TOWN OF CALEDON
PLANNING
RECEIVED

Feb 3, 2025

November 12, 2024

Reference: 20-731

The Alton Development Inc.
1402 Queen Street West
Alton, ON
L7K 0C3

Attention: Jeremy Grant and Jordan Grant, Developer
Reference: Urbanization of Agnes Street, Alton –Stormwater Management Design Brief

Dear Mr. Jeremy Grant and Mr. Jordan Grant,

Greck and Associates (Greck) have been retained to prepare a Stormwater Management Design Brief for the urbanization of a portion of Agnes Street. Agnes Street is located in the Village of Alton, the Town of Caledon (Town), Region of Peel (Region) and is within the Credit Valley Conservation (CVC) jurisdiction. This design brief is in support of the development application at 0 Agnes Street and to demonstrate compliance with the Town's Consolidated Linear Infrastructure Environmental Compliance Approvals (CLI ECA) criteria. The portion of Agnes Street to be urbanized is approximately 152m long starting from Queen Street West going south.

This design brief provides an overview of the proposed urbanization plans and considers the Town's CLI ECA criteria, which pertains to drainage and stormwater management:

- Water Quality
- Water Quantity
- Water Balance
- Erosion Control

This memo has been prepared in accordance with accepted engineering practices and criteria from the Town of Caledon Development Standards Manual (2019) and Environmental Compliance Approval 324-S701 (CLI ECA, October 2022). This brief has been updated to address comments from the Town of Caledon dated April 2024.

1. EXISTING CONDITIONS

Based on publicly available LiDAR data from Land Information Ontario (DTM Peel 2016 Package B), topographic survey prepared by Van Harten Surveying Inc. (September 16, 2022) and the provided Alton Sewershed Map from the Town, 5.78ha drains towards the south side of the intersection of Queen Street West and Agnes Street. Since this memo only pertains to the urbanization of Agnes Street south of Queen Street West, the north area that drains to Queen Street West has been excluded from the stormwater management (SWM) analysis.

Note that there is also a small 0.52ha area within the 0 Agnes Street property that drains towards Emeline Street. This area has been included in the overall study catchment as it is part of the property's development area. In the proposed conditions, all drainage from the property will discharge to Agnes Street. The Alton Sewershed Map provided by the Town and the topographic survey by Van Harten Surveying Inc. have been appended to the end of this memo.

The 5.78ha drainage area has been further divided into six (6) catchments; all of which ultimately discharge to Shaw's Creek located northeast of the study area:

- Area 101 (3.53ha) is a part of the property to be developed by The Alton Development Inc. (0 Agnes Street). It currently consists of a grassed field and a driveway area. It drains in the northeasterly direction towards the intersection of Queen Street West and Agnes Street.
- Area 102 (0.52ha) is a part of the property to be developed by The Alton Development Inc. (0 Agnes Street). It currently consists of a grassed field and drains in the west direction towards Emeline Street. Runoff is then piped northeast along Queen Street West.
- Area 103 (1.23ha) consists of single detached dwellings, grassed lawns and private driveways. It generally drains in the northeasterly direction towards Agnes Street. This area will remain unchanged in the existing and proposed conditions.
- Area 104a (0.16ha) consists of the west side of the Agnes Street ROW. There is a roadside ditch that runs parallel to the road and directs drainage north to a ditch inlet catchbasin at the north end of Agnes Street.
- Area 104b (0.18ha) consists of the east side of the Agnes Street ROW. There is a roadside ditch that runs parallel to the road and directs drainage north to a ditch inlet catchbasin at the north end of Agnes Street.
- Area 105 (0.16ha) consists of grassed lawns, private driveways, and a small portion of King Street which forms a T-junction with Agnes Street. It generally drains north, parallel to Agnes Street towards Queen Street. This area will remain unchanged in existing and proposed conditions.

Note that ultimately, all catchments drain to Shaw's Creek located north of Queen Street West. Agnes Street is currently a bidirectional two (2) lane street and has a 15m right of way (ROW)

Table 1 is an area breakdown of the existing land uses.

Table 1 Existing Area Breakdown

Surface	Area 101	Area 102	Area 103	Area 104a	Area 104b	Area 105
Asphalt (m^2)	1,574.9	0.0	623.9	947.9	1,186.9	467.0
Permeable Pavers (m^2)	0.0	0.0	0.0	0.0	0.0	0.0
Hardscape (m^2)	0.0	0.0	108.5	0.0	0.0	0.0
Roof (m^2)	516.4	0.0	1,003.1	0.0	0.0	0.0
Grassed (m^2)	33,202.8	5,179.3	10,590.1	678.8	633.7	1,133.9
Total (m^2)	35,294.1	5,179.3	12,325.6	1,626.7	1,820.6	1,600.9
Percent Impervious	5.9%	0.0%	14.1%	58.3%	65.2%	29.2%
Runoff Coefficient	0.29	0.25	0.34	0.63	0.67	0.44

Table 2 presents the pre-development peak flows. Intensity was calculated using the intensity-duration-frequency curves from the Town of Caledon's Development Standards Manual (2019).

Table 2 Pre-Development Peak Flows

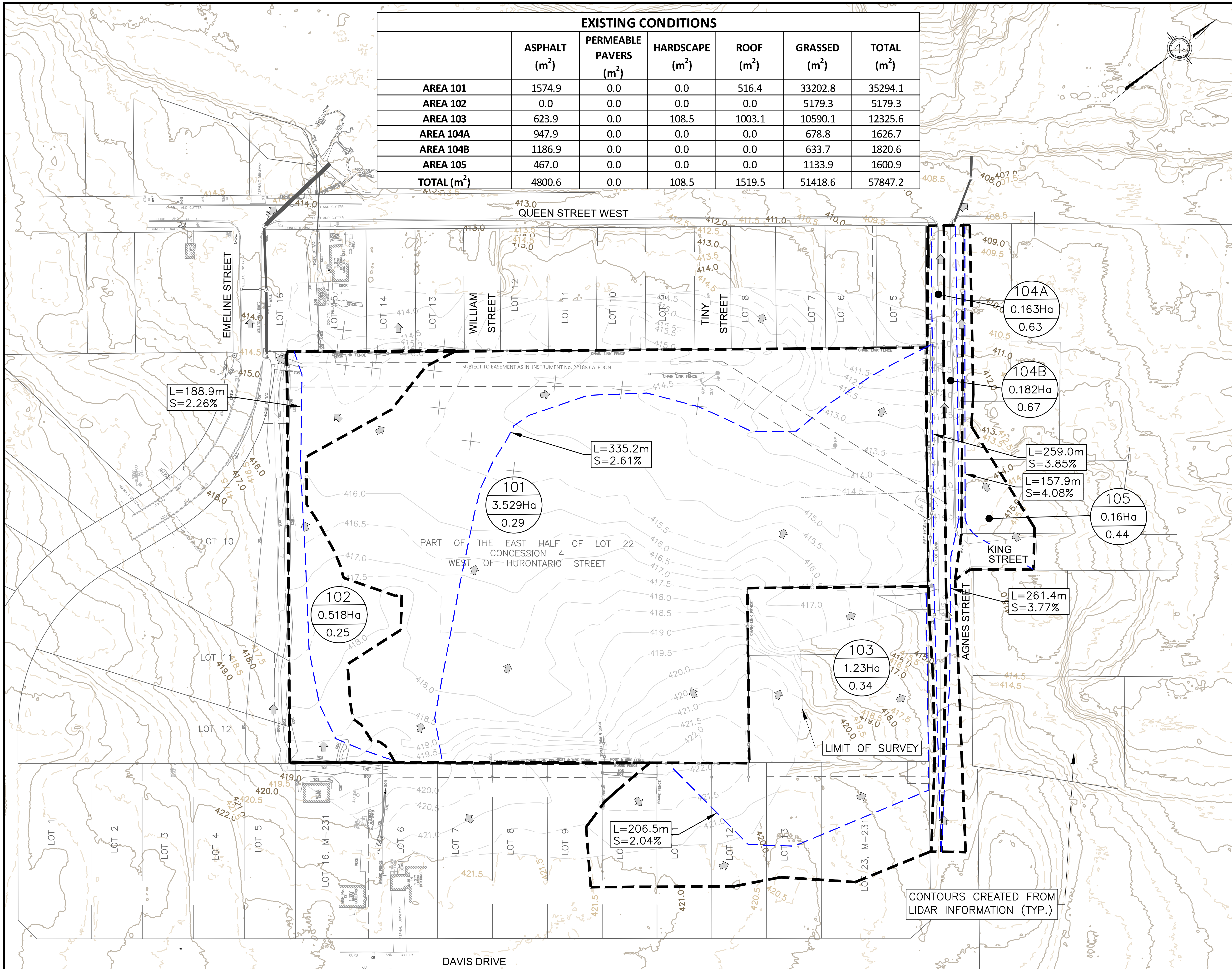
Storm Event	Area 101 (L/s)	Area 102 (L/s)	Area 103 (L/s)	Area 104a (L/s)	Area 104b (L/s)	Area 105 (L/s)	Total (L/s)
2	111.9	16.3	54.3	20.8	25.0	14.3	242.6
5	154.9	22.3	74.3	27.2	32.6	18.7	330.1
10	189.4	27.4	91.0	33.3	40.0	22.9	404.0
25*	253.6	36.4	121.1	43.2	47.2	29.8	531.3
50*	313.8	45.1	149.8	53.3	53.2	36.6	651.7
100*	367.9	52.8	175.4	62.0	59.5	42.7	760.3

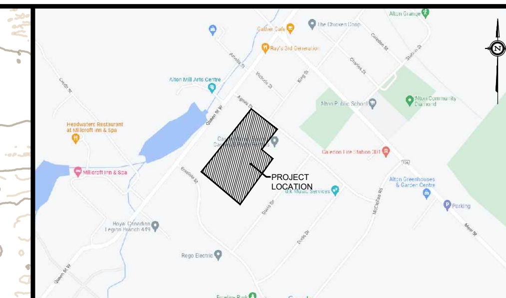
*Incorporates runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25

Detailed calculations are included in the attachments at the end of this memo. See **Figure 1** below for the study area location and delineated catchments for existing conditions.

EXISTING CONDITIONS

	ASPHALT (m^2)	PERMEABLE PAVERS (m^2)	HARDSCAPE (m^2)	ROOF (m^2)	GRASSED (m^2)	TOTAL (m^2)
AREA 101	1574.9	0.0	0.0	516.4	33202.8	35294.1
AREA 102	0.0	0.0	0.0	0.0	5179.3	5179.3
AREA 103	623.9	0.0	108.5	1003.1	10590.1	12325.6
AREA 104A	947.9	0.0	0.0	0.0	678.8	1626.7
AREA 104B	1186.9	0.0	0.0	0.0	633.7	1820.6
AREA 105	467.0	0.0	0.0	0.0	1133.9	1600.9
TOTAL (m^2)	4800.6	0.0	108.5	1519.5	51418.6	57847.2





KEY PLAN

N.T.S.

LEGEND

EXISTING	PROPOSED	
MH1	MH1	STORM MANHOLE
MH1	MH1	STORM CATCHBASIN MANHOLE
CB	CB	SINGLE CATCHBASIN
DCB	DCB	DOUBLE CATCHBASIN
		STORM SEWER
		PROPOSED BIORETENTION PLANTERS
		PROPOSED PERMEABLE PAVERS
		LIMIT OF SUBJECT PROPERTY
		EASEMENT
		RIGHT OF WAY
		LOT LINE
		FENCE LINE
		CURB/SIDEWALK
		BUILDING
		MAJOR CONTOUR LABEL
		MINOR CONTOUR LABEL
		SWALE
		OVERLAND FLOW
		TREE
		STORM DRAINAGE BOUNDARY
		LONGEST TRAVEL PATH
	3	DENOTES AREA NUMBER
	0.023Ha	DENOTES AREA IN HECTARES
	0.40	DENOTES RUNOFF COEFFICIENT

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONTOUR INTERVAL IS 0.50m.
3. ALL DIMENSIONS SHALL BE CHECKED AND VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO ANY CONSTRUCTION, AND ANY DISCREPANCIES SHALL BE REPORTED IMMEDIATELY TO THE ENGINEER.
4. ALL WORK SHALL BE IN ACCORDANCE WITH CURRENT TOWN OF CALEDON STANDARD SPECIFICATIONS AND DRAWINGS UNLESS OTHERWISE NOTED HEREIN.
5. ORDER OF PRECEDENCE OF STANDARDS DRAWINGS IS FIRSTLY TOWN OF CALEDON, AND SECONDLY ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD).

BENCHMARK

BENCHMARK No. N/A
ELEVATION = N/A
DESCRIPTION:
ELEVATIONS ARE BASED ON GPS OBSERVATIONS FROM PERMANENT REFERENCE STATIONS IN THE NAD83 (CSRS–2010) COORDINATE SYSTEM, WITH HEIGHTS CONVERTED TO ORTHOMETRIC ELEVATION ON THE CGVD28 DATUM (1978 ADJUSTMENT) WITH GEOID MODEL HTV2.0, AS SUPPLIED BY NATURAL RESOURCES CANADA.

COMPLETED BY: VAN HARTEN SURVEYING INC.
COMPLETED ON: MAY 10, 2018

DEM SOURCE:
LIDAR DTM PEEL 2016 PACKAGE B AVAILABLE FROM LAND INFORMATION ONTARIO. DATUM ADJUSTED TO CGVD28 FROM CGVD2013 BY RAISING ELEVATIONS BY 0.414m.

Greck
5770 Highway 7, Woodbridge, Ontario, L4L 1T8 www.greck.ca

CLIENT NAME:

THE ALTON DEVELOPMENTS INC.
1402 QUEEN STREET
ALTON, ON
L7K 0C3

PROJECT NAME:

AGNES STREET SUBDIVISION

AGNES STREET CALEDON, ON

DRAINAGE PLAN EXISTING CONDITIONS (AGNES STREET URBANIZATION)

DESIGNED BY: A.J.	SCALES:		PROJECT No. 20-731
CHECKED BY: J.C.	HORIZONTAL:	1:1500	DRAWING No. FIG. 1
DRAWN BY: A.J.	VERTICAL:	N/A	SHEET No.
DATE: NOV 30, 2023	SHEET SIZE:	11"x17"	

C:\Users\stevi\CloudStation\Projects\2020\20-731 - Agnes Street Subdivision, Alton\05_Drawings\CAD\DRAINAGE\20-731_DRAINAGE-urban.dwg Date Plotted: Oct 8, 2024 – 7:32 PM

1.1 UNDERLYING SOILS

Terraprobe Inc. prepared a Geotechnical Investigation dated March 2019, and Englobe (previously Terraprobe) prepared a Hydrogeological Investigation and Septic Impact Assessment dated October 2024. Both of these reports pertain to the property at 0 Agnes Street. Since a site-specific report for Agnes Street has not been done, these two reports will be used for reference as the property fronts Agnes Street. The following is a summary of the report findings.

The work included drilling eight (8) boreholes equipped with monitoring wells to boreholes 2, 5, and 8 spread throughout the property. The soil conditions within the limits of the property consist primarily of the following:

- A surficial topsoil layer with a measured thickness of 150mm to 600mm, encountered at eight (8) boreholes.
- Fill consisting predominantly of silt fine sand with trave gravel and topsoil was encountered immediately beneath the ground covers in Boreholes 2,5,6,7, and 8. The fill extended to a depth generally varying from 0.8m to 2.1m below ground.
- Boreholes 1,5, and 6 penetrated a stratum of silty fine sand to depths ranging from 2.1m to 4.0m below ground.
- A deposit of silt sand and gravel with cobbles and boulders was encountered in all boreholes beneath the filly and silty fine sand to depths of about 2.5m to 6.7m below ground.

As shown within the hydrogeological investigation, monitoring wells were installed in boreholes 2, 5, and 8, and groundwater measurements were taken from March 4, 2019 to August 9, 2019. The seasonal high groundwater table at the site ranged from 1.1m to 6.4m below ground surface (BGS). The groundwater flow direction is easterly towards Shaw's Creek.

Borehole 8 is the closest borehole to Agnes Street and where the urbanization is proposed; it has a seasonal high groundwater elevation of 412.8m or 1.1mBGS. The Groundwater Flow Direction Plan by Terraprobe has been included in the memo attachments. The full geotechnical and hydrogeological reports prepared by Terraprobe and Englobe respectively are submitted under separate cover.

Since there is no available reference borehole within the portion of Agnes Street to be urbanized, it is assumed that the groundwater table will follow the slope of the existing ground at 1.1mBGS towards Shawss Creek.

2 PROPOSED CONDITIONS

In the proposed conditions, 152m of Agnes Street south of Queen Street West will be urbanized into a 15m wide ROW with a sidewalk on the west side. A cross section detail of the ROW has been appended to the end of this memo. Overall drainage patterns will be maintained in proposed conditions as the delineated catchments will continue to drain in the northeasterly direction towards Agnes Street and ultimately discharge at Shaw's Creek.

