,350	203,606
Run-On (m^3/yr)	0	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0	0
Total Inputs (m^3/yr)	65,715	91,151	25,842	15,548	5,350	203,606
Outputs (Volumes)						
Precipitation Surplus (m^3/yr)	62,429	86,594	11,176	6,540	2,313	169,052
Net Surplus (m^3/yr)	62,429	86,594	11,176	6,540	2,313	169,052
Evapotranspiratin (m^3/yr)	3,286	4,558	14,666	9,008	3,036	34,554
Infiltration (m^3/yr)	0	43,297	6,705	3,924	1,388	55,314
Rooftop Infiltration (m^3/yr)	31,215	0	0	0	0	31,215
Total Infiltration (m^3/yr)	31,215	43,297	6,705	3,924	1,388	86,529
Runoff Pervious Area (m^3/yr)	0	0	4,470	2,616	925	8,012
Runoff Impervious Area (m^3/yr)	31,215	43,297	0	0	0	74,512
Total Runoff (m^3/yr)	31,215	43,297	4,470	2,616	925	82,523
Total Outputs (m^3/yr)	65,715	91,151	25,842	15,548	5,350	203,606
Difference (Inputs-Outputs)	0	0	0	0	0	0

* Based on the Design Chart 1.07 (MTO, 1997), the runoff coefficients for rooftop and pavement are 0.7 - 0.95 and 0.8 - 0.95, respectively. We used the maximum ratio of 95% for both Asphalt Pavement and Rooftops.

WATER BUDGET SUMMARY

WATER BALANCE/WATER BUDGET ASSESSMENT

Characterstic	Site				
	Pre-Development	Post-Development	Change (Pre- to Post-)	Post-Development with Mitigation	Change (Pre- to Post- with Mitigation)
Inputs (Volumes)					
Precipitaiton (m^3/yr)	203,606	203,606	0.0%	203,606	0.0%
Run-On (m^3/yr)	0	0	0.0%	0	0.0%
Other Inputs (m^3/yr)	0	0	0.0%	0	0.0%
Total Inputs (m^3/yr)	203,606	203,606	0.0%	203,606	0.0%
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	88,523	169,052	91.0%	169,052	91.0%
Net Surplus (m^3/yr)	88,523	169,052	91.0%	169,052	91.0%
Evapotranspiratin (m^3/yr)	115,083	34,554	-70.0%	34,554	-70.0%
Infiltration (m^3/yr)	52,059	12,671	-75.7%	55,314	6.3%
Rooftop Infiltration (m^3/yr)	0	0	0.0%	31,215	0.0%
Total Infiltration (m^3/yr)	52,059	12,671	-75.7%	86,529	66.2%
Runoff Pervious Area (m^3/yr)	34,706	7,358	-78.8%	8,012	-76.9%
Runoff Impervious Area (m^3/yr)	1,758	149,023	8379.1%	74,512	4139.5%
Total Runoff (m^3/yr)	36,464	156,381	328.9%	82,523	126.3%
Total Outputs (m^3/yr)	203,606	172,415	-15.3%	203,606	0.0%

APPENDIX XIV– OGS

Stormceptor®

Rinker MATERIALS

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20
Site Name:	Lot 1
Drainage Area (ha):	4.32
% Imperviousness:	79.70

Runoff Coefficient 'c': 0.77

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	57.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	108.62
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	2522
Estimated Average Annual Sediment Volume (L/yr):	2051

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	31
EFO6	41
EFO8	49
EFO10	54
EFO12	57

Recommended Stormceptor EFO Model:	**EFO12**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**57**
Water Quality Runoff Volume Capture (%):	**> 90**

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

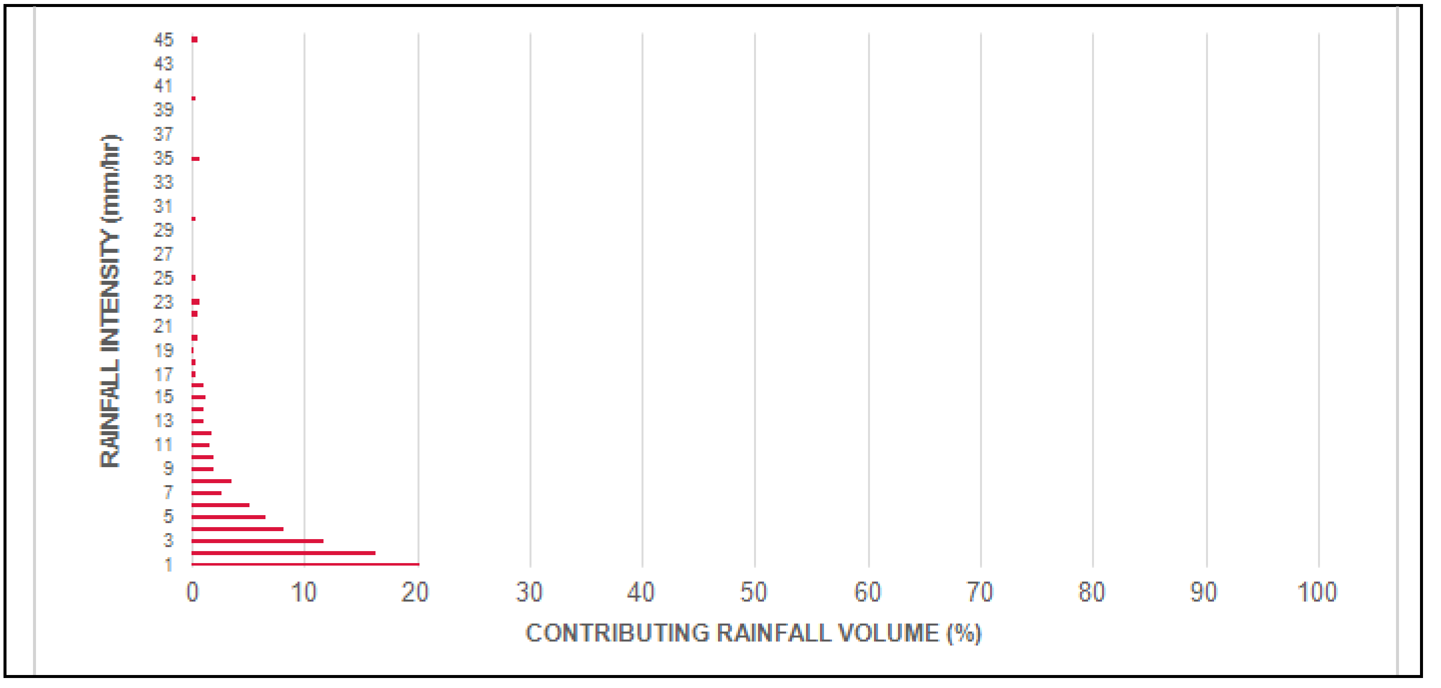
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

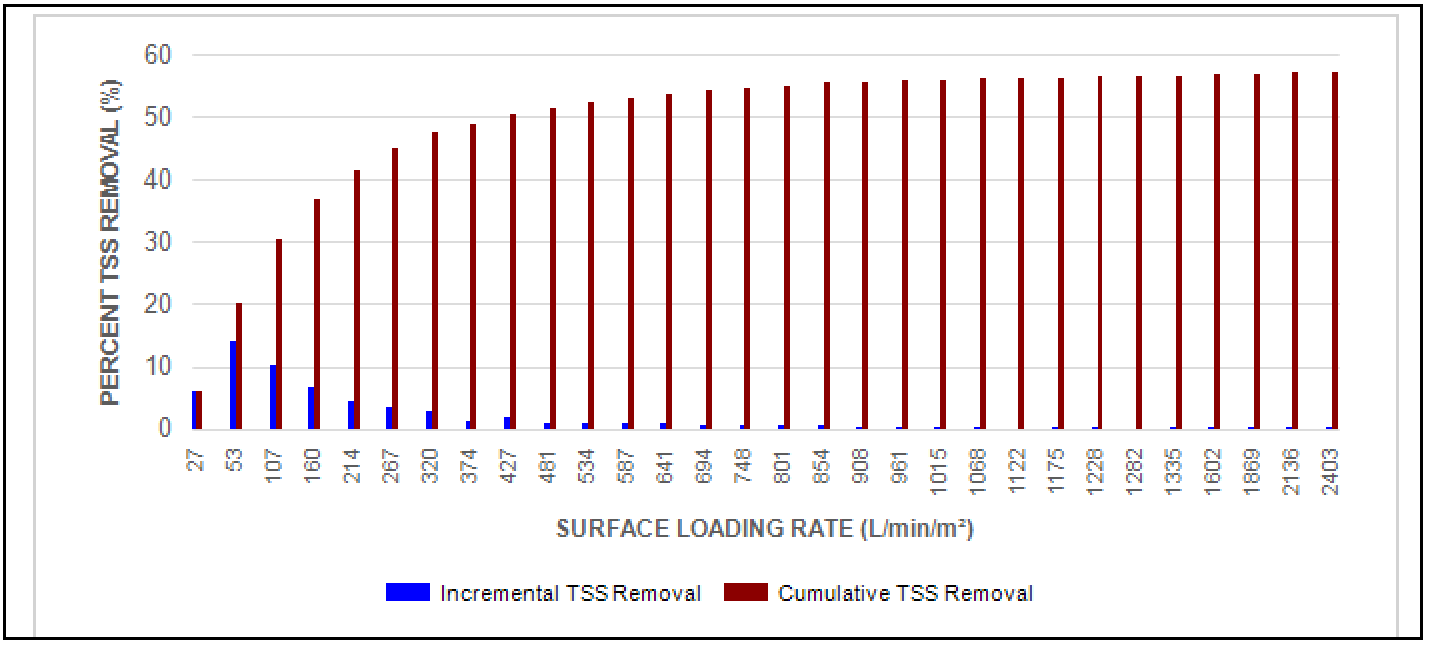
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	4.67	280.0	27.0	70	6.1	6.1
1.00	20.2	28.9	9.35	561.0	53.0	69	13.9	20.0
2.00	16.4	45.3	18.69	1122.0	107.0	62	10.2	30.3
3.00	11.8	57.1	28.04	1682.0	160.0	57	6.8	37.0
4.00	8.1	65.2	37.38	2243.0	214.0	54	4.4	41.4
5.00	6.6	71.9	46.73	2804.0	267.0	52	3.5	44.8
6.00	5.2	77.1	56.08	3365.0	320.0	50	2.6	47.5
7.00	2.7	79.8	65.42	3925.0	374.0	49	1.3	48.8
8.00	3.6	83.4	74.77	4486.0	427.0	47	1.7	50.5
9.00	2.0	85.4	84.11	5047.0	481.0	46	0.9	51.4
10.00	1.9	87.3	93.46	5608.0	534.0	44	0.8	52.2
11.00	1.6	88.9	102.80	6168.0	587.0	43	0.7	52.9
12.00	1.8	90.7	112.15	6729.0	641.0	42	0.7	53.7
13.00	1.0	91.6	121.50	7290.0	694.0	42	0.4	54.1
14.00	1.0	92.7	130.84	7851.0	748.0	41	0.4	54.5
15.00	1.3	93.9	140.19	8411.0	801.0	41	0.5	55.0
16.00	1.0	95.0	149.53	8972.0	854.0	41	0.4	55.4
17.00	0.4	95.3	158.88	9533.0	908.0	41	0.1	55.6
18.00	0.4	95.7	168.23	10094.0	961.0	40	0.2	55.7
19.00	0.2	95.9	177.57	10654.0	1015.0	40	0.1	55.8
20.00	0.6	96.5	186.92	11215.0	1068.0	39	0.2	56.1
21.00	0.0	96.5	196.26	11776.0	1122.0	38	0.0	56.1
22.00	0.5	97.0	205.61	12337.0	1175.0	37	0.2	56.2
23.00	0.7	97.7	214.96	12897.0	1228.0	37	0.3	56.5
24.00	0.0	97.7	224.30	13458.0	1282.0	36	0.0	56.5
25.00	0.3	98.0	233.65	14019.0	1335.0	35	0.1	56.6
30.00	0.3	98.3	280.38	16823.0	1602.0	30	0.1	56.7
35.00	0.8	99.1	327.11	19626.0	1869.0	25	0.2	56.9
40.00	0.4	99.5	373.83	22430.0	2136.0	22	0.1	57.0
45.00	0.5	100.0	420.56	25234.0	2403.0	20	0.1	57.1
Estimated Net Annual Sediment (TSS) Load Reduction =								**57 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter (m)	Model Diameter (ft)	Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter (mm)	Max Inlet Pipe Diameter (in)	Max Outlet Pipe Diameter (mm)	Max Outlet Pipe Diameter (in)	Peak Conveyance Flow Rate (L/s)	Peak Conveyance Flow Rate (cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

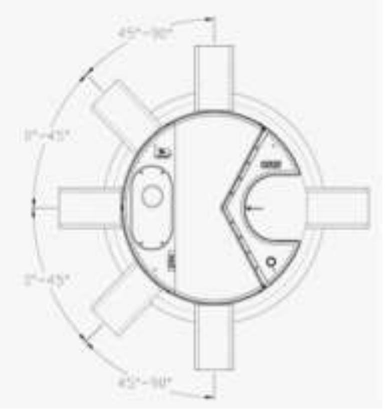
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

DESIGN FLEXIBILITY

►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.



INLET-TO-OUTLET DROP
Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS
The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR
"OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor®

Rinker

Stormceptor® EF Sizing Report

Imbrium® Systems

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20
Site Name:	Lot 2
Drainage Area (ha):	0.89
% Imperviousness:	73.80

Runoff Coefficient 'c': 0.74

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	21.36
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	540
Estimated Average Annual Sediment Volume (L/yr):	439

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	52
EFO6	59
EFO8	64
EFO10	66
EFO12	68

Recommended Stormceptor EFO Model: EFO8

Estimated Net Annual Sediment (TSS) Load Reduction (%): 64

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

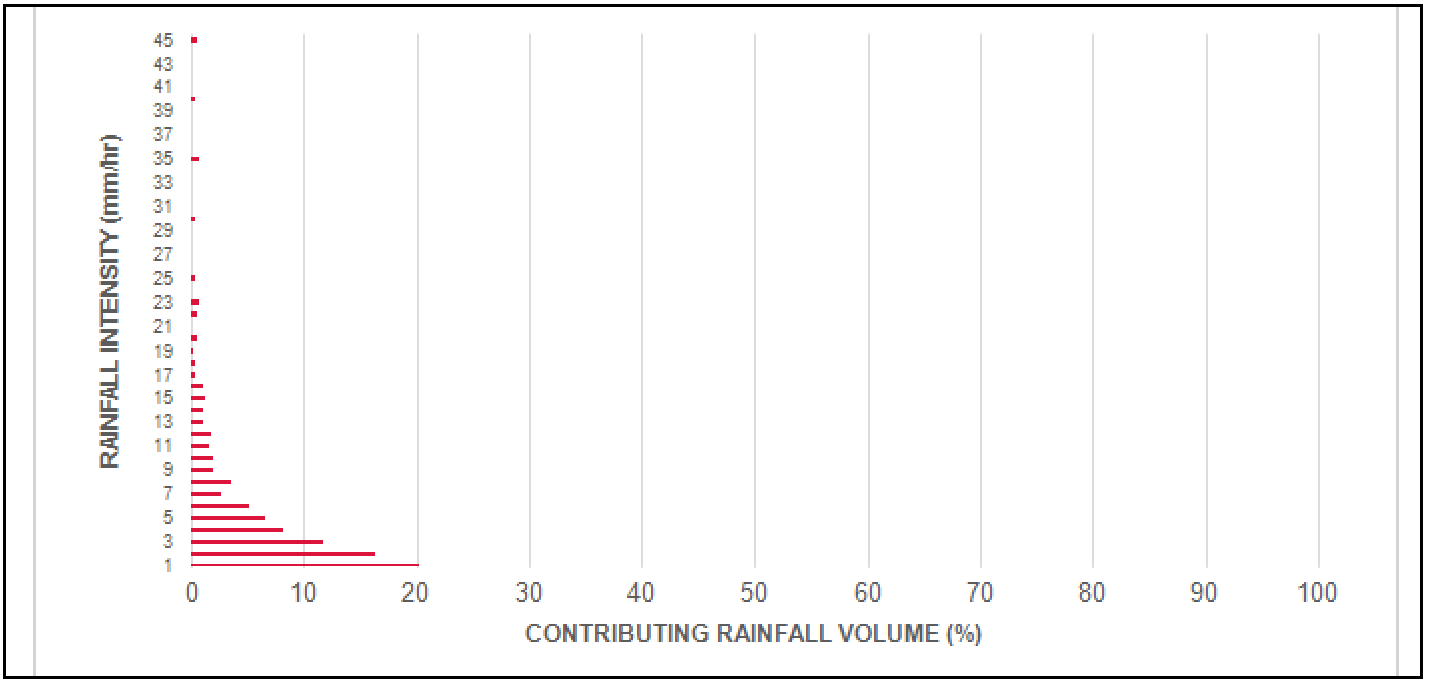
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

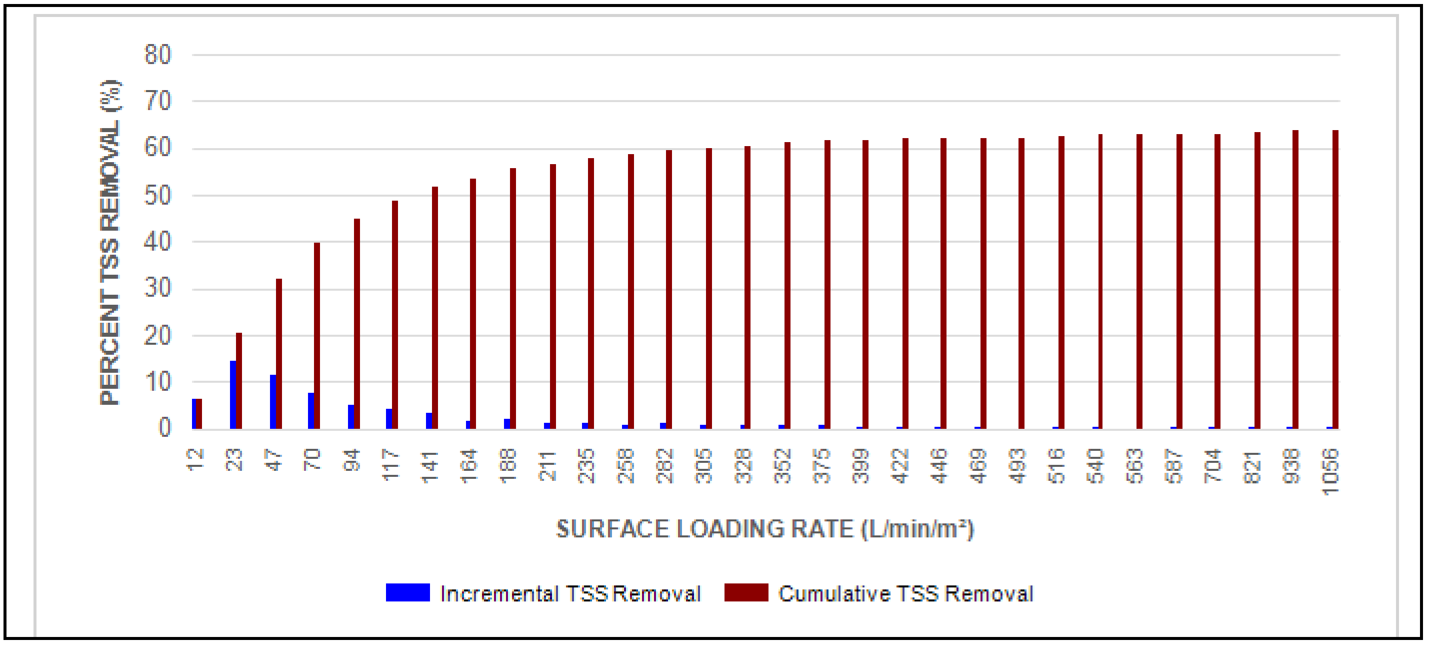
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	0.92	55.0	12.0	70	6.1	6.1
1.00	20.2	28.9	1.84	110.0	23.0	70	14.2	20.4
2.00	16.4	45.3	3.68	221.0	47.0	70	11.6	31.9
3.00	11.8	57.1	5.51	331.0	70.0	66	7.7	39.6
4.00	8.1	65.2	7.35	441.0	94.0	63	5.1	44.8
5.00	6.6	71.9	9.19	551.0	117.0	62	4.1	48.9
6.00	5.2	77.1	11.03	662.0	141.0	59	3.1	51.9
7.00	2.7	79.8	12.86	772.0	164.0	57	1.5	53.5
8.00	3.6	83.4	14.70	882.0	188.0	56	2.0	55.5
9.00	2.0	85.4	16.54	992.0	211.0	54	1.1	56.5
10.00	1.9	87.3	18.38	1103.0	235.0	53	1.0	57.6
11.00	1.6	88.9	20.22	1213.0	258.0	53	0.8	58.4
12.00	1.8	90.7	22.05	1323.0	282.0	52	0.9	59.3
13.00	1.0	91.6	23.89	1434.0	305.0	51	0.5	59.8
14.00	1.0	92.7	25.73	1544.0	328.0	50	0.5	60.3
15.00	1.3	93.9	27.57	1654.0	352.0	50	0.6	61.0
16.00	1.0	95.0	29.41	1764.0	375.0	49	0.5	61.5
17.00	0.4	95.3	31.24	1875.0	399.0	48	0.2	61.6
18.00	0.4	95.7	33.08	1985.0	422.0	47	0.2	61.8
19.00	0.2	95.9	34.92	2095.0	446.0	47	0.1	61.9
20.00	0.6	96.5	36.76	2205.0	469.0	46	0.3	62.2
21.00	0.0	96.5	38.59	2316.0	493.0	45	0.0	62.2
22.00	0.5	97.0	40.43	2426.0	516.0	45	0.2	62.4
23.00	0.7	97.7	42.27	2536.0	540.0	44	0.3	62.7
24.00	0.0	97.7	44.11	2646.0	563.0	43	0.0	62.7
25.00	0.3	98.0	45.95	2757.0	587.0	43	0.1	62.8
30.00	0.3	98.3	55.14	3308.0	704.0	42	0.1	63.0
35.00	0.8	99.1	64.32	3859.0	821.0	41	0.3	63.3
40.00	0.4	99.5	73.51	4411.0	938.0	40	0.2	63.5
45.00	0.5	100.0	82.70	4962.0	1056.0	39	0.2	63.7
Estimated Net Annual Sediment (TSS) Load Reduction =								**64 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

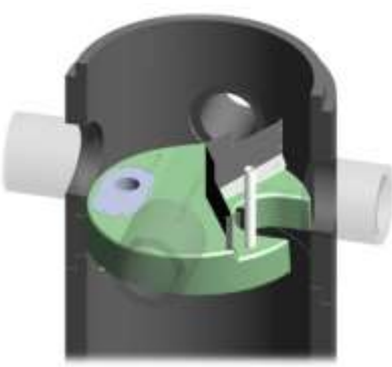
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

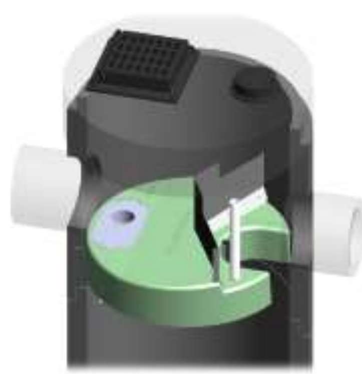
DESIGN FLEXIBILITY

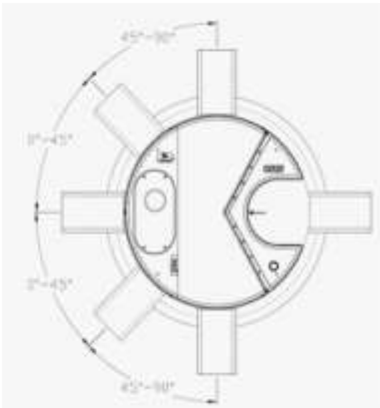
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION 11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20
Site Name:	Lot 3
Drainage Area (ha):	0.96
% Imperviousness:	79.20

Runoff Coefficient 'c': 0.77

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	24.04
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	616
Estimated Average Annual Sediment Volume (L/yr):	500

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	50
EFO6	58
EFO8	63
EFO10	66
EFO12	67

Recommended Stormceptor EFO Model: EFO8

Estimated Net Annual Sediment (TSS) Load Reduction (%): 63

Water Quality Runoff Volume Capture (%): > 90

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

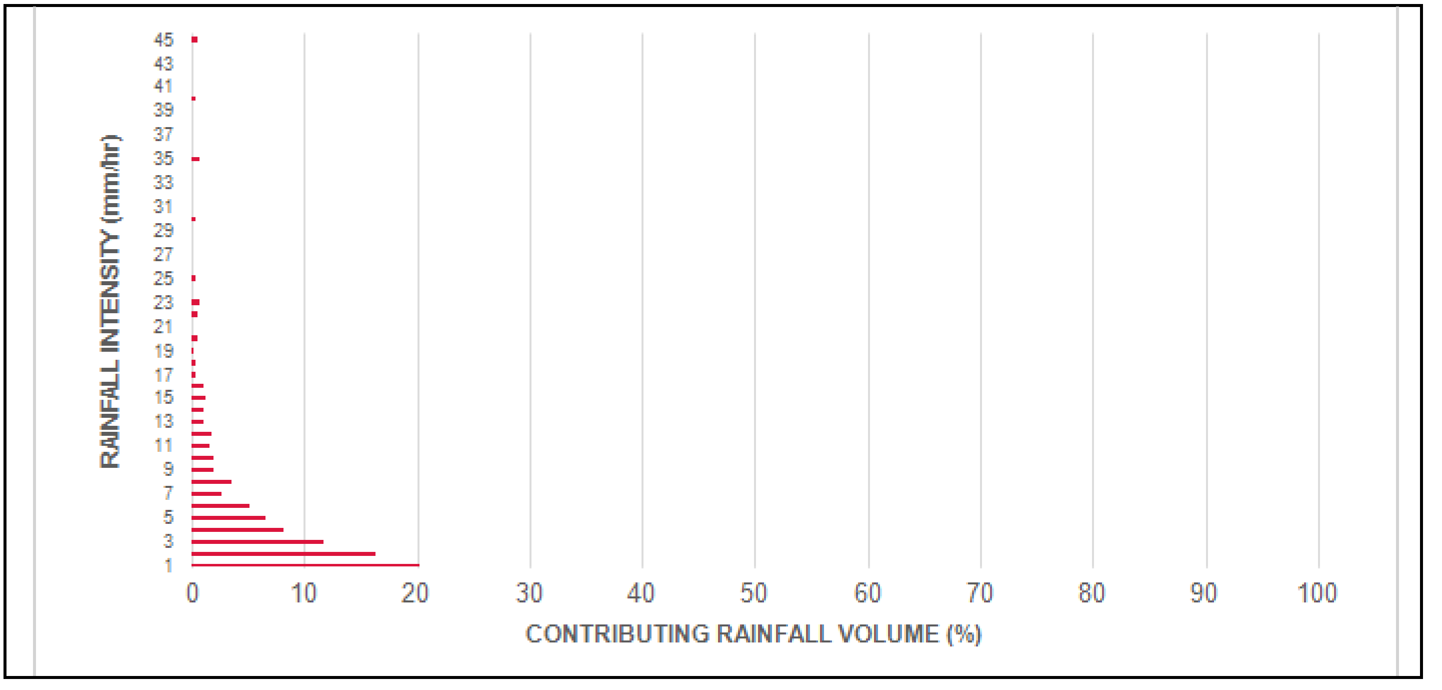
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

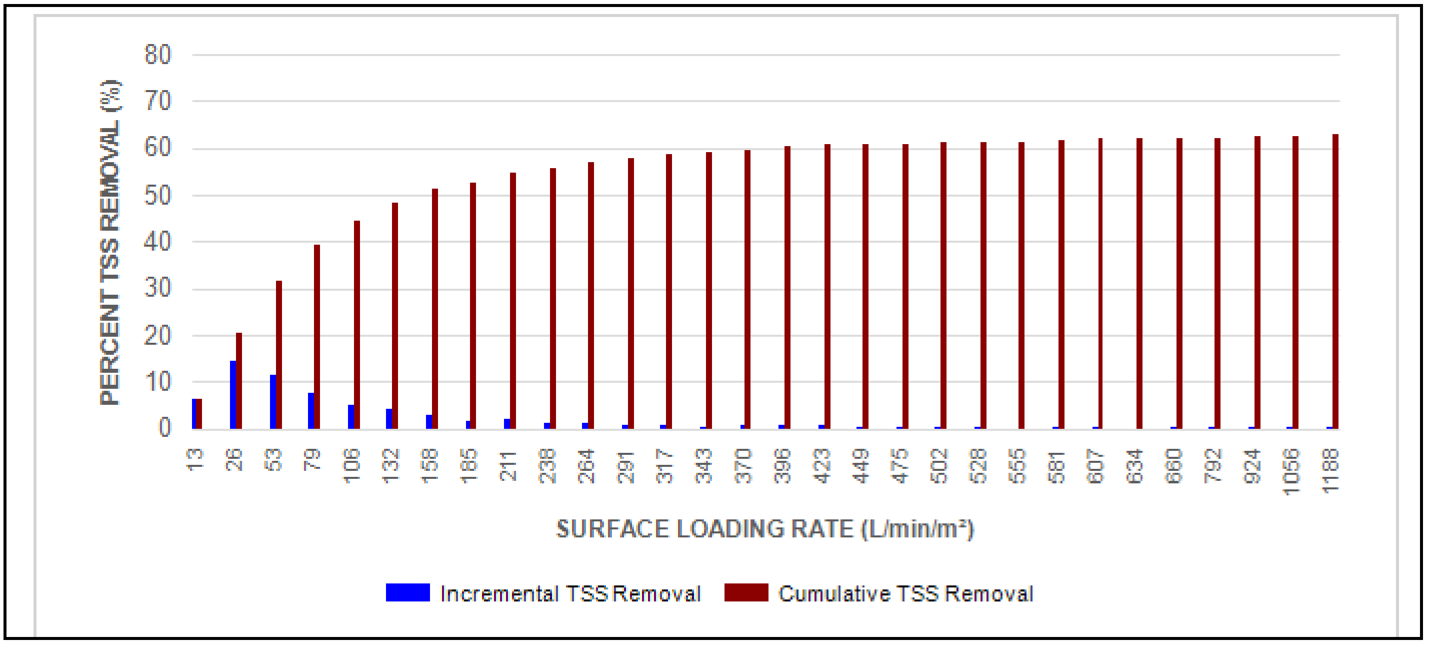
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	1.03	62.0	13.0	70	6.1	6.1
1.00	20.2	28.9	2.07	124.0	26.0	70	14.2	20.4
2.00	16.4	45.3	4.14	248.0	53.0	69	11.3	31.7
3.00	11.8	57.1	6.21	372.0	79.0	64	7.5	39.2
4.00	8.1	65.2	8.28	497.0	106.0	62	5.1	44.3
5.00	6.6	71.9	10.34	621.0	132.0	60	4.0	48.2
6.00	5.2	77.1	12.41	745.0	158.0	58	3.0	51.3
7.00	2.7	79.8	14.48	869.0	185.0	56	1.5	52.7
8.00	3.6	83.4	16.55	993.0	211.0	54	1.9	54.7
9.00	2.0	85.4	18.62	1117.0	238.0	53	1.1	55.7
10.00	1.9	87.3	20.69	1241.0	264.0	52	1.0	56.7
11.00	1.6	88.9	22.76	1365.0	291.0	51	0.8	57.6
12.00	1.8	90.7	24.83	1490.0	317.0	51	0.9	58.5
13.00	1.0	91.6	26.90	1614.0	343.0	50	0.5	59.0
14.00	1.0	92.7	28.96	1738.0	370.0	49	0.5	59.5
15.00	1.3	93.9	31.03	1862.0	396.0	48	0.6	60.1
16.00	1.0	95.0	33.10	1986.0	423.0	47	0.5	60.6
17.00	0.4	95.3	35.17	2110.0	449.0	47	0.2	60.7
18.00	0.4	95.7	37.24	2234.0	475.0	46	0.2	60.9
19.00	0.2	95.9	39.31	2358.0	502.0	45	0.1	61.0
20.00	0.6	96.5	41.38	2483.0	528.0	44	0.3	61.3
21.00	0.0	96.5	43.45	2607.0	555.0	44	0.0	61.3
22.00	0.5	97.0	45.51	2731.0	581.0	43	0.2	61.5
23.00	0.7	97.7	47.58	2855.0	607.0	42	0.3	61.8
24.00	0.0	97.7	49.65	2979.0	634.0	42	0.0	61.8
25.00	0.3	98.0	51.72	3103.0	660.0	42	0.1	61.9
30.00	0.3	98.3	62.07	3724.0	792.0	41	0.1	62.0
35.00	0.8	99.1	72.41	4345.0	924.0	40	0.3	62.3
40.00	0.4	99.5	82.75	4965.0	1056.0	39	0.2	62.5
45.00	0.5	100.0	93.10	5586.0	1188.0	37	0.2	62.7
Estimated Net Annual Sediment (TSS) Load Reduction =								**63 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

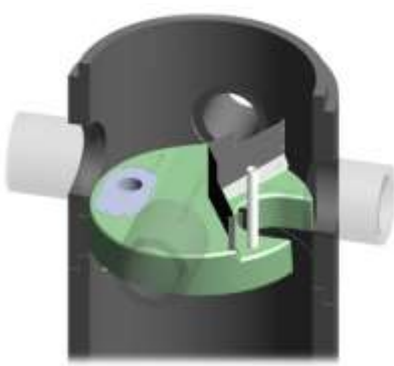
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

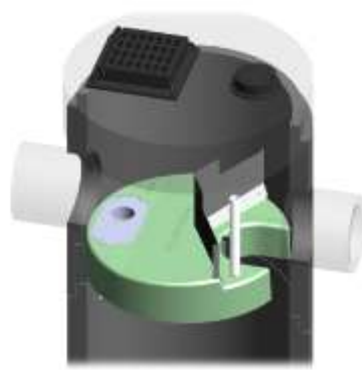
DESIGN FLEXIBILITY

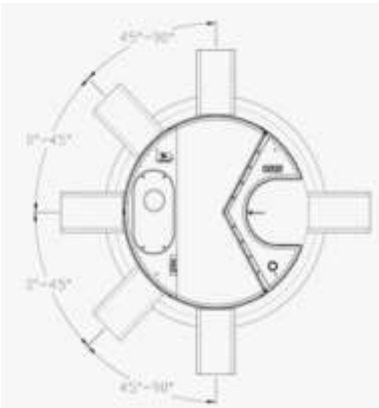
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor® EF Sizing Report

Imbrium® Systems

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION 11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20
Site Name:	Lot 4
Drainage Area (ha):	2.05
% Imperviousness:	79.70
Runoff Coefficient 'c':	0.77
Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	51.54
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	1260
Estimated Average Annual Sediment Volume (L/yr):	1024

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	41
EFO6	50
EFO8	57
EFO10	60
EFO12	63

Recommended Stormceptor EFO Model: EFO10

Estimated Net Annual Sediment (TSS) Load Reduction (%): 60

Water Quality Runoff Volume Capture (%): > 90

THIRD-PARTY TESTING AND VERIFICATION

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PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

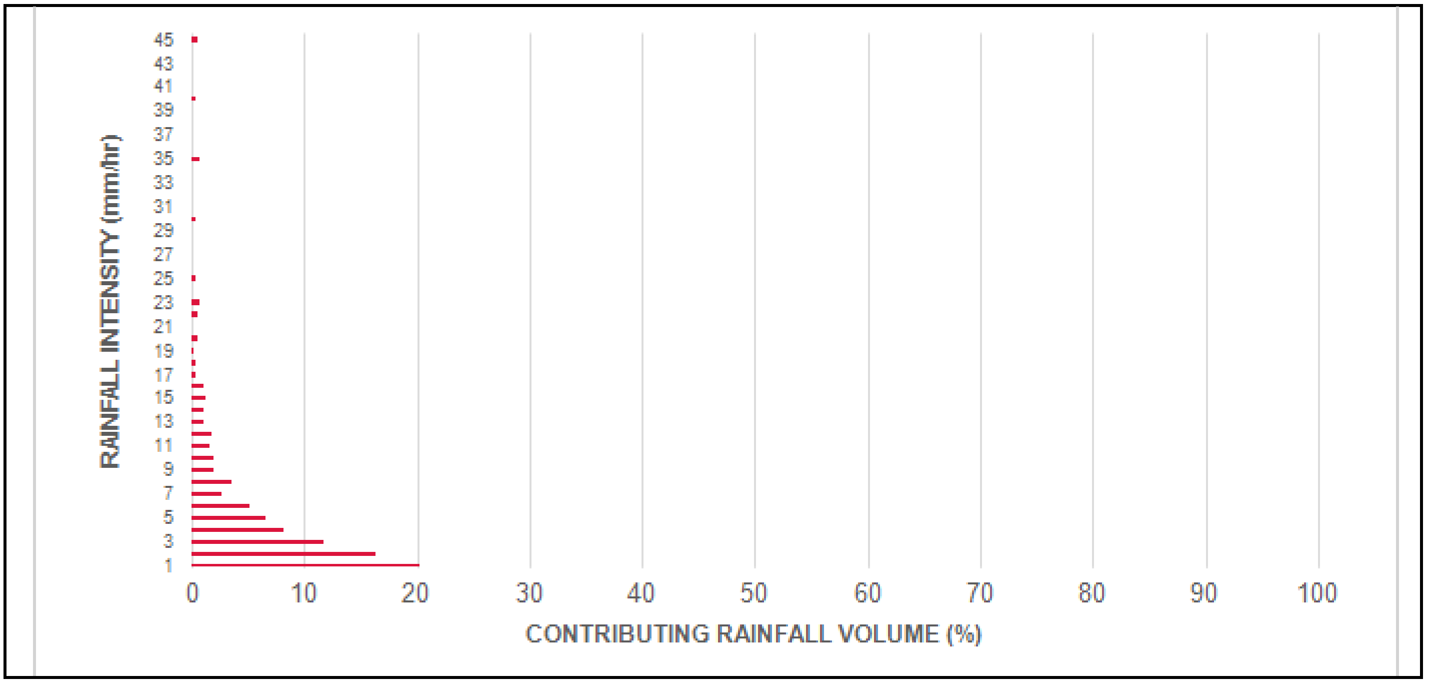
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

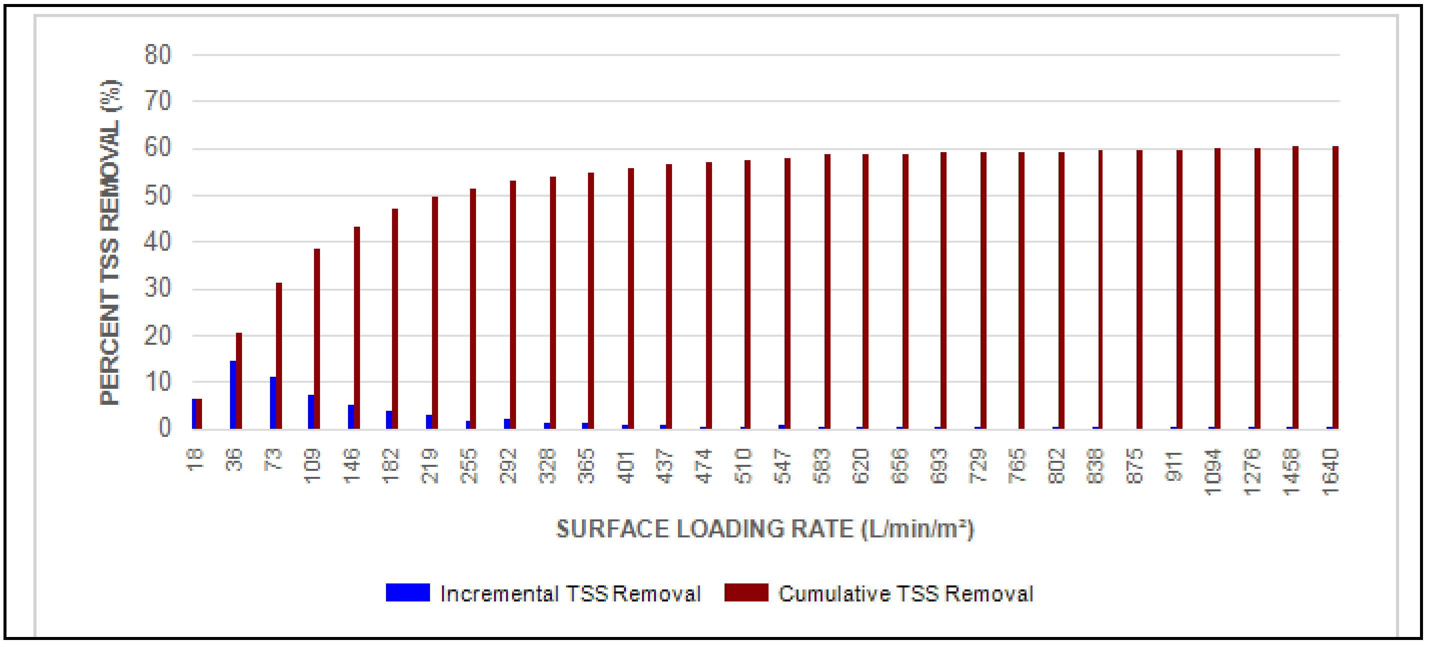
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	2.22	133.0	18.0	70	6.1	6.1
1.00	20.2	28.9	4.43	266.0	36.0	70	14.2	20.4
2.00	16.4	45.3	8.87	532.0	73.0	66	10.8	31.1
3.00	11.8	57.1	13.30	798.0	109.0	62	7.2	38.4
4.00	8.1	65.2	17.74	1064.0	146.0	59	4.8	43.2
5.00	6.6	71.9	22.17	1330.0	182.0	56	3.7	46.9
6.00	5.2	77.1	26.61	1597.0	219.0	54	2.8	49.7
7.00	2.7	79.8	31.04	1863.0	255.0	53	1.4	51.1
8.00	3.6	83.4	35.48	2129.0	292.0	51	1.9	52.9
9.00	2.0	85.4	39.91	2395.0	328.0	50	1.0	53.9
10.00	1.9	87.3	44.35	2661.0	365.0	49	0.9	54.9
11.00	1.6	88.9	48.78	2927.0	401.0	48	0.8	55.6
12.00	1.8	90.7	53.22	3193.0	437.0	47	0.8	56.5
13.00	1.0	91.6	57.65	3459.0	474.0	46	0.4	56.9
14.00	1.0	92.7	62.09	3725.0	510.0	45	0.5	57.4
15.00	1.3	93.9	66.52	3991.0	547.0	44	0.6	57.9
16.00	1.0	95.0	70.96	4258.0	583.0	43	0.4	58.4
17.00	0.4	95.3	75.39	4524.0	620.0	42	0.1	58.5
18.00	0.4	95.7	79.83	4790.0	656.0	42	0.2	58.7
19.00	0.2	95.9	84.26	5056.0	693.0	42	0.1	58.8
20.00	0.6	96.5	88.70	5322.0	729.0	41	0.3	59.0
21.00	0.0	96.5	93.13	5588.0	765.0	41	0.0	59.0
22.00	0.5	97.0	97.57	5854.0	802.0	41	0.2	59.2
23.00	0.7	97.7	102.00	6120.0	838.0	41	0.3	59.5
24.00	0.0	97.7	106.44	6386.0	875.0	41	0.0	59.5
25.00	0.3	98.0	110.87	6652.0	911.0	40	0.1	59.6
30.00	0.3	98.3	133.05	7983.0	1094.0	39	0.1	59.7
35.00	0.8	99.1	155.22	9313.0	1276.0	36	0.3	60.0
40.00	0.4	99.5	177.40	10644.0	1458.0	33	0.1	60.1
45.00	0.5	100.0	199.57	11974.0	1640.0	29	0.2	60.3
Estimated Net Annual Sediment (TSS) Load Reduction =								**60 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

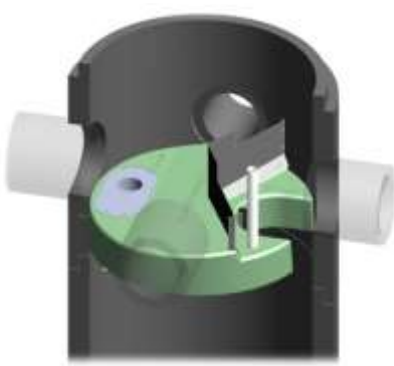
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

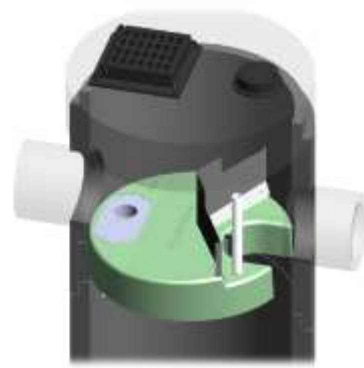
DESIGN FLEXIBILITY

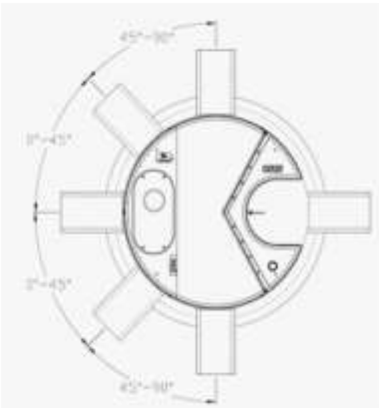
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP
Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS
The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS
For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION
For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor® Rinker

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20

Site Name:	Lot 5

Drainage Area (ha):	2.14
% Imperviousness:	78.90

Runoff Coefficient 'c': 0.77

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	53.47
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	1302
Estimated Average Annual Sediment Volume (L/yr):	1059

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	40
EFO6	50
EFO8	56
EFO10	60
EFO12	63