The proposed condition study area has been delineated into six (6) catchments:

- Area 201 (2.29ha) is a part of the property to be developed by The Alton Development Inc. (0 Agnes Street). It will consist of townhome blocks, a 6.0m wide private roadway and an amenity area. Drainage from this area will be piped to the proposed storm sewer on Agnes Street.
- Area 202 (1.76ha) is a part of the property to be developed by The Alton Development Inc. (0 Agnes Street). It will consist of townhome blocks and a 6.0m wide private roadway. Drainage from this area will be piped to the proposed storm sewer on Agnes Street.
- Area 203 (1.23ha) consists of single detached dwellings, grassed lawns and private driveways. It generally drains in the northeast direction towards the intersection of Queen Street West and Agnes Street. This area will remain unchanged in the existing and proposed conditions.
- Area 204a (0.16ha) consists of the west side of the Agnes Street ROW. Approximately 152m of Agnes Street will be urbanized into a 15m wide ROW. The urbanized portion will include a sidewalk, curbs, gutters, catchbasins and bioretention planters on the west side of the street that will replace the existing roadside ditch. A new 525mm diameter storm sewer will be installed on Agnes Street. Runoff will continue to flow in a northern direction towards the ditch inlet catchbasin at the north side of Agnes Street. The remaining southern portion of Agnes Street will remain unchanged.
- Area 204b (0.18ha) consists of the east side of the Agnes Street ROW. Approximately 152m of Agnes Street will be urbanized into a 15m ROW. The urbanization will include installation of curbs, gutters and catchbasins. The existing roadside ditch will be replaced with bioretention planters to provide stormwater management. Runoff will continue to flow in a northern direction towards the north side of Agnes Street; the existing ditch inlet catchbasin will be replaced with an oil grit separator with grate inlet. The remaining southern portion of Agnes Street will remain unchanged.
- Area 205 (0.16ha) consists of grassed lawns, private driveways, and a small portion of King Street which forms a T-junction with Agnes Street. This area will remain unchanged in the existing and proposed conditions.

The development at 0 Agnes Street (Area 201 and Area 202) will provide its own stormwater management to meet water quality, water quantity and water balance criteria, as such, the property area will be omitted from this memo's SWM analysis. A separate Functional Servicing and Stormwater Management Report for this development has been submitted under separate cover.

Table 3 is an area breakdown of the proposed land uses.

Table 3 Proposed Area Breakdown

Surface	Area 201	Area 202	Area 203	Area 204a	Area 204b	Area 205
Asphalt (m^2)	2,865.5	1,588.7	623.9	947.9	1,186.9	467.0
Permeable Pavers (m^2)	2,019.7	418.6	0.0	0.0	0.0	0.0
Hardscape (m^2)	1,940.9	1,819.5	108.5	236.3	0.0	0.0
Roof (m^2)	6,206.0	4,657.2	1,003.1	0.0	0.0	0.0
Grassed (m^2)	9,874.7	9,082.6	10,590.1	442.5	633.7	1,133.9
Total (m^2)	22,906.8	17,566.6	12,325.6	1,626.7	1,820.6	1,600.9
Percent Impervious	52.5%	47.1%	14.1%	72.8%	65.2%	29.2%
Runoff Coefficient	0.59	0.56	0.34	0.72	0.67	0.44

Table 4 presents the post-development peak flows. Intensity was calculated using the intensity-duration-frequency curves from the Town of Caledon's Development Standards Manual (2019).

Table 4 Post-Development Peak Flows

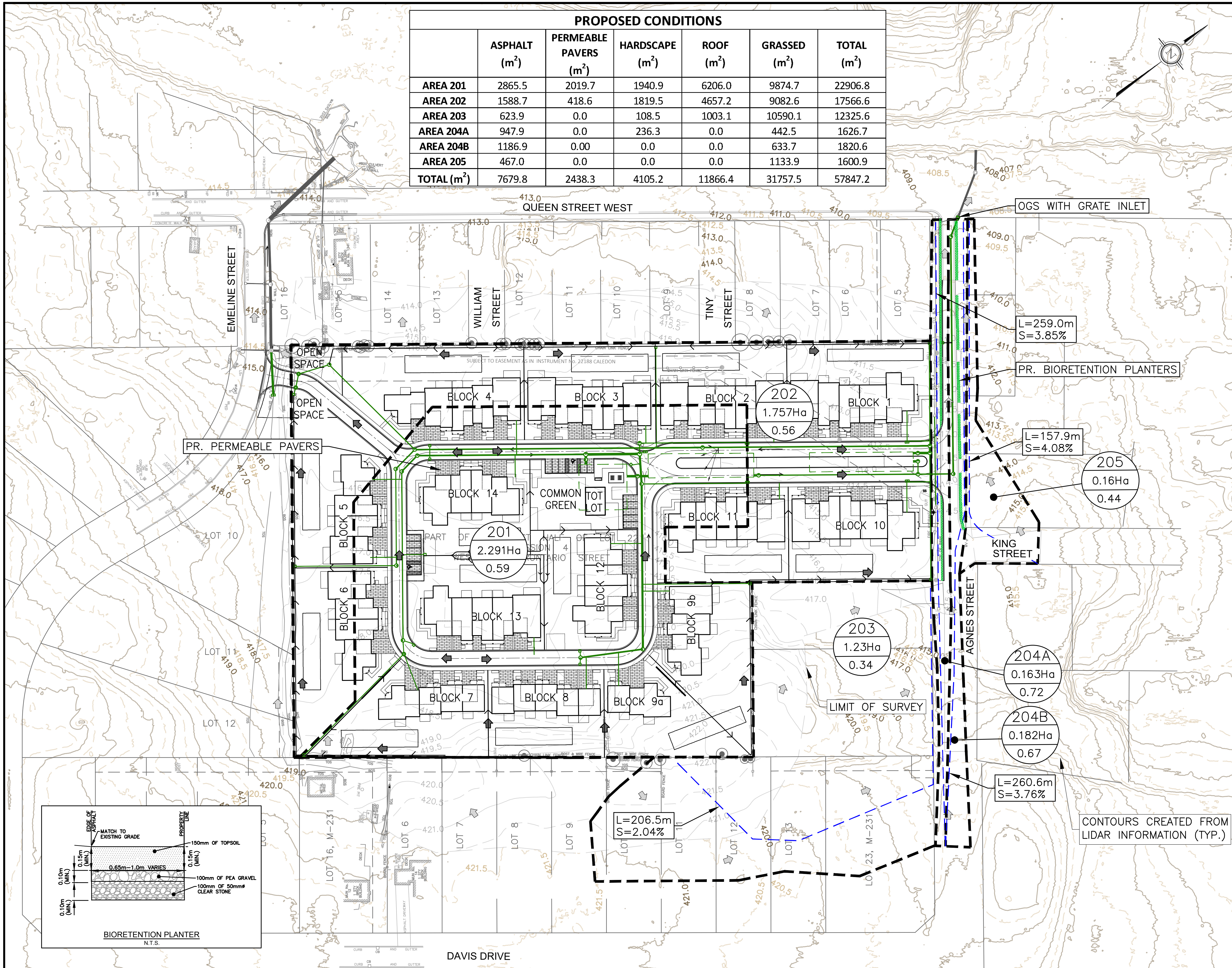
Storm Event	Area 201 (L/s)	Area 202 (L/s)	Area 203 (L/s)	Area 204a (L/s)	Area 204b (L/s)	Area 205 (L/s)	Total (L/s)
2	322.5	232.7	54.3	23.9	25.0	14.3	672.6
5	412.6	297.7	74.3	31.3	32.6	18.7	867.2
10	504.7	364.1	91.0	38.3	40.0	22.9	1061.0
25*	647.5	467.2	121.1	49.7	47.2	29.8	1362.4
50*	795.3	573.9	149.8	61.3	53.2	36.6	1670.1
100*	924.1	666.8	175.4	71.4	59.5	42.7	1939.9

*Incorporates Runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25

Detailed calculations are included in the attachments at the end of this memo. See **Figure 2** below for the proposed drainage patterns and catchments.

PROPOSED CONDITIONS

	ASPHALT (m^2)	PERMEABLE PAVERS (m^2)	HARDSCAPE (m^2)	ROOF (m^2)	GRASSED (m^2)	TOTAL (m^2)
AREA 201	2865.5	2019.7	1940.9	6206.0	9874.7	22906.8
AREA 202	1588.7	418.6	1819.5	4657.2	9082.6	17566.6
AREA 203	623.9	0.0	108.5	1003.1	10590.1	12325.6
AREA 204A	947.9	0.0	236.3	0.0	442.5	1626.7
AREA 204B	1186.9	0.00	0.0	0.0	633.7	1820.6
AREA 205	467.0	0.0	0.0	0.0	1133.9	1600.9
TOTAL (m^2)	7679.8	2438.3	4105.2	11866.4	31757.5	57847.2



KEY PLAN
N.T.S.

LEGEND

EXISTING	PROPOSED	
MH1	MH1	STORM MANHOLE
MH1	MH1	STORM CATCHBASIN MANHOLE
CB	CB	SINGLE CATCHBASIN
DCB	DCB	DOUBLE CATCHBASIN
		STORM SEWER
		PROPOSED BIORETENTION PLANTERS
		PROPOSED PERMEABLE PAVERS
		LIMIT OF SUBJECT PROPERTY
		EASEMENT
		RIGHT OF WAY
		LOT LINE
		FENCE LINE
		CURB/SIDEWALK
		BUILDING
		MAJOR CONTOUR LABEL
		MINOR CONTOUR LABEL
		SWALE
		OVERLAND FLOW
		TREE
		STORM DRAINAGE BOUNDARY
		LONGEST TRAVEL PATH
		DENOTES AREA NUMBER
		DENOTES AREA IN HECTARES
		DENOTES RUNOFF COEFFICIENT

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONTOUR INTERVAL IS 0.50m.
3. ALL DIMENSIONS SHALL BE CHECKED AND VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO ANY CONSTRUCTION, AND ANY DISCREPANCIES SHALL BE REPORTED IMMEDIATELY TO THE ENGINEER.
4. ALL WORK SHALL BE IN ACCORDANCE WITH CURRENT TOWN OF CALEDON STANDARD SPECIFICATIONS AND DRAWINGS UNLESS OTHERWISE NOTED HEREIN.
5. ORDER OF PRECEDENCE OF STANDARDS DRAWINGS IS FIRSTLY TOWN OF CALEDON, AND SECONDLY ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD).

BENCHMARK

BENCHMARK No. N/A
ELEVATION = N/A
DESCRIPTION:
ELEVATIONS ARE BASED ON GPS OBSERVATIONS FROM PERMANENT REFERENCE STATIONS IN THE NAD83 (CSRS-2010) COORDINATE SYSTEM, WITH HEIGHTS CONVERTED TO ORTHOMETRIC ELEVATION ON THE CGVD28 DATUM (1978 ADJUSTMENT) WITH GEOID MODEL HTV2.0, AS SUPPLIED BY NATURAL RESOURCES CANADA.

COMPLETED BY: VAN HARTEN SURVEYING INC.
COMPLETED ON: MAY 10, 2018

DEM SOURCE:
LIDAR DTM PEEL 2016 PACKAGE B AVAILABLE FROM LAND INFORMATION ONTARIO. DATUM ADJUSTED TO CGVD28 FROM CGVD2013 BY RAISING ELEVATIONS BY 0.414m.

Greck
5770 Highway 7, Woodbridge, Ontario, L4L 1T8 www.greck.ca

CLIENT NAME:
THE ALTON DEVELOPMENTS INC.
1402 QUEEN STREET
ALTON, ON
L7K 0C3

PROJECT NAME:
AGNES STREET SUBDIVISION
AGNES STREET CALEDON, ON

DRAINAGE PLAN
PROPOSED CONDITIONS
(AGNES STREET URBANIZATION)

DESIGNED BY:	A.J.	SCALES:		PROJECT No.	20-731
CHECKED BY:	J.C.	HORIZONTAL:	1:1500	DRAWING No.	FIG. 2
DRAWN BY:	A.J.	VERTICAL:	N/A	SHEET No.	
DATE:	NOV 30, 2023	SHEET SIZE:	11"x17"		

3 STORMWATER MANAGEMENT

The following stormwater management criteria is to be addressed in accordance with regulatory policy and requirements set in the Town of Caledon's Environmental Compliance Approval 324-S701 (October 2022). Note that the urbanization of Agnes Street is considered a retrofit scenario.

- **Water Quality** – Improve current level of water quality control and consider the Town's water quality criteria in the Development Standards Manual (2019)
- **Water Quantity** – Post-development peak flows to be controlled to pre-development levels.
- **Water Balance** – Maintain pre-development infiltration volumes in post-development conditions.
- **Erosion Control** – Improve level of erosion control

Area 203 and 205 consists of private residential properties and will remain unchanged in proposed conditions, as such, runoff flows will also remain unchanged. These post-development flows will match pre-development flows so no water quantity control is required. Further, the land uses for Area 203 and 205 consist majorly of roof areas and grassed lawns; these areas are considered clean with respect to water quality – no water quality controls are needed for these areas.

Looking at the study area (Area 203-205) holistically, with the addition of the proposed bioretention planters in the urbanized portion of Agnes Street, the level of erosion control has been improved and the pre-development water balance is exceeded in post-development conditions. As such, while SWM is not explicitly provided for Area 203 and 205, it meets the Town's CLI ECA criteria. As such, SWM will only be provided for Area 204a and 204b which includes the urbanized portion of Agnes Street.

3.1 WATER QUALITY

As per the CLI ECA requirements for retrofit scenarios, the proposed urbanization must improve the current level of water quality control and consider the Town's water quality criteria in the Development Standards Manual (2019).

Stormwater from the development area can be characterized by the Agnes Street right of way (ROW), proposed sidewalk and landscaped areas. Given the relatively small area, water quality from the proposed development is likely to be relatively clean with the main contaminants of concern being:

- Suspended sediments
- Other (oil, grease, gas)

Water quality control will be provided by a treatment train consisting of bioretention planters with infiltration capacity and an oil grit separator (OGS). Bioretention planters are proposed for both the east and west side of Agnes Street along the 152m urbanized area.

A clearstone base underneath the bioretention planters will provide an Enhanced Level of protection which is 80% total suspended solids (TSS) removal. Table 3.2 of the MECP Stormwater Management Planning and Design Manual will guide the required water quality volume. The following **Table 5** shows the required and provided volumes.

Table 5 Bioretention Planter Design

Specification	Area 204a	Area 204b
Area (m^2)	1,626.7	1,820.6
Percent Impervious (%)	73%	65%
Required Unitary Volume (m^3)	36.0	33.7
Required Volume (m^3)	5.9	6.1
Bioretention Planter Footprint (m^2)	78.0	100.0
Bioretention Planter Clearstone Depth (mm)	200	200
Provided Volume (m^3)	6.2	12.0

The clearstone base underneath the planters has a porosity of 0.4. The provided storage within the clearstone base exceeds the required infiltration volume for quality control.

As per Terraprobe's Hydrogeological Investigation (December 2023), the percolation rate for the 0 Agnes Street development is 12min/cm which is equivalent to an infiltration ate of 50mm/hr. A drawdown time of 4.0 hours was calculated for the clearstone bases which achieves a maximum drawdown time of less than 48 hours. Detailed bioretention planter calculations can be found in the memo attachments.

As discussed under the Underlying Soils section, the groundwater table is estimated to be approximately 1.1mBGS. The clearstone bases will be 0.20m deep and the topsoil will be 0.15m which means that there is 0.75m clearance from the groundwater table. Note that this is 0.25m less than the typically required 1m clearance, however, this is the most optimized clearstone depth due to the high groundwater conditions while maintaining the existing grades on the Agnes Street laneway and existing adjacent private properties/driveways. The bioretention planter footprints were optimized to conform to the limited space within the existing Agnes Street ROW while still providing the required infiltration volumes. Further, due to the high groundwater table, subsurface infiltration chamber products are not feasible for this urbanized portion of Agnes Street, as such, bioretention planters were chosen to keep the bottom of the clearstone base as high as possible. Note that bioretention planters have been successfully implemented on fully urbanized streets in the City of Toronto's Green Streets program.

The runoff from the Agnes Street ROW will be directed to the planters by curb cuts on both the east and west side. Design details of the bioretention planters an urbanized portion of Agnes Steet are to be confirmed during the detailed design stage.

The second stage of the treatment train will be an OGS located downstream of the bioretention planters. The existing ditch inlet catchbasin at the southeast corner of Queen Street West and Agnes Street will be replaced with an OGS with grate inlet. The OGS specifications can be found in the memo attachments.

3.2 WATER QUANTITY

The Town's Environmental Compliance Approval 324-S701 (October 2022) and Development Standards Manual (2019) requires that for retrofit scenarios, post-development peak flows be controlled to the pre-development peak flows.

In the existing condition, the average runoff coefficient for Area 104a and 104b is 0.65 and the corresponding percent impervious is 62%. In the proposed condition, the average runoff coefficient for Area 204a and 204b is 0.70 and the percent impervious is 69%. Therefore, in the proposed condition, the runoff coefficient will increase by 0.04 and the percent impervious will increase by 7%; both of which can be considered minor changes. **Table 6** presents a comparison of the pre- and post-development peak runoff rates from Area 103-105 and 204--205.

Table 6 Pre- to Post-Development Peak Runoff Comparison

Storm Event	Area 103, 104a, 104b, 105 Peak Runoff (L/s)	Area 203, 204a, 204b, 205 Peak Runoff (L/s)	Difference (L/s)	% Change
2	114.4	117.5	3.1	2.7%
5	152.8	156.9	4.1	2.7%
10	187.2	192.2	5.0	2.7%
25*	241.3	247.7	6.5	2.7%
50*	292.9	300.9	8.0	2.7%
100*	339.7	349.0	9.3	2.7%

*Incorporates Runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25

Note that in the proposed condition, the maximum increase in flows is 9.3L/s in the 100-year storm event which equates to a percent change of 2.7%. This change can be considered negligible, as such, quantity control has not been provided for the urbanized portion of Agnes Street. Detailed peak flow calculations can be found in the memo attachments.