Recommended Stormceptor EFO Model: EFO10

Estimated Net Annual Sediment (TSS) Load Reduction (%): 60

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

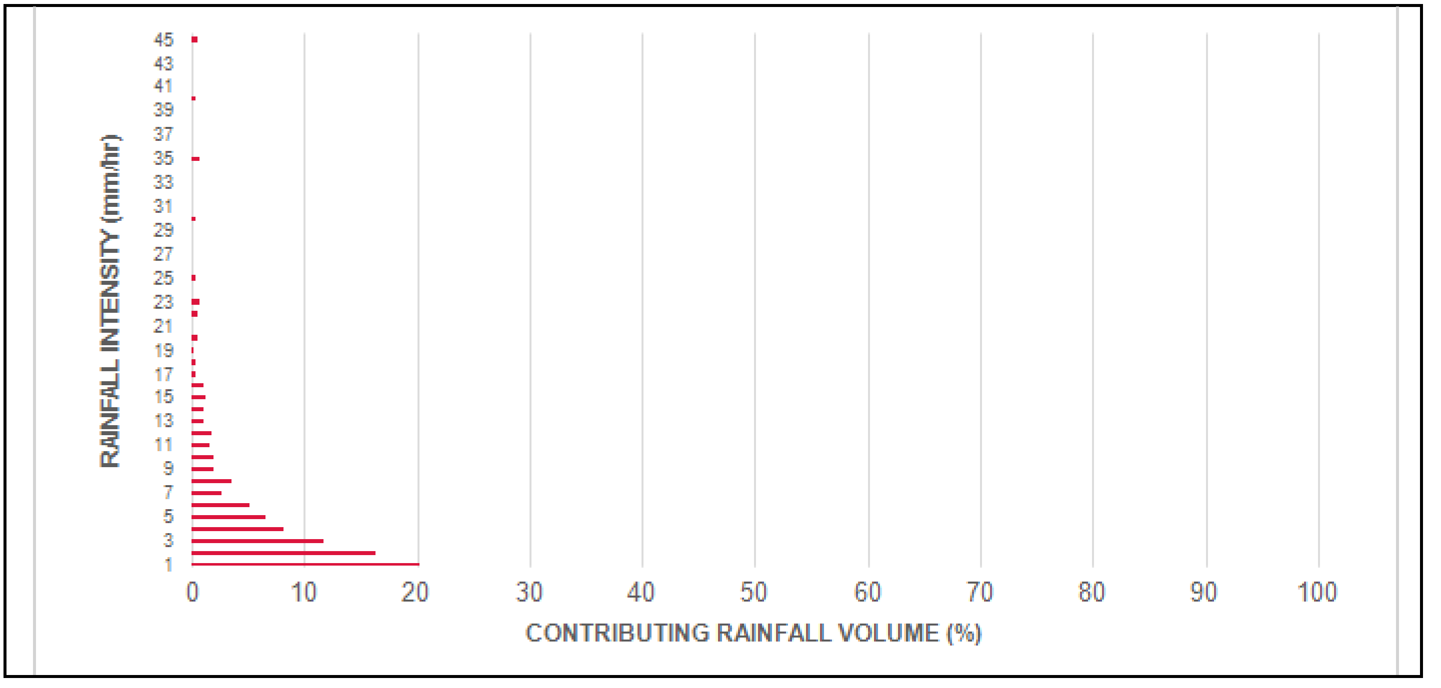
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

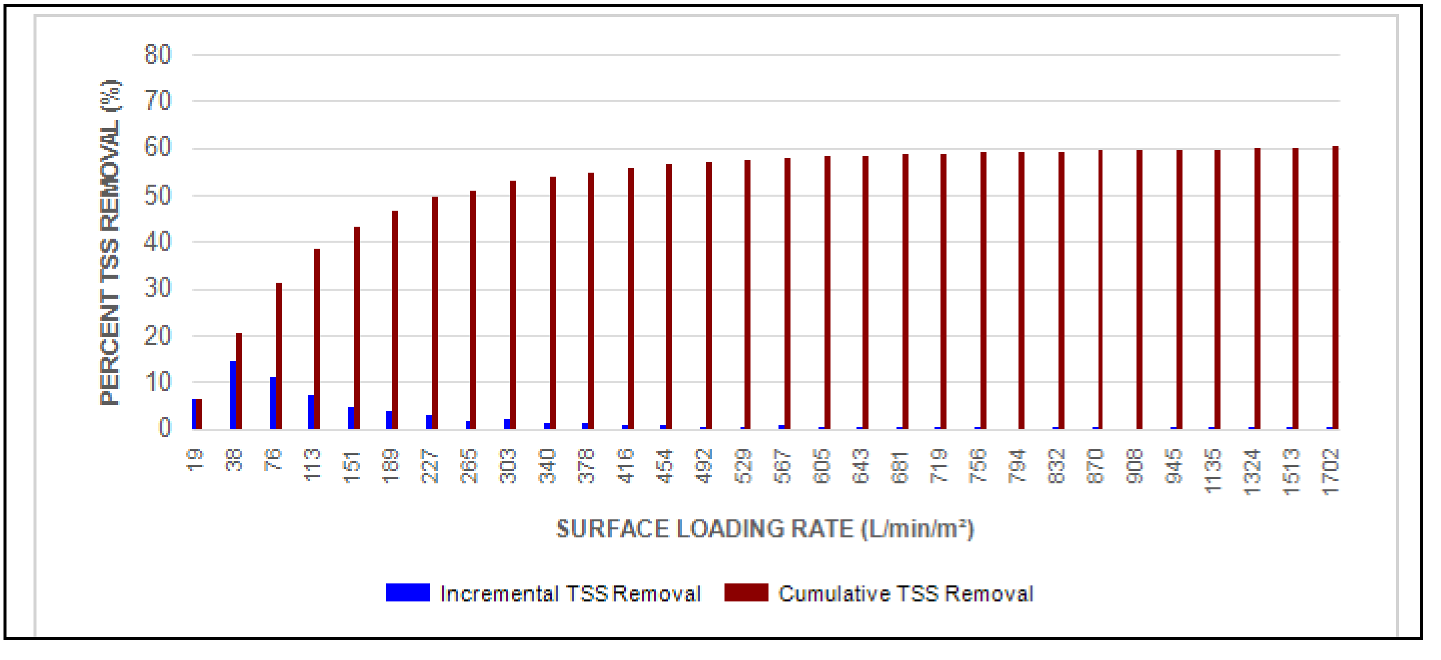
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	2.30	138.0	19.0	70	6.1	6.1
1.00	20.2	28.9	4.60	276.0	38.0	70	14.2	20.4
2.00	16.4	45.3	9.20	552.0	76.0	66	10.8	31.1
3.00	11.8	57.1	13.80	828.0	113.0	62	7.2	38.4
4.00	8.1	65.2	18.40	1104.0	151.0	58	4.7	43.1
5.00	6.6	71.9	23.01	1380.0	189.0	55	3.6	46.7
6.00	5.2	77.1	27.61	1656.0	227.0	53	2.8	49.5
7.00	2.7	79.8	32.21	1932.0	265.0	52	1.4	50.9
8.00	3.6	83.4	36.81	2209.0	303.0	51	1.8	52.8
9.00	2.0	85.4	41.41	2485.0	340.0	50	1.0	53.8
10.00	1.9	87.3	46.01	2761.0	378.0	49	0.9	54.7
11.00	1.6	88.9	50.61	3037.0	416.0	48	0.8	55.5
12.00	1.8	90.7	55.21	3313.0	454.0	47	0.8	56.3
13.00	1.0	91.6	59.81	3589.0	492.0	45	0.4	56.7
14.00	1.0	92.7	64.42	3865.0	529.0	44	0.5	57.2
15.00	1.3	93.9	69.02	4141.0	567.0	43	0.6	57.7
16.00	1.0	95.0	73.62	4417.0	605.0	42	0.4	58.2
17.00	0.4	95.3	78.22	4693.0	643.0	42	0.1	58.3
18.00	0.4	95.7	82.82	4969.0	681.0	42	0.2	58.5
19.00	0.2	95.9	87.42	5245.0	719.0	41	0.1	58.5
20.00	0.6	96.5	92.02	5521.0	756.0	41	0.3	58.8
21.00	0.0	96.5	96.62	5797.0	794.0	41	0.0	58.8
22.00	0.5	97.0	101.22	6073.0	832.0	41	0.2	59.0
23.00	0.7	97.7	105.83	6350.0	870.0	41	0.3	59.3
24.00	0.0	97.7	110.43	6626.0	908.0	41	0.0	59.3
25.00	0.3	98.0	115.03	6902.0	945.0	40	0.1	59.4
30.00	0.3	98.3	138.03	8282.0	1135.0	38	0.1	59.5
35.00	0.8	99.1	161.04	9662.0	1324.0	35	0.3	59.8
40.00	0.4	99.5	184.04	11043.0	1513.0	32	0.1	59.9
45.00	0.5	100.0	207.05	12423.0	1702.0	28	0.1	60.1
Estimated Net Annual Sediment (TSS) Load Reduction =								**60 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

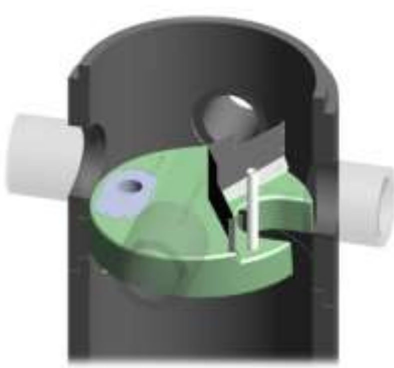
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

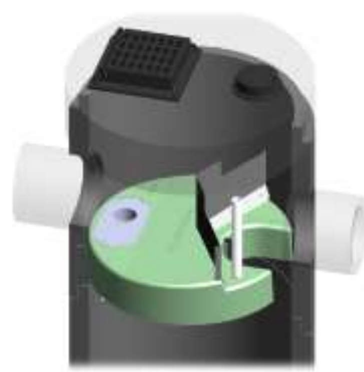
DESIGN FLEXIBILITY

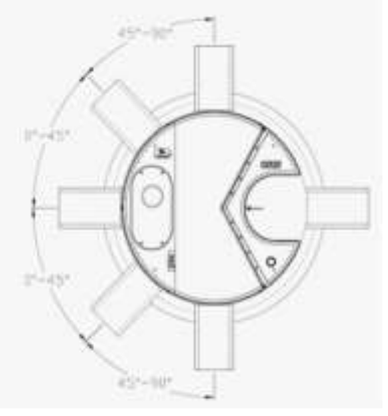
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor®

Rinker

Stormceptor® EF Sizing Report

Imbrium® Systems

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20

Site Name:	Lot 6

Drainage Area (ha):	0.99
% Imperviousness:	77.00

Runoff Coefficient 'c': 0.76

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	24.37
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	617
Estimated Average Annual Sediment Volume (L/yr):	502

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	50
EFO6	58
EFO8	63
EFO10	65
EFO12	67

Recommended Stormceptor EFO Model: EFO8

Estimated Net Annual Sediment (TSS) Load Reduction (%): 63

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

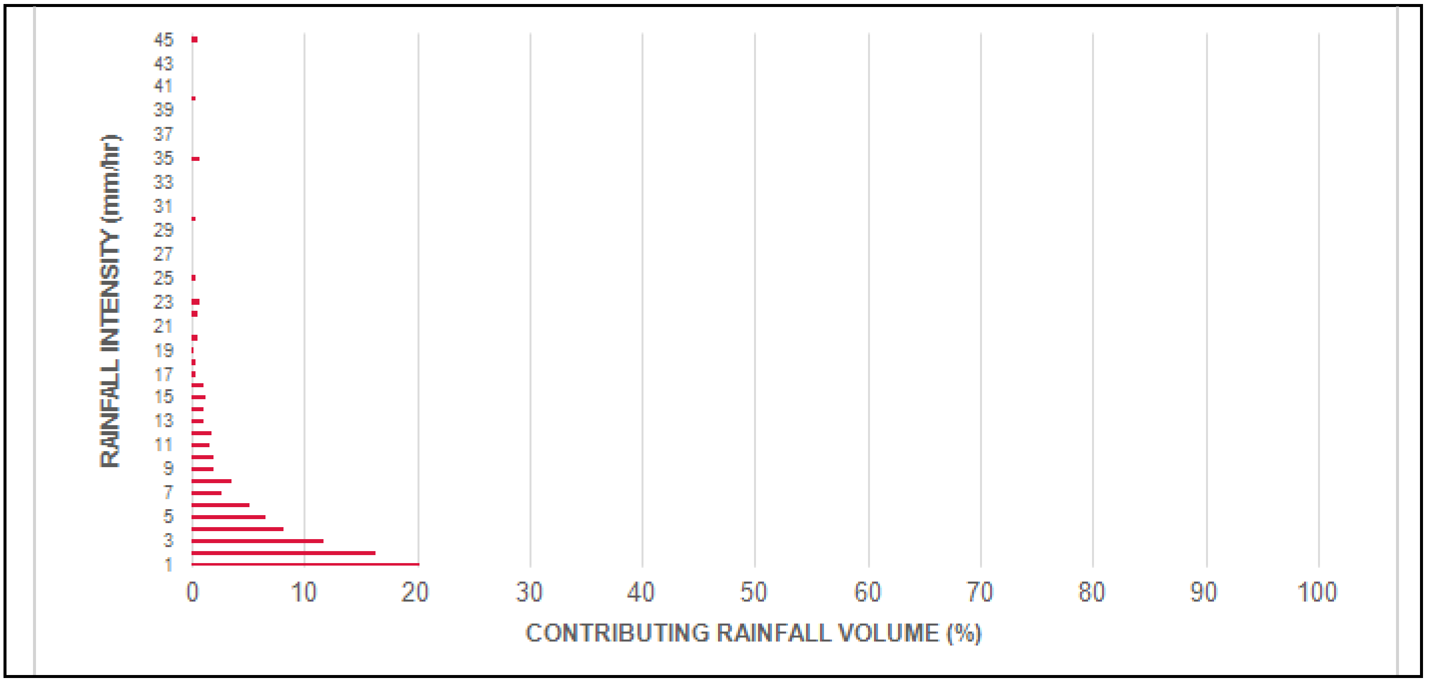
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

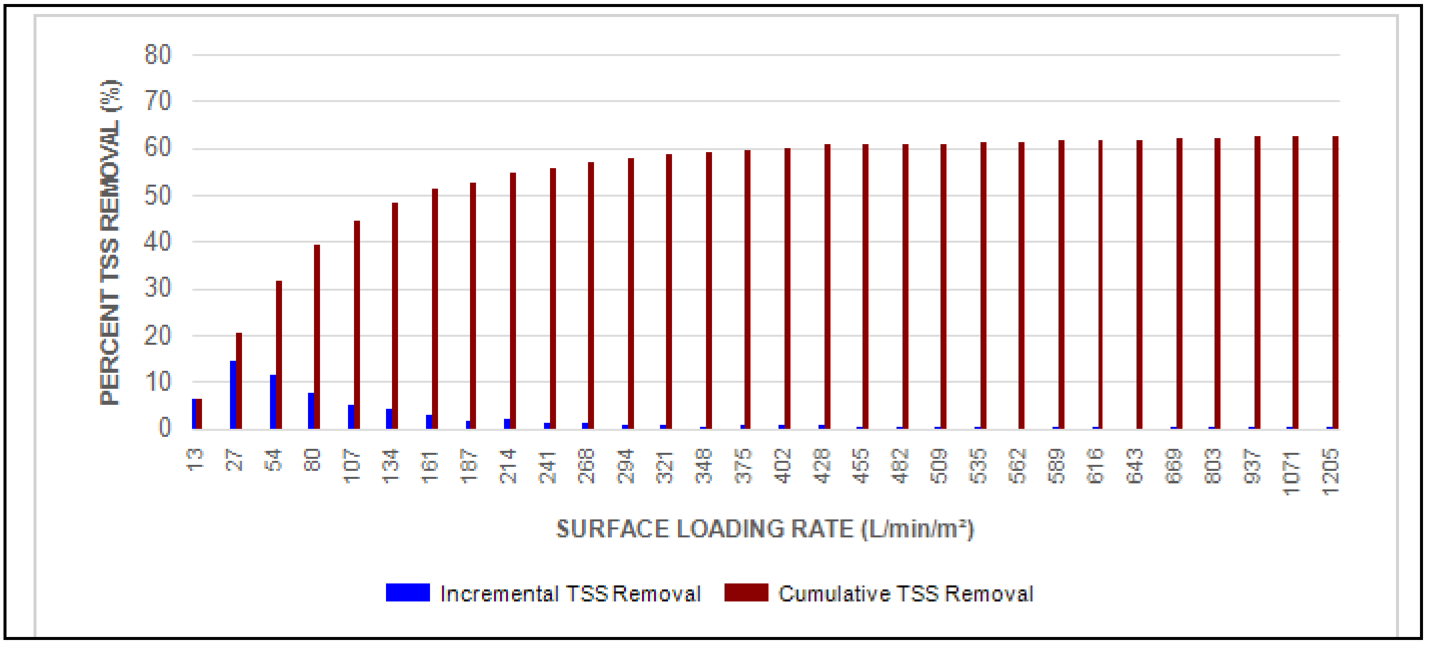
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	1.05	63.0	13.0	70	6.1	6.1
1.00	20.2	28.9	2.10	126.0	27.0	70	14.2	20.4
2.00	16.4	45.3	4.19	252.0	54.0	69	11.3	31.7
3.00	11.8	57.1	6.29	377.0	80.0	64	7.5	39.2
4.00	8.1	65.2	8.39	503.0	107.0	62	5.1	44.3
5.00	6.6	71.9	10.49	629.0	134.0	60	4.0	48.2
6.00	5.2	77.1	12.58	755.0	161.0	57	3.0	51.2
7.00	2.7	79.8	14.68	881.0	187.0	56	1.5	52.7
8.00	3.6	83.4	16.78	1007.0	214.0	54	1.9	54.6
9.00	2.0	85.4	18.87	1132.0	241.0	53	1.1	55.7
10.00	1.9	87.3	20.97	1258.0	268.0	52	1.0	56.7
11.00	1.6	88.9	23.07	1384.0	294.0	51	0.8	57.5
12.00	1.8	90.7	25.17	1510.0	321.0	50	0.9	58.4
13.00	1.0	91.6	27.26	1636.0	348.0	50	0.5	58.9
14.00	1.0	92.7	29.36	1762.0	375.0	49	0.5	59.4
15.00	1.3	93.9	31.46	1887.0	402.0	48	0.6	60.0
16.00	1.0	95.0	33.55	2013.0	428.0	47	0.5	60.5
17.00	0.4	95.3	35.65	2139.0	455.0	47	0.2	60.7
18.00	0.4	95.7	37.75	2265.0	482.0	46	0.2	60.8
19.00	0.2	95.9	39.85	2391.0	509.0	45	0.1	60.9
20.00	0.6	96.5	41.94	2517.0	535.0	44	0.3	61.2
21.00	0.0	96.5	44.04	2642.0	562.0	43	0.0	61.2
22.00	0.5	97.0	46.14	2768.0	589.0	43	0.2	61.4
23.00	0.7	97.7	48.24	2894.0	616.0	42	0.3	61.7
24.00	0.0	97.7	50.33	3020.0	643.0	42	0.0	61.7
25.00	0.3	98.0	52.43	3146.0	669.0	42	0.1	61.8
30.00	0.3	98.3	62.92	3775.0	803.0	41	0.1	61.9
35.00	0.8	99.1	73.40	4404.0	937.0	40	0.3	62.3
40.00	0.4	99.5	83.89	5033.0	1071.0	39	0.2	62.4
45.00	0.5	100.0	94.37	5662.0	1205.0	37	0.2	62.6
Estimated Net Annual Sediment (TSS) Load Reduction =								**63 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter (m)	Model Diameter (ft)	Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter (mm)	Max Inlet Pipe Diameter (in)	Max Outlet Pipe Diameter (mm)	Max Outlet Pipe Diameter (in)	Peak Conveyance Flow Rate (L/s)	Peak Conveyance Flow Rate (cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

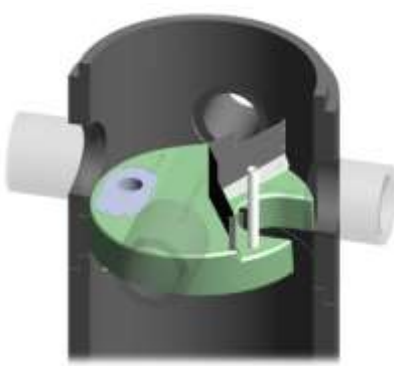
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

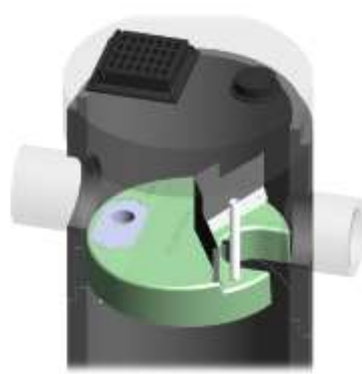
DESIGN FLEXIBILITY

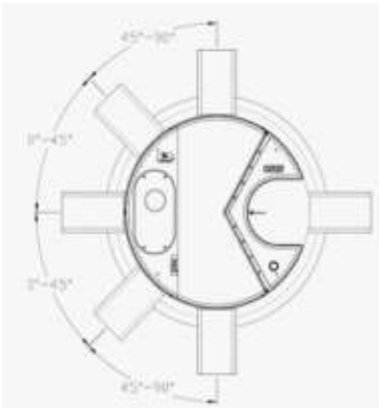
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP
Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS
The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS
For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION
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Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor® Rinker

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20
Site Name:	Lot 7
Drainage Area (ha):	1.75
% Imperviousness:	77.60

Runoff Coefficient 'c': 0.76

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	43.29
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	1082
Estimated Average Annual Sediment Volume (L/yr):	880

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	43
EFO6	52
EFO8	58
EFO10	62
EFO12	64

Recommended Stormceptor EFO Model: EFO10

Estimated Net Annual Sediment (TSS) Load Reduction (%): 62

Water Quality Runoff Volume Capture (%): > 90

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THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® Rinker

Stormceptor® EF Sizing Report

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	1.86	112.0	15.0	70	6.1	6.1
1.00	20.2	28.9	3.72	223.0	31.0	70	14.2	20.4
2.00	16.4	45.3	7.45	447.0	61.0	67	11.0	31.4
3.00	11.8	57.1	11.17	670.0	92.0	63	7.4	38.8
4.00	8.1	65.2	14.90	894.0	122.0	61	4.9	43.8
5.00	6.6	71.9	18.62	1117.0	153.0	58	3.9	47.6
6.00	5.2	77.1	22.35	1341.0	184.0	56	2.9	50.5
7.00	2.7	79.8	26.07	1564.0	214.0	54	1.4	52.0
8.00	3.6	83.4	29.80	1788.0	245.0	53	1.9	53.9
9.00	2.0	85.4	33.52	2011.0	276.0	52	1.0	54.9
10.00	1.9	87.3	37.25	2235.0	306.0	51	1.0	55.9
11.00	1.6	88.9	40.97	2458.0	337.0	50	0.8	56.7
12.00	1.8	90.7	44.70	2682.0	367.0	49	0.9	57.6
13.00	1.0	91.6	48.42	2905.0	398.0	48	0.5	58.0
14.00	1.0	92.7	52.15	3129.0	429.0	47	0.5	58.5
15.00	1.3	93.9	55.87	3352.0	459.0	46	0.6	59.1
16.00	1.0	95.0	59.59	3576.0	490.0	45	0.5	59.6
17.00	0.4	95.3	63.32	3799.0	520.0	44	0.2	59.7
18.00	0.4	95.7	67.04	4023.0	551.0	44	0.2	59.9
19.00	0.2	95.9	70.77	4246.0	582.0	43	0.1	60.0
20.00	0.6	96.5	74.49	4470.0	612.0	42	0.3	60.2
21.00	0.0	96.5	78.22	4693.0	643.0	42	0.0	60.2
22.00	0.5	97.0	81.94	4917.0	673.0	42	0.2	60.4
23.00	0.7	97.7	85.67	5140.0	704.0	42	0.3	60.7
24.00	0.0	97.7	89.39	5363.0	735.0	41	0.0	60.7
25.00	0.3	98.0	93.12	5587.0	765.0	41	0.1	60.8
30.00	0.3	98.3	111.74	6704.0	918.0	40	0.1	61.0
35.00	0.8	99.1	130.36	7822.0	1071.0	39	0.3	61.3
40.00	0.4	99.5	148.99	8939.0	1225.0	37	0.1	61.4
45.00	0.5	100.0	167.61	10057.0	1378.0	34	0.2	61.6
Estimated Net Annual Sediment (TSS) Load Reduction =								**62 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

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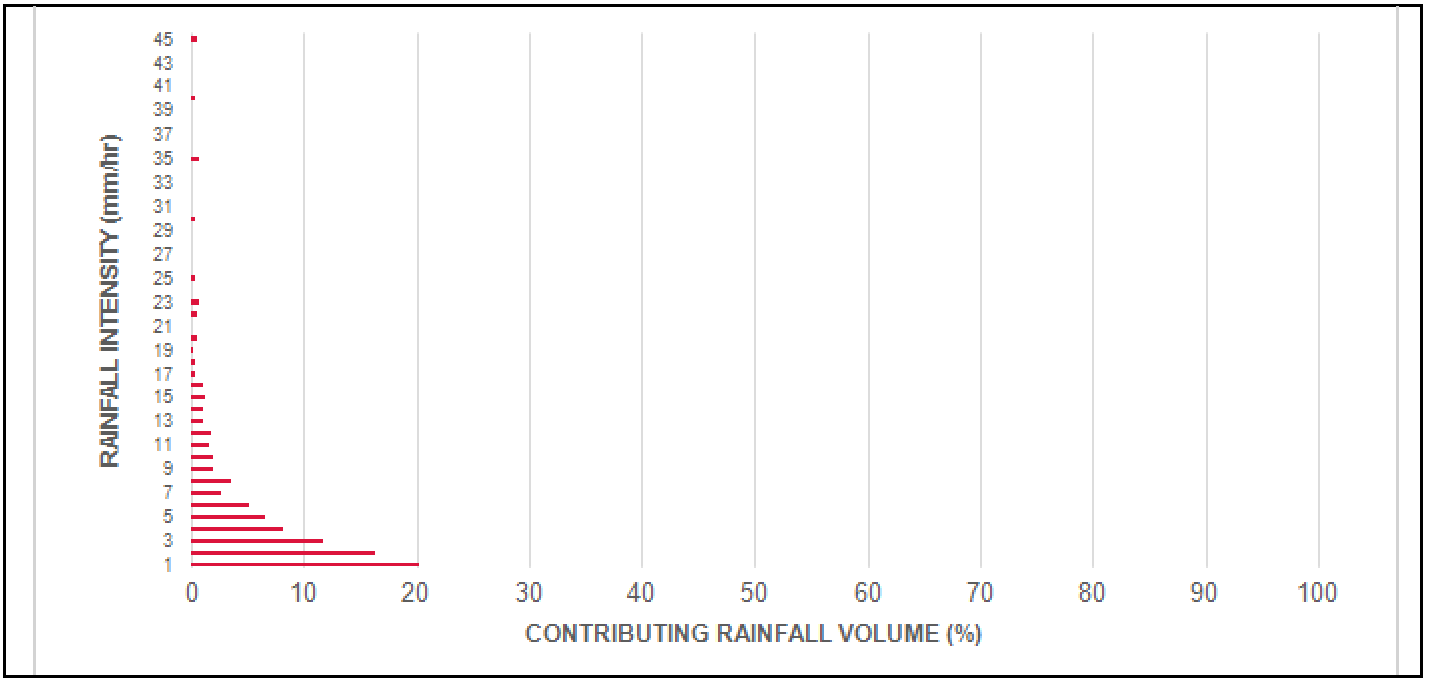
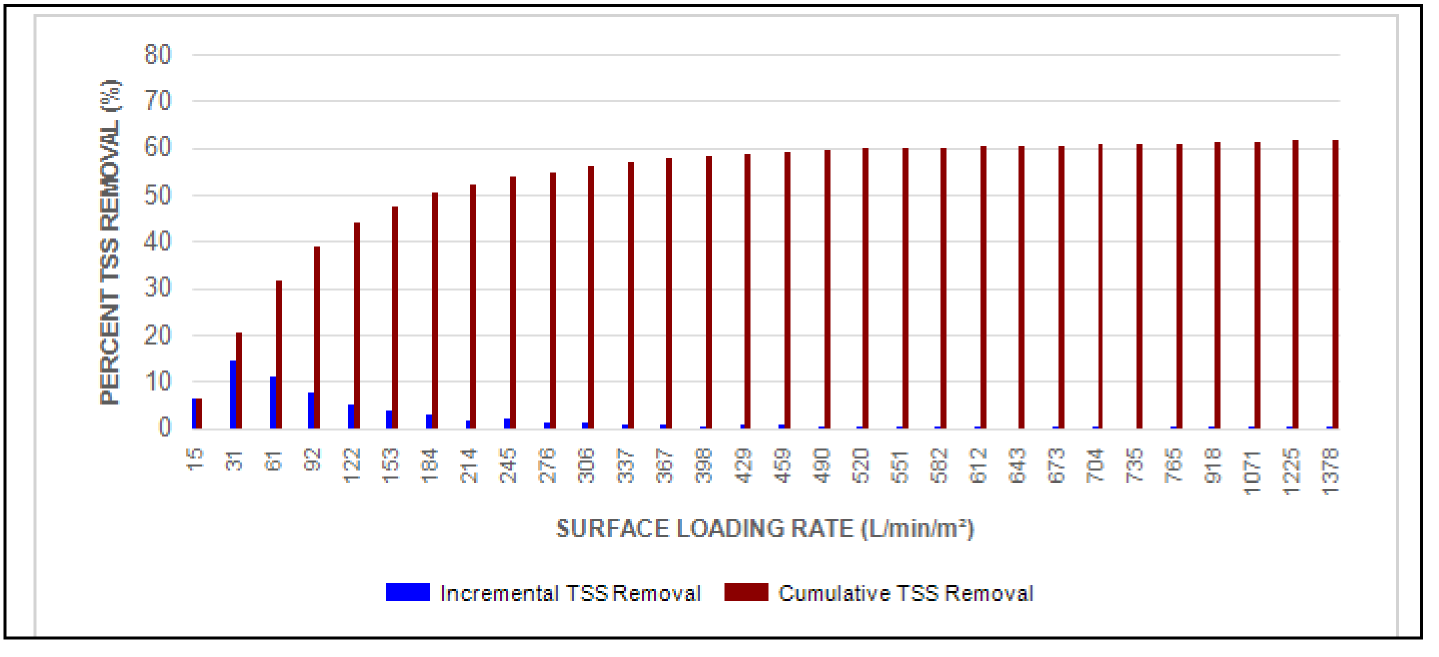
RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

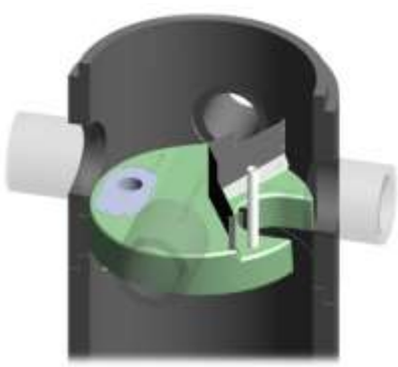
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

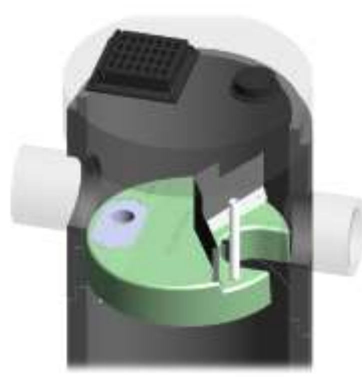
DESIGN FLEXIBILITY

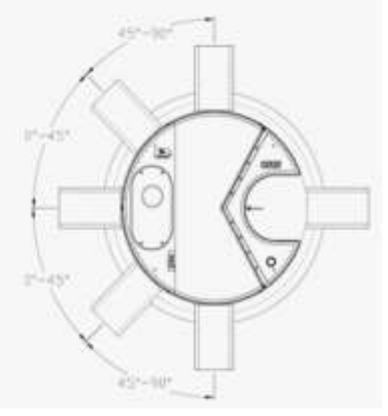
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 <u>WORK INCLUDED</u>

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 <u>REFERENCE STANDARDS & PROCEDURES</u>

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 <u>SUBMITTALS</u>

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 <u>OGS POLLUTANT STORAGE</u>

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20
Site Name:	Lot 8
Drainage Area (ha):	0.61
% Imperviousness:	70.40

Runoff Coefficient 'c': 0.72

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	14.24
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	342
Estimated Average Annual Sediment Volume (L/yr):	278

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	56
EFO6	62
EFO8	66
EFO10	68
EFO12	69

Recommended Stormceptor EFO Model: EFO6

Estimated Net Annual Sediment (TSS) Load Reduction (%): 62

Water Quality Runoff Volume Capture (%): > 90

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

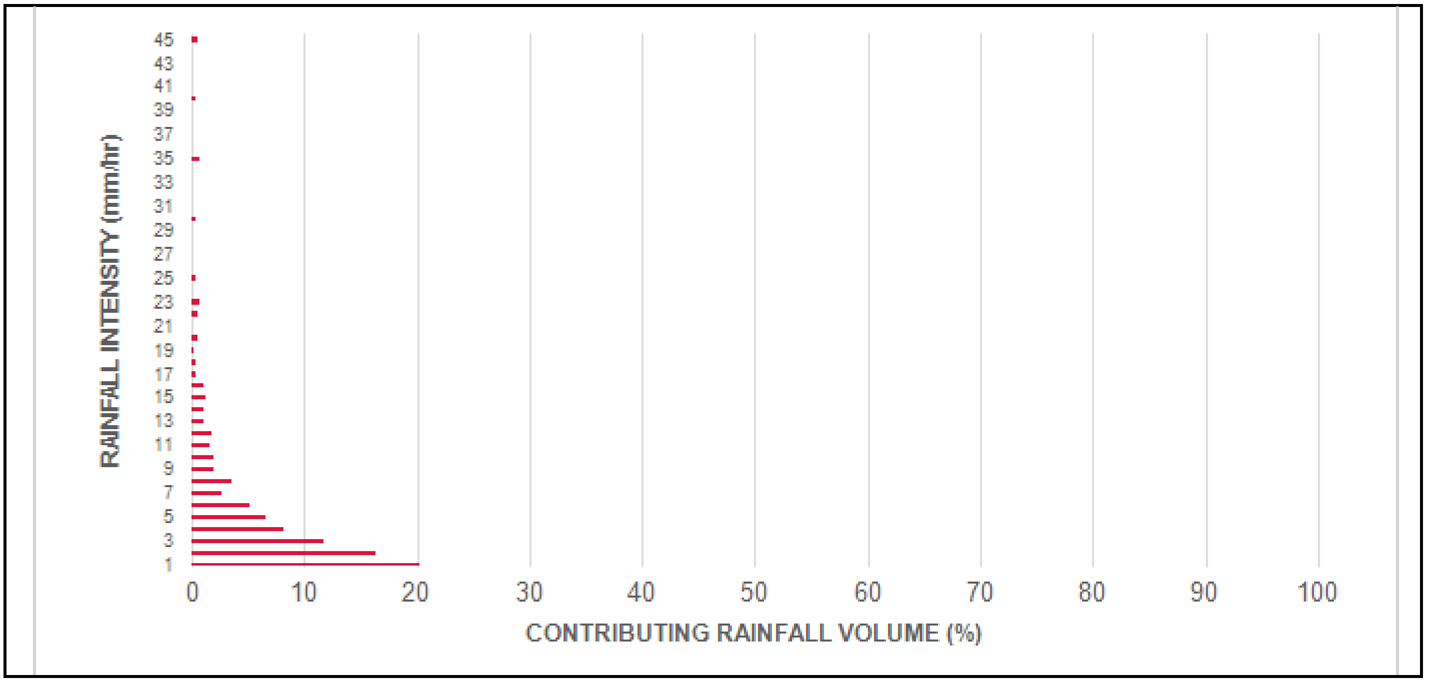
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

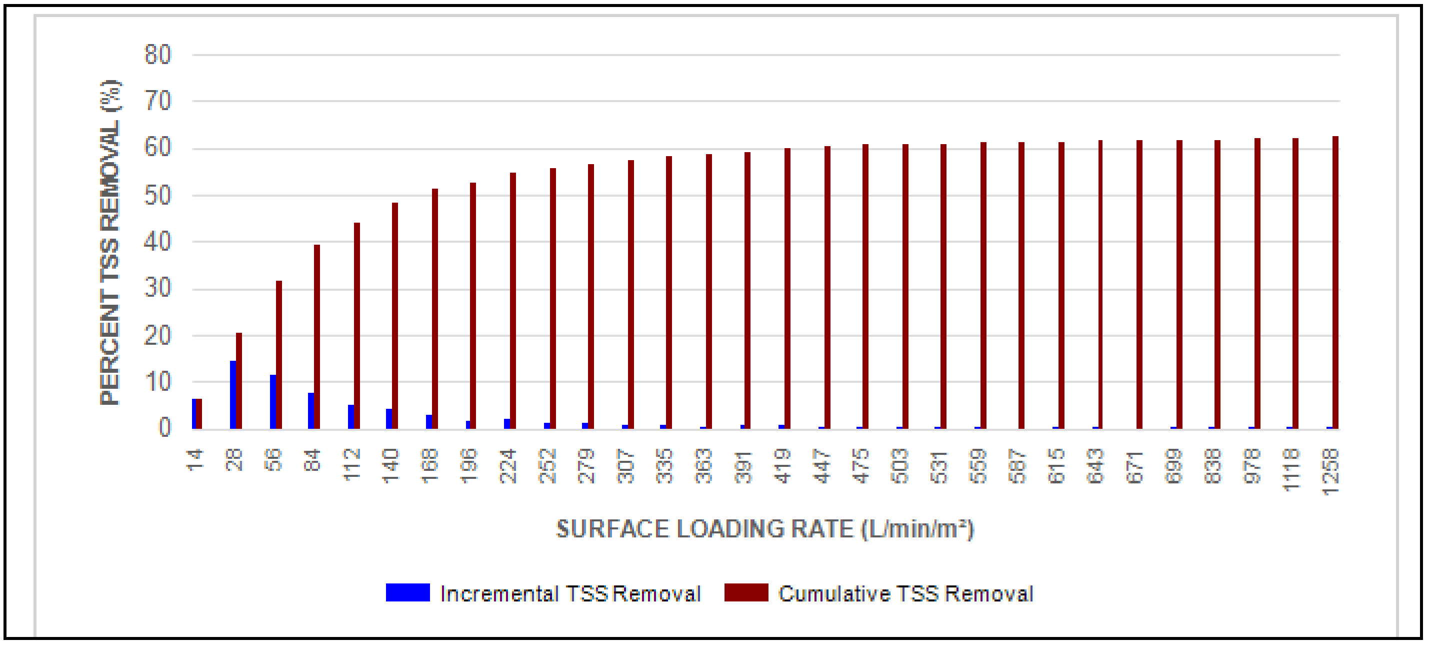
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	0.61	37.0	14.0	70	6.1	6.1
1.00	20.2	28.9	1.23	74.0	28.0	70	14.2	20.4
2.00	16.4	45.3	2.45	147.0	56.0	69	11.3	31.7
3.00	11.8	57.1	3.68	221.0	84.0	64	7.5	39.2
4.00	8.1	65.2	4.90	294.0	112.0	62	5.0	44.2
5.00	6.6	71.9	6.13	368.0	140.0	59	3.9	48.1
6.00	5.2	77.1	7.35	441.0	168.0	57	3.0	51.1
7.00	2.7	79.8	8.58	515.0	196.0	55	1.5	52.6
8.00	3.6	83.4	9.80	588.0	224.0	53	1.9	54.5
9.00	2.0	85.4	11.03	662.0	252.0	53	1.1	55.5
10.00	1.9	87.3	12.25	735.0	279.0	52	1.0	56.5
11.00	1.6	88.9	13.48	809.0	307.0	51	0.8	57.3
12.00	1.8	90.7	14.70	882.0	335.0	50	0.9	58.2
13.00	1.0	91.6	15.93	956.0	363.0	49	0.5	58.7
14.00	1.0	92.7	17.15	1029.0	391.0	48	0.5	59.2
15.00	1.3	93.9	18.38	1103.0	419.0	47	0.6	59.8
16.00	1.0	95.0	19.60	1176.0	447.0	47	0.5	60.3
17.00	0.4	95.3	20.83	1250.0	475.0	46	0.2	60.5
18.00	0.4	95.7	22.05	1323.0	503.0	45	0.2	60.6
19.00	0.2	95.9	23.28	1397.0	531.0	44	0.1	60.7
20.00	0.6	96.5	24.50	1470.0	559.0	44	0.3	61.0
21.00	0.0	96.5	25.73	1544.0	587.0	43	0.0	61.0
22.00	0.5	97.0	26.95	1617.0	615.0	42	0.2	61.2
23.00	0.7	97.7	28.18	1691.0	643.0	42	0.3	61.5
24.00	0.0	97.7	29.40	1764.0	671.0	42	0.0	61.5
25.00	0.3	98.0	30.63	1838.0	699.0	42	0.1	61.6
30.00	0.3	98.3	36.75	2205.0	838.0	41	0.1	61.7
35.00	0.8	99.1	42.88	2573.0	978.0	40	0.3	62.0
40.00	0.4	99.5	49.00	2940.0	1118.0	38	0.2	62.2
45.00	0.5	100.0	55.13	3308.0	1258.0	36	0.2	62.4
Estimated Net Annual Sediment (TSS) Load Reduction =								**62 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

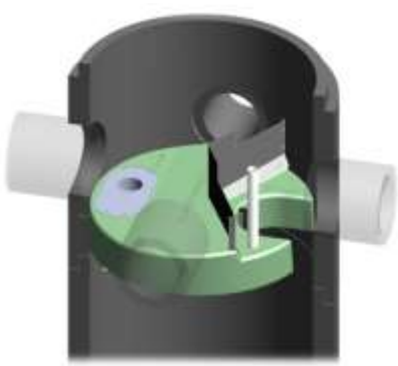
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

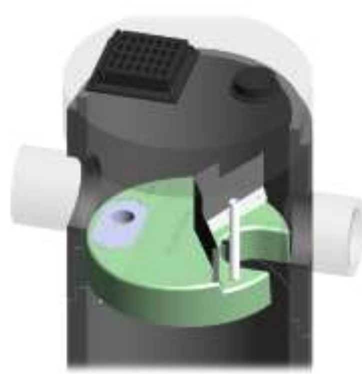
DESIGN FLEXIBILITY

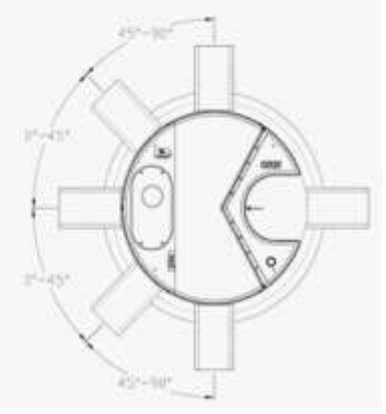
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor®

Rinker

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20

Site Name:	Lot 9

Drainage Area (ha):	0.59
% Imperviousness:	77.70

Runoff Coefficient 'c': 0.76

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	14.61
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	365
Estimated Average Annual Sediment Volume (L/yr):	297

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	56
EFO6	62
EFO8	66
EFO10	68
EFO12	69

Recommended Stormceptor EFO Model:	**EFO6**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**62**
Water Quality Runoff Volume Capture (%):	**> 90**

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

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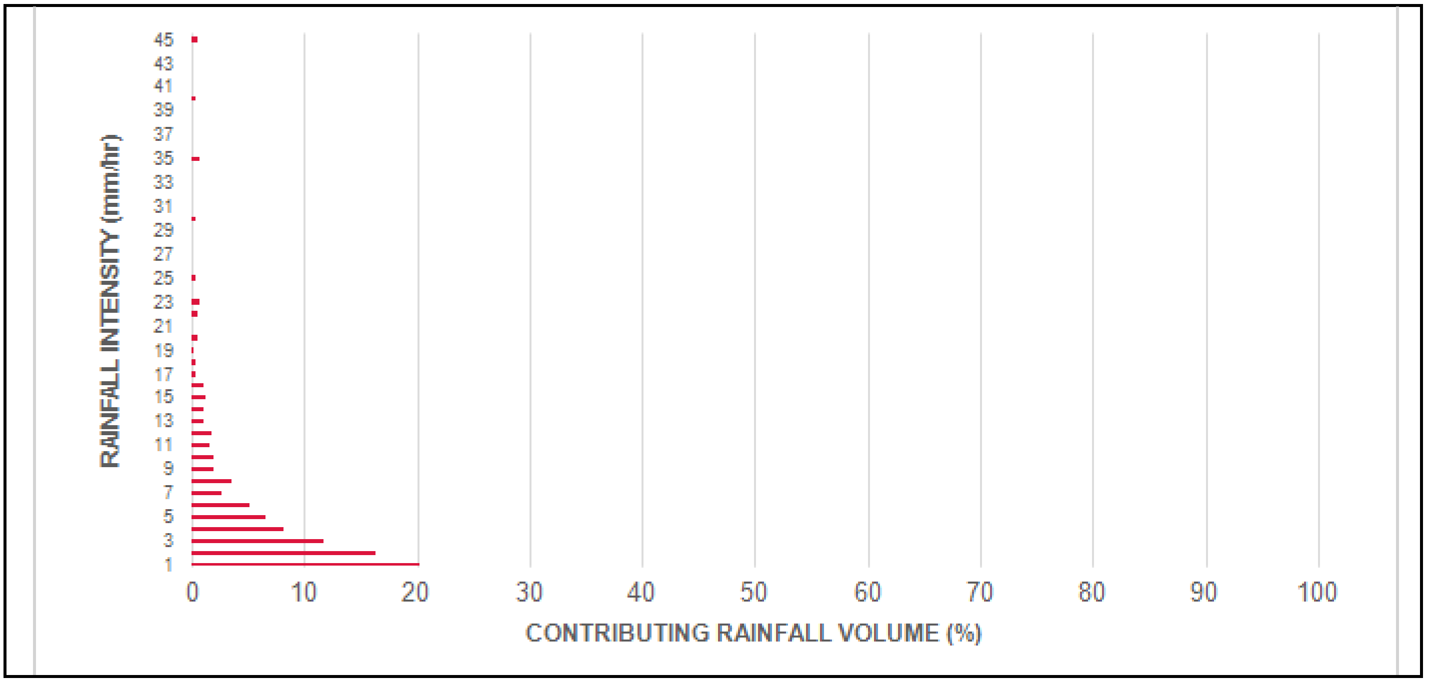
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