3.3 WATER BALANCE

Urbanization increases impervious cover, which, if left unmitigated, results in a decrease in infiltration. This decrease in infiltration reduces groundwater recharge and soil moisture replenishment. It also reduces stream baseflow needed for sustaining aquatic life. Therefore, it is important to maintain the natural hydrologic cycle. Groundwater recharge helps maintain aquifer water levels and supports significant watershed features that are necessary components to the maintenance of a healthy watershed. As a result, a water balance analysis is required to estimate the pre-development and post-development infiltration and runoff.

For retrofit scenarios, pre-development infiltration volumes should be maintained in post-development conditions as per the Town's CLI ECA, and Terms of Reference: Water Balance

Assessment Draft document. There is no other higher-level study that dictates the water balance criteria in the urbanization area.

A site-specific water balance was completed for the urbanized area of Agnes Street (Area 204a and 204b) using MECP's Stormwater Management Planning and Design Manual dated March 2003. This approach uses the method developed by Thornthwaite and Mather. A summary of the pervious and impervious areas is provided below in **Table 7**.

Table 7 Existing and Proposed Land Cover

Area	Existing Area 104a +104b (m^2)	Proposed Area 204a+204b (m^2)
Pervious	1,313	1,076
Impervious	2,135	2,371
Total	3,447	3,447

The parameters used for the water balance analysis are provided in **Table 8**.

Table 8 MECP Water Balance Infiltration Parameters

	Comment	Factor
Topography	Hilly Land	0.1
Soils	Open Sandy Loam	0.4
Cover	Cultivated Land	0.1

A total deficit volume of 47m^3/year will not be infiltrated into the ground given the proposed development plan and resulting change in pervious cover. As such, this annual volume must be balanced and infiltrated back into the ground under proposed conditions.

The water balance target of 47m^3/year will be provided through the bioretention planters for Area 204a and 204b.

The bioretention planters have been sized to capture the 5mm storm event, which represents approximately 50% of all rainfall events in a given year (City of Toronto WWFMG Figure 1b, November 2006).

An annual precipitation of 902mm was determined (MECP's Orangeville MOE climate station). Assuming that 10% of the rainfall is evaporated, an impervious annual surplus of 811mm was determined and directed towards the enhanced grassed swale.

Based on an annual impervious surplus of 811mm per year, and assuming 50% of all rainfall events are infiltrated, the annual infiltration volume towards the infiltration facility equates to 1,058m^3 for a total annual infiltration volume of 1,272m^3.

However, for design and conservative purposes, a factor of safety of 1.5 was applied to the total infiltration facility infiltrated volume in the event that infiltration does not occur as efficiently due to soil saturation, partially full infiltration facility from previous rainfall events, or unexpected in-situ soil conditions. This equates to an annual infiltration volume towards the infiltration facility of 705m^3 for a total infiltration volume of 920m^3, therefore exceeding pre-development conditions.

A summary of the infiltration volumes is provided in **Figure 3**.

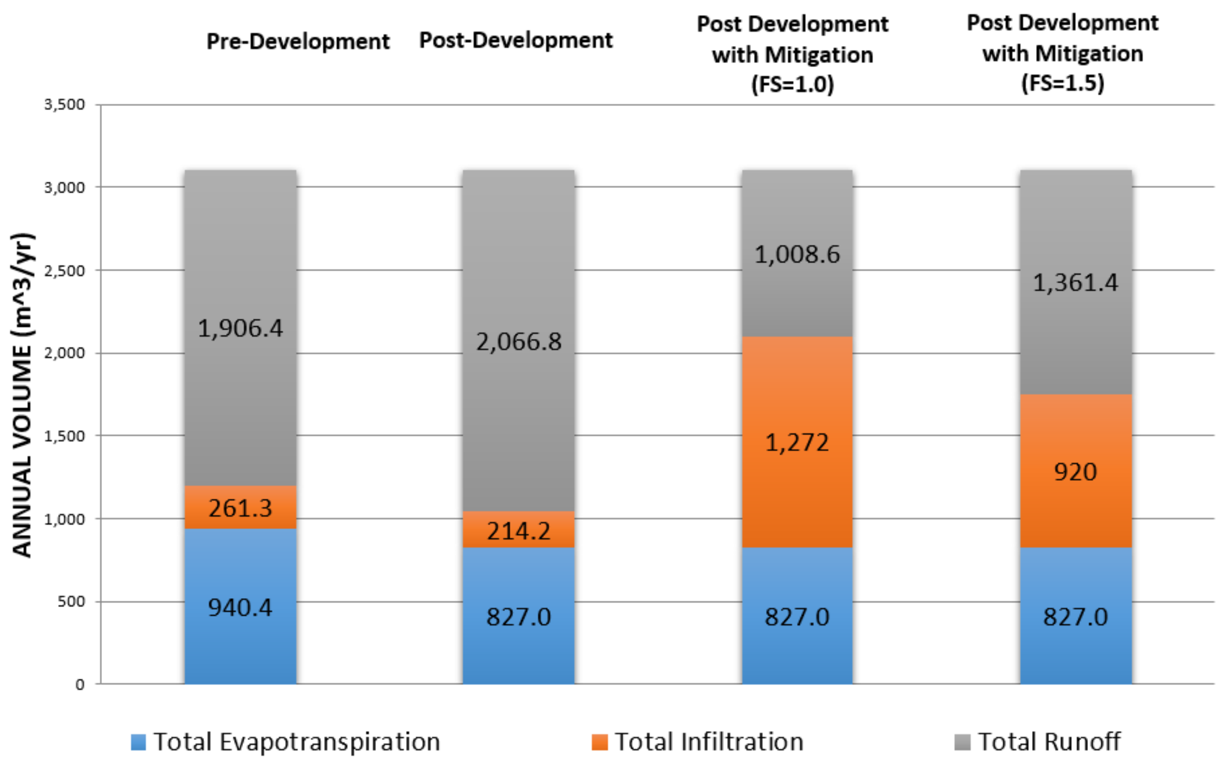


Figure 3: Water Balance Summary

As such, the application of the enhanced grass swale achieves a net increase in overall infiltration, which meets the CVC criteria of maintaining pre-development infiltration levels and providing 5mm of on-site retention. For water balance calculations, please see **Appendix E**.

3.4 EROSION CONTROL

The Town's Environmental Compliance Approval 324-S701 (October 2022) requires that for retrofit scenarios, the proposed condition should improve the level of erosion control.

The CVC Stormwater Management Guidelines (July 2022) state that "the minimum erosion control requirement for all watercourses within CVC's jurisdiction is retention of the first 5mm of every rainfall event. Industry-standard storage volumes for pervious areas of 5mm were applied, therefore, the erosion control storage volume requirement will be characterized by impervious surfaces.

It is proposed to capture the equivalent of the 5mm event on the impervious area within Area 204. See **Table 9** below for a summary of erosion control volume requirements and the storage provided by the infiltration facility during the 5mm storm event.

Table 9 Erosion Control Volume Summary

Catchment ID	Post Dev. Impervious Area (m^2)	Required Volume (m^3)	Proposed Volume (m^3)
Area 204a	1,184.2	5.9	6.2
Area 204b	1,186.9	5.9	12.0

During the 5mm event, the proposed bioretention planters will provide a total of 18.2m^3 of subsurface storage. A total erosion control storage of 18.2m^3 is provided, exceeding the required 11.8m^3.

A maximum 48-hour drawdown time is required for the underground infiltration facility as per MECP criteria. Based on the Hydrogeological Investigation and Septic Impact Assessment dated December 2023 by Terraprobe, the underground infiltration facility will infiltrate into a layer of silt fine sand. Based on the grain size analysis testing, the percolation rate is 12min/cm which is equivalent to an infiltration rate of 50mm/hr.

A drawdown time of 4.0 hours was calculated for the underground infiltration facility. As such, the underground infiltration facility will achieve a maximum drawdown time of less than 48 hours. Erosion control, infiltration facility sizing, and drawdown calculations are provided in the memo attachments.

4 EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION

Erosion and sediment controls (ESC) will be implemented for all construction activities, including topsoil striping, material stockpiling, and grading operations. The following erosion and sediment control elements are proposed on site:

- Sediment control fence – Fencing will be constructed downslope of the proposed development area prior to all construction activities. Geotextile material should have a non-woven density of 270R or equivalent;
- Filtrexx Siltsoxx check dams are to be placed within drainage swales/ditches and low points to hold back water and reduce velocities to prevent erosion and promote sedimentation.
- Restoration of landscaped areas – all exposed soil after grading is to be immediately sodded to promote vegetation growth and protection for erosion and sediment control
- ESC's will be erected prior to the start of construction works and maintained through all phases of development. ESC strategies are not static and may need to be upgraded/amended as site conditions change to minimize sediment laden runoff from leaving the work areas;
- Sediment controls must be inspected on a regular basis and after every rain fall event. Repairs must be done in a timely manner to prevent movement of sediment.

5 CONCLUSIONS

Greck and Associates is confident that this memo and the analyses completed are consistent with the latest municipal and provincial standards and guidelines with respect to scientific analysis and engineering principles. In summary:

- 152m of Agnes Street is to be urbanized with a sidewalk, curb, gutter, storm sewer and bioretention planters.
- Bioretention planters and OGS to create a treatment train to provide water quality control for the urbanized portion of Agnes Street.
- Bioretention plants to also provide water balance and erosion control.
- Details of the bioretention planters are to be confirmed during the detailed design stage.

If you require additional information or have any questions, please feel free to contact me at (289) 657-9797 ext. 226.

Respectfully submitted,

Jennifer Chan, P.Eng.
Water Resources Engineer

ATTACHMENTS

- Alton Sewershed Map provided by the Town of Caledon
- Topographic Survey prepared by Van Harten Surveying Inc. dated September 16, 2022
- Groundwater Flow Direction Plan by Terraprobe from Hydrogeological Investigation dated March 2023
- Cross Section Detail of Agnes Street updated by Greck
- Water Quality Unit Specifications and Manual
- Stormwater Management Calculations by Greck

Legend

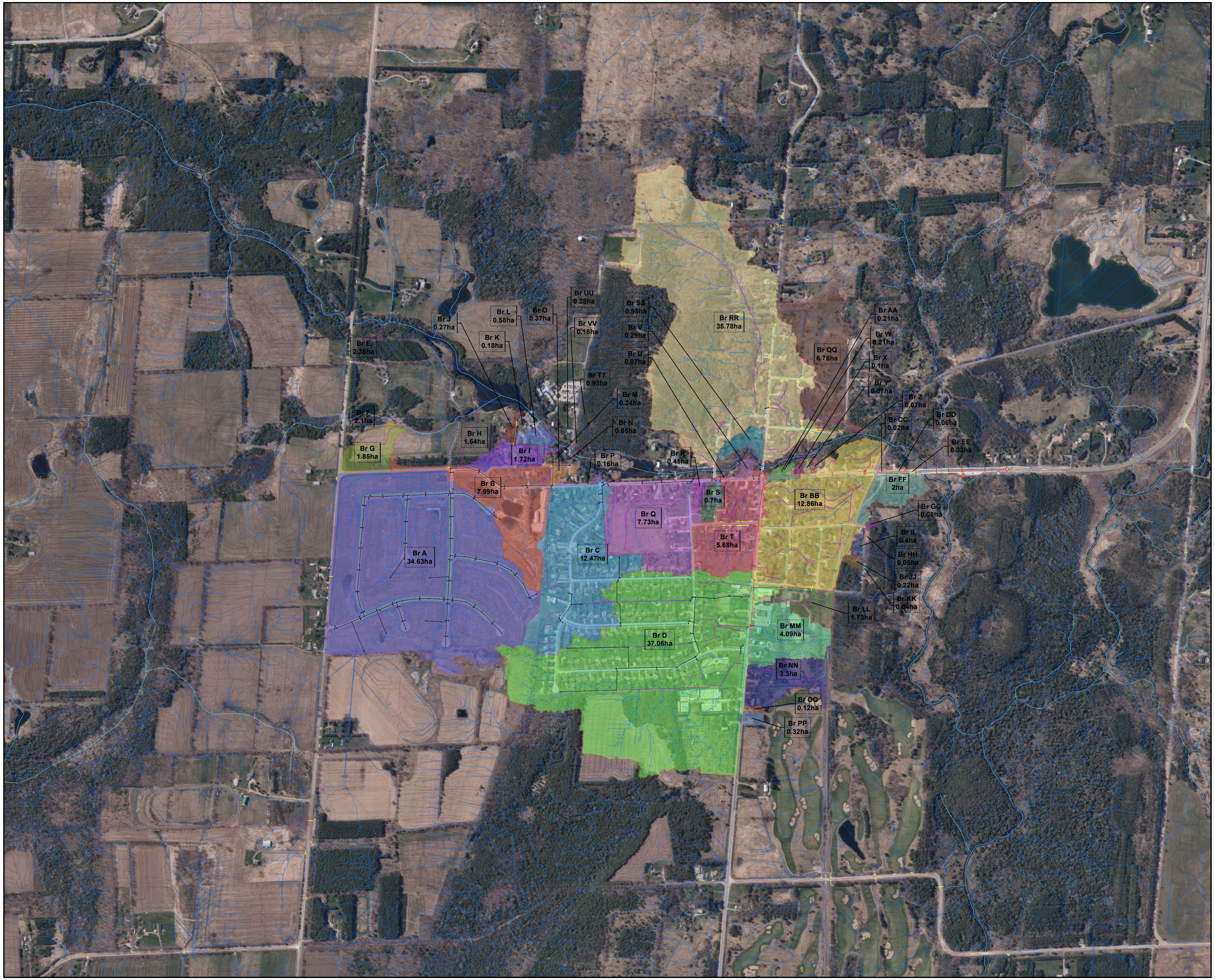
- Storm_Outflow
- Storm_Manhole
- Storm_Inlet
- Outfalls
- Manholes
- CatchBasins
- Rivers_and_streams
- Storm_Main
- Storm_Inlet_Lead
- STML_Pipes
- Pipes
- Lead_Pipes
- Minor system subcatchment/Branch
- Property lines
- Private swale
- Public swale
- Culverts

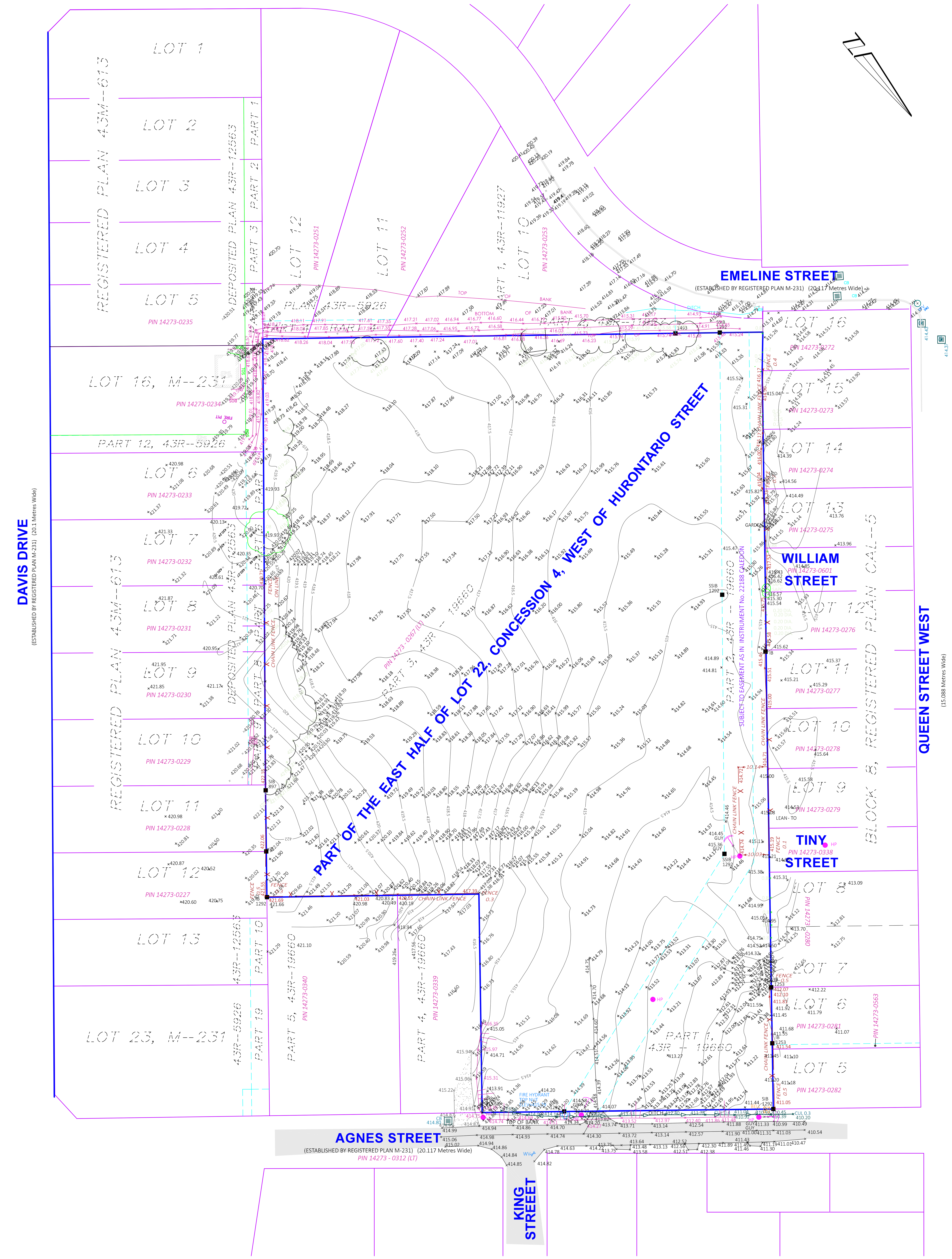
1937PEEL_15cm_2019.sid

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3

Branch ID
Total area in ha



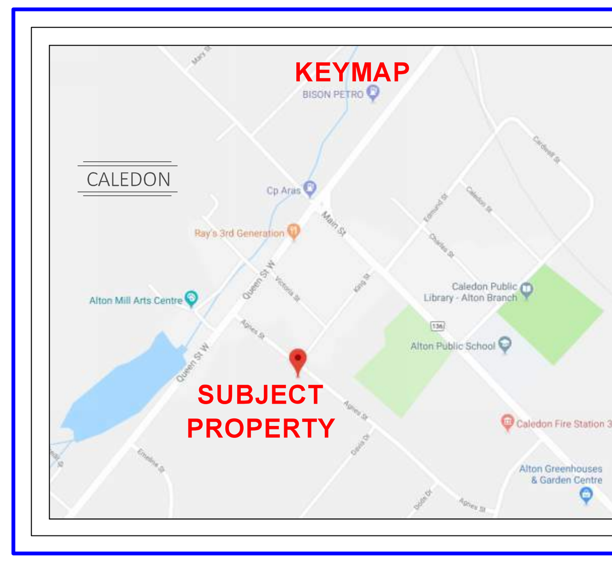


TOPOGRAPHIC SURVEY OF PART OF EAST HALF OF LOT 22, CONCESSION 4, WEST OF HURONTARIO STREET

GEOGRAPHIC TOWNSHIP OF CALEDON, COUNTY OF PEEL

TOWN OF CALEDON

REGIONAL MUNICIPALITY OF PEEL



SCALE 1 : 750

0 5 10 20 30 40 50 metres

VAN HARTEN SURVEYING INC.