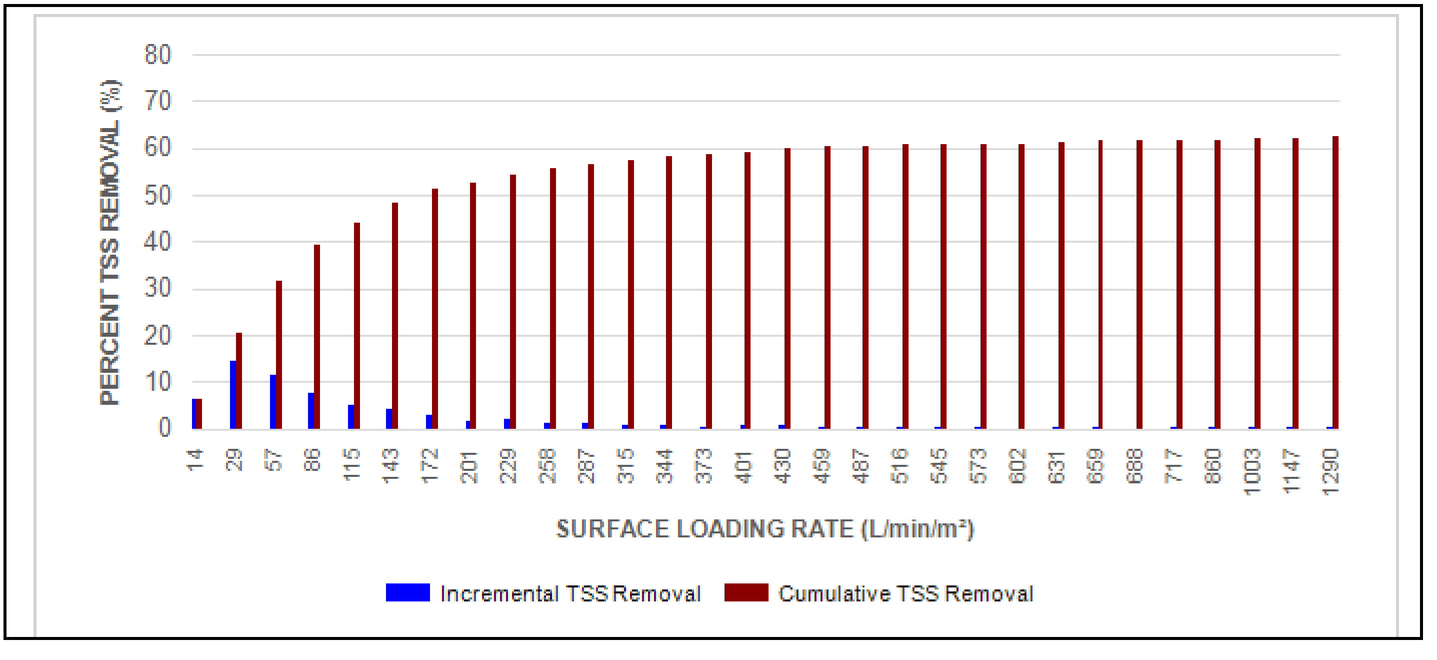
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	0.63	38.0	14.0	70	6.1	6.1
1.00	20.2	28.9	1.26	75.0	29.0	70	14.2	20.4
2.00	16.4	45.3	2.51	151.0	57.0	69	11.3	31.7
3.00	11.8	57.1	3.77	226.0	86.0	64	7.5	39.2
4.00	8.1	65.2	5.03	302.0	115.0	62	5.0	44.2
5.00	6.6	71.9	6.28	377.0	143.0	59	3.9	48.1
6.00	5.2	77.1	7.54	452.0	172.0	57	3.0	51.1
7.00	2.7	79.8	8.80	528.0	201.0	54	1.4	52.5
8.00	3.6	83.4	10.05	603.0	229.0	53	1.9	54.4
9.00	2.0	85.4	11.31	679.0	258.0	53	1.1	55.5
10.00	1.9	87.3	12.57	754.0	287.0	52	1.0	56.4
11.00	1.6	88.9	13.82	829.0	315.0	51	0.8	57.3
12.00	1.8	90.7	15.08	905.0	344.0	50	0.9	58.1
13.00	1.0	91.6	16.34	980.0	373.0	49	0.5	58.6
14.00	1.0	92.7	17.59	1056.0	401.0	48	0.5	59.1
15.00	1.3	93.9	18.85	1131.0	430.0	47	0.6	59.7
16.00	1.0	95.0	20.11	1206.0	459.0	47	0.5	60.2
17.00	0.4	95.3	21.36	1282.0	487.0	46	0.2	60.4
18.00	0.4	95.7	22.62	1357.0	516.0	45	0.2	60.5
19.00	0.2	95.9	23.88	1433.0	545.0	44	0.1	60.6
20.00	0.6	96.5	25.13	1508.0	573.0	43	0.3	60.9
21.00	0.0	96.5	26.39	1583.0	602.0	42	0.0	60.9
22.00	0.5	97.0	27.65	1659.0	631.0	42	0.2	61.1
23.00	0.7	97.7	28.90	1734.0	659.0	42	0.3	61.4
24.00	0.0	97.7	30.16	1810.0	688.0	42	0.0	61.4
25.00	0.3	98.0	31.42	1885.0	717.0	41	0.1	61.5
30.00	0.3	98.3	37.70	2262.0	860.0	41	0.1	61.6
35.00	0.8	99.1	43.99	2639.0	1003.0	40	0.3	61.9
40.00	0.4	99.5	50.27	3016.0	1147.0	38	0.2	62.1
45.00	0.5	100.0	56.55	3393.0	1290.0	36	0.2	62.3
Estimated Net Annual Sediment (TSS) Load Reduction =								**62 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter (m)	Model Diameter (ft)	Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter (mm)	Max Inlet Pipe Diameter (in)	Max Outlet Pipe Diameter (mm)	Max Outlet Pipe Diameter (in)	Peak Conveyance Flow Rate (L/s)	Peak Conveyance Flow Rate (cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

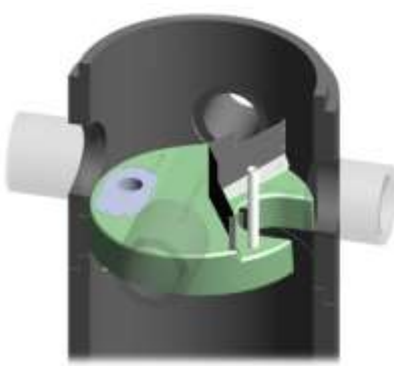
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

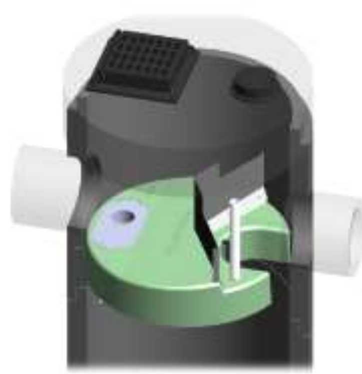
DESIGN FLEXIBILITY

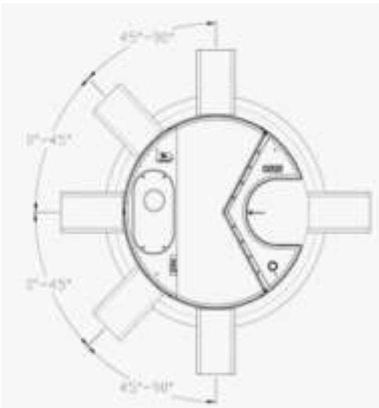
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor®

Rinker

Stormceptor® EF Sizing Report

Imbrium® Systems

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20

Site Name:	Lot 10

Drainage Area (ha):	0.59
% Imperviousness:	77.70

Runoff Coefficient 'c': 0.76

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	14.61
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	365
Estimated Average Annual Sediment Volume (L/yr):	297

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	56
EFO6	62
EFO8	66
EFO10	68
EFO12	69

Recommended Stormceptor EFO Model: EFO6

Estimated Net Annual Sediment (TSS) Load Reduction (%): 62

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	0.63	38.0	14.0	70	6.1	6.1
1.00	20.2	28.9	1.26	75.0	29.0	70	14.2	20.4
2.00	16.4	45.3	2.51	151.0	57.0	69	11.3	31.7
3.00	11.8	57.1	3.77	226.0	86.0	64	7.5	39.2
4.00	8.1	65.2	5.03	302.0	115.0	62	5.0	44.2
5.00	6.6	71.9	6.28	377.0	143.0	59	3.9	48.1
6.00	5.2	77.1	7.54	452.0	172.0	57	3.0	51.1
7.00	2.7	79.8	8.80	528.0	201.0	54	1.4	52.5
8.00	3.6	83.4	10.05	603.0	229.0	53	1.9	54.4
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21.00	0.0	96.5	26.39	1583.0	602.0	42	0.0	60.9
22.00	0.5	97.0	27.65	1659.0	631.0	42	0.2	61.1
23.00	0.7	97.7	28.90	1734.0	659.0	42	0.3	61.4
24.00	0.0	97.7	30.16	1810.0	688.0	42	0.0	61.4
25.00	0.3	98.0	31.42	1885.0	717.0	41	0.1	61.5
30.00	0.3	98.3	37.70	2262.0	860.0	41	0.1	61.6
35.00	0.8	99.1	43.99	2639.0	1003.0	40	0.3	61.9
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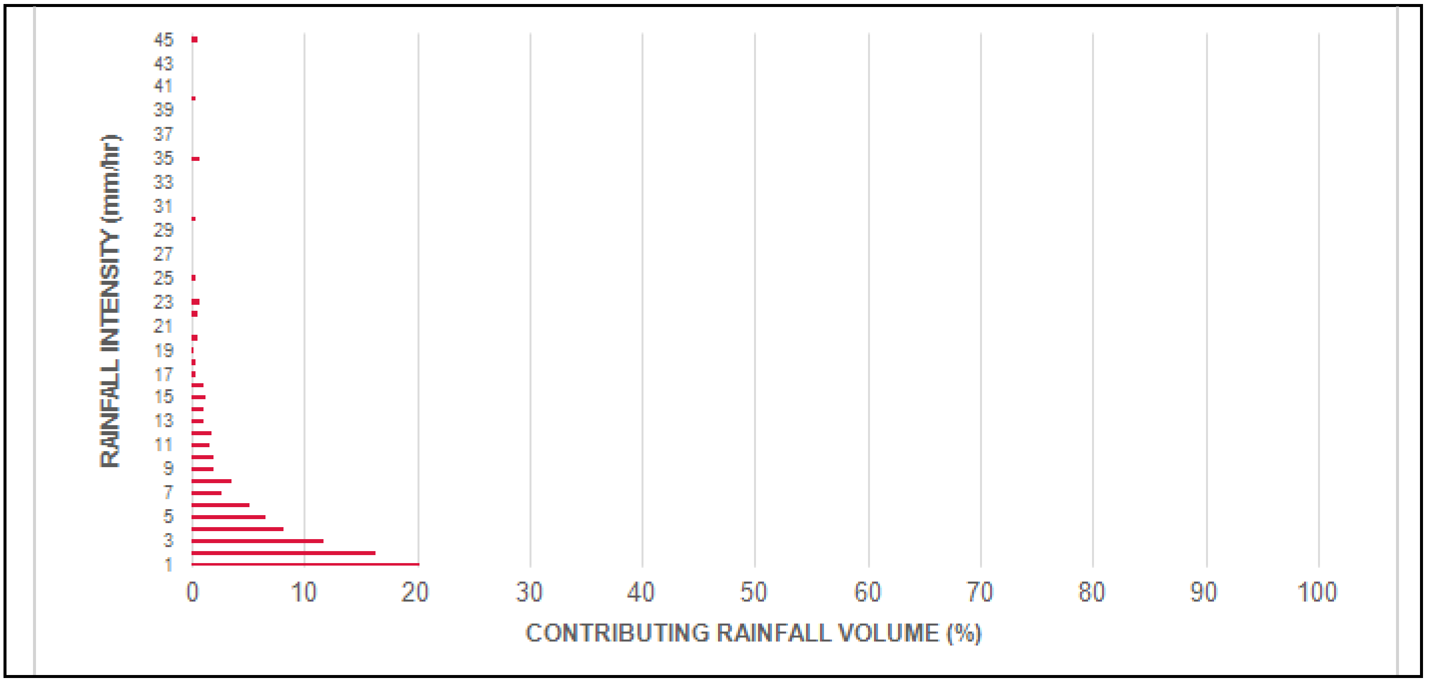
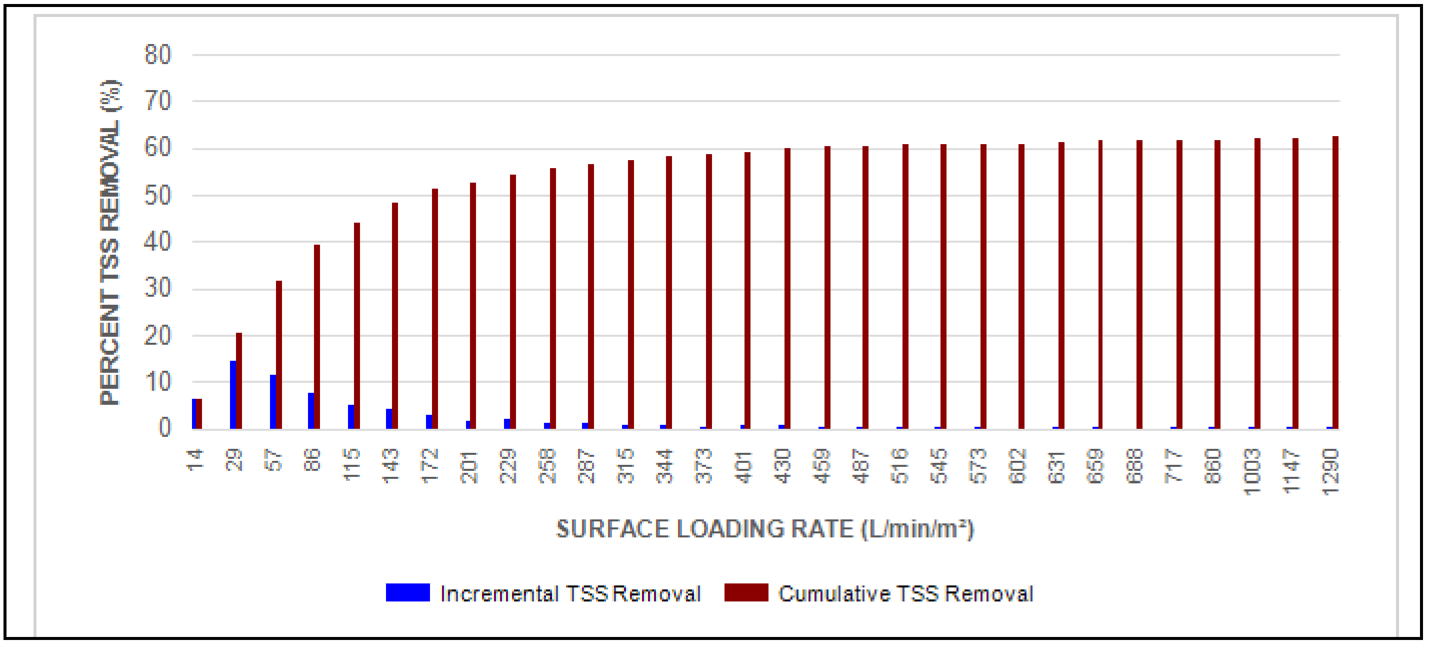


INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter (m)	(ft)	Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter (mm)	(in)	Max Outlet Pipe Diameter (mm)	(in)	Peak Conveyance Flow Rate (L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

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OIL CAPTURE AND RETENTION

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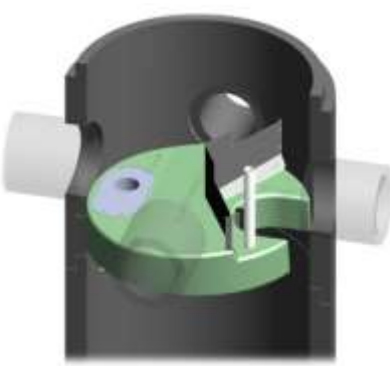

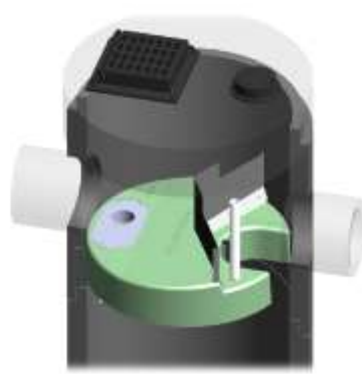

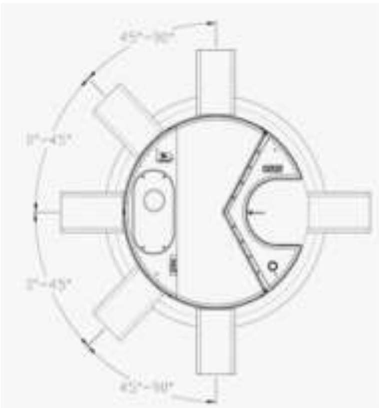

INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor®

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Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20
Site Name:	Lot 11
Drainage Area (ha):	0.61
% Imperviousness:	75.30

Runoff Coefficient 'c': 0.75

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	14.82
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	366
Estimated Average Annual Sediment Volume (L/yr):	298

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	55
EFO6	62
EFO8	66
EFO10	68
EFO12	69

Recommended Stormceptor EFO Model: EFO6

Estimated Net Annual Sediment (TSS) Load Reduction (%): 62

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

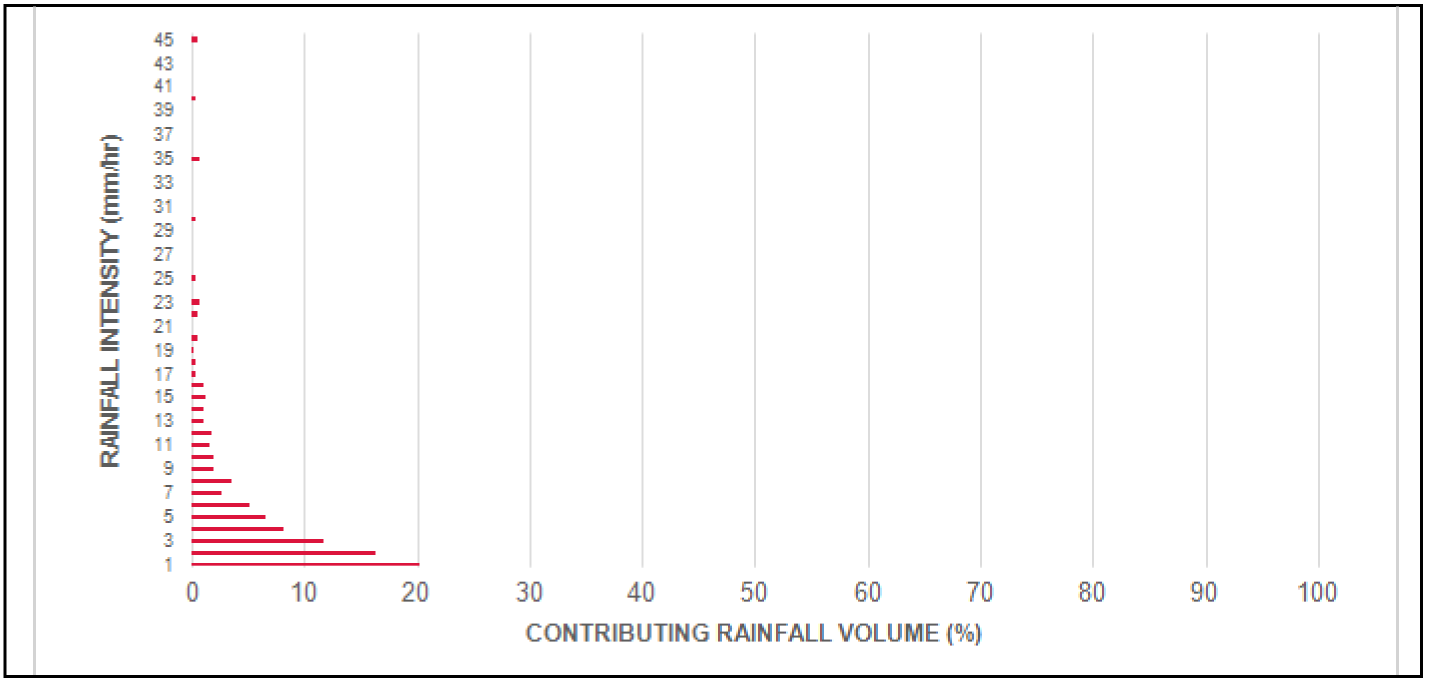
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

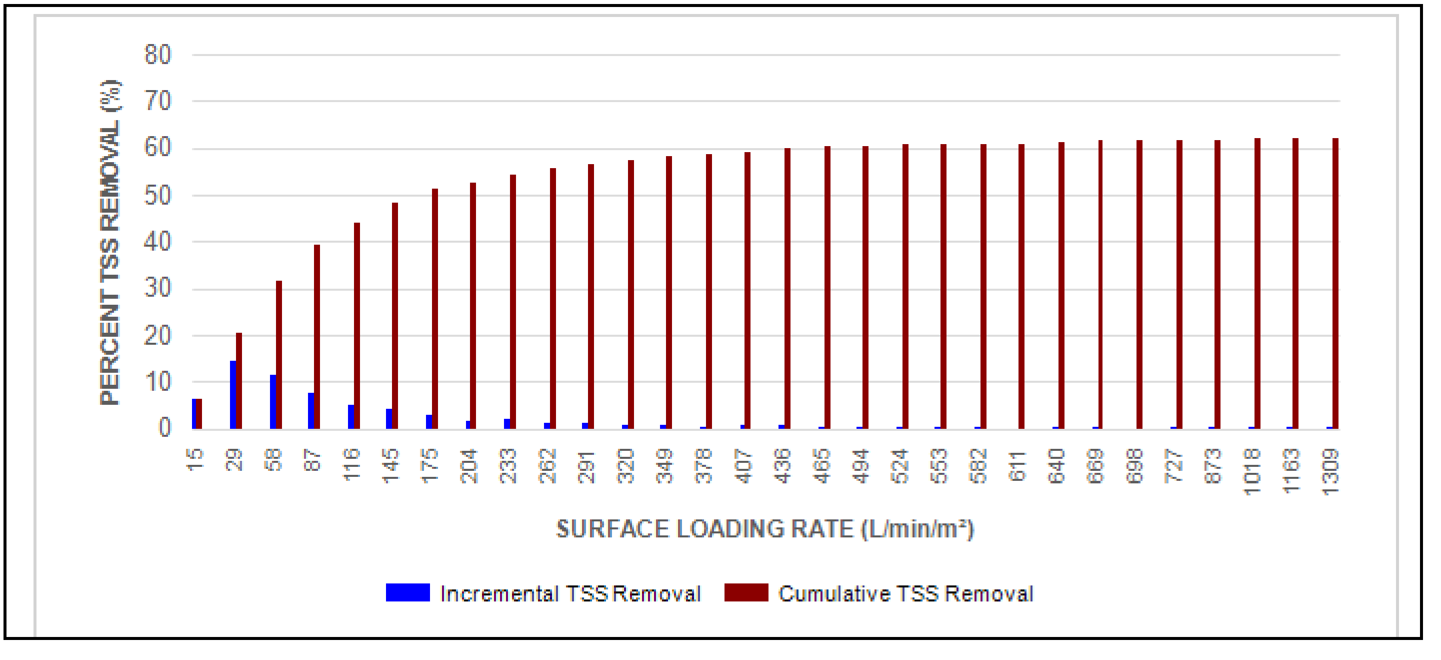
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	0.64	38.0	15.0	70	6.1	6.1
1.00	20.2	28.9	1.27	76.0	29.0	70	14.2	20.4
2.00	16.4	45.3	2.55	153.0	58.0	69	11.3	31.7
3.00	11.8	57.1	3.82	229.0	87.0	64	7.5	39.2
4.00	8.1	65.2	5.10	306.0	116.0	62	5.0	44.2
5.00	6.6	71.9	6.37	382.0	145.0	59	3.9	48.1
6.00	5.2	77.1	7.65	459.0	175.0	57	3.0	51.1
7.00	2.7	79.8	8.92	535.0	204.0	54	1.4	52.5
8.00	3.6	83.4	10.20	612.0	233.0	53	1.9	54.4
9.00	2.0	85.4	11.47	688.0	262.0	52	1.0	55.5
10.00	1.9	87.3	12.75	765.0	291.0	51	1.0	56.4
11.00	1.6	88.9	14.02	841.0	320.0	50	0.8	57.2
12.00	1.8	90.7	15.30	918.0	349.0	50	0.9	58.1
13.00	1.0	91.6	16.57	994.0	378.0	49	0.5	58.6
14.00	1.0	92.7	17.85	1071.0	407.0	48	0.5	59.1
15.00	1.3	93.9	19.12	1147.0	436.0	47	0.6	59.7
16.00	1.0	95.0	20.40	1224.0	465.0	46	0.5	60.2
17.00	0.4	95.3	21.67	1300.0	494.0	45	0.2	60.3
18.00	0.4	95.7	22.95	1377.0	524.0	44	0.2	60.5
19.00	0.2	95.9	24.22	1453.0	553.0	44	0.1	60.6
20.00	0.6	96.5	25.50	1530.0	582.0	43	0.3	60.9
21.00	0.0	96.5	26.77	1606.0	611.0	42	0.0	60.9
22.00	0.5	97.0	28.05	1683.0	640.0	42	0.2	61.1
23.00	0.7	97.7	29.32	1759.0	669.0	42	0.3	61.4
24.00	0.0	97.7	30.60	1836.0	698.0	42	0.0	61.4
25.00	0.3	98.0	31.87	1912.0	727.0	41	0.1	61.5
30.00	0.3	98.3	38.25	2295.0	873.0	41	0.1	61.6
35.00	0.8	99.1	44.62	2677.0	1018.0	40	0.3	61.9
40.00	0.4	99.5	51.00	3060.0	1163.0	38	0.2	62.0
45.00	0.5	100.0	57.37	3442.0	1309.0	36	0.2	62.2
Estimated Net Annual Sediment (TSS) Load Reduction =								**62 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