750

LEGEND

	DENOTES SURVEY MONUMENT SET
	DENOTES SURVEY MONUMENT FOUND
SIB	DENOTES .025 x .025 x 1.20 STANDARD IRON BAR
IB	DENOTES .015 x .015 x 0.60 IRON BAR
SSIB	DENOTES .025 x .025 x 0.60 SHORT STANDARD IRON BAR
RP	DENOTES .015 DIA. X 0.07 ROUND IRON BAR WITH STAMPED WASHER
PB	DENOTES .025 x .025 x 0.30 PLASTIC BAR
CC	DENOTES CUT CROSS
WIT	DENOTES WITNESS
OU	DENOTES ORIGIN UNKNOWN
VH	DENOTES VAN HARTEN SURVEYING INC., O.L.S.'s
1292	DENOTES WM. E. BENNETT SURVEYING LTD., O.L.S.'s
897	DENOTES WILLIAM J. QUINSEY, O.L.S.'s
1493	DENOTES YOUNG AND YOUNG SURVEYORS INC., O.L.S.
375	DENOTES D.J. CULLEN LTD., O.L.S.

EXISTING ELEVATION × 206.55
GUY WIRE GUY
HYDRO POLE HP
FIRE HYDRANT FH
CATCHBASIN CB
BELL PEDESTAL BELL

LINETYPES

OVERHEAD HYDRO OH
FENCELINE X
DITCH/SWALE
CENTRELINE OF ROAD
TOP OF BANK

HATCHES

ASPHALT
GRAVEL

BENCHMARK:

ELEVATIONS ARE BASED ON GPS OBSERVATIONS FROM PERMANENT REFERENCE STATIONS IN THE NAD83 (CSRS-2010) COORDINATE SYSTEM, WITH HEIGHTS CONVERTED TO ORTHOMETRIC ELEVATIONS ON THE CVGD28 DATUM (1978 ADJUSTMENT) WITH GEOID MODEL HTv2.0, AS SUPPLIED BY NATURAL RESOURCES CANADA.

REFERENCE:

1. BEARINGS ARE GRID BEARINGS AND ARE DERIVED FROM GPS OBSERVATIONS AND ARE REFERRED TO THE UTM PROJECTION, ZONE 17. NAD 83-CSRS (2010) ADJUSTMENT.
2. DISTANCES SHOWN ON THE PLAN ARE ADJUSTED GROUND DISTANCES AND CAN BE CONVERTED TO UTM GRID DISTANCES BY MULTIPLYING BY AN AVERAGED COMBINED SCALE FACTOR OF 0.9996086

NOTE:

BOUNDARY INFORMATION SHOWN ON THIS PLAN WAS COMPILED FROM REGISTRY OFFICE INFORMATION AND PLAN FOR THE SUBJECT PROPERTY: 43R-19660

FIELD WORK FOR THIS SURVEY WAS COMPLETED ON THE 10th DAY OF MAY , 2018
ADDITIONAL FIELD WORK FOR THIS SURVEY WAS COMPLETED ON THE 2 AUGUST 2022

SEPTEMBER 16, 2022

JAMES M. LAWS
ONTARIO LAND SURVEYOR

METRIC:

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

REVISION SCHEDULE

No.	DATE	BY	COMMENTS
1	7/25/18	S.J.	INITIAL SUBMISSION
2	9/16/22	JL	2ND SUBMISSION

Van Harten SURVEYING INC.
LAND SURVEYORS and ENGINEERS

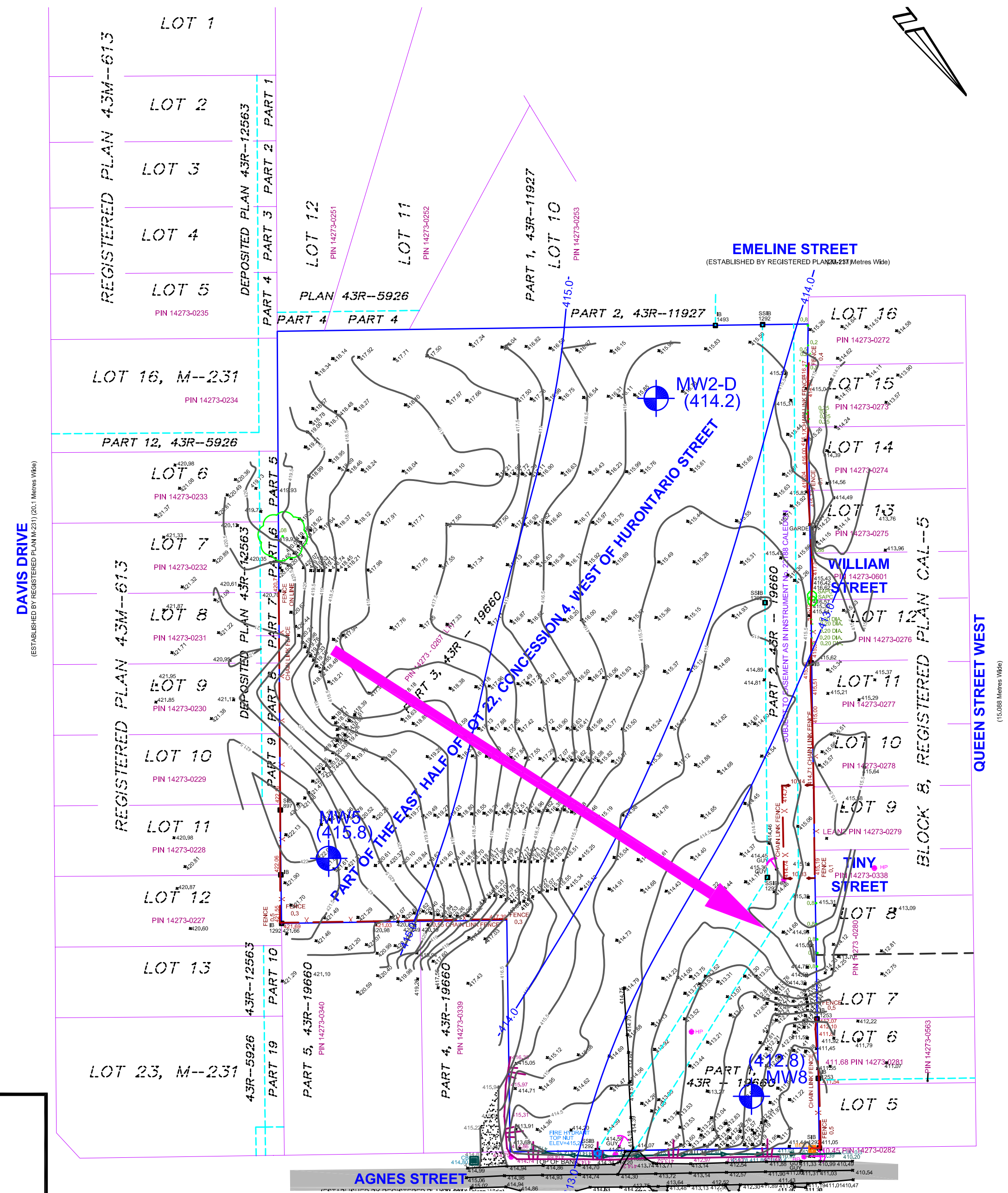
Kitchener	Guelph	Orangeville
Ph: 519-742-8371	Ph: 519-821-2763	Ph: 519-940-4110

www.vanharten.com info@vanharten.com

DRAWN BY: S.J.	CHECKED BY: JML	PROJECT No. 25228-17

Sep 16,2022-12:12pm
G:\CALEDON\CON4WHS\AGNES ST DEVELPOMENT\ACAD\TOPO-ROBB UTM 2010 NR REV 1.dwg

SEATON GROUP



LEGEND

- Monitoring Well Location
- Inferred Groundwater Flow Direction
- (412.8) Groundwater Elevation (Apr.25,2019)
- 414 Groundwater Contour (1.0m Interval)

Source:

REVISION SCHEDULE

No.	DATE	BY	COMMENTS
1	7/25/18	S.J.	INITIAL SUBMISSION

Van Harten SURVEYING INC. LAND SURVEYORS and ENGINEERS

Kitchener Ph: 519-742-8371 | Guelph Ph: 519-821-2763 | Orangeville Ph: 519-940-4110

www.vanharten.com info@vanharten.com

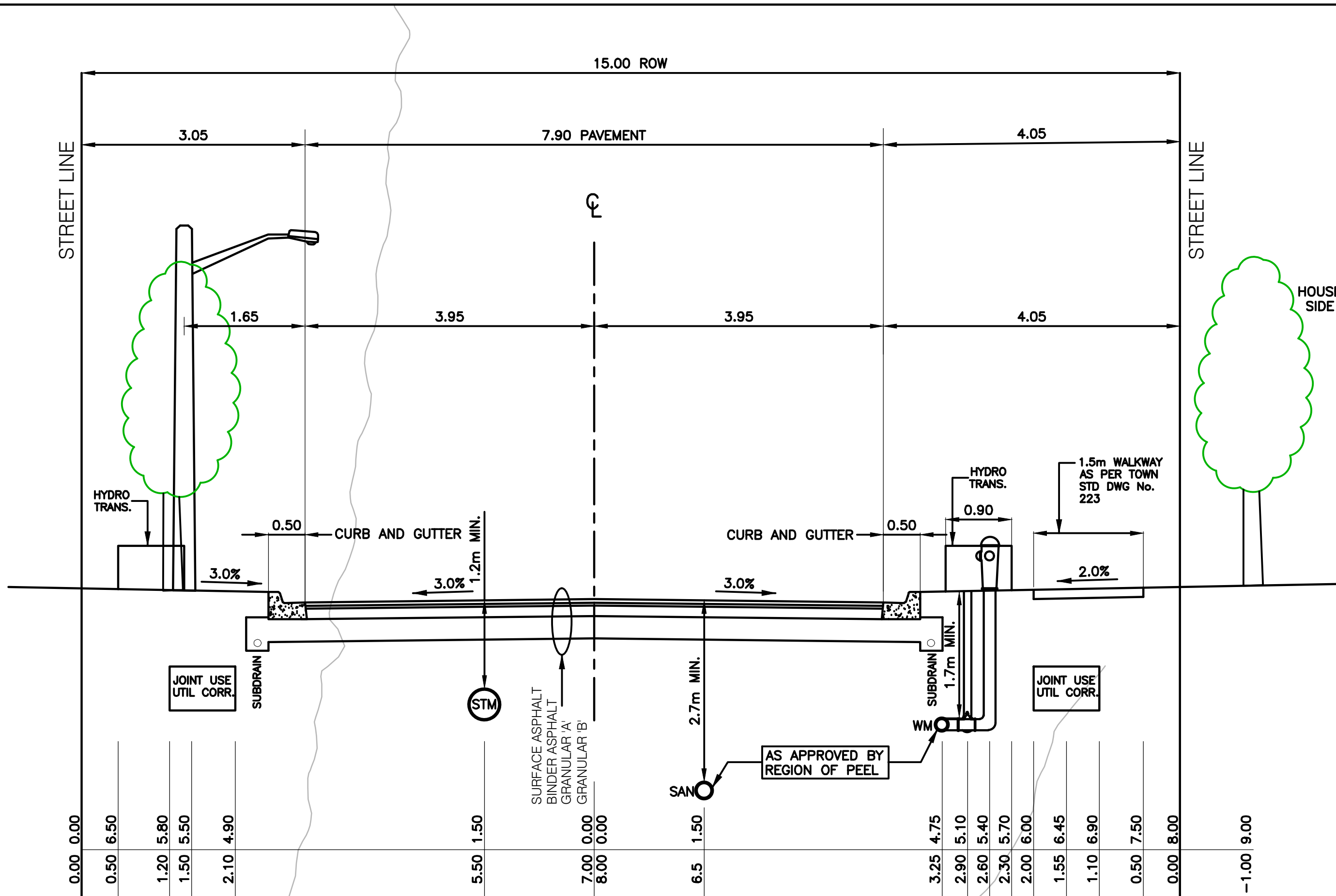
DRAWN BY: S.J. | CHECKED BY: ML | PROJECT No. 25228-17

Terraprobe
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title: GROUNDWATER FLOW DIRECTION PLAN

File No. 7-18-0158-01

FIGURE : 3



TYPICAL ROAD CROSS SECTION

15m LOCAL WINDOW STREET

7.90m PAVEMENT

SCALE 1:75

NOTE:

THIS CROSS SECTION IS BASED ON A STANDARD CROSS SECTION PROVIDED BY THE TOWN THAT INCLUDES A SANITARY SEWER. IN THIS PROJECT THERE IS NO SANITARY SEWER BENEATH AGNES STREET. THE LOCATION OF THE WATERMAIN IS TO BE CONFIRMED AT THE DETAILED DESIGN STAGE.

AGNES STREET CROSS SECTION

(QUEEN STREET WEST TO KING STREET)

Stormceptor® EF Sizing Report

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

10/03/2024

Province:	Ontario
City:	Alton
Nearest Rainfall Station:	TORONTO INTL AP
Climate Station Id:	6158731
Years of Rainfall Data:	20

Project Name:	Agnes Street
Project Number:	20-731
Designer Name:	Jennifer Chan
Designer Company:	Greck
Designer Email:	jchan@greck.ca
Designer Phone:	289-657-9797
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Site Name:	Agnes St Urbanization

Drainage Area (ha):	0.34
% Imperviousness:	69.00

Runoff Coefficient 'c': 0.71

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):	7.55
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):	176
Estimated Average Annual Sediment Volume (L/yr):	143

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	61
EFO6	66
EFO8	69
EFO10	70
EFO12	70

Recommended Stormceptor EFO Model:	**EFO4**
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)

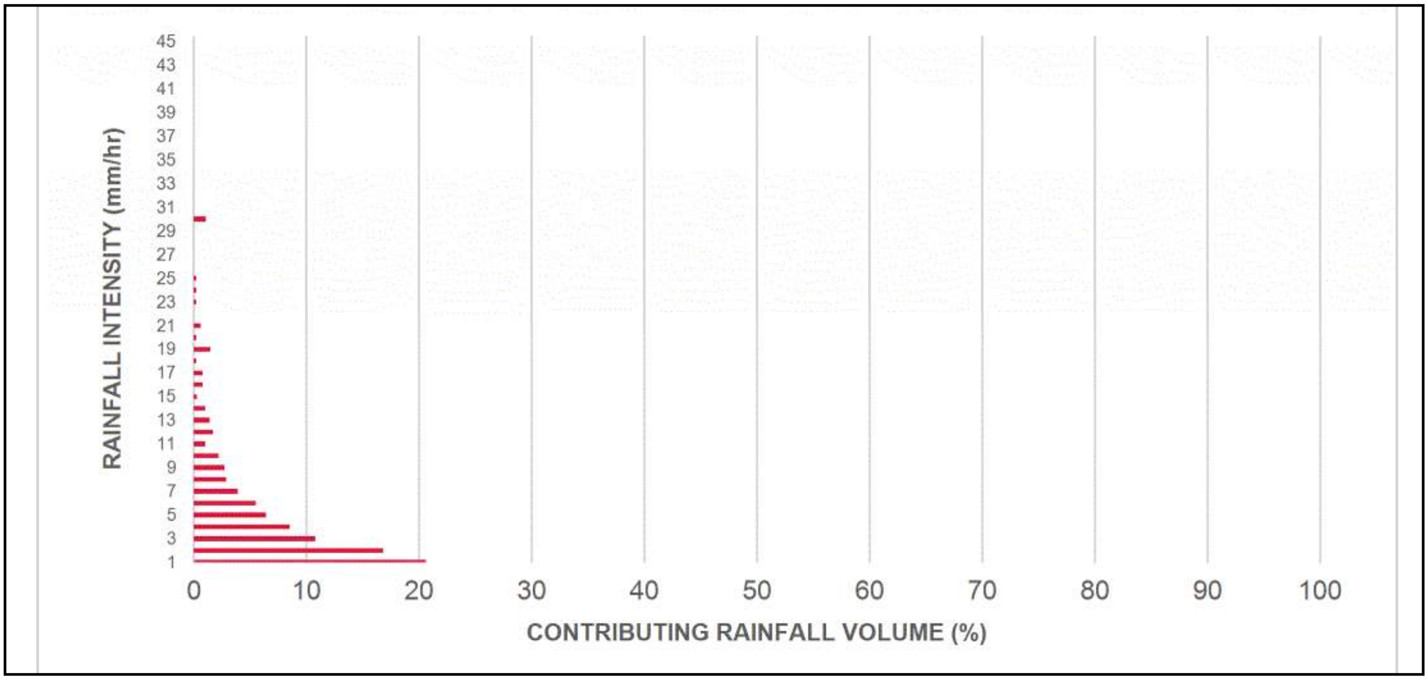
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a 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

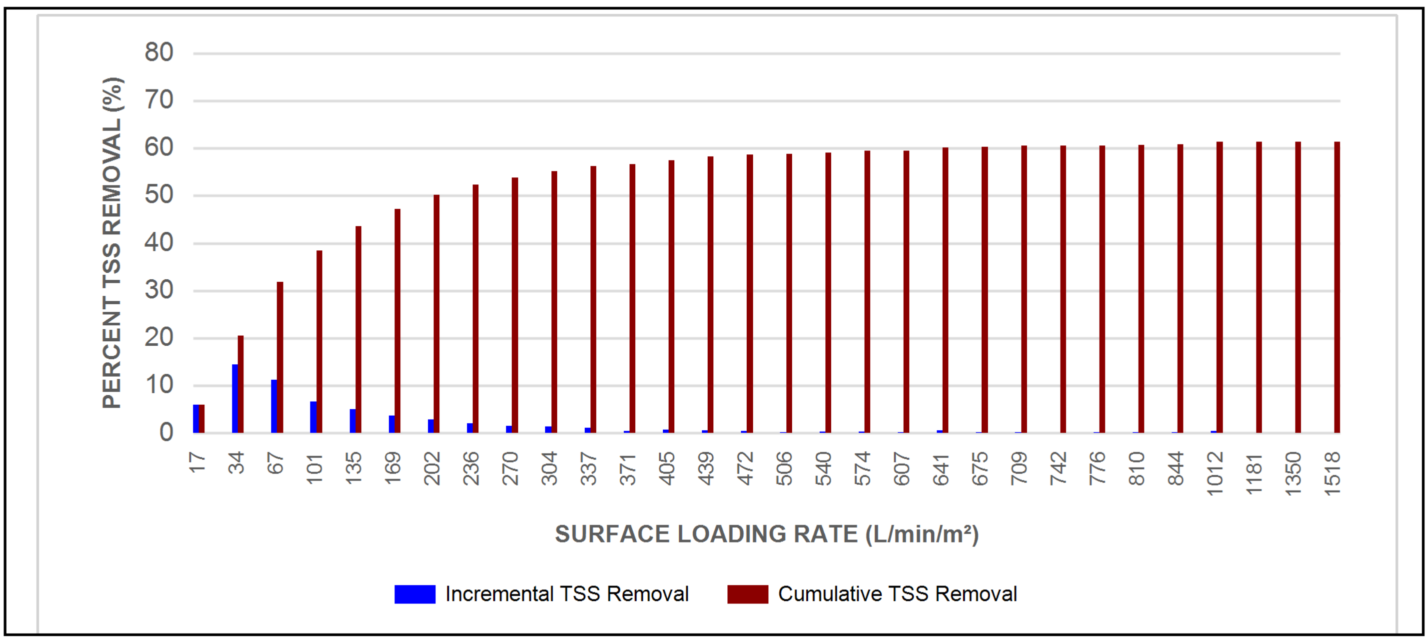
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.5	8.5	0.34	20.0	17.0	70	6.0	6.0
1.00	20.6	29.1	0.67	40.0	34.0	70	14.5	20.5
2.00	16.8	45.9	1.35	81.0	67.0	67	11.3	31.8
3.00	10.8	56.7	2.02	121.0	101.0	62	6.7	38.5
4.00	8.5	65.2	2.70	162.0	135.0	60	5.1	43.6
5.00	6.4	71.6	3.37	202.0	169.0	57	3.7	47.2
6.00	5.5	77.0	4.05	243.0	202.0	54	2.9	50.2
7.00	3.9	81.0	4.72	283.0	236.0	53	2.1	52.3
8.00	2.9	83.9	5.40	324.0	270.0	52	1.5	53.8
9.00	2.7	86.5	6.07	364.0	304.0	51	1.4	55.2
10.00	2.2	88.7	6.75	405.0	337.0	50	1.1	56.2
11.00	1.0	89.7	7.42	445.0	371.0	49	0.5	56.7
12.00	1.7	91.3	8.10	486.0	405.0	48	0.8	57.5
13.00	1.4	92.8	8.77	526.0	439.0	47	0.7	58.2
14.00	1.0	93.7	9.45	567.0	472.0	46	0.4	58.6
15.00	0.3	94.0	10.12	607.0	506.0	45	0.1	58.8
16.00	0.8	94.8	10.80	648.0	540.0	44	0.3	59.1
17.00	0.8	95.7	11.47	688.0	574.0	43	0.4	59.5
18.00	0.2	95.8	12.15	729.0	607.0	42	0.1	59.5
19.00	1.5	97.3	12.82	769.0	641.0	42	0.6	60.2
20.00	0.2	97.5	13.50	810.0	675.0	42	0.1	60.3
21.00	0.6	98.2	14.17	850.0	709.0	42	0.3	60.5
22.00	0.0	98.2	14.85	891.0	742.0	41	0.0	60.5
23.00	0.2	98.4	15.52	931.0	776.0	41	0.1	60.6
24.00	0.2	98.6	16.20	972.0	810.0	41	0.1	60.7
25.00	0.2	98.9	16.87	1012.0	844.0	41	0.1	60.8
30.00	1.1	100.0	20.25	1215.0	1012.0	40	0.5	61.3
35.00	0.0	100.0	23.62	1417.0	1181.0	37	0.0	61.3
40.00	0.0	100.0	26.99	1620.0	1350.0	35	0.0	61.3
45.00	0.0	100.0	30.37	1822.0	1518.0	32	0.0	61.3
							Estimated Net Annual Sediment (TSS) Load Reduction =	**61 %**

Climate Station ID: 6158731 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO INTL AP 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

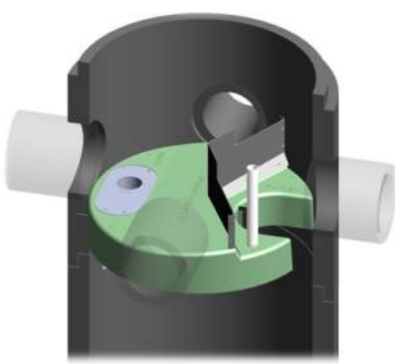
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test 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.

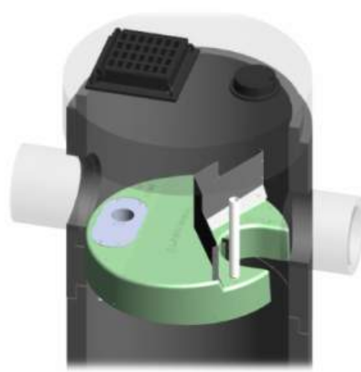
DESIGN FLEXIBILITY

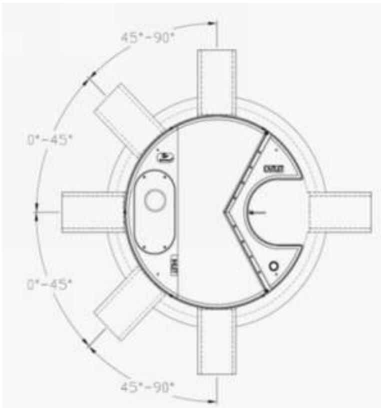
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend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

Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Stormceptor® EF and EFO Oil-Grit Separators

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

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

In accordance with

ISO 14034:2016

Environmental management —
Environmental technology verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

November 15, 2020
Vancouver, BC, Canada

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

Technology description and application

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

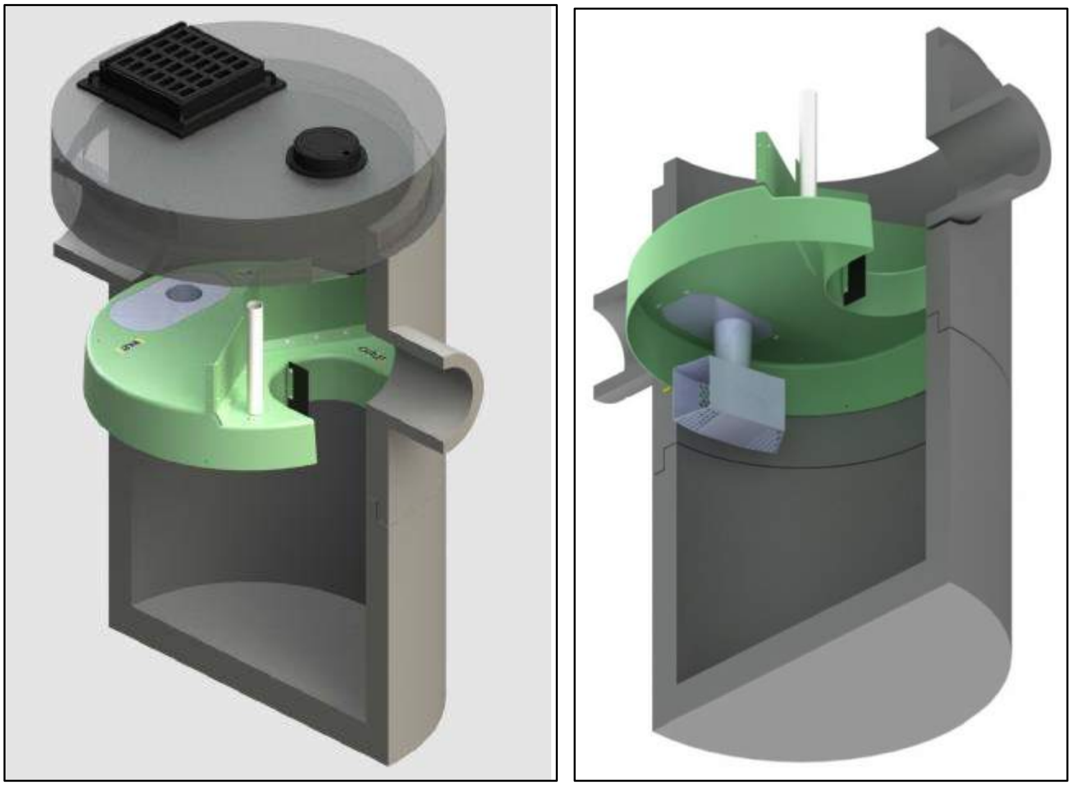


Figure 1. Graphic of typical inline Stormceptor® unit and core components.

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

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

Performance conditions

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

Performance claim(s)

Capture test[a]:

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

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

Scour test[a]:

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

Light liquid re-entrainment test[a]:

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

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

Performance results

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

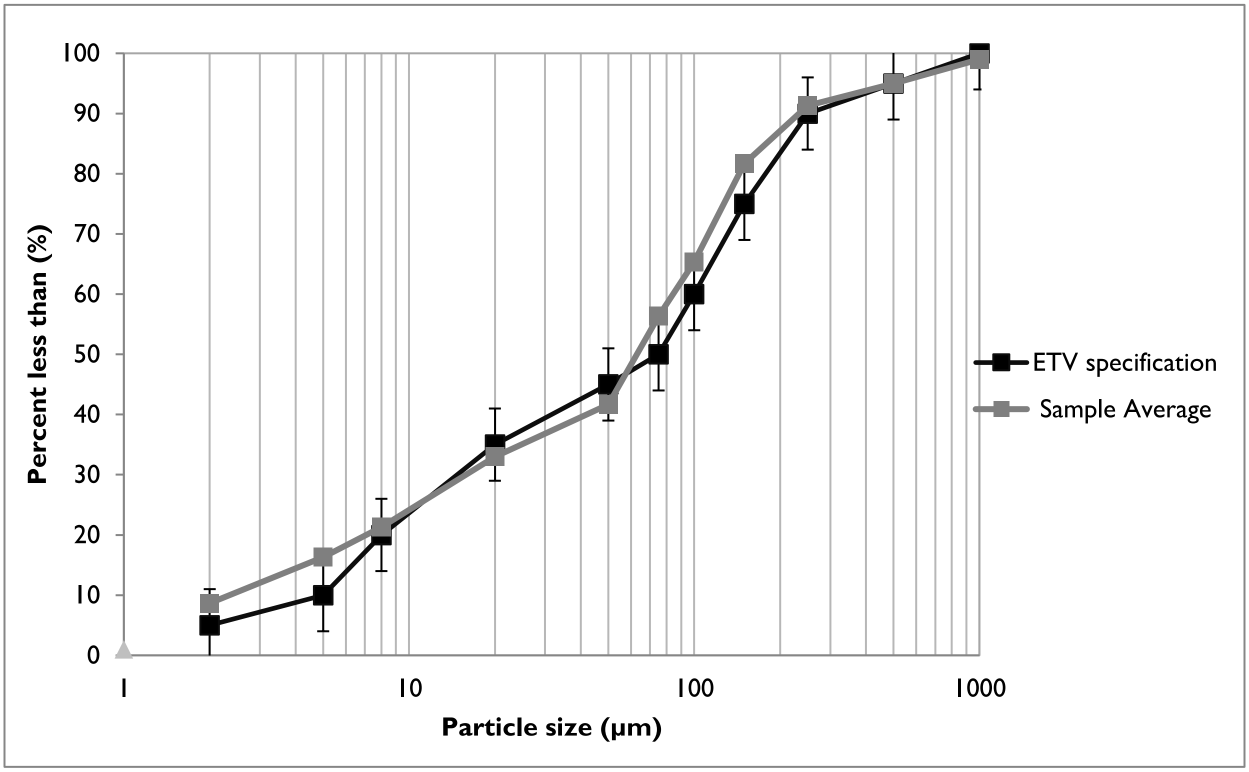


Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

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

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

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

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

[a] An outlier in the feed sample sieve data resulted in a negative removal efficiency for this size fraction.
* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 171% (average 128%). See text and Bulletin # CETV 2016-11-0001 for more information.

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

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

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

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

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

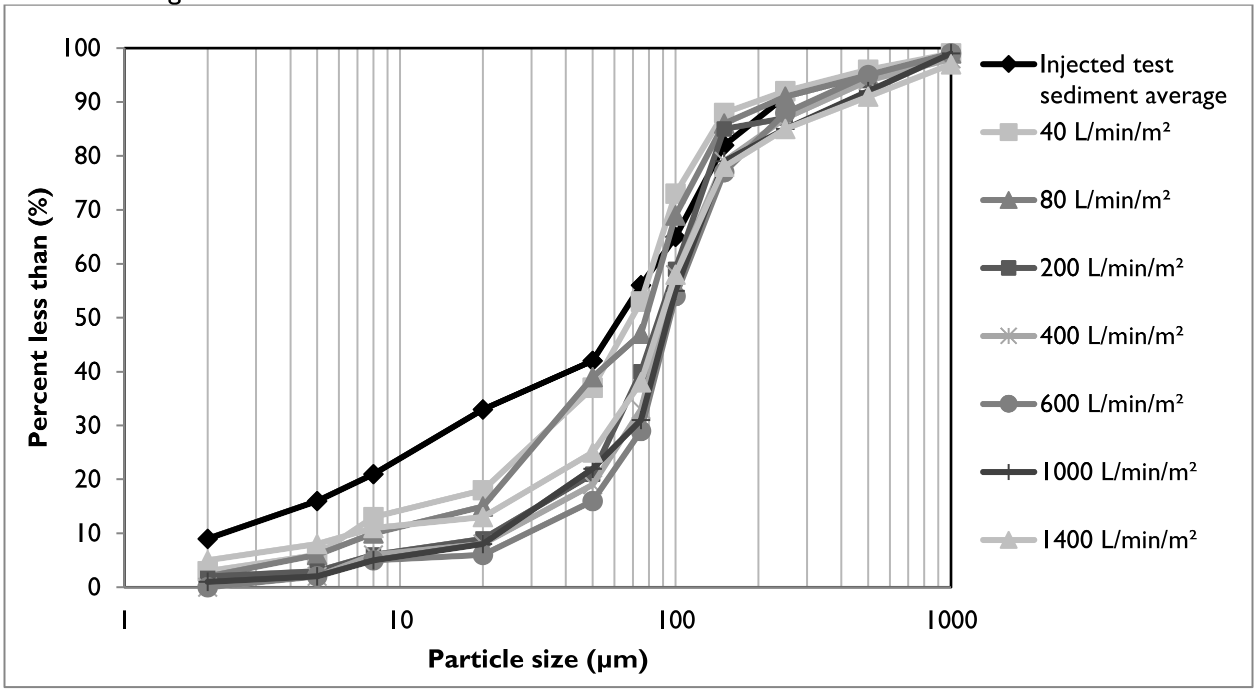


Figure 3. Particle size distribution of sediment retained in the EF4 in relation to the injected test sediment average.