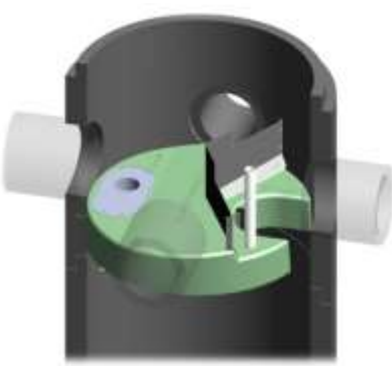
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

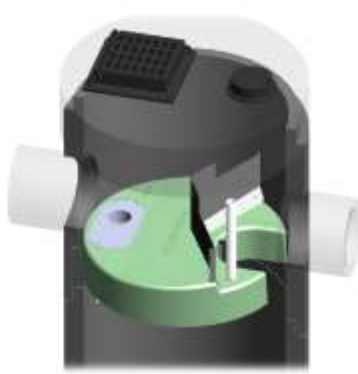
DESIGN FLEXIBILITY

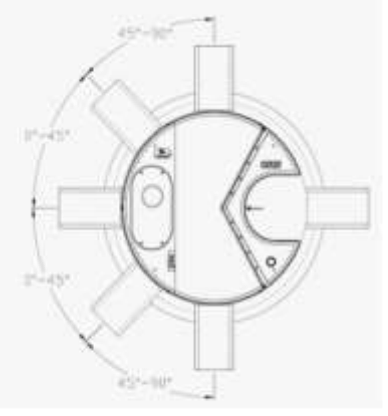
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
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EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION 11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20

Site Name:	Lot 12

Drainage Area (ha):	0.74
% Imperviousness:	76.60

Runoff Coefficient 'c': 0.75

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	18.16
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	444
Estimated Average Annual Sediment Volume (L/yr):	361

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	54
EFO6	61
EFO8	64
EFO10	67
EFO12	68

Recommended Stormceptor EFO Model: EFO6

Estimated Net Annual Sediment (TSS) Load Reduction (%): 61

Water Quality Runoff Volume Capture (%): > 90

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

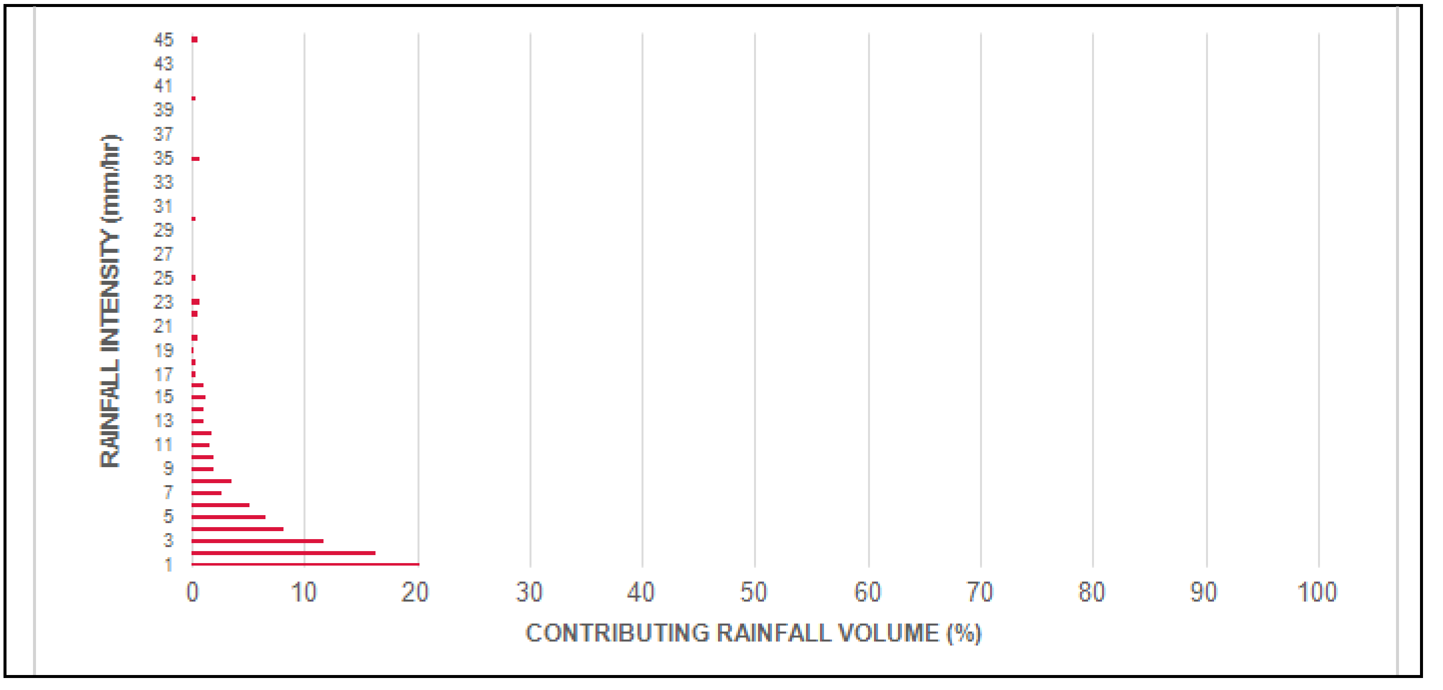
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

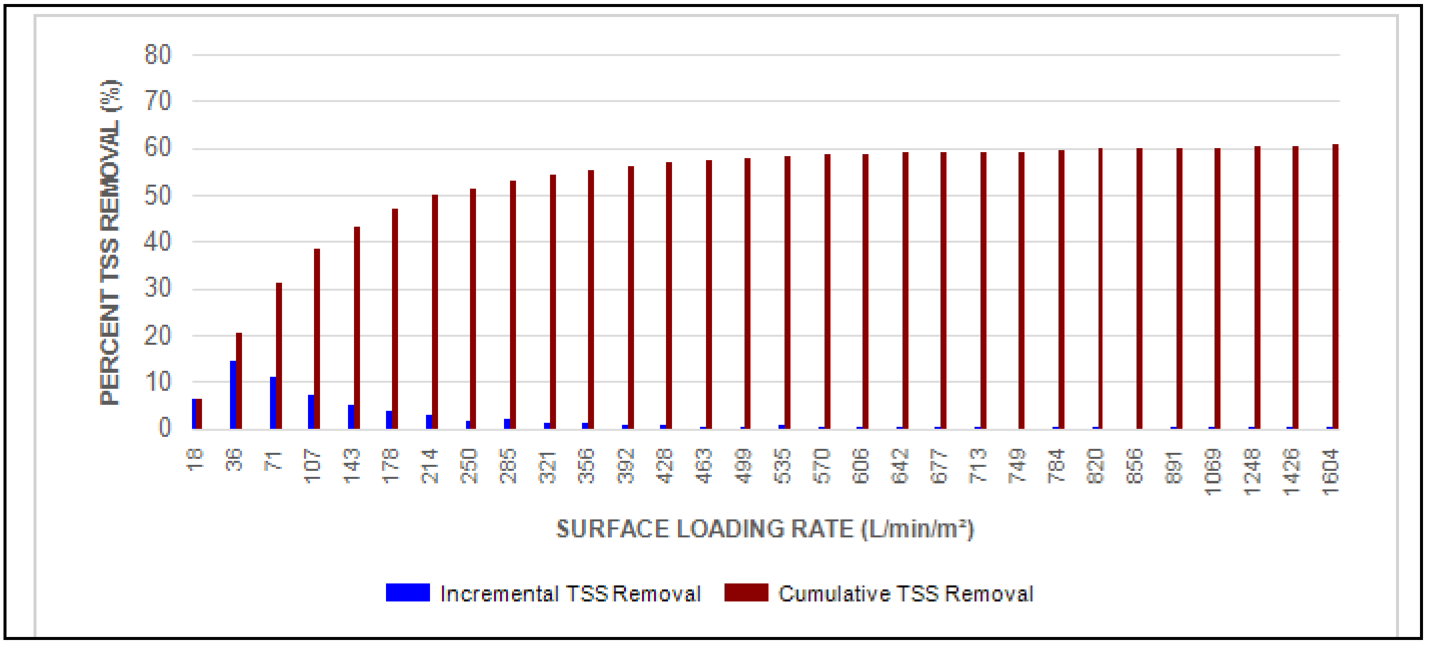
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	0.78	47.0	18.0	70	6.1	6.1
1.00	20.2	28.9	1.56	94.0	36.0	70	14.2	20.4
2.00	16.4	45.3	3.13	188.0	71.0	66	10.8	31.1
3.00	11.8	57.1	4.69	281.0	107.0	62	7.3	38.5
4.00	8.1	65.2	6.25	375.0	143.0	59	4.8	43.3
5.00	6.6	71.9	7.81	469.0	178.0	57	3.8	47.0
6.00	5.2	77.1	9.38	563.0	214.0	54	2.8	49.8
7.00	2.7	79.8	10.94	656.0	250.0	53	1.4	51.2
8.00	3.6	83.4	12.50	750.0	285.0	52	1.9	53.1
9.00	2.0	85.4	14.06	844.0	321.0	50	1.0	54.1
10.00	1.9	87.3	15.63	938.0	356.0	50	0.9	55.0
11.00	1.6	88.9	17.19	1031.0	392.0	48	0.8	55.8
12.00	1.8	90.7	18.75	1125.0	428.0	47	0.8	56.7
13.00	1.0	91.6	20.31	1219.0	463.0	46	0.4	57.1
14.00	1.0	92.7	21.88	1313.0	499.0	45	0.5	57.6
15.00	1.3	93.9	23.44	1406.0	535.0	44	0.6	58.1
16.00	1.0	95.0	25.00	1500.0	570.0	43	0.4	58.6
17.00	0.4	95.3	26.57	1594.0	606.0	42	0.1	58.7
18.00	0.4	95.7	28.13	1688.0	642.0	42	0.2	58.9
19.00	0.2	95.9	29.69	1781.0	677.0	42	0.1	59.0
20.00	0.6	96.5	31.25	1875.0	713.0	41	0.3	59.2
21.00	0.0	96.5	32.82	1969.0	749.0	41	0.0	59.2
22.00	0.5	97.0	34.38	2063.0	784.0	41	0.2	59.4
23.00	0.7	97.7	35.94	2156.0	820.0	41	0.3	59.7
24.00	0.0	97.7	37.50	2250.0	856.0	41	0.0	59.7
25.00	0.3	98.0	39.07	2344.0	891.0	41	0.1	59.8
30.00	0.3	98.3	46.88	2813.0	1069.0	39	0.1	59.9
35.00	0.8	99.1	54.69	3282.0	1248.0	36	0.3	60.2
40.00	0.4	99.5	62.51	3750.0	1426.0	34	0.1	60.4
45.00	0.5	100.0	70.32	4219.0	1604.0	30	0.2	60.5
Estimated Net Annual Sediment (TSS) Load Reduction =								**61 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

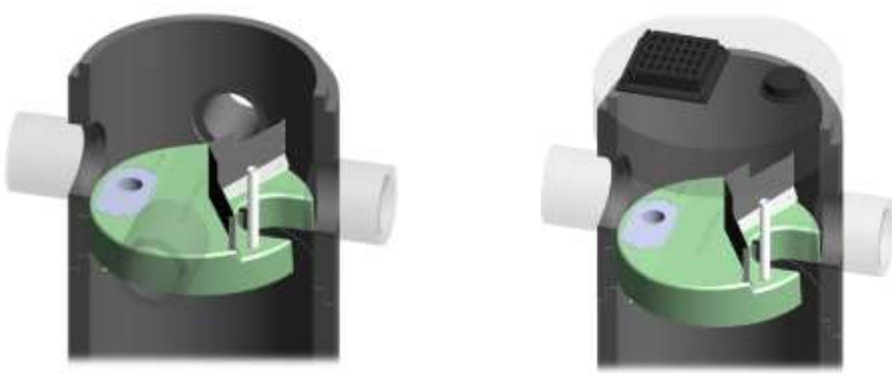
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

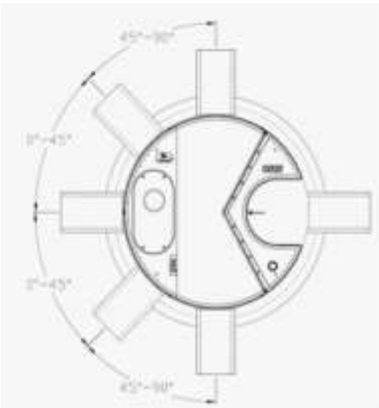
DESIGN FLEXIBILITY

►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.





INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

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PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor®

Rinker

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20

Site Name:	Lot 13

Drainage Area (ha):	0.86
% Imperviousness:	79.30

Runoff Coefficient 'c': 0.77

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	21.56
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	561
Estimated Average Annual Sediment Volume (L/yr):	456

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	52
EFO6	59
EFO8	64
EFO10	66
EFO12	68

Recommended Stormceptor EFO Model:	**EFO8**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**64**
Water Quality Runoff Volume Capture (%):	**> 90**

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THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

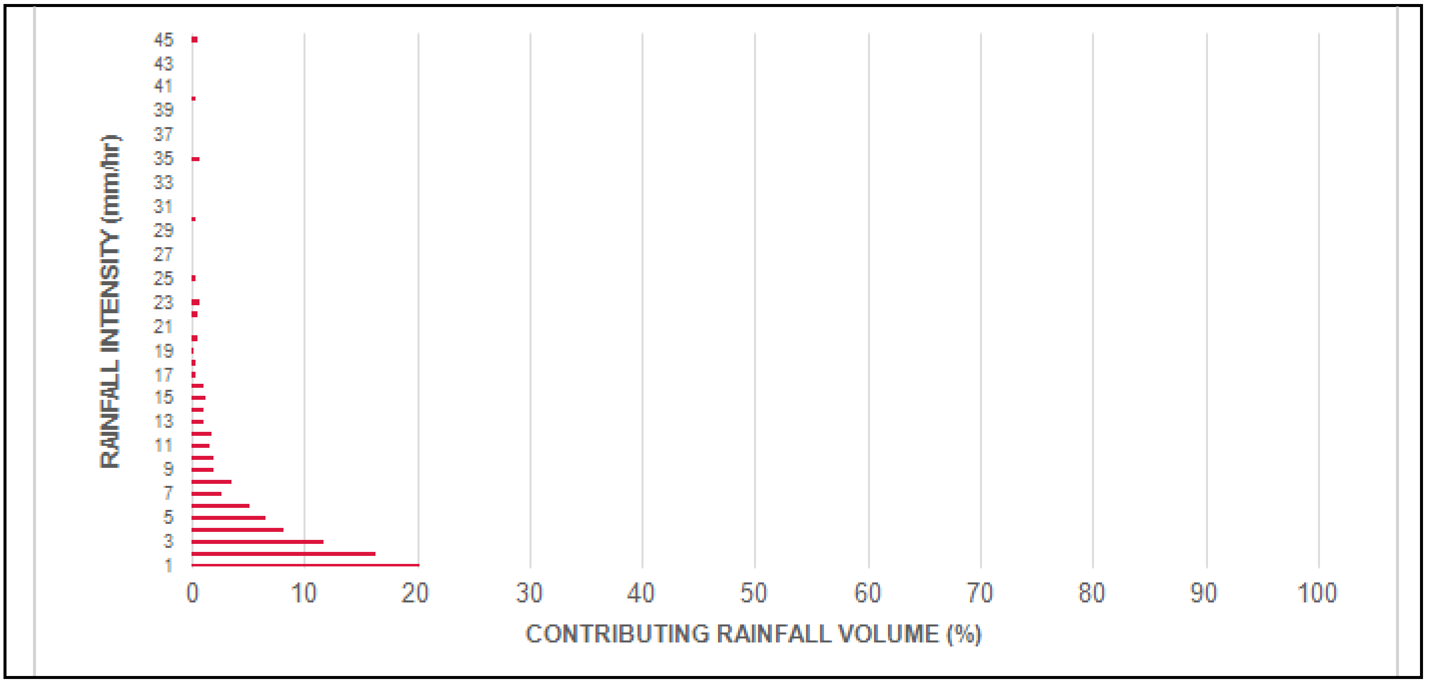
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

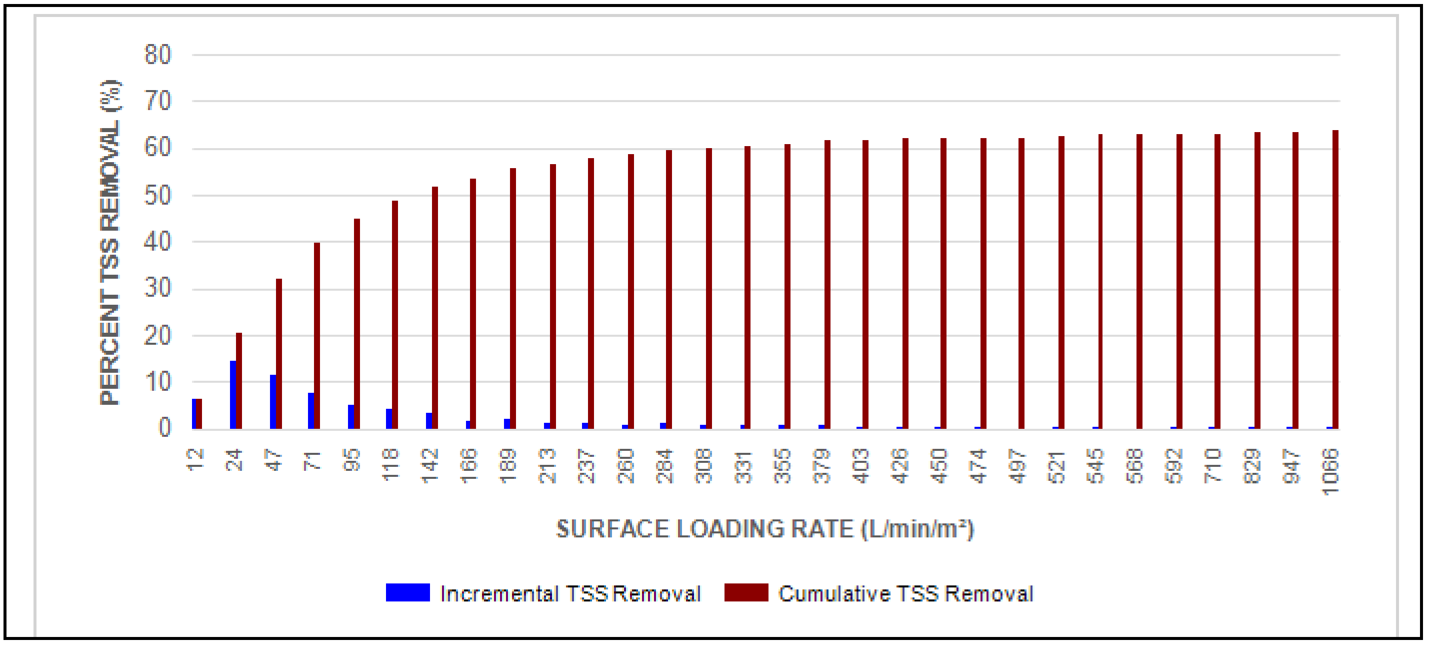
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	0.93	56.0	12.0	70	6.1	6.1
1.00	20.2	28.9	1.85	111.0	24.0	70	14.2	20.4
2.00	16.4	45.3	3.71	223.0	47.0	70	11.6	31.9
3.00	11.8	57.1	5.56	334.0	71.0	66	7.7	39.6
4.00	8.1	65.2	7.42	445.0	95.0	63	5.1	44.8
5.00	6.6	71.9	9.27	556.0	118.0	62	4.1	48.9
6.00	5.2	77.1	11.13	668.0	142.0	59	3.1	51.9
7.00	2.7	79.8	12.98	779.0	166.0	57	1.5	53.5
8.00	3.6	83.4	14.84	890.0	189.0	55	2.0	55.4
9.00	2.0	85.4	16.69	1002.0	213.0	54	1.1	56.5
10.00	1.9	87.3	18.55	1113.0	237.0	53	1.0	57.5
11.00	1.6	88.9	20.40	1224.0	260.0	52	0.8	58.4
12.00	1.8	90.7	22.26	1335.0	284.0	52	0.9	59.3
13.00	1.0	91.6	24.11	1447.0	308.0	51	0.5	59.8
14.00	1.0	92.7	25.97	1558.0	331.0	50	0.5	60.3
15.00	1.3	93.9	27.82	1669.0	355.0	50	0.6	60.9
16.00	1.0	95.0	29.68	1781.0	379.0	49	0.5	61.4
17.00	0.4	95.3	31.53	1892.0	403.0	48	0.2	61.6
18.00	0.4	95.7	33.39	2003.0	426.0	47	0.2	61.8
19.00	0.2	95.9	35.24	2114.0	450.0	47	0.1	61.9
20.00	0.6	96.5	37.10	2226.0	474.0	46	0.3	62.2
21.00	0.0	96.5	38.95	2337.0	497.0	45	0.0	62.2
22.00	0.5	97.0	40.81	2448.0	521.0	44	0.2	62.4
23.00	0.7	97.7	42.66	2560.0	545.0	44	0.3	62.7
24.00	0.0	97.7	44.51	2671.0	568.0	43	0.0	62.7
25.00	0.3	98.0	46.37	2782.0	592.0	42	0.1	62.8
30.00	0.3	98.3	55.64	3339.0	710.0	41	0.1	62.9
35.00	0.8	99.1	64.92	3895.0	829.0	41	0.3	63.2
40.00	0.4	99.5	74.19	4451.0	947.0	40	0.2	63.4
45.00	0.5	100.0	83.47	5008.0	1066.0	39	0.2	63.6
Estimated Net Annual Sediment (TSS) Load Reduction =								**64 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter (m)	Model Diameter (ft)	Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter (mm)	Max Inlet Pipe Diameter (in)	Max Outlet Pipe Diameter (mm)	Max Outlet Pipe Diameter (in)	Peak Conveyance Flow Rate (L/s)	Peak Conveyance Flow Rate (cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

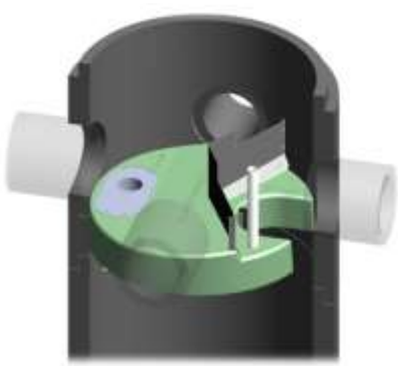
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

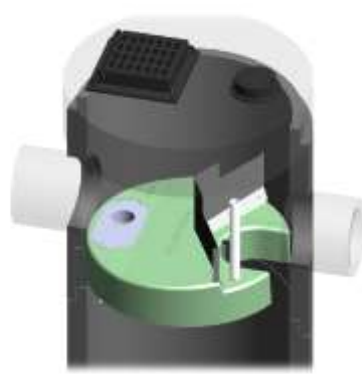
DESIGN FLEXIBILITY

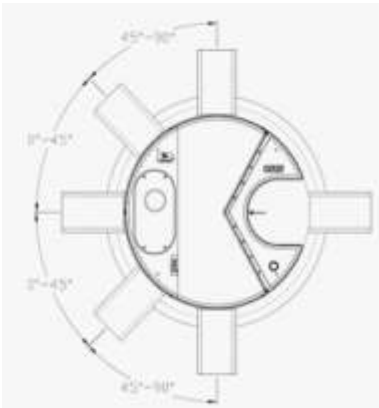
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor® Rinker

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/22/2023

Province:	Ontario
City:	Uxbridge
Nearest Rainfall Station:	TORONTO CITY
Climate Station Id:	6158355
Years of Rainfall Data:	20
Site Name:	Lot 14
Drainage Area (ha):	0.60
% Imperviousness:	72.40

Runoff Coefficient 'c': 0.73

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	14.24
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	346
Estimated Average Annual Sediment Volume (L/yr):	281

Project Name:	123 HYW 47
Project Number:	2023-16
Designer Name:	Kent Campbell
Designer Company:	Forterra Pipe & Products
Designer Email:	kent.campbell@forterrabp.com
Designer Phone:	519-622-7574
EOR Name:	Amir Samadi
EOR Company:	KingEPCM
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	56
EFO6	62
EFO8	66
EFO10	68
EFO12	69

Recommended Stormceptor EFO Model: EFO6

Estimated Net Annual Sediment (TSS) Load Reduction (%): 62

Water Quality Runoff Volume Capture (%): > 90

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THIRD-PARTY TESTING AND VERIFICATION

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PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

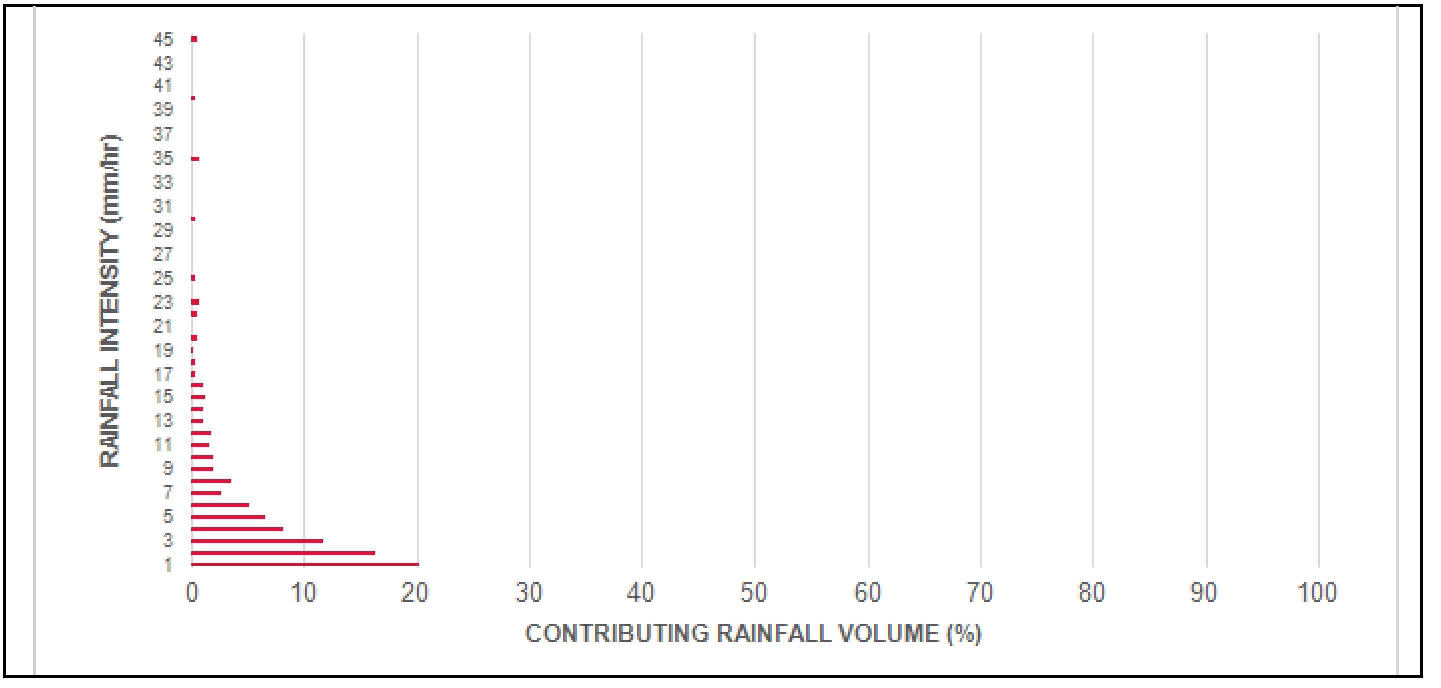
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

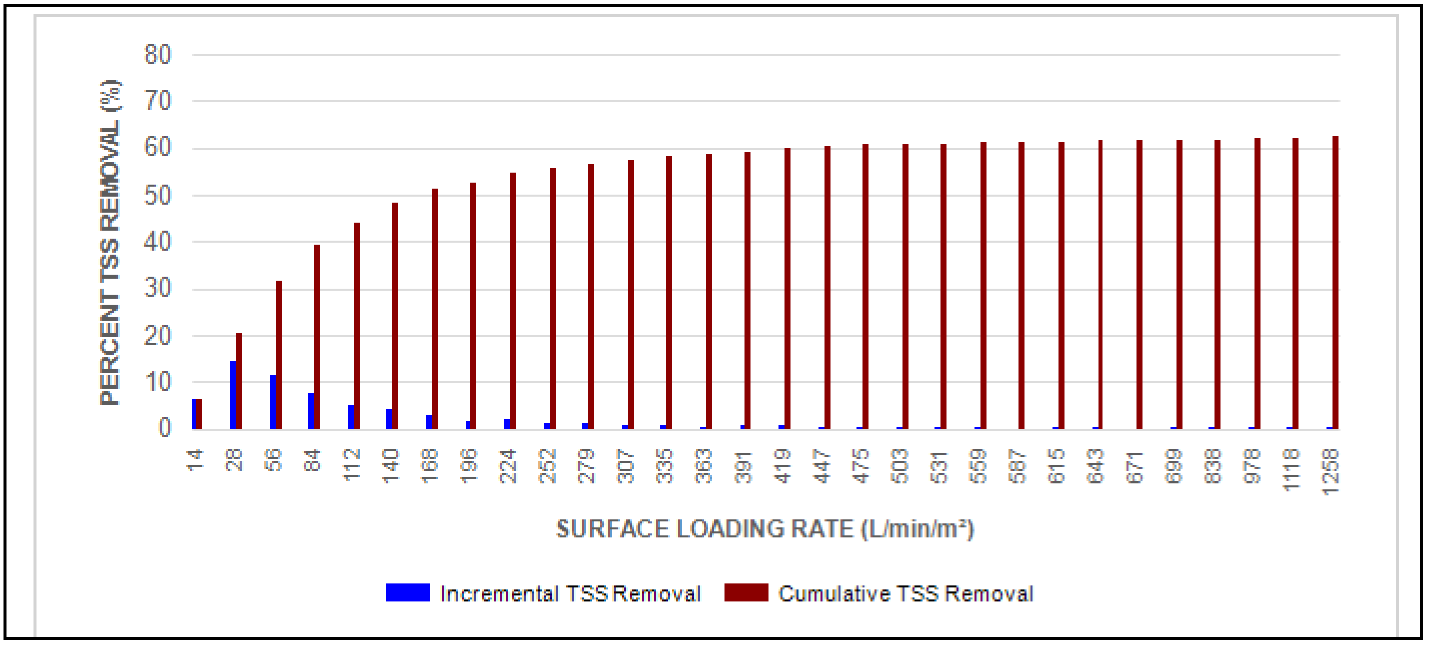
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.7	8.7	0.61	37.0	14.0	70	6.1	6.1
1.00	20.2	28.9	1.22	73.0	28.0	70	14.2	20.4
2.00	16.4	45.3	2.45	147.0	56.0	69	11.3	31.7
3.00	11.8	57.1	3.67	220.0	84.0	64	7.5	39.2
4.00	8.1	65.2	4.90	294.0	112.0	62	5.0	44.2
5.00	6.6	71.9	6.12	367.0	140.0	59	3.9	48.1
6.00	5.2	77.1	7.35	441.0	168.0	57	3.0	51.1
7.00	2.7	79.8	8.57	514.0	196.0	55	1.5	52.6
8.00	3.6	83.4	9.80	588.0	224.0	53	1.9	54.5
9.00	2.0	85.4	11.02	661.0	252.0	53	1.1	55.5
10.00	1.9	87.3	12.25	735.0	279.0	52	1.0	56.5
11.00	1.6	88.9	13.47	808.0	307.0	51	0.8	57.3
12.00	1.8	90.7	14.70	882.0	335.0	50	0.9	58.2
13.00	1.0	91.6	15.92	955.0	363.0	49	0.5	58.7
14.00	1.0	92.7	17.15	1029.0	391.0	48	0.5	59.2
15.00	1.3	93.9	18.37	1102.0	419.0	47	0.6	59.8
16.00	1.0	95.0	19.60	1176.0	447.0	47	0.5	60.3
17.00	0.4	95.3	20.82	1249.0	475.0	46	0.2	60.5
18.00	0.4	95.7	22.05	1323.0	503.0	45	0.2	60.6
19.00	0.2	95.9	23.27	1396.0	531.0	44	0.1	60.7
20.00	0.6	96.5	24.50	1470.0	559.0	44	0.3	61.0
21.00	0.0	96.5	25.72	1543.0	587.0	43	0.0	61.0
22.00	0.5	97.0	26.95	1617.0	615.0	42	0.2	61.2
23.00	0.7	97.7	28.17	1690.0	643.0	42	0.3	61.5
24.00	0.0	97.7	29.40	1764.0	671.0	42	0.0	61.5
25.00	0.3	98.0	30.62	1837.0	699.0	42	0.1	61.6
30.00	0.3	98.3	36.75	2205.0	838.0	41	0.1	61.7
35.00	0.8	99.1	42.87	2572.0	978.0	40	0.3	62.0
40.00	0.4	99.5	49.00	2940.0	1118.0	38	0.2	62.2
45.00	0.5	100.0	55.12	3307.0	1258.0	36	0.2	62.4
Estimated Net Annual Sediment (TSS) Load Reduction =								**62 %**

Climate Station ID: 6158355 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO CITY RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter (m)	Model Diameter (ft)	Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter (mm)	Max Inlet Pipe Diameter (in)	Max Outlet Pipe Diameter (mm)	Max Outlet Pipe Diameter (in)	Peak Conveyance Flow Rate (L/s)	Peak Conveyance Flow Rate (cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

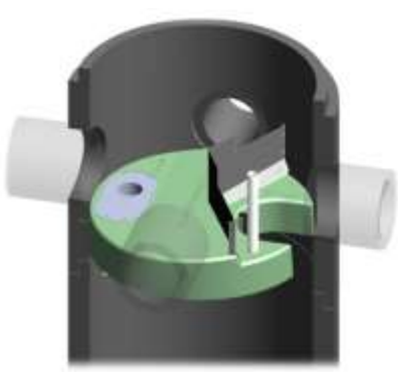
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

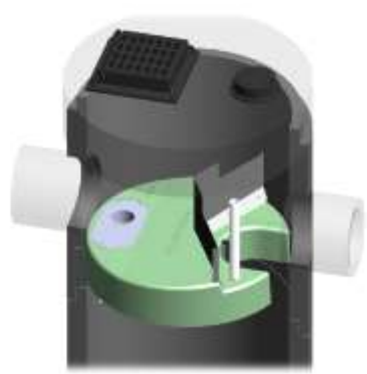
DESIGN FLEXIBILITY

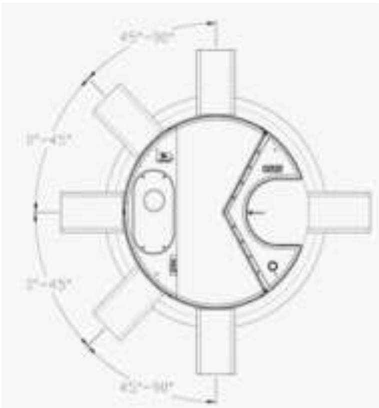
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR
"OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

> 3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.
>
> 3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.
>
> 3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.
>
> 3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in

accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

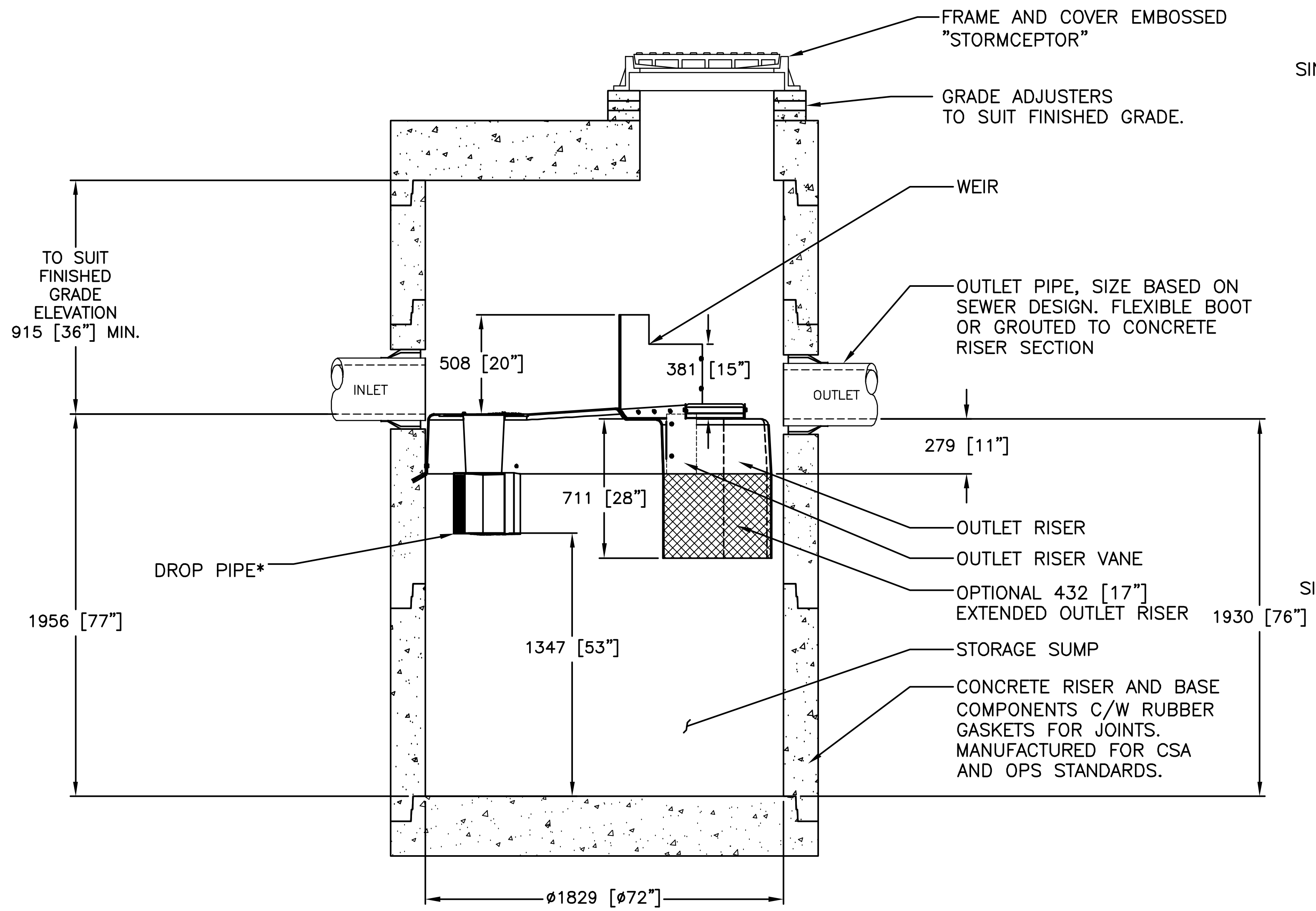
3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

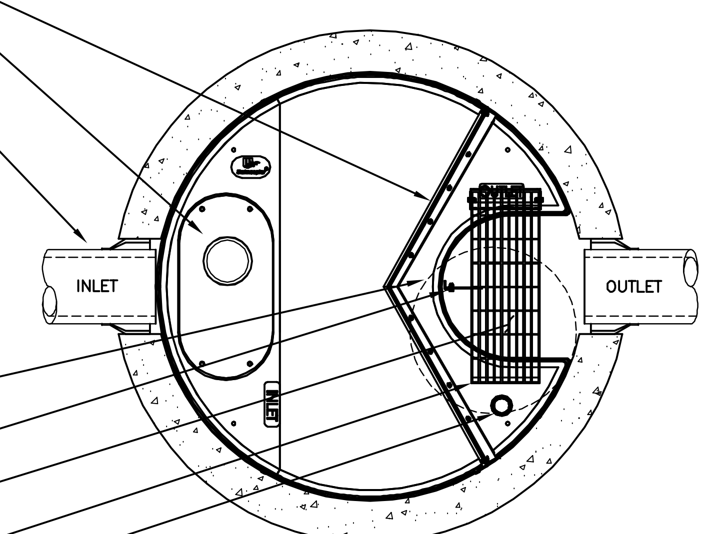
The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

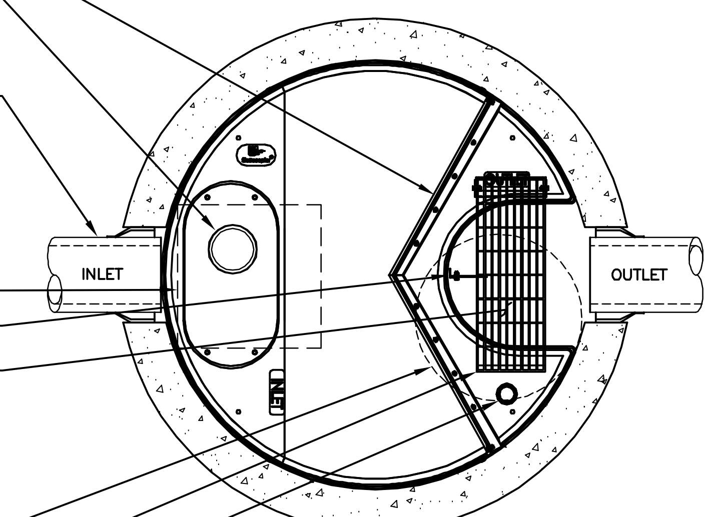
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF6 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO6 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO6				
STRUCTURE ID					*
HYDROCARBON STORAGE REQ'D (L)					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
DRAINAGE AREA (HA)					*
DRAINAGE AREA IMPERVIOUSNESS (%)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
0	05/26/17	INITIAL RELEASE	JSK
1	6/8/18	OUTLET PLATFORM	JSK
####	####	####	####
####	####	####	####
####	####	####	####

Stormceptor® EF

SCALE = NTS

imbrium

DATE: 10/13/2017
DESIGNED: JSK
DRAWN: JSK
CHECKED: BSF
APPROVED: SP
PROJECT No.: EFO6
SEQUENCE No.: *
SHEET: 1 OF 1

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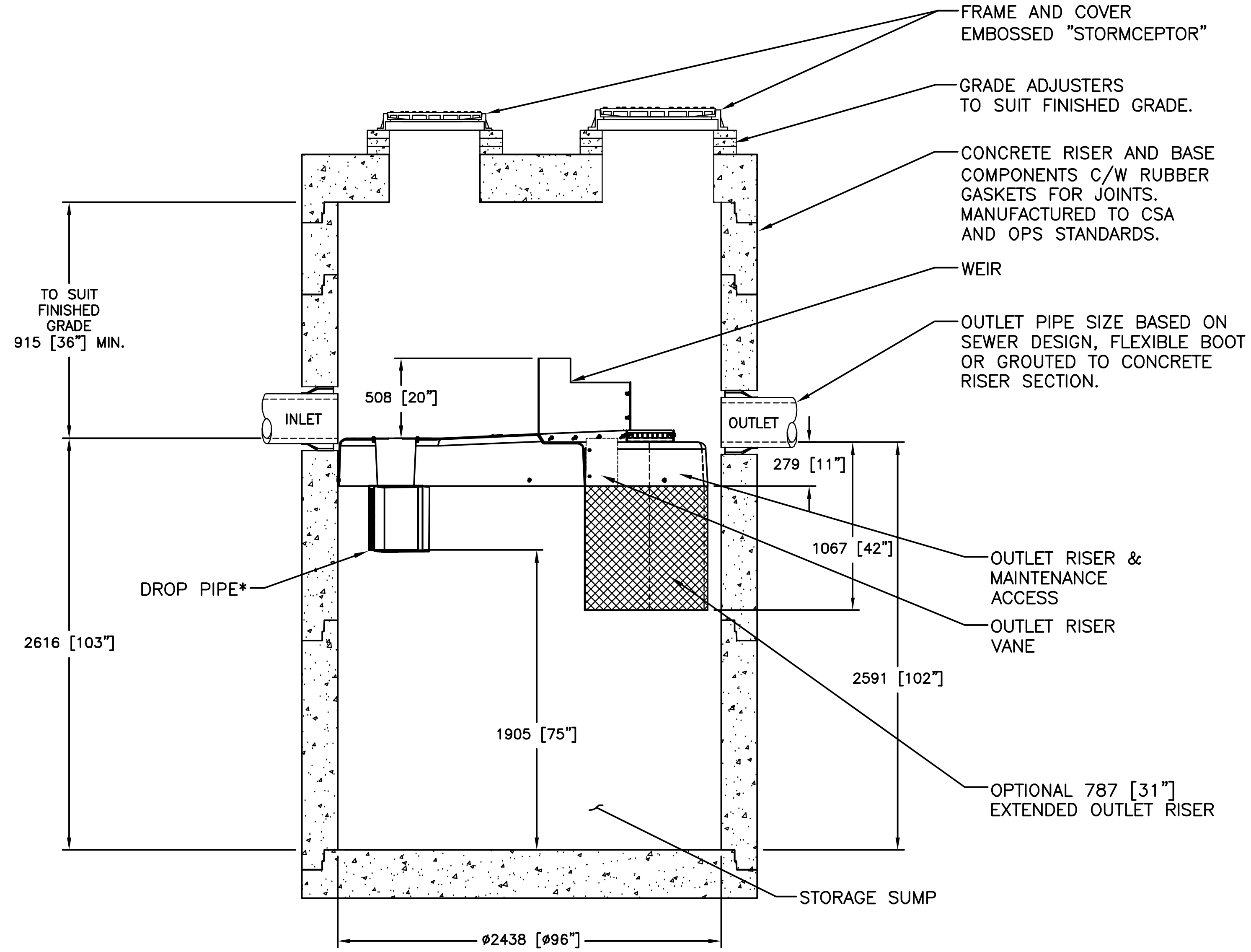
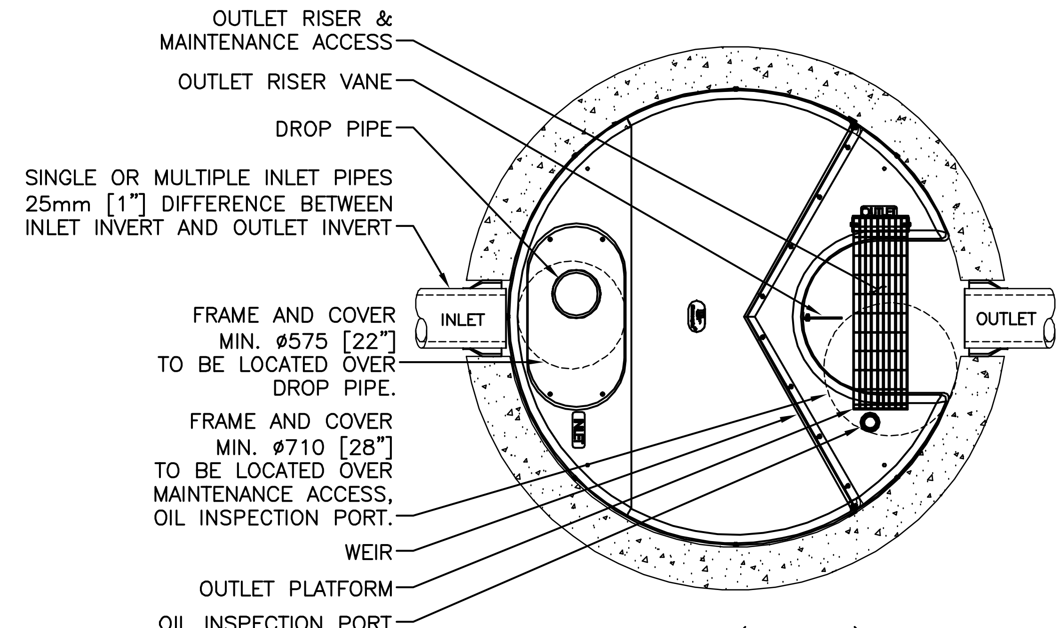
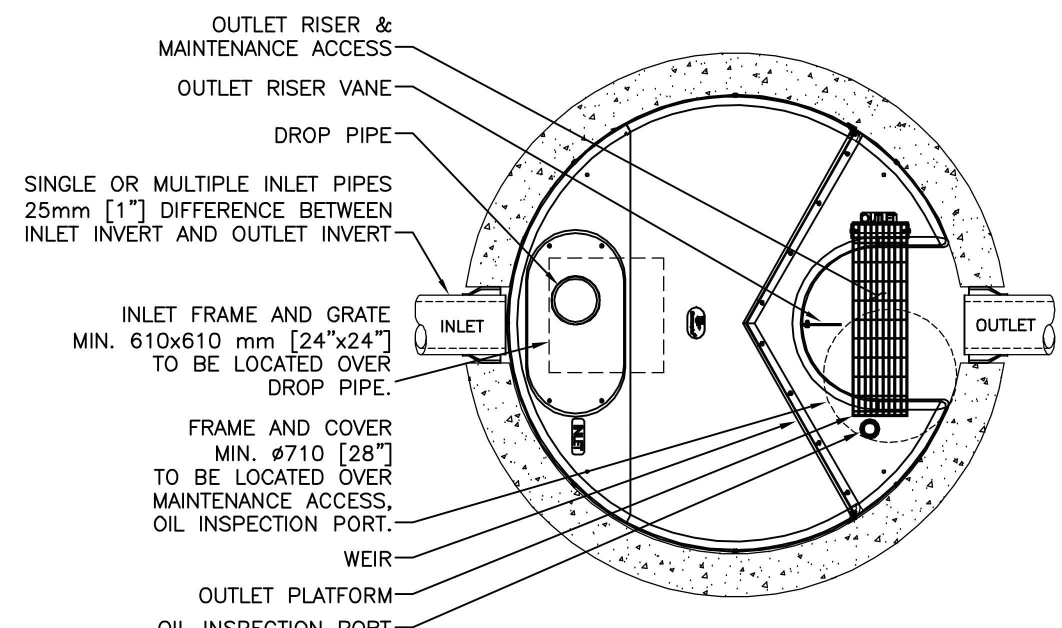
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF8 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO8 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