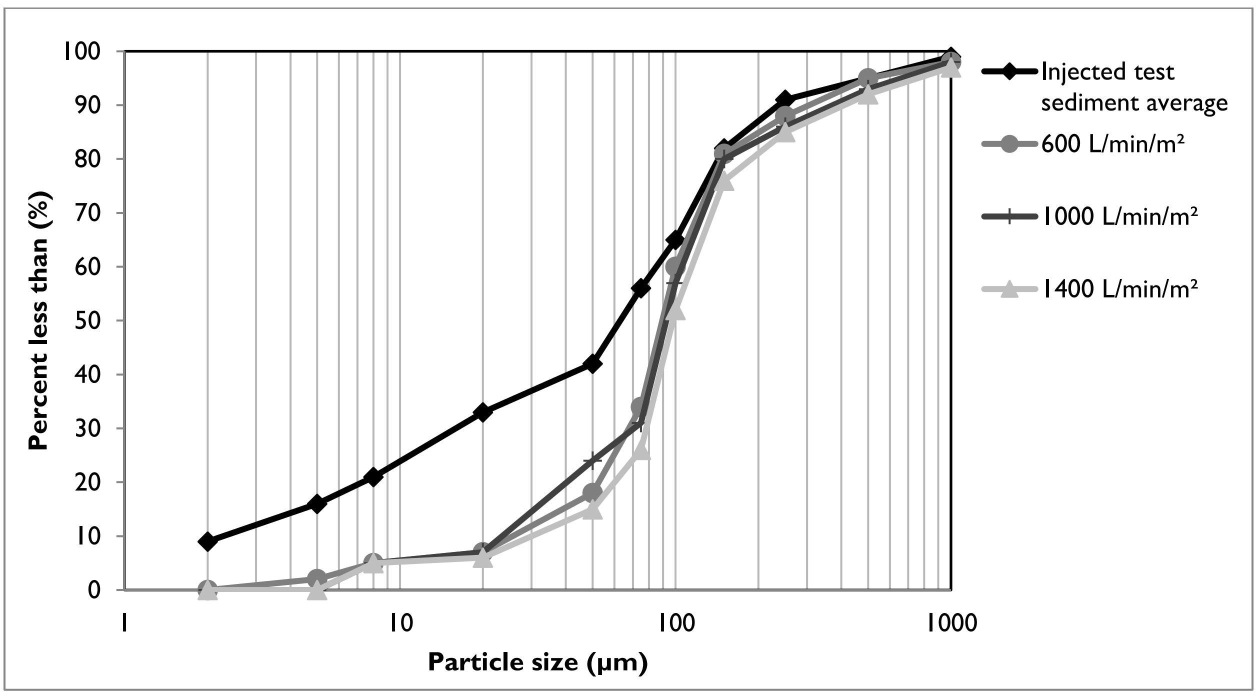


Figure 4. Particle size distribution of sediment retained in the EFO4 in relation to the injected test sediment average at surface loading rates above the bypass rate of 535 L/min/m²

Table 4 shows the results of the sediment scour and re-suspension test for the EF4 unit. The EFO4 was not tested as it was reasonably assumed that scour rates would be lower given that flow bypass occurs at a lower surface loading rate. The scour test involved preloading 10.2 cm of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Clean water was run through the device at five surface loading rates over a 30 minute period. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water. Typically, the smallest 5% of particles captured during the 40 L/min/m^2 sediment capture test is also used to adjust the concentration, as per the method described in Bulletin # CETV 2016-09-0001. However, since the composites of effluent concentrations were below the Reporting Detection Limit of the Laser Diffraction PSD methodology, this adjustment was not made. Results showed average adjusted effluent sediment concentrations below 5 mg/L at all tested surface loading rates.

It should be noted that the EF4 starts to internally bypass water at 1135 L/min/m^2, potentially resulting in the dilution of effluent concentrations, which would not normally occur under typical field conditions because the field influent concentration would contain a much higher sediment concentration than during the lab test. Recalculation of effluent concentrations to account for dilution at surface loading rates above the bypass rate showed sediment effluent concentrations to be below 1.6 mg/L.

Table 4. Scour test adjusted effluent sediment concentration.

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

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

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

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

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

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

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

Variances from testing Procedure

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

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

2. During the scour test, the coefficient of variation (COV) for the lowest flow rate tested (200 L/min/m²) was 0.07, which exceeded the specified limit of 0.04 target specified in the OGS Procedure. A pump capable of attaining the highest flow rate of 3036 L/min had difficulty maintaining the lowest flow of 234 L/min but still remained within +/- 10% of the target flow and is viewed as having very little impact on the observed results. Similarly, for the light liquid re-entrainment test the COV for the flow rate of the 200 L/min/m² run was 0.049, exceeding the limit of 0.04, but is believed to introduce negligible bias.

3. Due to pressure build up in the filters, the runs at 1000 L/min/m² for the Stormceptor® EF4 and 1000 and 1400 L/min/m² for the Stormceptor® EFO4 were slightly shorter than the target. The run times were 54, 59 and 43 minutes respectively, versus targets of 60 and 50 minutes. The final feed samples were timed to coincide with the end of the run. Since >25 lbs of sediment was fed, the shortened time did not invalidate the runs.

Verification

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

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

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

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

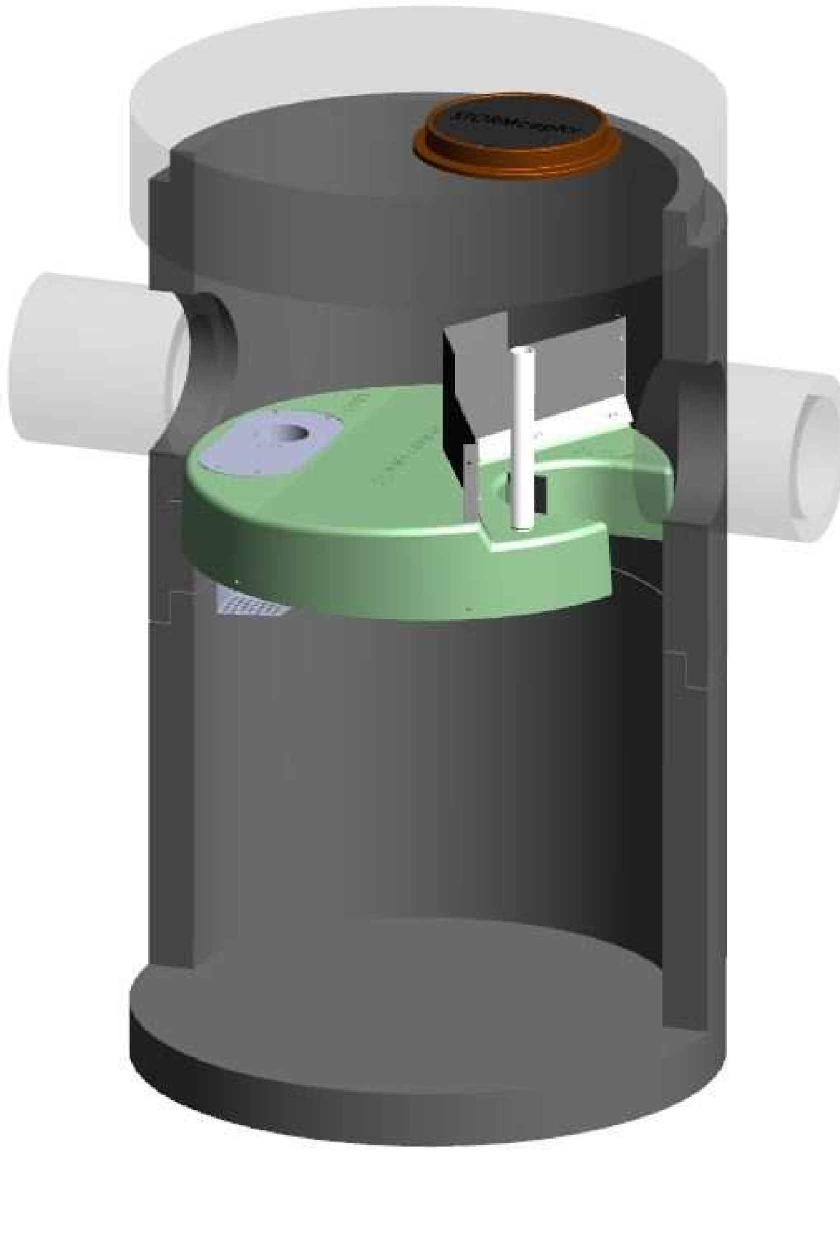
Imbrium Systems, Inc.
407 Fairview Drive
Whitby, ON
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

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

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

Stormceptor® EF

Owner's Manual



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

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

Table of Contents:

1 - Stormceptor EF Overview

2 - Stormceptor EF Operation, Components

3 - Stormceptor EF Model Details

4 - Stormceptor EF Identification

5 - Stormceptor EF Inspection & Maintenance

6 – Stormceptor Contacts

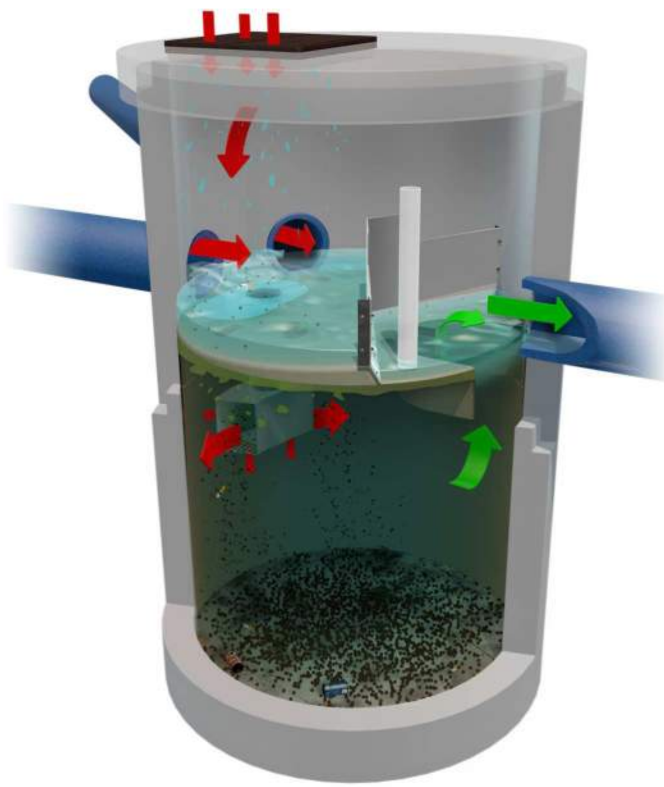
OVERVIEW

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

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

OPERATION

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



COMPONENTS

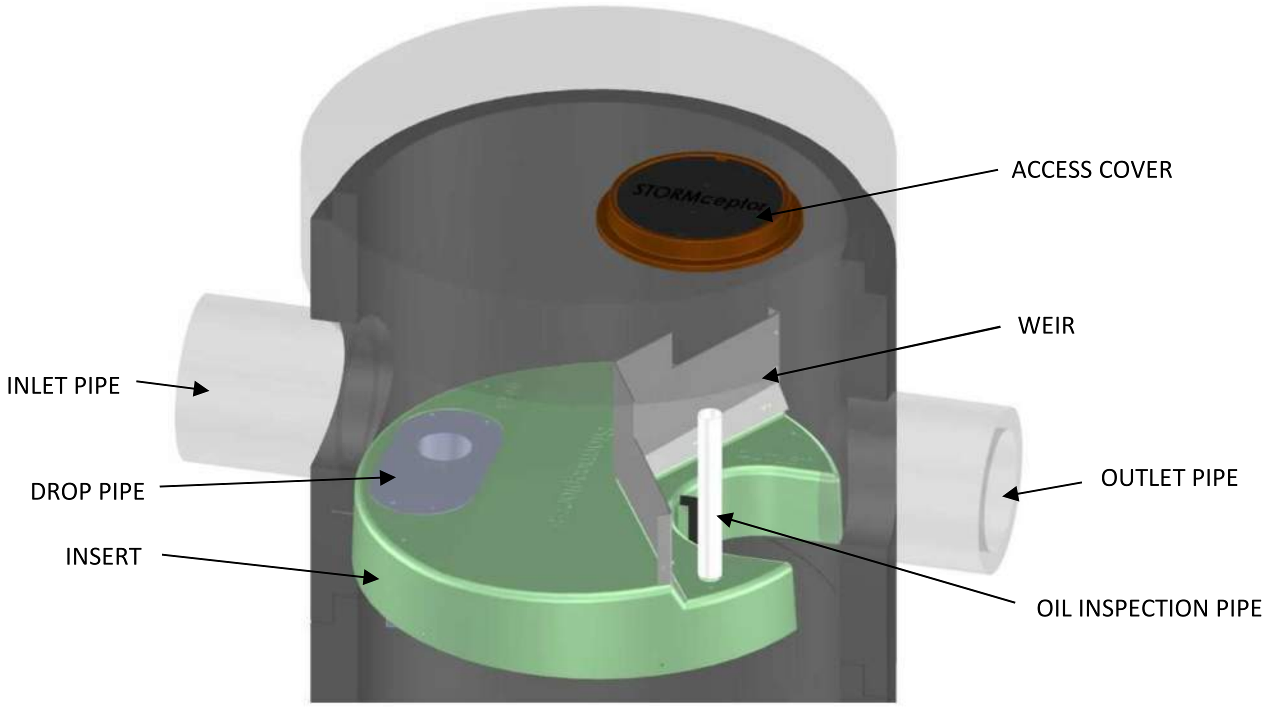


Figure 1

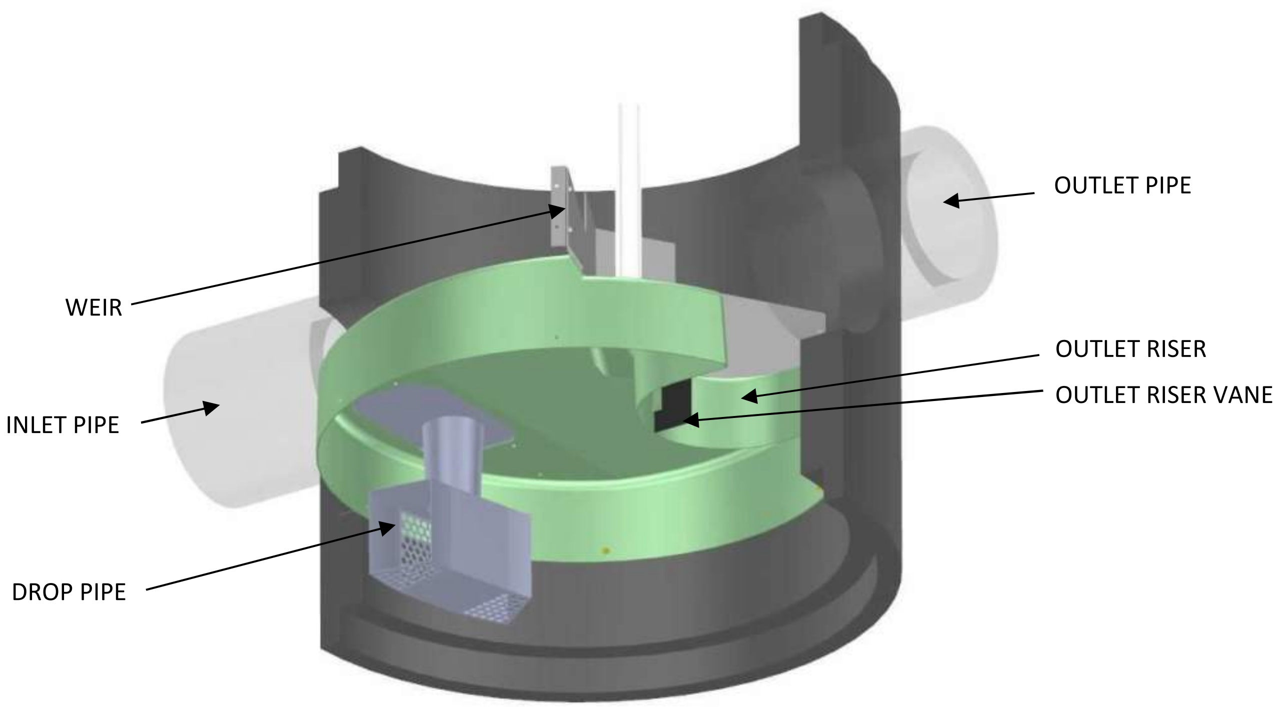


Figure 2

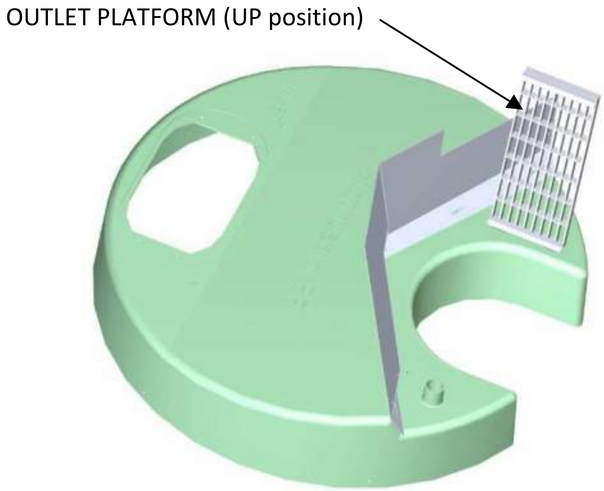


Figure 3A

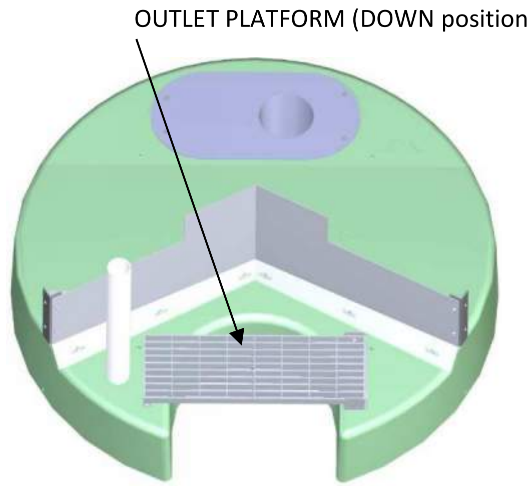


Figure 3B

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

PRODUCT DETAILS

METRIC DIMENSIONS AND CAPACITIES

Table 1

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

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

U.S. DIMENSIONS AND CAPACITIES

Table 2

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

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

IDENTIFICATION

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

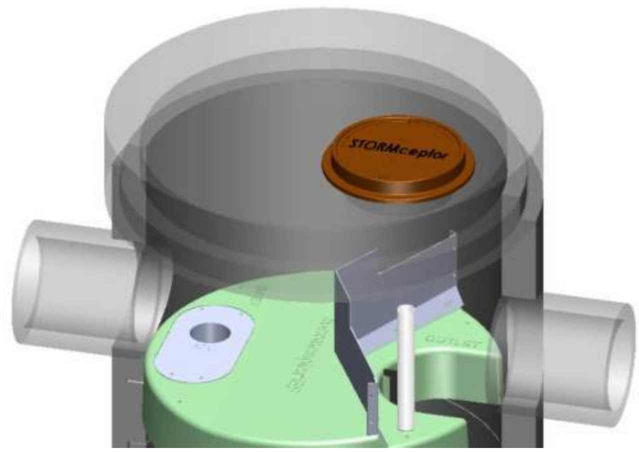


Figure 4

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

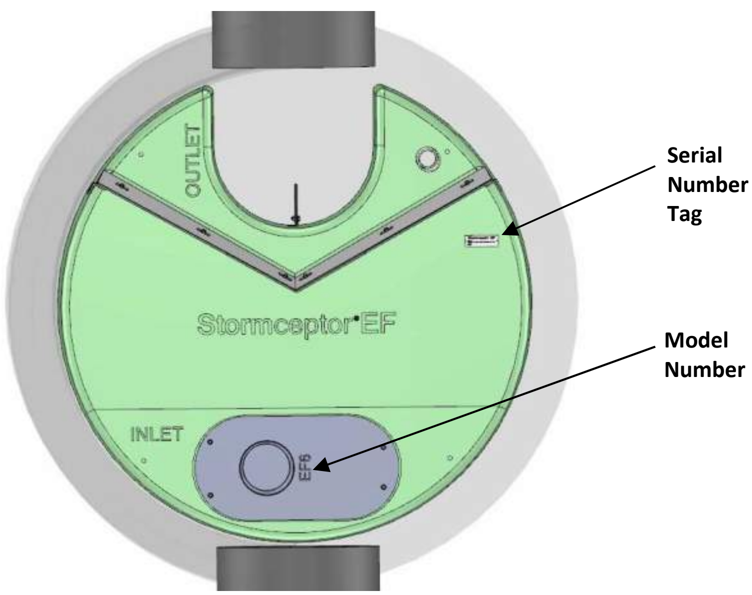


Figure 5

INSPECTION AND MAINTENANCE

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

Quick Reference

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

When is inspection needed?

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

What equipment is typically required for inspection?

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

When is maintenance cleaning needed?

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

Table 3

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

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

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

What equipment is typically required for maintenance?

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

What conditions can compromise Stormceptor performance?

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

Maintenance Procedures

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

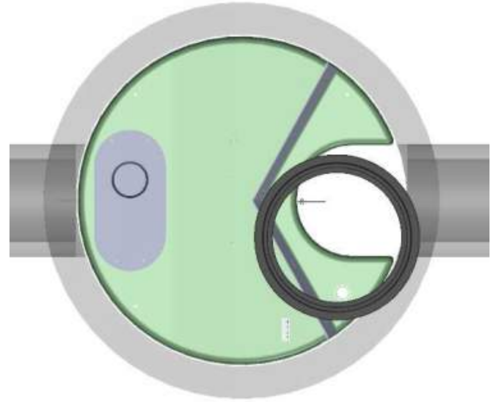


Figure 6

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

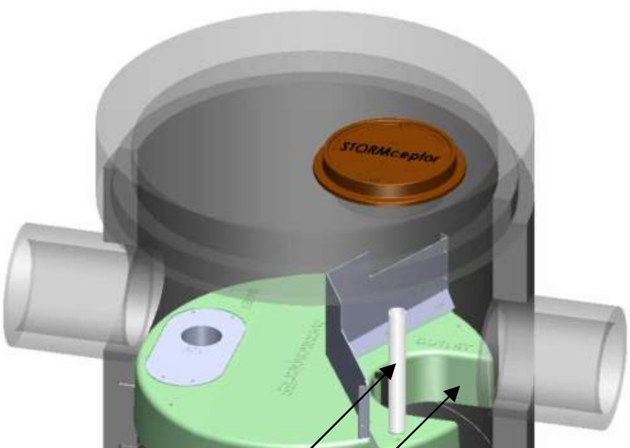


Figure 7

Figure 8

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

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

Figure 9

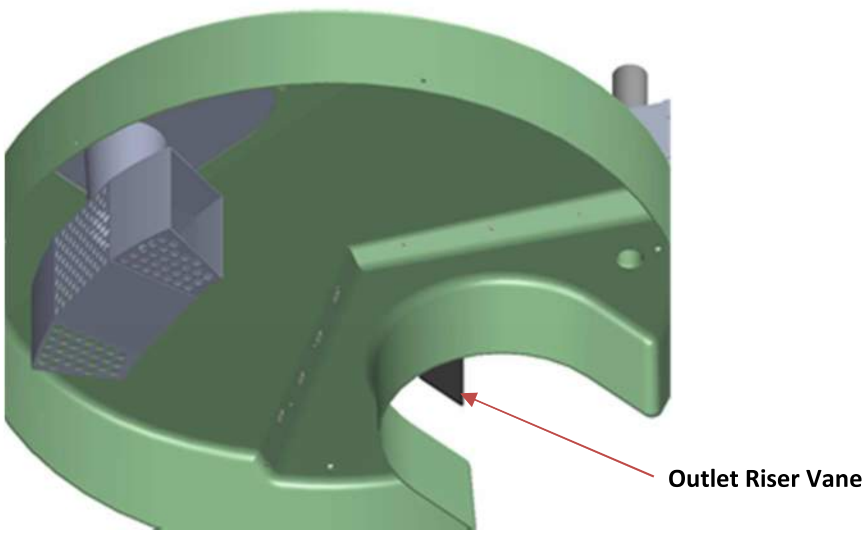


Figure 10

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

Removable Flow Deflector

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

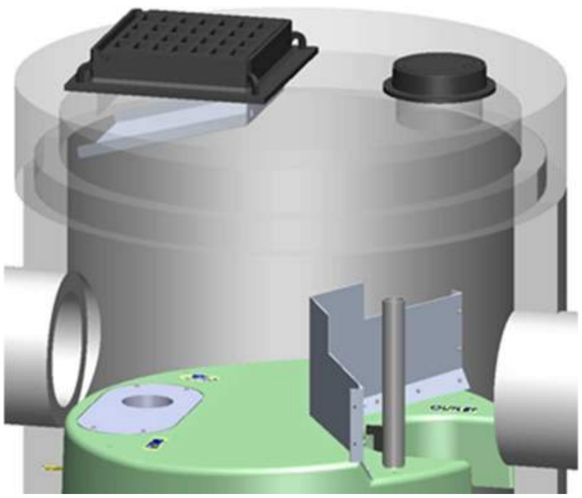
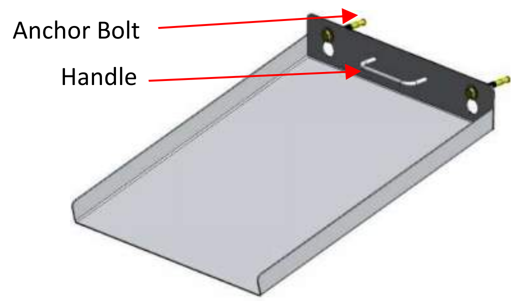


Figure 11

How to Remove:

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



Removable Flow Deflector

Hydrocarbon Spills

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

Disposal

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

Oil Sheens

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

Oil Level Alarm

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

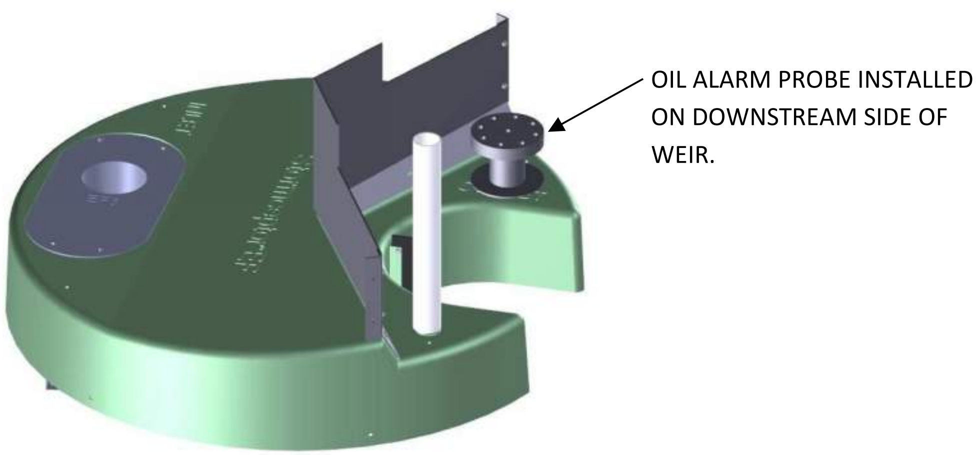


Figure 12

Replacement Parts

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

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: ________________________

Serial Number: ________________________

Installation Date: ________________________

Location Description of Unit: ________________________

Recommended Sediment Maintenance Depth: ________________________

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

Other Comments:

Contact Information

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

Imbrium Systems Inc. & Imbrium Systems LLC

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

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

Site Characteristics
Site: Agnes Street Urbanization, Alton, Ontario
November 12, 2024

Pre-Development

Land-Use	Impervious Ratio	Area 101 (m^2)	Area 102 (m^2)	Area 103 (m^2)	Area 104a (m^2)	Area 104b (m^2)	Area 105 (m^2)	Total (m^2)	Coverage
Asphalt	1.00	1,574.9	0.0	623.9	947.9	1,186.9	467.0	4,800.6	8%
Permeable Pavers	0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%
Hardscape	1.00	0.0	0.0	108.5	0.0	0.0	0.0	108.5	0%
Roof	1.00	516.4	0.0	1,003.1	0.0	0.0	0.0	1,519.5	3%
Grassed	0.00	33,202.8	5,179.3	10,590.1	678.8	633.7	1,133.9	51,418.6	89%
Total		35,294.1	5,179.3	12,325.6	1,626.7	1,820.6	1,600.9	57,847.2	100%
	Area (ha) =	3.529	0.518	1.233	0.163	0.182	0.160	5.785	
	% Impervious =	5.9%	0.0%	14.1%	58.3%	65.2%	29.2%	11.1%	
	Runoff Coefficient* =	0.29	0.25	0.34	0.63	0.67	0.44	0.32	

*Pervious areas were assigned a runoff coefficient of 0.25 and impervious areas were assigned a runoff coefficient of 0.90

Post-Development

Land-Use	Impervious Ratio	Area 201 (m^2)	Area 202 (m^2)	Area 203 (m^2)	Area 204a (m^2)	Area 204b (m^2)	Area 205 (m^2)	Total (m^2)	Coverage
Asphalt	1.00	2,865.5	1,588.7	623.9	947.9	1,186.9	467.0	7,679.9	13%
Permeable Pavers	0.50	2,019.7	418.6	0.0	0.0	0.0	0.0	2,438.3	4%
Hardscape	1.00	1,940.9	1,819.5	108.5	236.3	0.0	0.0	4,105.2	7%
Roof	1.00	6,206.0	4,657.2	1,003.1	0.0	0.0	0.0	11,866.4	21%
Grassed	0.00	9,874.7	9,082.6	10,590.1	442.5	633.7	1,133.9	31,757.5	55%
Total		22,906.8	17,566.6	12,325.6	1,626.7	1,820.6	1,600.9	57,847.2	100%
	Area (ha) =	2.291	1.757	1.233	0.163	0.182	0.160	5.785	
	% Impervious =	52.5%	47.1%	14.1%	72.8%	65.2%	29.2%	43.0%	
	Runoff Coefficient* =	0.59	0.56	0.34	0.72	0.67	0.44	0.53	

*Pervious areas were assigned a runoff coefficient of 0.25 and impervious areas were assigned a runoff coefficient of 0.90

Peak Runoff Assessment
Site: Agnes Street Urbanization, Alton, Ontario
November 12, 2024

Peak Runoff Assessment

Town of Caledon Intensity-Duration Frequency Curves (from Development Standards Manual 2019)

Return Period	A	B	C
2	1,070	0.8759	7.85
5	1,593	0.8789	11
10	2,221	0.908	12
25	3,158	0.9335	15
50	3,886	0.9495	16
100	4,688	0.9624	17

$$I = \frac{A}{(t+C)^B}$$

a, b, c = IDF Parameters
I = Intensity (mm/h)
t = Storm Duration, 10 minutes minimum (min)

Time of Concentration

Airport
If Runoff Coefficient < 0.4

$$T_c = \frac{3.26\,(1.1 - C)\,L^{0.5}}{S_w^{0.33}}$$

where, L = Flow length (m)
Sw = slope (%)
C = Runoff Coefficient

Bransby
If Runoff Coefficient > 0.4

$$T_c = \frac{0.057\,L}{S_w^{0.2}\,A^{0.1}}$$

where, L = Flow length (m)
Sw = slope (%)

Parameter	Existing 101	Existing 102	Existing 103	Existing 104a	Existing 104b	Existing 105*
C	0.29	0.25	0.34	0.63	0.67	0.44
L	335.2	188.9	206.5	259.0	261.4	157.90
A	3.529	0.518	1.233	0.163	0.182	0.160
S_w	2.61	2.26	2.04	3.85	3.77	4.08
Method	Airport	Airport	Airport	Bransby	Bransby	Bransby
T =	35	29	28	14	14	10

**10 minute mininum time of concentration as per Town of Caledon Development Standards Manual 2019)*

Parameter	Proposed 201*	Proposed 202*	Proposed 203	Proposed 204a	Proposed 204b	Proposed 205*
C	0.59	0.56	0.34	0.72	0.67	0.44
L	233.5	194.0	206.5	259.0	260.6	157.9
A	2.291	1.757	1.233	0.163	0.182	0.160
S_w	0.81	2.74	2.04	3.85	3.76	4.08
Method	Bransby	Bransby	Airport	Bransby	Bransby	Bransby
T =	10	10	28	14	14	10

**10 minute mininum time of concentration as per Town of Caledon Development Standards Manual 2019)*

Rational Method

$$Q = 2.778CIA$$

C = Runoff Coefficient
I = Intensity (mm/h)
A = Area (ha)

Existing Condition

Return Period	Existing 101		Existing 102		Existing 103		Existing 104			Existing 105		Total Runoff (L/s)
								Existing 104a	Existing 104b			
	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	
2	39.6	111.9	45.3	16.3	46.4	54.3	73.2	20.8	25.0	85.7	14.3	242.6
5	54.8	154.9	62.1	22.3	63.5	74.3	95.7	27.2	32.6	109.7	18.7	330.1
10	67.0	189.4	76.1	27.4	77.8	91.0	117.3	33.3	40.0	134.2	22.9	404.0
25*	81.5	253.6	92.1	36.4	94.1	121.1	138.4	43.2	47.2	156.5	29.8	531.3
50*	92.4	313.8	104.4	45.1	106.7	149.8	156.2	53.3	53.2	176.2	36.6	651.7
100*	104.0	367.9	117.4	52.8	120.0	175.4	174.7	62.0	59.5	196.5	42.7	760.3

Proposed Condition

Return Period	Proposed 201		Proposed 202		Proposed 203		Proposed 204			Proposed 205		Total Runoff (L/s)
								Proposed 204a	Proposed 204b			
	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	
2	85.7	322.5	85.7	232.7	46.4	54.3	73.2	23.9	25.0	85.7	14.3	672.6
5	109.7	412.6	109.7	297.7	63.5	74.3	95.7	31.3	32.6	109.7	18.7	867.2
10	134.2	504.7	134.2	364.1	77.8	91.0	117.3	38.3	40.0	134.2	22.9	1061.0
25*	156.5	647.5	156.5	467.2	94.1	121.1	138.4	49.7	47.2	156.5	29.8	1362.4
50*	176.2	795.3	176.2	573.9	106.7	149.8	156.2	61.3	53.2	176.2	36.6	1670.1
100*	196.5	924.1	196.5	666.8	120.0	175.4	174.7	71.4	59.5	196.5	42.7	1939.9

*Incorporates Runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25

Pre- and Post-Development Peak Flow Comparison

Return Period	Area 103, 104a, 104b, 105 Existing Runoff (L/s)	Area 203, 204a, 204b, 205 Proposed Runoff (L/s)	Difference (L/s)	% Change
2	114.4	117.5	3.1	2.7%
5	152.8	156.9	4.1	2.7%
10	187.2	192.2	5.0	2.7%
25*	241.3	247.7	6.5	2.7%
50*	292.9	300.9	8.0	2.7%
100*	339.7	349.0	9.3	2.7%

Water Balance/Infiltration Targets
Site: Agnes Street Urbanization, Alton, Ontario
November 12, 2024

Greck

Infiltration Target Volume

The roadside ditch parallel to Agnes Street will be retrofit to provide infiltration capabilities.