INSTALLATION NOTES

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C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO8				
STRUCTURE ID					*
HYDROCARBON STORAGE REQ'D (L)					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
DRAINAGE AREA (HA)					*
DRAINAGE AREA IMPERVIOUSNESS (%)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
0	5/26/17	INITIAL RELEASE	JSK
1	6/8/18	OUTLET PLATFORM	JSK
####	####	####	####
####	####	####	####
####	####	####	####

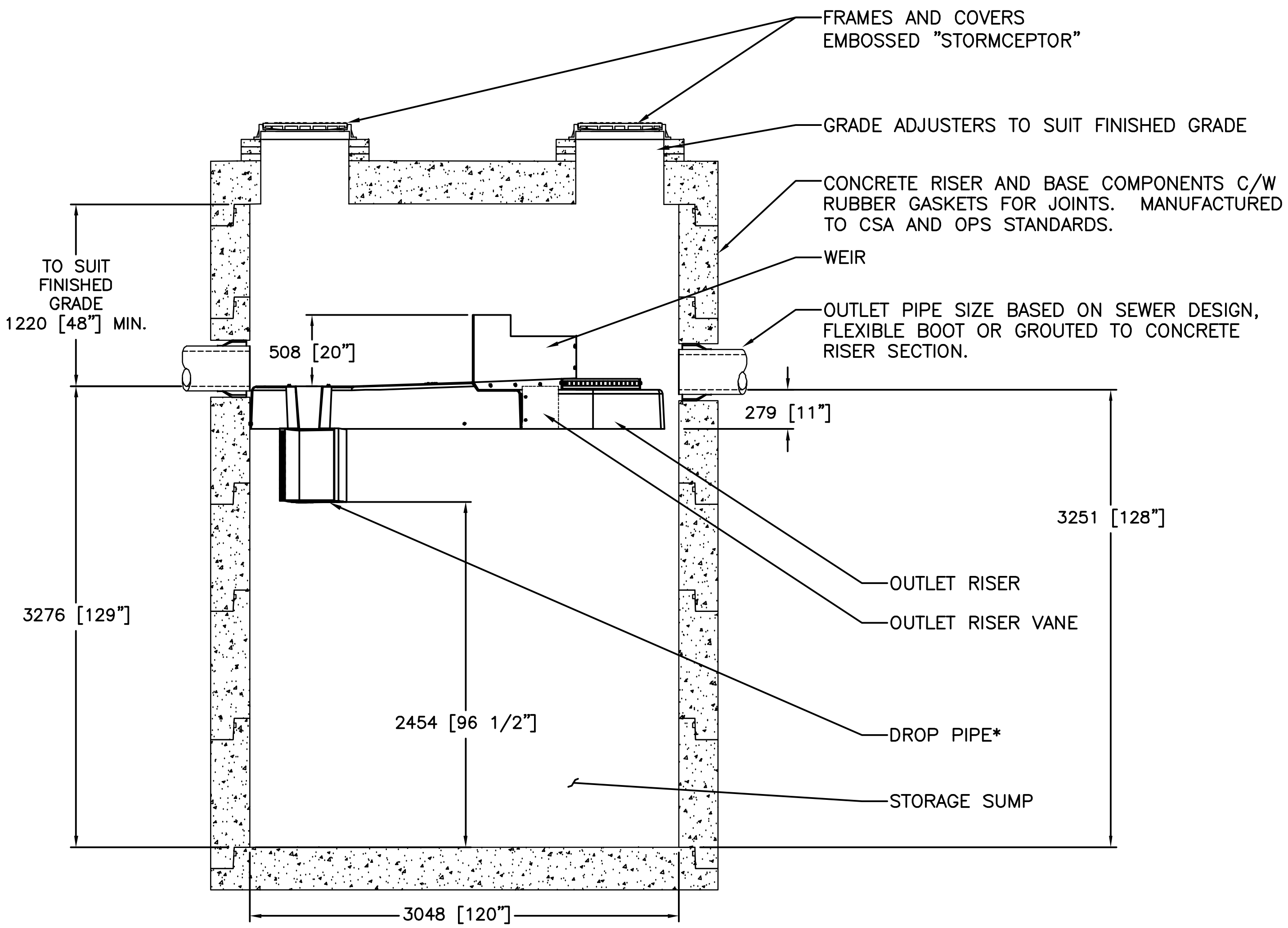
SCALE = NTS

Stormceptor® EF

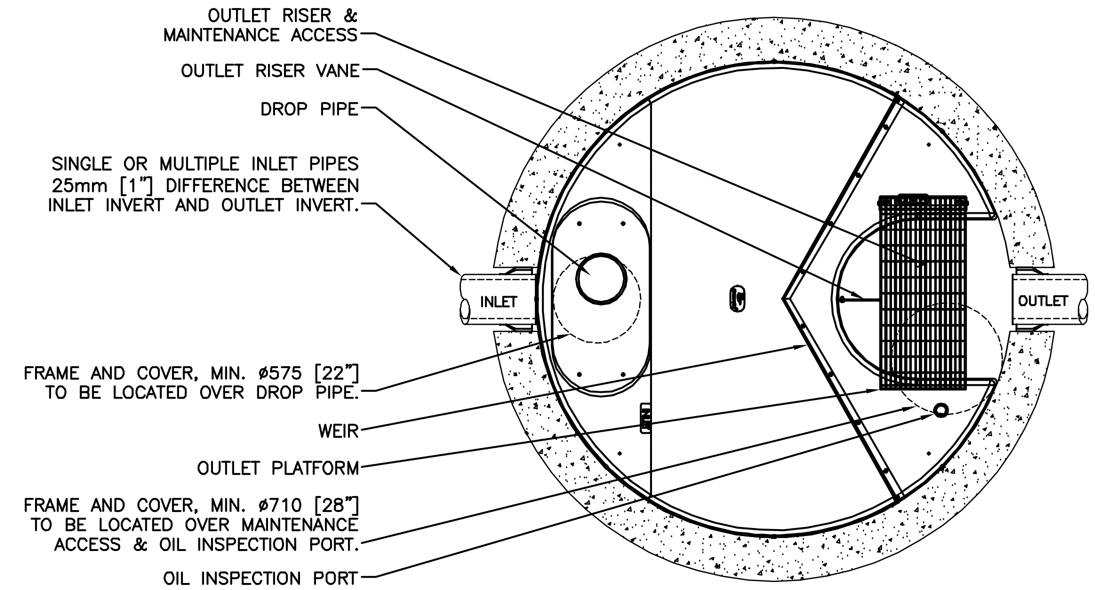
imbrium

DATE: 10/13/2017
DESIGNED: JSK
DRAWN: JSK
CHECKED: BSF
APPROVED: *
PROJECT No.: EFO8
SEQUENCE No.: *
SHEET: 1 OF 1

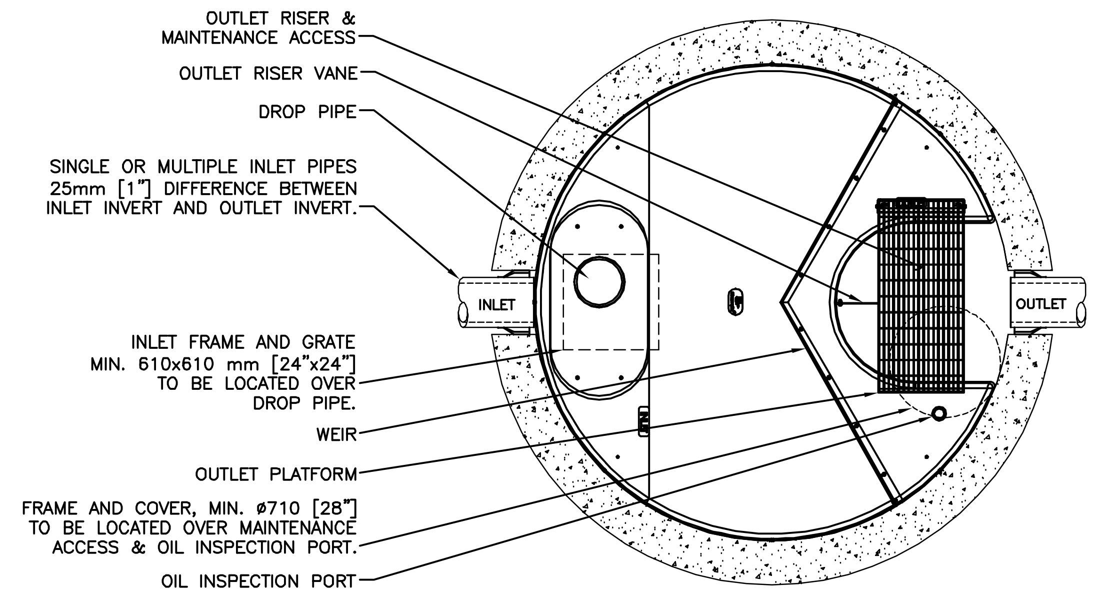
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF10 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO10 (OIL CAPTURE CONFIGURATION).

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2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL		EFO10			
STRUCTURE ID					*
HYDROCARBON STORAGE REQ'D (L)					*
WATER QUALITY FLOW RATE (L/s)					
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
DRAINAGE AREA (HA)					*
DRAINAGE AREA IMPERVIOUSNESS (%)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

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MARK	DATE	REVISION DESCRIPTION	BY
####	####	####	####
####	####	####	####
####	####	####	####
1	6/8/18	OUTLET PLATFORM	JSK
0	5/26/17	INITIAL RELEASE	JSK

SCALE = NTS

Stormceptor® EF

imbrium

407 FAIRVIEW DRIVE, WHITBY, ON L1N 3A9
TF 800-565-4801 CA 416-960-9900 INTL +1-416-960-9900

DATE: 10/24/2017	
DESIGNED: JSK	DRAWN: JSK
CHECKED: BSF	APPROVED: SP
PROJECT No.: EFO10	SEQUENCE No.: *
SHEET: 1 OF 1	

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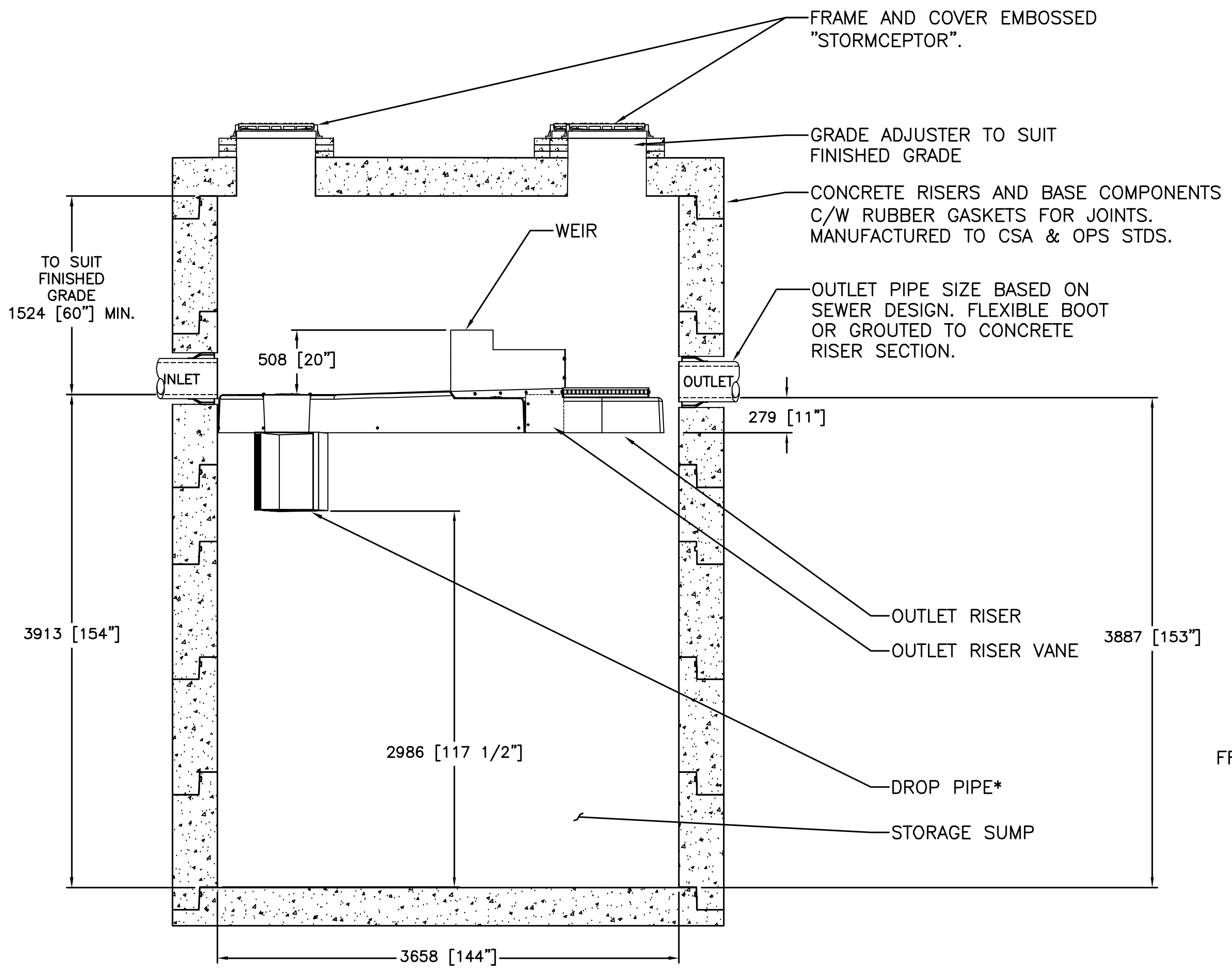
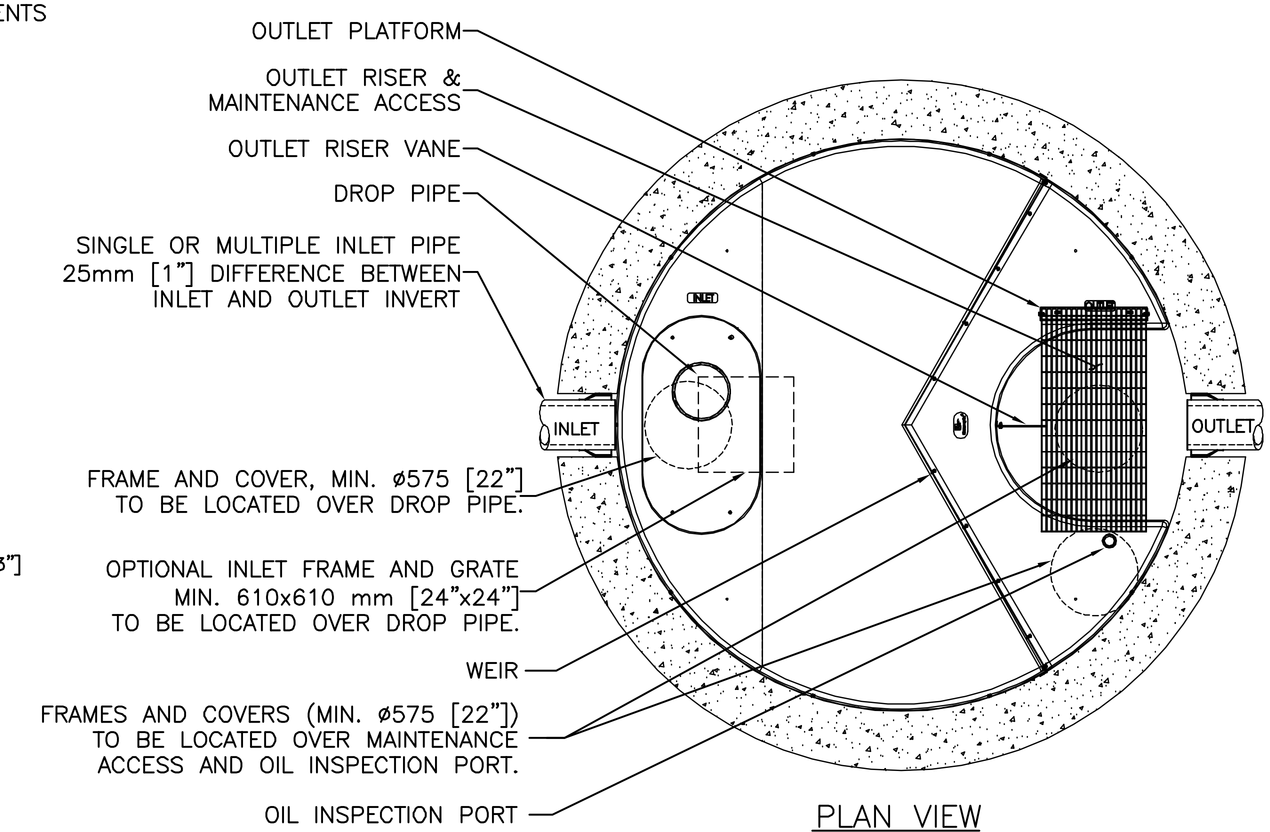
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF12 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO12 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
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STANDARD DETAIL NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO12
STRUCTURE ID	*
HYDROCARBON STORAGE REQ'D (L)	*
WATER QUALITY FLOW RATE (L/s)	*
PEAK FLOW RATE (L/s)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
DRAINAGE AREA (HA)	*
DRAINAGE AREA IMPERVIOUSNESS (%)	*

PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
0	5/26/17	INITIAL RELEASE	JSK
1	6/8/18	OUTLET PLATFORM	JSK
####	####	####	####
####	####	####	####
####	####	####	####

Stormceptor® EF

imbrium

SCALE = NTS

DATE: 10/24/2017	
DESIGNED: JSK	DRAWN: JSK
CHECKED: BSF	APPROVED: SP
PROJECT No.: EFO12	SEQUENCE No.: *
SHEET: 1 OF 1	

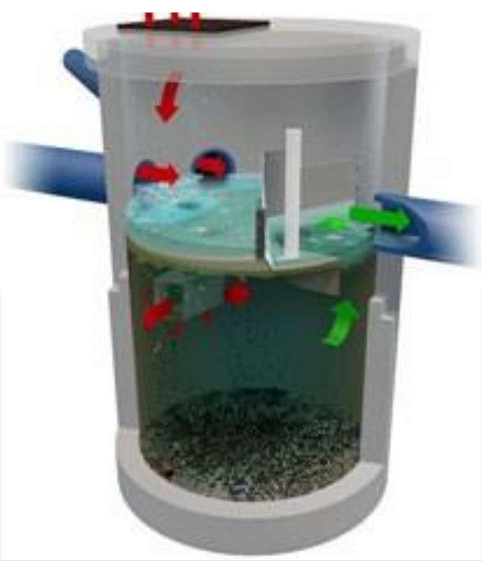
Rinker Materials Quality Assurance Program (QAP)

Rinker Materials is committed to providing the most effective, environmentally friendly, and economical Oil Grit Separators (OGS), leading the way in protecting our water resources.

We've got you covered

Your QAP starts with post construction inspection to ensure the unit has been installed as designed. The unit is recorded in our expansive database summarizing all installed units with their GPS locations. When you inspect and maintain these OGS units, you play an important part in protecting the environment, while ensuring your stormwater assets remain in compliance with environmental regulations

Rinker Materials's industry leading line of Stormceptor products are one of the lowest-cost OGS units in the market, functioning effectively in all aspects of keeping pollutants out of our waterways. The Rinker Quality Assurance Program is in place at no extra cost to the asset's owner, providing inspections for up to 5 years.



Improving products, improving service.

Our commitment to providing the best storm water quality devices continues as we have recently expanded our already impressive line of Stormceptor® products with the addition of the ISO14034/ETV verified Stormceptor EF and EFO - simply the most cost competitive stormwater quality device on the market. Now we're improving our service by ensuring inspections on our entire Stormceptor product line for up to 5 years after installation.

At Rinker Materials, we understand that maintaining a high standard of water quality is crucial to the environment and to our lives. That's why, 20 years ago, we introduced a 2-year inspection plan with every Stormceptor unit sold. As municipalities continue to focus on OGS units operating as designed, we felt it was time to strengthen our program even further. We are now offering at no additional cost to the asset's owner, a 5-year QAP with every Stormceptor unit to ensure water quality continues to be at its best.

Stormceptor® Quality Assurance Program

Based on initial inspection results, there are two ways to ensure Stormceptor® performance:

First way (5 years, cleaning not included)

- Six inspections over a 5-year period, cleaning not included
- First inspection when installed
- At 6 months a second inspection.
- Inspections every 12 months thereafter for 5 years
- Oil and sediment level are documented along with maintenance recommendations,

Second way (2.5 years, includes one cleaning)

- Initial inspection of the unit
- One post construction sediment (clean material) cleaning at 6 months
- Two additional annual inspections, resulting in the unit being maintained for the first 30 months

All QAP programs are Completed by Minotaur

Rinker Materials | 2099 Roseville Road, Cambridge, On N1R 5S3 | 519-622-7574