	204a	204b	
Development Area =	1,626.7	1,820.6	**m^2**
% Impervious =	73%	65%	
Impervious Area =	1,184.2	1,186.9	**m^2**

Table 3.2 of the MECP Stormwater Management Planning and Design Manual will guide the required water quality volume. The upgraded swale will be sized to provide Enhanced Level of protection.

Impervious Level (%)	35	55	70	85
Storage Volume (m^3/ha)	25	30	35	40

Required Unitary Quality Volume =	36.0	33.7	m^3/ha
Required Quality Volume =	5.9	6.1	m^3

As per the Town of Caledon Design Standards Manual 2019, the bioswale should be sized to infiltrate the 5 mm event for water balance over impervious surfaces as pervious surfaces have an initial abstraction of 5mm.

Rainfall Depth =	5	5	mm
Required Infiltration Volume =	5.9	5.9	m^3

Therefore the bioswale will be designed to infiltrate 5.9 m3. This will be the minimum void volume in the base stone.

Infiltration Facility Drawdown

	204a	204b	
Target volume is the greater of water balance and quality, V =	5.9	6.1	m^3
<u>Maximum Allowable Depth</u>			
$d_{c\ max}$ =	$i\ (t_s\text{-}d_p/i)\ /\ V_r$	$i\ (t_s\text{-}d_p/i)\ /\ V_r$	
$d_{c\ max}$ =	6000	6000	mm
Topsoil Depth =	150	150	mm
Proposed Clearstone Depth =	200	200	mm
Prop. Drawdown (Subsurface)=	4.0	4.0	hours
Safety Factor =	12.0	12.0	
<u>Required Footprint</u>			
Af =	V / d Vr	V / d Vr	
WQV	5.9	6.1	m^3
d =	0.20	0.20	m
Total Proposed Bioretention Area =	78.0	150.0	m^2
Clearstone Infiltrated Volume =	6.2	12.0	m^3
Separation from GW table =	0.75	0.75	m

Percolation Time =	12	min/cm *from Englobe HydroG Report*
I = infiltration rate =	50	mm/hr
ts = time to drain =	48	hours
Vr = void ratio =	0.4	
Groundwater Elevation =	1.1	mBGS *from Englobe HydroG Report*
dp = Depth of ponding =	0	

Climate Data								Pervious Area			Impervious Area		
Month	**Days in the month**	**Hours of Sunlight****	**Mean Temperature ****	**Heat Index**	**Potential Evapo-transpiration***	**Daylight Correction Value**	**Total Precipitation****	**Adjusted Potential Evapo-transpiration**	**Surplus**	**Deficit**	**Evaporation**	**Surplus**	**Deficit**
			(T) #	**I**	**mm/month**		**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**
January	31	9.3	-7.5	0.00	0.0	0.80	64.3	0.00	64.3	0.0	6.4	57.9	0.0
February	28	10.5	-6.5	0.00	0.0	0.82	54.5	0.00	54.5	0.0	5.5	49.1	0.0
March	31	12.1	-2.1	0.00	0.0	1.04	60.9	0.00	60.9	0.0	6.1	54.8	0.0
April	30	13.6	5.3	1.09	25.9	1.13	70.1	29.36	40.7	0.0	7.0	63.1	0.0
May	31	14.7	11.7	3.62	58.4	1.27	86.6	73.91	12.7	0.0	8.7	77.9	0.0
June	30	15.0	16.9	6.32	85.1	1.25	81.3	106.44	0.0	25.1	8.1	73.2	0.0
July	31	14.8	19.4	7.79	98.1	1.27	80.8	125.02	0.0	44.2	8.1	72.7	0.0
August	31	14.2	18.4	7.19	92.9	1.22	88.2	113.61	0.0	25.4	8.8	79.4	0.0
September	30	13.1	14.3	4.91	71.7	1.09	87.0	78.31	8.7	0.0	8.7	78.3	0.0
October	31	10.7	7.8	1.96	38.5	0.92	76.6	35.49	41.1	0.0	7.7	68.9	0.0
November	30	9.7	2.0	0.25	9.5	0.81	87.1	7.70	79.4	0.0	8.7	78.4	0.0
December	31	8.8	-4.1	0.00	0.0	0.76	64.2	0.00	64.2	0.0	6.42	57.8	0.0
TOTAL	365			33.1	480.2		**901.6**	**570**	**426.5**	**95**	**90.2**	**811.4**	**0**

Notes

* PET = 16 [10 T / I]$^{\alpha}$

where, $\alpha = (675 * 10^{-9} * I^3) - (771 * 10^{-7} * I^2) + (1792 * 10^{-5} * I) + 0.49239 = 1.112$

**Canadian Climate Normals 1981-2010 Station Data - Orangeville MOE - located 9 km nor th of the site https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=orangeville&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=4991&dispBack=1

***Canadian Climate Normals 1981-2010 Station Data - Toronto Lester B Pearson Int'l A -located 59 km southwest of the site https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=pearson&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=5097&dispBack=1

Pervious Surplus: 331.8 **mm**

Impervious Surplus: 811.4 **mm**

Assumes 10% of rainfall is evaporated (no evapotranspiration occurs)

Impervious Factor = 0.10

Water Balance Design Sheet — **Pre-Development**

Site: Agnes Street Infill Subdivision, Alton, ON

November 12, 2024

			Existing Drainage Area 104a+104b	
Catchment Parameter	**Units**	**Perv**	**Imperv**	**Total**
Area	m^2	1,313	2,135	3,447
Pervious Area	m^2	1,313	0	1,313
Impervious Area	m^2	0	2,135	2,135
Infiltration Factors				
Topography		0.1	0.1	0.10
Soil		0.4	0.4	0.40
Land Cover		0.1	0.1	0.10
MECP Infiltration Factor		0.60	0.60	0.60
Actual Infiltration Factor		0.60	0.00	0.23
Runoff Coefficient		0.25	0.95	0.68
Runoff from Impervious Surfaces*		0%	0%	0%
Inputs (per Unit Area)				
Precipitation	mm/yr	902	902	902
Run- on	mm/yr	0	0	0
Other	mm/yr	0	0	0
Total Inputs	mm/yr	902	902	902
Outputs (per Unit Area)				
Precipitation Surplus	mm/yr	332	811	
Net Surplus	mm/yr	0	0	
Total Evapotranspiration	**mm/yr**	**570**	**90**	
Infiltration	mm/yr	199	0	
Rooftop Infiltration	mm/yr	0	0	
Total Infiltration	**mm/yr**	**199**	**0**	
Runoff Pervious Areas	mm/yr	133	811	
Runoff Impervious Areas	mm/yr	0	0	
Total Runoff	**mm/yr**	**133**	**811**	
Total Outputs	**mm/yr**	**902**	**902**	
Difference (input - output)	mm/yr	0	0	
Inputs (Volumes)				
Precipitation	m^3/yr	1,183	1,925	3,108
Run-on	m^3/yr	0	0	0
Other Inputs	m^3/yr	0	0	0
Total Inputs	m^3/yr	1,183	1,925	3,108
Outputs (Volumes)				
Precipitation Surplus	m^3/yr	435	1,732	2,168
Net Surplus	m^3/yr	0	0	0
Total Evapotranspiration	m^3/yr	**748**	**192**	**940**
Infiltration	m^3/yr	261	0	261
Rooftop Infiltration	m^3/yr	0	0	0
Total Infiltration	m^3/yr	**261**	**0**	**261**
Runoff Pervious Areas	m^3/yr	174	1,732	1,906
Runoff Impervious Areas	m^3/yr	0	0	0
Total Runoff	m^3/yr	**174**	**1,732**	**1,906**
Total Outputs	m^3/yr	**1,183**	**1,925**	**3,108**
Difference (input - output)	m^3/yr	0	0	0

Water Balance Design Sheet		**Post Development**		
Site: Agnes Street Infill Subdivision, Alton, ON				
November 12, 2024				
		Proposed Drainage Area 204a + 204b		
Catchment Parameter	**Units**	**Perv**	**Imperv**	**Total**
Area	m^2	1,076	2,371	3,447
Pervious Area	m^2	1,076	0	1,076
Impervious Area	m^2	0	2,371	2,371
Infiltration Factors				
Topography		0.1	0.1	0.10
Soil		0.4	0.4	0.40
Land Cover		0.1	0.1	0.10
MECP Infiltration Factor		0.60	0.60	0.60
% Impervious		0%	100%	69%
Actual Imperv Factor		0.60	0.00	0.19
Inputs (per Unit Area)				
Precipitation	mm/yr	902	902	
Run- on	mm/yr	0	0	
Other	mm/yr	0	0	
Total Inputs	mm/yr	902	902	
Outputs (per Unit Area)				
Precipitation Surplus	mm/yr	332	811	
Net Surplus	mm/yr	332	811	
Total Evapotranspiration	**mm/yr**	**570**	**90**	
Infiltration	mm/yr	199	0	
LID Infiltration	mm/yr	0	0	
Total Infiltration	**mm/yr**	**199**	**0**	
Runoff Pervious Areas	mm/yr	133	0	
Runoff Impervious Areas	mm/yr	0	811	
Total Runoff	**mm/yr**	**133**	**811**	
Total Outputs	**mm/yr**	**902**	**902**	
Difference (input - output)	mm/yr	0	0	
Inputs (Volumes)				
Precipitation	m^3/yr	970	2138	3108
Run-on	m^3/yr	0	0	0
Other Inputs	m^3/yr	0	0	0
Total Inputs	m^3/yr	970	2,138	3,108
Outputs (Volumes)				
Precipitation Surplus	m^3/yr	357	1,924	2,281
Net Surplus	m^3/yr	357	1,924	2,281
Total Evapotranspiration	**m^3/yr**	**613**	**214**	**827**
Infiltration	m^3/yr	214	0	214
Rooftop Infiltration	m^3/yr	0	0	0
Total Infiltration	**m^3/yr**	**214**	**0**	**214**
Runoff Pervious Areas	m^3/yr	143	0	143
Runoff Impervious Areas	m^3/yr	0	1,924	1,924
Total Runoff	**m^3/yr**	**143**	**1,924**	**2,067**
Total Outputs	**m^3/yr**	**970**	**2,138**	**3,108**
Difference (input - output)	m^3/yr	0	0	0

Water Balance Design Sheet		**Post Development with SWM, FS = 1.0**		
Site: Agnes Street Infill Subdivision, Alton, ON				
November 12, 2024				
		Proposed Drainage Area 204a + 204b		
Catchment Parameter	**Units**	**Perv**	**Imperv**	**Total**
Area	m^2	1,076	2,371	3,447
Pervious Area	m^2	1,076	0	1,076
Impervious Area	m^2	0	2,371	2,371
Infiltration Factors				
Topography		0.1	0.1	0.10
Soil		0.4	0.4	0.40
Land Cover		0.1	0.1	0.10
MECP Infiltration Factor		0.60	0.60	0.60
% Impervious		0%	100%	69%
Actual Imperv Factor		0.60	0.00	0.19
Inputs (per Unit Area)				
Precipitation	mm/yr	902	902	
Run- on	mm/yr	0	0	
Other	mm/yr	0	0	
Total Inputs	mm/yr	902	902	
Outputs (per Unit Area)				
Precipitation Surplus	mm/yr	332	811	
Net Surplus	mm/yr	332	811	
Total Evapotranspiration	**mm/yr**	**570**	**90**	
Infiltration	mm/yr	199	0	
LID Infiltration*	mm/yr	0	446	
Total Infiltration	**mm/yr**	**199**	**446**	
Runoff Pervious Areas	mm/yr	133	0	
Runoff Impervious Areas	mm/yr	0	365	
Total Runoff	**mm/yr**	**133**	**365**	
Total Outputs	**mm/yr**	**902**	**902**	
Difference (input - output)	mm/yr	0	0	
Inputs (Volumes)				
Precipitation	m^3/yr	970	2,138	3,108
Run-on	m^3/yr	0	0	0
Other Inputs	m^3/yr	0	0	0
Total Inputs	m^3/yr	970	2,138	3,108
Outputs (Volumes)				
Precipitation Surplus	m^3/yr	357	1,924	2,281
Net Surplus	m^3/yr	357	1,924	2,281
Total Evapotranspiration	$\mathbf{m^3/yr}$	**613**	**214**	**827**
Infiltration	m^3/yr	214	0	214
LID Infiltration*	m3/yr	0	1,058	1,058
Total Infiltration	$\mathbf{m^3/yr}$	**214**	**1,058**	**1,272**
Runoff Pervious Areas	m^3/yr	143	0	143
Runoff Impervious Areas	m^3/yr	0	866	866
Total Runoff	$\mathbf{m^3/yr}$	**143**	**866**	**1,009**
Total Outputs	$\mathbf{m^3/yr}$	**970**	**2,138**	**3,108**
Difference (input - output)	m^3/yr	0	0	0

*5mm of rainfall to be retained. 55% of rainfall events are less than 5mm, therefore it is assumed 55% of annual precipitation surplus is infiltrated

Water Balance Design Sheet		**Post Development with SWM, FS = 1.5**		
Site: Agnes Street Infill Subdivision, Alton, ON				
November 12, 2024				
		Proposed Drainage Area 204a + 204b		
Catchment Parameter	**Units**	**Perv**	**Imperv**	**Total**
Area	m^2	1,076	2,371	3,447
Pervious Area	m^2	1,076	0	1,076
Impervious Area	m^2	0	2,371	2,371
Infiltration Factors				
Topography		0.1	0.1	0.10
Soil		0.4	0.4	0.40
Land Cover		0.1	0.1	0.10
MECP Infiltration Factor		0.60	0.60	0.60
% Impervious		0%	100%	69%
Actual Imperv Factor		0.60	0.00	0.19
Inputs (per Unit Area)				
Precipitation	mm/yr	902	902	
Run- on	mm/yr	0	0	
Other	mm/yr	0	0	
Total Inputs	mm/yr	902	902	
Outputs (per Unit Area)				
Precipitation Surplus	mm/yr	332	811	
Net Surplus	mm/yr	332	811	
Total Evapotranspiration	**mm/yr**	**570**	**90**	
Infiltration	mm/yr	199	0	
LID Infiltration*	mm/yr	0	298	
Total Infiltration	**mm/yr**	**199**	**298**	
Runoff Pervious Areas	mm/yr	133	0	
Runoff Impervious Areas	mm/yr	0	514	
Total Runoff	**mm/yr**	**133**	**514**	
Total Outputs	**mm/yr**	**902**	**902**	
Difference (input - output)	mm/yr	0	0	
Inputs (Volumes)				
Precipitation	m^3/yr	970	2,138	3,108
Run-on	m^3/yr	0	0	0
Other Inputs	m^3/yr	0	0	0
Total Inputs	m^3/yr	970	2,138	3,108
Outputs (Volumes)				
Precipitation Surplus	m^3/yr	357	1,924	2,281
Net Surplus	m^3/yr	357	1,924	2,281
Total Evapotranspiration	**m^3/yr**	**613**	**214**	**827**
Infiltration	m^3/yr	214	0	214
LID Infiltration*	m3/yr	0	705	705
Total Infiltration	**m^3/yr**	**214**	**705**	**920**
Runoff Pervious Areas	m^3/yr	143	0	143
Runoff Impervious Areas	m^3/yr	0	1,219	1,219
Total Runoff	**m^3/yr**	**143**	**1,219**	**1,361**
Total Outputs	**m^3/yr**	**970**	**2,138**	**3,108**
Difference (input - output)	m^3/yr	0	0	0

*5mm of rainfall to be retained. 55% of rainfall events are less than 5mm, therefore it is assumed 55% of annual precipitation surplus is infiltrated. Assuming a factor of safety of 1.5, this equates to 37% of rainfall events

Water Balance Summary Sheet
Site: Agnes Street Infill Subdivision, Alton, ON
November 12, 2024

Mean Temperature **

Potential Evapo-transpiration*

	Units	Pre-Development	Post-Development	Change (Pre- to Post-)	Post Development with Mitigation (FS=1.0)	Post Development with Mitigation (FS=1.5)	Change (Pre- to Post-Mitigation)
Inputs (Volumes)							
Precipitation	m^3/yr	3,108.1	3,108.1	0%	3,108.1	3,108.1	0%
Run-on	m^3/yr	0.0	0.0	0%	0.0	0.0	0%
Other Inputs	m^3/yr	0.0	0.0	0%	0.0	0.0	0%
Total Inputs		**3,108.09**	**3,108.09**	0%	**3,108.1**	**3,108.1**	0%
Outputs (Volumes)							
Precipitation Surplus	m^3/yr	2,167.7	2,281.0	5%	2,281.0	2,281.0	5%
Net Surplus	m^3/yr	0.0	2,281.0	0%	2,281.0	2,281.0	0%
Total Evapotranspiration	**m^3/yr**	940.4	827.0	-12%	827.0	827.0	-12%
Infiltration	m^3/yr	261.3	214.2	-18%	214.2	214.2	-18%
LID Infiltration	m^3/yr	0.0	0.0	0%	1,058	705	0%
Total Infiltration	**m^3/yr**	**261.3**	**214.2**	-18%	**1,272**	**920**	387%
Runoff Pervious Areas	m^3/yr	1,906.4	142.8	-93%	142.8	142.8	-93%
Runoff Impervious Areas	m^3/yr	0.0	1,924.0	0%	865.8	1,218.5	0%
Total Runoff	**m^3/yr**	**1,906.4**	**2,066.8**	8%	**1,008.6**	**1,361.4**	-47%
Total Outputs	**m^3/yr**	3,108.1	3,108.1	0%	3,108.1	3,108.1	0%